Interconnected Economies

BENEFITING FROM GLOBAL VALUE CHAINS

OECD

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BETTER POLICIES FOR BETTER LIVES

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Foreword

The international fragmentation of production in global value chains (GVCs) challenges the way we look at the global economy. It is essential to understand how GVCs work, how they affect economic performance, and what policies help to derive greater benefits from them. This publication sets out the main evidence and policy implications of the OECD's work on GVCs, including trade policy, investment policies, innovation policies, and framework and structural policies that affect how, and to what extent, countries, including emerging and developing economies, can benefit from participation in GVCs.

The OECD's interest in GVCs and their impacts on national economies is far from new. At the 2004 Ministerial Council Meeting, Ministers considered that the OECD could help to dispel fears about the increased outsourcing of industrial production – often outside the OECD area. They felt that a systematic empirical overview of trends and developments was lacking even though the political concerns are high on the policy agenda in many OECD countries.

In 2007, the OECD Directorate for Science, Technology and Industry published *Staying Competitive in the Global Economy: Moving up the Value Chain*, accompanied by a collection of papers bundled in *Staying Competitive in the Global Economy: Compendium of Studies on Global Value Chains*. A summary of the reports was presented at the OECD Ministerial meeting in May 2007.

This work was the basis of a much broader programme of work in which different OECD directorates have participated. The Directorate for Science, Technology and Industry, the Trade and Agriculture Directorate, the Statistics Directorate, and the Directorate for Financial and Enterprise Affairs have all contributed to this publication. Comments and inputs were also provided by the Development Centre and the Directorate for Development Co-operation, in particular on the role of GVCs for economic development (Chapter 5).

At the same time, the OECD and the World Trade Organization (WTO) joined forces to produce new estimates of international trade (i.e. measured in value added instead of gross terms). The OECD-WTO Initiative on Trade in Value Added (TiVA) aims to provide solid evidence to underpin the identification of policy issues and responses in an era of GVCs. The first results were launched in January 2013, followed by a second release, covering more years, countries and indicators, in May 2013. The OECD and the WTO will continue to update this database, improve its quality and reliability, and extend the industrial and geographical coverage.

Owing to the cross-directorate character of the OECD work on GVCs, the different chapters of this publication were discussed and declassified by various OECD Committees including the Committee on Industry, Innovation and Entrepreneurship (CIIE), which took the lead in this work, the Trade Committee, the Committee on Statistics and the Investment Committee. The comments and inputs formulated by national delegates to these OECD official bodies are gratefully acknowledged.

The synthesis report containing the main policy messages was discussed by the OECD Executive Committee and OECD Council and was presented at the OECD's Ministerial Council Meeting of May 2013.

A large number of OECD staff contributed to this work. The report was written under the directorship of Andy Wyckoff, Ken Ash and Martine Durand. Dirk Pilat provided overall guidance and was responsible for the synthesis report. The publication was co-ordinated by Koen De Backer who is also the (co-)author of Chapter 1 (The Rise of Global Value Chains), Chapter 5 (The Role of Global Value Chains in Economic Development), Chapter 6 (Global Value Chains and Competitiveness), Chapter 7 (Upgrading in Global Value Chains – The Role of Knowledge-based Capital) and Chapter 8 (Global Value Chains – Managing the Risks). Other (co-)authors of this report are Nadim Ahmad (Chapter 2 – Measuring Trade in Value Added), Sébastien Miroudot and Dorothée Rouzet (Chapter 3 – Implications of Global Value Chains for Trade Policy), Mike Gestrin (Chapter 4 – Global Value Chains and International Investment) and Naomitsu Yashiro (Chapter 7 – Upgrading in Global Value Chains – The Role of Knowledge Based Capital).

Isabelle Desnoyers-James, Laurent Moussiegt and Alexandros Ragoussis prepared the statistical/econometric work. The study benefited significantly from the input and comments of Carlos Alvarez, Andrea Beltramello, Crawford Falconer, Frans Lammersen, Carlo Menon, Jose Ramon Perea, Karine Perset, Raed Safadi and Paul Schreyer. Florence Hourtouat and Sarah Ferguson provided secretarial support. Julia Gregory and Joseph Loux prepared the final manuscript for publication.

The empirical evidence presented in this publication builds heavily on the joint OECD-WTO Trade in Value Added Initiative. The co-operation with the WTO in developing the TiVA initiative is greatly acknowledged. The OECD-WTO cooperation has greatly benefited from related work on the EU-supported World Input-Output Database (WIOD) and by researchers at the United States International Trade Commission (USITC) and the Institute of Developing Economies – Japan External Trade Organisation (IDE-JETRO). The TiVA initiative was developed on the basis of the OECD Input-Output Database, which has benefited from the financial support of Japan over time.

The OECD TiVA project team consisted of Norihiko Yamano, Nadim Ahmad, Sébastien Miroudot, Colin Webb, Agnes Cimper, Guannan Miao, Dorothée Rouzet and Bo Werth. Their input is particularly acknowledged as the new TiVA results have provided much needed empirical evidence on the importance and effects of GVCs in today's global economy.

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Executive summary

Today, "what you do" (the activities a firm or country is involved in) matters more for growth and employment than "what you sell" (the final product). Global value chains (GVCs) allow firms and economies to "do" the part of the process they are best at, using intermediate goods and services from elsewhere without having to develop a whole industry. They affect countries' competitiveness and patterns of trade and investment, offer potential for development in less developed countries, but also imply risks.

Old-style support policies that ignore the interconnected nature of production in GVCs and the need for international competition and openness may result in protectionism, but success in international markets depends as much on the capacity to import high-quality inputs as on the capacity to export. The growing interconnectedness of economies creates important opportunities but also new policy challenges.

Competitiveness

Competitiveness in GVCs requires strengthening factors of production that are "sticky" and unlikely to cross national borders. This implies investment in human capital and skills and high-quality infrastructure, and encouraging strong industry-university linkages and other tacit knowledge. The quality of institutions and government are also important.

Outsourcing and offshoring enhance competitiveness by providing access to cheaper, more differentiated, and better quality inputs. Manufacturing remains a core activity in GVCs, although services are also a source of much value creation. Governments in advanced economies can help anchor production and value creation by supporting investment in skills and advanced manufacturing technologies, including in traditional industries, and through policies that strengthen networks and co-operation.

As small and medium-sized enterprises (SMEs) play an important role in niche areas of GVCs and contribute to the exports of larger firms, governments can encourage the development of SMEs' linkages with international firms by fostering their ability to innovate and facilitating their adoption of product standards.

Trade

Trade-facilitating measures, such as fast and efficient port and custom procedures, permit the smooth operation of value chains. In most economies, around a third of intermediate imports end up in exports. In GVCs, tariffs and other import barriers are therefore effectively a tax on exports. Export restrictions can also impede the efficient functioning of GVCs and raise costs. The negative effects of trade protection are compounded when parts and components cross borders many times.

GVCs strengthen the economic case for advancing multilateral trade negotiations, as barriers between third countries upstream or downstream matter as much as barriers in direct trading partners and are best addressed together. Convergence of standards and certification requirements and mutual recognition agreements can also alleviate burdens on exporting firms.

While abolishing tariffs is a starting point for creating new trade opportunities, GVCs also require efficient services and the possibility to move people, capital and technology across borders. Services already account for over half of value creation in GVCs in many OECD countries and over 30% in China. Regulatory reforms and liberalisation of trade and investment in services are essential to enhance competition and increase the productivity and quality of services.

Investment

Investment policies need to focus more closely on activities in GVCs than on industries because success in GVCs depends on the promotion and facilitation of both inward and outward investment. Given the important role of multinational enterprises (MNEs) in GVCs, lowering investment barriers is an efficient way for a country to participate. Moreover, by inhibiting the efficient functioning of GVCs, impediments to cross-border investment can have significant negative welfare impacts.

Governments should work together to ensure that the multilateral investment system continues to support growth. A regime built on thousands of bilateral and regional investment agreements does not adequately reflect the interconnected nature of economies in GVCs. Multilateral co-operation and co-ordination are needed to maintain the open and predictable international investment climate that has supported international investment in GVCs. Governments should not engage in incentive wars to attract high-value stages of a GVC.

Development

Through access to networks, global markets, capital, knowledge and technology, integration in a GVC can be a first step to economic development. Developing economies can enter GVCs by opening their markets to trade and foreign direct investment and strengthening domestic capabilities to engage in international trade. They need to strengthen their business environment, support investment in knowledge assets such as R&D and design, and foster the development of economic competencies such as skills and management.

Since GVCs involve activities contracted within and between MNEs and independent suppliers, the ability to enforce contracts is crucial. Countries with sound legal systems tend to export more in more complex industries, and tasks that require more complex contracts are more easily carried out in countries with well-functioning contractual institutions.

Many low-income countries remain excluded from GVCs, owing to their location, lack of natural resources, lack of infrastructure, or business environment. These constraints can sometimes be overcome through capacity building, but this may be difficult for the poorest developing economies, which would benefit from donor support through “aid for trade” initiatives.

Adjustment and risks

Participation in GVCs inevitably entails adjustment costs, as some activities grow and others decline, and as these are relocated across countries. Policy needs to facilitate the adjustment process through labour market and social policies and through investment in education and skills. Structural policies also help strengthen the economy's flexibility and resilience.

Given the broad welfare implications of GVCs, governments, enterprises and other stakeholders need to remain mindful of their respective roles and responsibilities for governance. The prominence of large MNEs, including some state-owned enterprises, in GVCs raises some policy concerns, for example about the effects on competition and markets further downstream.

While the growing interconnectedness of economies is a source of resilience it can also lead to contagion if events in part of the GVC feed through the system. While firms have the first responsibility to address such risks, a multi-stakeholder approach, involving governments, should support information sharing and capability building. Greater international co-operation can help reconcile national policies with the global nature of economic activity.

Informed policies require good data and analysis. Work is needed to measure the role of investment in GVCs, and the impacts of GVCs on employment, skills and incomes.

Chapter 1

The rise of global value chains

Companies increasingly divide up their production processes and locate productive activities in many countries. The resulting global value chains (GVCs) are dramatically changing the nature of economic globalisation. Lower trade and investment barriers, falling transport costs and advances in information and communication technologies have made it easier to fragment the production of goods and services and to offshore certain activities and tasks to other countries. Recent evidence documents the rapid emergence of GVCs, the participation and position of individual countries, and the role played by large and small companies. To fully capture the benefits of GVCs and minimise potential adjustment costs, GVCs call for a rethinking of government policies on economic globalisation.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

A new phase in economic globalisation

Production, trade and investment increasingly take place as part of global value chains (GVCs) (Box 1.1). Production processes have become more geographically dispersed as companies increasingly locate different production stages across different countries through a network of independent suppliers and their own affiliates (OECD, 2007a; WTO and IDE-JETRO, 2011). A 2009 survey reported that for the group of 300 global companies with sales of over USD 1 billion, on average, 51% of component manufacturing, 47% of final assembly, 46% of warehousing, 43% of customer service, and 39% of product development took place outside the home country (MIT Center for Transportation and Logistics, 2009).

Box 1.1. What is a global value chain?

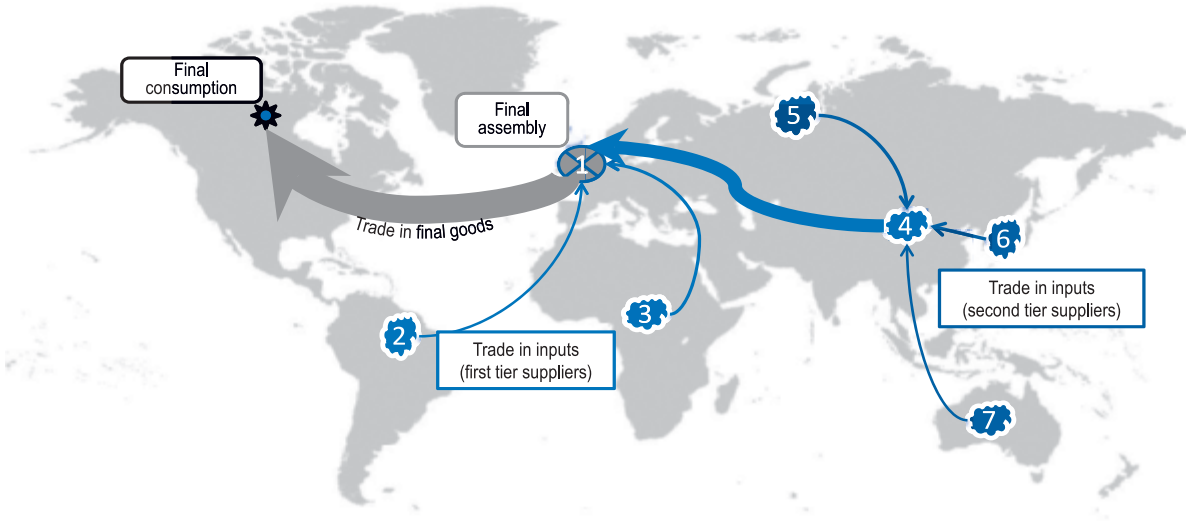
The full range of firms' activities, from the conception of a product to its end use and beyond is called a value chain. It includes activities such as design, production, marketing, distribution and support to the final consumer (Porter, 1986; Gereffi et al., 2001). The activities in a value chain can be undertaken by a single company or divided among several (supplier) firms. They cover goods as well as services and can be concentrated at one location or spread out over different locations. The term "global value chains" was coined to reflect a strong trend towards the dispersion of value chain activities across the world. Many companies have broken up their value chains and distributed production stages across many countries; at the same time, they have outsourced parts of their value chains to external partners.

Global value chains are very heterogeneous across industries, companies, products and services. Some parts of the value chain follow the classic assembly-line arrangement where a product/service undergoes sequential processing (i.e. "snakes" value chains), while other value chain activities include the (final) assembly of several intermediates into a product/service (i.e. "spiders" value chains) (Baldwin and Venables, 2010).

As production stages and technologies have become more mobile, the value is increasing added to many goods and services throughout the production process in countries around the world. Figure 1.1 depicts a simplified global value chain. It shows that the production of parts and components, the final assembly, and the sale of the final goods involve a number of countries. The sequential stages in the value chain are typically performed in the location best suited to the activity. The pattern of trade accordingly shows that a good produced in one economy and exported to its market of final consumption includes inputs supplied by producers in other economies (first tier suppliers) who themselves source their inputs from third economies (second tier suppliers).

The general perception is that economic globalisation has expanded greatly during the past two decades and may have entered a new phase due to the unbundling of activities in GVCs (Box 1.2). While GVCs may not be an entirely new phenomenon (Gereffi and Lee, 2012), they are a defining feature of modern globalisation; particularly new are the speed, scale and complexity they add to the process of economic globalisation. GVCs have deepened the process of globalisation geographically (by including more countries, including emerging economies), sectorally (by affecting manufacturing but also increasingly services industries) and functionally (by including not only production and distribution but also R&D and innovation).

Figure 1.1. A simplified representation of a global value chain



Note: 2, 3 and 4 represent intermediate products which are combined into 1 (i.e. the final product); 4 as an intermediate product itself is composed of inputs 5, 6 and 7.

Source: OECD (2012a). *Map source:* ARTICQUE© – all rights reserved.

Box 1.2. Economic globalisation and unbundling

Economic globalisation, or international economic integration, dates back to the mid-19th century and a significant increase in international trade and cross-border flows of financial capital and labour. It stalled or retreated after the imposition of protectionist measures following the First World War, but took off again after the Second World War and has since continued to expand.

Economic globalisation has been characterised by strong growth of international trade in the wake of falling obstacles to trade, declining transport costs as a result of technological innovations, and international investment as a complement to international trade. The liberalisation of capital movements further spurred international economic integration by eliminating restrictions on foreign direct investment, and multinational enterprises, with headquarters mainly in OECD economies, established affiliates in foreign markets. In economies with large FDI inflows merchandise trade typically expanded strongly.

Baldwin (2009) describes this as a first process of unbundling, i.e. the separation of production and consumption, as falling transport costs and tariffs made it possible to ship and trade goods internationally. Because of economies of scale and scope it was initially economical to keep productive activities in one place, with large-scale manufacturing plants and geographically concentrated industries that reflected countries' comparative advantages. Most companies undertook all stages of the production process as co-ordinating geographically dispersed activities was difficult and costly.

This changed with the strong decline in communication costs in the 1990s that facilitated the next stage of unbundling and the development of global value chains. With modern communication networks, the various stages of production can be linked across greater physical distances; economies of scale and scope remain important but on the level of individual activities rather than industries. This has drastically changed the pace and character of economic globalisation: international trade today increasingly consists of imports and exports of intermediates in addition to trade in final goods. In addition to trade in goods, there is now also "trade in tasks" (Baldwin, 2009; Grossman and Rossi-Hansberg, 2008).

Recent increases in international economic integration are closely linked to the rise of GVCs. First, the pace and scale of today's globalisation are unprecedented; the increased trade in intermediates within GVCs has helped growth in trade to outpace growth in gross domestic product (GDP). The strong rise in foreign direct investment (FDI) has further boosted globalisation; at face value some multinational enterprises (MNEs) are bigger than certain countries. Nevertheless, the financial crisis has had a substantial impact on globalisation and there are indications that "murky", or hidden, protectionism has increased (OECD, 2010).

Second, the global dimension of economic integration has expanded rapidly as countries such as the People's Republic of China, India and Brazil have become major players in the global economy, in part because of their increasing participation in GVCs. Behind these emerging giants, a growing number of smaller economies are also working to get a foothold in the global economy. Spurred by wide-ranging policy reforms as well as on-going technological change, emerging countries have attracted substantial activity in manufacturing and services industries.

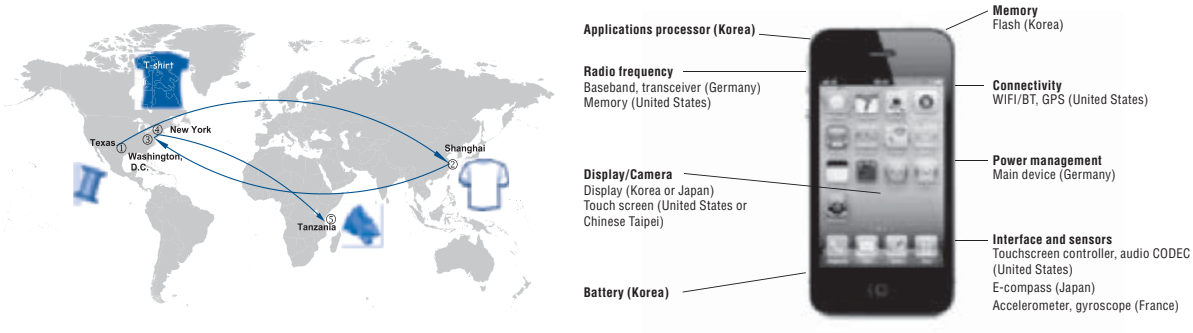
Third, while manufactured goods still account for the largest share of international trade, globalisation increasingly extends to FDI and trade in services (although comparable statistics are not always available). Many service activities are part of GVCs, as information and communication technologies (ICTs) have facilitated the sourcing of services from abroad. Rapid advances in ICTs have also increased the tradability of many service activities and created new kinds of tradable services. GVCs are significantly changing the nature and interconnectedness of the world economy. Countries now participate in a process of "vertical specialisation", a vertical division of labour in which countries specialise in specific stages and tasks of the value chain. This is a departure from the long-established view of comparative advantage as concerning specific goods or industries. The global reallocation of resources that has accompanied globalisation has been discussed for many years and the rise of GVCs has certainly nourished the debate. While GVCs have captured the attention of policy makers in many countries, their policy implications are not yet clear-cut or well understood. This chapter argues that GVCs raise important policy issues and will reshape policy thinking on economic globalisation; later chapters address the implications of GVCs in several policy areas.

Understanding global value chains

Exploring the GVC concept

As companies disperse their operations across the world, goods, and increasingly services, contain inputs sourced from many countries. Intermediate inputs such as parts and components are produced in one country and then exported to other countries for further production and/or assembly in final products. Figure 1.2 shows the GVCs of two goods: a simple T-shirt and a high-technology mobile handset. Rivoli (2005) described a T-shirt's travels to reach the final consumer: cotton grown in the United States is exported to China to be manufactured, after which it returns to the United States for imprinting with logos and graphics for wholesaling and retail sales; sometimes the (used) T-shirt is exported to Tanzania for resale or is shredded as furniture padding. A mobile handset is at the other end of the technology spectrum; the Apple iPhone has a large number of intermediate inputs produced by different companies and sourced from all over the world (Linden et al., 2009; Dedrick et al., 2009).

Figure 1.2. Global value chains: From apparel to electronics



Source: T-shirt example based on Rivoli (2009); iPhone 4 example based on analysis by IHS-Isuppli (the teardown analysis only takes into account components; it does not include other expenses such as manufacturing, software, royalties and licensing fees). *Map source:* ARTICQUE© – all rights reserved.

The term GVC originated in the management literature and has been associated in the economic literature with concepts such as: global production sharing (Yeats, 1997); international fragmentation (Jones and Kierzkowski, 1990); vertical specialisation (Hummels et al., 1998); multistage production (Dixit and Grossman, 1982); sub-contracting, offshoring and outsourcing (see Box 1.3); and most recently with trade in tasks (Grossman and Rossi-Hansberg, 2008). The different terms all relate to the increasing importance of vertical production and trading chains across countries (*i.e.* the production in one country of inputs which are then traded to other countries for further processing), although the concepts differ somewhat.

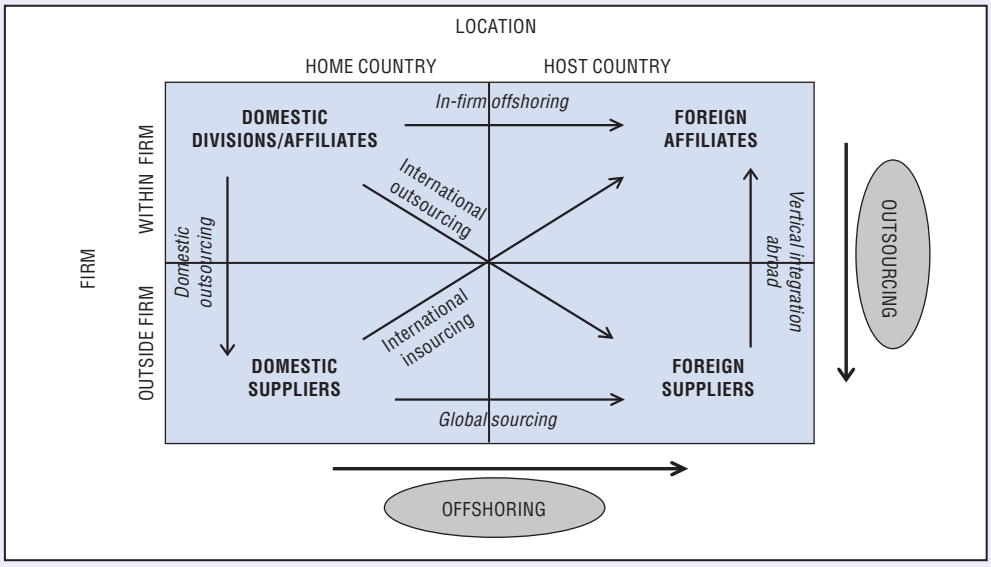
A more recent notion concerns the international production networks across firms, industries and countries that result from the international fragmentation of production (Coe and Hess, 2007). While value chains refer to the sequence of productive (value-adding) activities that lead to final production and end use, production networks refer to the relationships that link companies together. The shift in focus from "chain" to "network" reflects the increasingly complex interactions among global producers and suppliers: "economic processes must be conceptualised in terms of a complex circuitry with a multiplicity of linkages and feedback loops rather than just 'simple' circuits or, even worse, linear flows" (Hudson, 2004).

The idea of a (global) value chain is also closely related to that of a supply chain, the latter representing the total flow of physical goods from suppliers to ultimate users and the broad integration of business processes along the supply chain, such as (inbound and outbound) logistics, inventory management, procurement, etc. The focus of supply chain management is on the cost and efficiency of the supply and the flow of materials from various suppliers to the final customer (Feller et al., 2006). The value chain has a broader objective, in that it tries to capture the determinants of the organisation of (global) industries by incorporating elements from the literature on industrial organisation, international business, and trade and competitiveness (Porter, 1986). Moreover, a value chain incorporates the idea of value being created (or added) throughout the chain and thus establishes a close link with economic performance.

Box 1.3. Outsourcing and offshoring

Firms increasingly restructure their operations through the outsourcing and offshoring of activities (OECD, 2007b). Outsourcing refers to the purchase of intermediate goods and services from outside specialist providers; offshoring refers to purchases by firms of intermediate goods and services from foreign providers. Offshoring includes both international outsourcing (where activities are contracted out to independent suppliers abroad) and international in-sourcing (the transfer of particular tasks within the firm to a foreign affiliate). The cross-border aspect of offshoring, *i.e.* the sourcing of goods and services from abroad, determines the increasingly global character of value chains.

Firms' strategies of outsourcing and offshoring



Source: Based on OECD (2006), OECD (2007a) and Miroudot et al. (2009).

The decision to outsource a specific activity involves deciding whether to "make" or "buy", i.e. to undertake the activity in house or to obtain it from an independent supplier. The decision to offshore is the result of the search for the optimal location for the activity in question. As the "make or buy" decision is increasingly global in scale, companies must seek to optimise geographical and organisational dispersion. Co-ordination and management costs generally increase with geographical and organisational distance (Contractor et al., 2010).

The economic literature has extensively explored decisions to outsource and/or offshore, including decisions to split production into a vertical chain, to contract for some production activities with unrelated parties, or to split production activities across different locations (Mankiw and Swagel, 2006). Theoretical contributions have used elements of the transaction cost literature, agency theory, property rights studies and knowledge capital approaches in trade models to analyse such decisions (Antrás, 2003; Antrás and Chor, 2012; Acemoglu et al., 2007, Grossman and Helpman, 2005, etc.). However, the results often depend on the assumptions of the model, so that different hypotheses may lead to different patterns of outsourcing and offshoring (WTO, 2008).

Empirical research has shown that firms are somewhat reluctant to source more complex or high-value activities externally, as these are often considered strategic to a firm's core business. Because of the risk of losing control of strategically important activities, they prefer to offshore such activities to fully owned affiliates. In contrast, they often relocate high-volume production that requires low skills or standard technologies to external providers with cheaper or more efficient production capabilities (Alfaro and Charlton, 2009; Costinot et al., 2011; Corcos et al., 2012).

The drivers of GVCs

The emergence of GVCs and the international fragmentation of production have been fuelled by changes in the business and regulatory environment, as well as by shifts in corporate thinking and business organisation. Companies have included outsourcing and offshoring in their global strategies as falling trade costs (which make it cheaper to move products and services across borders) and plummeting costs of communication/information (which facilitate the co-ordination of activities across the globe) have made the international sourcing of intermediates cheaper and easier.

Trade costs (i.e. the range of costs incurred from the factory or office where the good or service is designed/produced and the final consumer) have decreased significantly over the past years. For goods, trade costs include transport and port costs, freight and insurance costs, tariffs and duties, costs associated with non-tariff measures, but also mark-ups by importers, wholesalers and retailers. For services, transport costs are replaced by communication costs (although services can also be provided by natural persons who travel to the country where the consumer is located). As intermediates often cross borders many times in GVCs, trade costs are likely to play a large role in GVCs (Yi, 2003; Ma and Van Assche, 2010).

In addition, successive rounds of liberalisation have resulted in rapidly falling barriers to trade and investment (Grossman and Rossi-Hansberg, 2008; Baldwin, 2009). Tariffs have fallen especially for manufactured goods, and the gradual lowering of non-tariff barriers has facilitated the international trade of goods and services. Specific agreements, such as the Information Technology Agreement, which eliminated duties on information technology (IT) products, have spurred GVCs in ICT industries. Liberalisation of investment through multilateral and bilateral agreements has allowed firms to use FDI to spread their production activities; investment reforms in emerging economies have helped to integrate them in GVCs as well.

Declining transport costs coupled with regulatory reforms in key transport and infrastructure sectors have thus facilitated moving activities across borders. Hummels (2007) provided empirical evidence on falling transport costs for air shipment owing to advances in technology (the jet engine); the evidence is less clear for ocean shipping despite the growing importance of containerisation (owing to the accompanying sharp increases in fuel and port costs). The composition of traded goods has also changed in recent decades as many valuable goods are now relatively light (OECD, 2008a). While trade costs are generally expressed as weight-based measures because of data availability and measurement, transport costs may have fallen more relative to the value of transported goods (*ad-valorem* measures of trade costs might show a stronger declining trend). In addition, trade costs do not always reflect the gains in time and quality of different transport modes over time.

While falling trade costs have driven globalisation for decades, the spread of GVCs has been greatly facilitated by rapid advances in ICTs. Baldwin (2009) refers to the ICT revolution as the technological breakthrough behind the expansion of GVCs and the second unbundling (see Box 1.2). As the international dispersion of activities requires co-ordination of their locations, GVCs will only develop if co-ordination or transaction costs (e.g. communication, information and governance costs) are lower than the expected cost advantages (Jones and Kierzkowski, 1990). Cheaper and more reliable telecommunications, information management software, and increasingly powerful personal computers have significantly decreased the cost of organising and co-ordinating complex activities over long distances both within and between companies. In addition, rapid advances in ICTs

have increased the tradability of many services. Data entry, information processing, research and consultancy can easily be carried out via the Internet and e-mail, or through tele- and video-conferencing, and call centres are increasingly off-shored.

As the competitive environment has evolved, companies have adjusted and optimised their value chain activities across companies and geographical locations. Generally speaking, companies have an incentive to spread production stages across different locations if the different stages have varying factor intensities, e.g. they will move labour-intensive activities to low-wage countries. While distribution, sales and production activities have led the way, R&D and decision-making activities are increasingly (re)located internationally (OECD, 2011a).

Various factors drive the globalisation of value chains, with enhancing efficiency the most important. Because of growing competition in domestic and international markets, the main reason to offshore production and distribution activities is greater efficiency and lower costs (Smith, 2006; Statistics Denmark et al., 2008). Sourcing inputs from low-cost or more efficient producers, either domestically or internationally, either within or outside the boundaries of the firm, can lower production costs. In addition, economies of scale and scope may (only) be available in specialised suppliers of particular parts/components and services, and these may also result in cost advantages (Kommerskollegium, National Board of Trade, 2010).

A second important driver is access to foreign markets as local presence often helps firms better understand and exploit markets abroad. Demographic shifts and rapid growth in several large non-OECD economies mean that an increasing share of global economic activity now takes place outside the OECD area. If companies wish to benefit fully from these new growth centres, they need to be present; their market size and growth are among the most important reasons for locating distribution, sales and production activities in those economies (OECD, 2011a). The presence of an affiliate in foreign markets helps protect the company's proprietary knowledge; with a partner or presence in a market, a company can more readily find opportunities to leverage its intellectual property and avoid abuse of its intellectual property.

A third driver, which has gained in importance in recent years, is access to knowledge. Companies may move 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. Tapping into foreign knowledge has become an important factor in the internationalisation of R&D activities (OECD, 2008b).

The main actors in global value chains

In providing a theoretical framework for the governance of GVCs, Gereffi et al. (2005) discussed in some detail the principal actors in GVCs: MNEs, their affiliates abroad, and independent suppliers in both domestic and foreign markets. Economic transactions within GVCs include intra-firm transactions between headquarters and affiliates as well transactions between companies and independent suppliers (arm's-length trade and transactions accompanied by specifications on quality, product design, etc.). The distribution of power and the direction of knowledge flows will differ depending on the type of GVC. They may be largely concentrated in the lead firm/MNE or shared between lead firms and (upper tier) suppliers. Factors such as the complexity of transactions, the ability to codify transactions, and capabilities in the supply bases enter the equation (Gereffi et al., 2005). Consequently, the governance of GVCs will also shape the distribution of profits and risk (Gereffi and Lee, 2012).

The difference between so-called "producer-driven" and "buyer-driven" chains reflects the different roles of MNEs and independent suppliers. Buyer-driven chains have developed around large retailers such as Wal-Mart and highly successful brand merchandisers such as Nike. Their products are often relatively simple, e.g. apparel, housewares and toys, and manufacturing such products requires relatively little capital and few skilled workers. Lead firms in these GVCs focus almost exclusively on marketing and sales; they have few factories of their own but source products (often via intermediaries such as trading companies) from a large network of independent supplier firms.

In contrast, producer-driven GVCs are typically found in high-technology sectors, such as the semiconductor, electronics, automotive and the pharmaceuticals industries. Because these industries rely on technology and R&D, large manufacturing firms such as GM, Sony and Apple control the design of products as well as most of the assembly, which takes place in a number of countries. Technology (including design) and production expertise are core competencies that are largely developed in house in the lead firms or in affiliates and captive suppliers that can be prevented from sharing technology with competitors. The importance of MNEs' role in these networks is reflected in their strong linkages with affiliates in different economies.

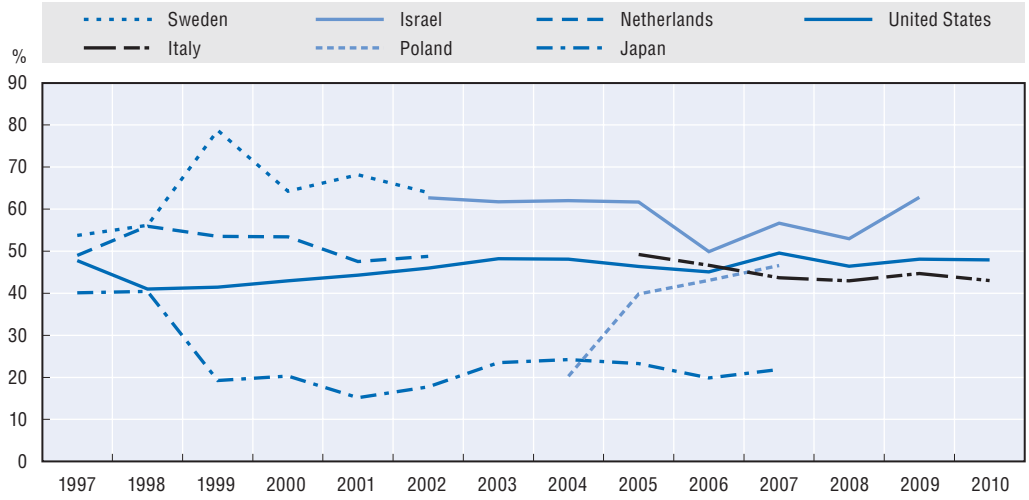
MNEs have offshored activities in search of better location factors for decades, with FDI accelerating the development of GVCs. Theory traditionally distinguishes between horizontal and vertical MNEs. Horizontal (or market-seeking) MNEs seek to produce close to customers and avoid trade costs while realising economies of scale. Their plants produce similar outputs in both home and host countries, thereby economising on the costs of exporting. Vertical (or efficiency-seeking) MNEs typically undertake different stages of production in different countries, with the location of the stages depending on the costs of the factors of production that are used intensively. As production in one country serves as input for production in other countries, this type of MNE is thought to have driven the international fragmentation of production. In reality, however, most MNE affiliates have both horizontal and vertical characteristics; an MNE setting up an affiliate in China often seeks to serve the large and rapidly growing Chinese market as well as to benefit from lower (labour) costs (see also Chapter 4).

MNE affiliates not only serve local markets in the host country, they are also essential links in GVCs as they serve other (neighbouring) markets and produce inputs for other affiliates in the multinational's network. Through their affiliates (i.e. offshoring) as well as through their arm's-length relationships with other companies/suppliers (i.e. outsourcing), MNEs organise their production processes across different geographical locations. In fact, cross-border trade between MNEs and their affiliates, often referred to as intra-firm trade, now accounts for a large share of international trade in goods (Figure 1.3).

Owing to their international trade and investment, MNEs are leading actors in GVCs. Firm-level evidence reveals that exports are driven by a limited number of large, often multinational, companies. Mayer and Ottaviano (2007) showed for example that 1%, 5% and 10% of companies account for no less than 40%, 70% and 80%, respectively, of aggregate exports in Europe. Similar results are reported for the United States (Bernard et al., 2007). However, these findings underestimate the participation in GVCs of smaller firms, which often supply intermediates to exporting firms in their country and are as such relatively more integrated in the domestic value chains. Slaughter (2013) calculated that the typical US MNE buys more than USD 3 billion in inputs from more than 6 000 US small and medium-sized enterprises (SMEs) – or almost 25% of the total input purchased by these firms. These domestic supplies are not reflected in international trade

statistics, which only count direct exports; estimates for the United States show that in 2007 the export share of SMEs increased from approximately 28% (in gross exports) to 41% (in value-added exports), when such indirect exports are taken into account (USITC, 2010).

Figure 1.3. Share of intra-firm exports in total exports of affiliates under foreign control, 1997-2010



Note: Data for Poland refer to manufacturing sector only.

Source: OECD (2010); OECD Statistics on Measuring Globalisation database, doi: 10.1787/global-data-en.

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Actors and linkages in GVCs may evolve as (smaller) firms upgrade their activities and reinforce their positions. SMEs may see new opportunities to expand their business abroad (OECD, 2008d), although it is generally difficult for them to reach international markets. The supply base of the automotive industry, for example, has globalised, resulting in the rapid internationalisation of smaller companies that have become key suppliers (i.e. second- or even first-tier suppliers). Often, as car assemblers set up final assembly plants in new locations, they have helped/urged their suppliers to move abroad with them (Van Biesebroeck and Sturgeon, 2010). The fragmentation of production together with advances in ICTs is also creating new entrepreneurial possibilities for SMEs to access markets abroad, giving rise to a new category of so-called micro-multinationals, small firms that develop global activities from their inception. The Internet and new business models make it possible for these smaller – often service-driven – companies to enter foreign markets at minimum costs (Mettler and Williams, 2011).

At the same time, SMEs face serious challenges in terms of managerial and financial resources and their ability to upgrade and protect in-house technology. Important barriers for integrating GVCs include insufficient scale to support the costs of adequate R&D, the training of personnel, and the fulfilment of strict requirements in terms of product standards and quality. Moreover, upgrading a small firm's position in the value chain is typically linked to the take-up of a wider and more complex set of tasks. They have to contribute to product development, to organise and monitor a network of sub-suppliers, to ensure compliance with a broader set of standards, and to ensure delivery and quality at competitive prices (OECD, 2008d).

Box 1.4. Screwdriver economics: Breakdowns of specific products

Economic researchers increasingly rely on (sometimes confidential) firm-level information to get a better picture of the GVCs of specific products. This "reverse engineering" helps to identify the origin and estimate the costs of different components and obtain a breakdown of the value chain of individual goods and services.

The Research Institute of the Finnish Economy (ETLA) has used this method on a wide variety of basic and more advanced products, including food, engineering, consumer electronics, mobile phones, metal products, business services, textiles, machinery and paper products. The different studies show how value creation differs across products, how value is added/captured across different countries, how the location of final assembly and headquarters (and the location of intangible assets) affects the value distribution, what the impact of the technology life cycle of the product is, etc. *(*Ali-Yrkkö et al., 2011; Ali-Yrkkö, 2013*)*.

The tables below show the breakdown of value added for two products, a smartphone and a bicycle, produced by two Finnish-based firms (Nokia Oyj and Helkama Velox Oy) and sold on the Finnish market.[1]

Distribution of value added by GVC partner; product sold in Finland

	Smartphone: Final assembly in China or Finland	Bicycle: Final assembly in Finland
Distribution & retail	14%	27 %
Manufacturer	50%	36 %
First-tier suppliers	14%	14 %
Suppliers of material inputs	19%	23 %
Unaccountable inputs	3%	0%

Value-added breakdown by region, product sold in Finland

	Smartphone: Final assembly in China	Smartphone: Final assembly in Finland	Bicycle: Manufacture in Finland
Finland	53%	55%	67%
EU27	13%	13%	13%
Asia	15%	13%	11%
North America	14%	14%	4.5%
Other	5%	5%	4.5%

The figures show that most value is added in Finland owing first to the distribution and retail margin (as both products are sold on the Finnish market). In addition and although most of the components for both products are supplied from Asia, the Finnish-based manufacturers and brand owners capture the largest share of the value added. This is due to the importance of intangible – or knowledge-based – assets (design, R&D, brand name, etc.), which are largely developed and kept in Finland in or close to the company headquarters. Final assembly of the smartphone only represents 2% of the total value added. The location of a GVC is determined by a range of factors: the degree of modularity of the embodied technologies, the role of industry technology standards and the transport alternatives and their respective costs. Locating the final assembly of a bicycle in Asia would increase the lead time by 6 to 8 weeks (it would have to be transported by sea), so that offshoring final assembly is a viable option for the smartphone but not for the bicycle.

1. The examples were provided by Timo Seppälä (ETLA) and Martin Kenney (University of California, Davis) and are based on publicly available information and (internal) invoice data. The authors acknowledge the assistance of Jyrki Ali-Yrkkö and Matias Kalm. This research is a part of the on-going research project "Value Creation and Capture – The Impact of Recycling and Global Dispersion of Intangible Capital" (2013-14), funded by the Finnish Funding Agency for Technology and Innovation (TEKES).

Mapping GVCs

From case studies to more aggregate evidence

While the concept of GVCs is clear, their measurement is not straightforward. Until recently, this mainly involved case studies of specific products; early examples include the Barbie Doll (Tempest, 1996; Feenstra, 1998), an "American" car (WTO, 1998), and the T-shirt discussed above. While these case studies offered interesting anecdotal evidence, recent, more stylised analysis of the geographical distribution of costs, value added and profits has received a great deal of attention, and well-known studies of Apple products (Linden et al., 2009; Dedrick et al., 2009) have stimulated analyses of other products (Box 1.4). Industry-level case studies offer additional empirical evidence on GVCs in a wide range of industries: apparel, wood, automotive, etc. The analysis has often been undertaken in a development perspective to study the position and integration of developing economies in GVCs.[1]

The rapidly growing literature on MNEs also provides some empirical evidence on GVCs, although it focuses less on their organisation. By analysing the trade and investment flows in multinational networks, this line of research has demonstrated the increasing importance of MNEs in national economies (OECD, 2010), the structural characteristics of MNEs relative to domestic firms, and the contributions of MNEs to host and home countries.

Evidence on GVCs at the aggregate level has been limited, and until recently there was little internationally comparable data on the importance of GVCs across economies. However, the OECD has addressed the measurement of GVCs during the past years, and new data and indicators on GVCs have been developed for a large number of OECD and non-OECD economies.

A first group of indicators shows the rise of GVCs during the past decades (OECD, 2011a). For example, most OECD economies have experienced a decreasing "depth of production": the falling ratio of value added to production directly reflects the growing use of intermediates and increased offshoring of activities and outsourcing. In addition, trade has been growing faster than GDP during the past decade for almost all countries, and some countries even have trade-to-GDP ratios of over 100%. The increasing trade-to-GDP ratios follow directly from the growing importance of GVCs, because intermediates are transferred several times across borders before the goods/services are sold to the final customer. Because international trade data are expressed in terms of gross output, they include the value of the intermediates imported at each border crossing. In contrast, GDP is a value-added concept and captures only the domestic value that countries add in the production of goods and services.

Second, highly disaggregated trade data have been used to show how the trade of intermediate inputs is a source of direct evidence on GVCs. As the globalisation of value chains implies the import and export of intermediates, data on trade in intermediate goods and services may give a more precise picture. Miroudot et al. (2009) and more recently Johnson and Noguera (2012) estimated that intermediates make up the majority of international trade (roughly two thirds: 56% of goods trade and 73% of services trade).[2]

GVCs through an input-output lens

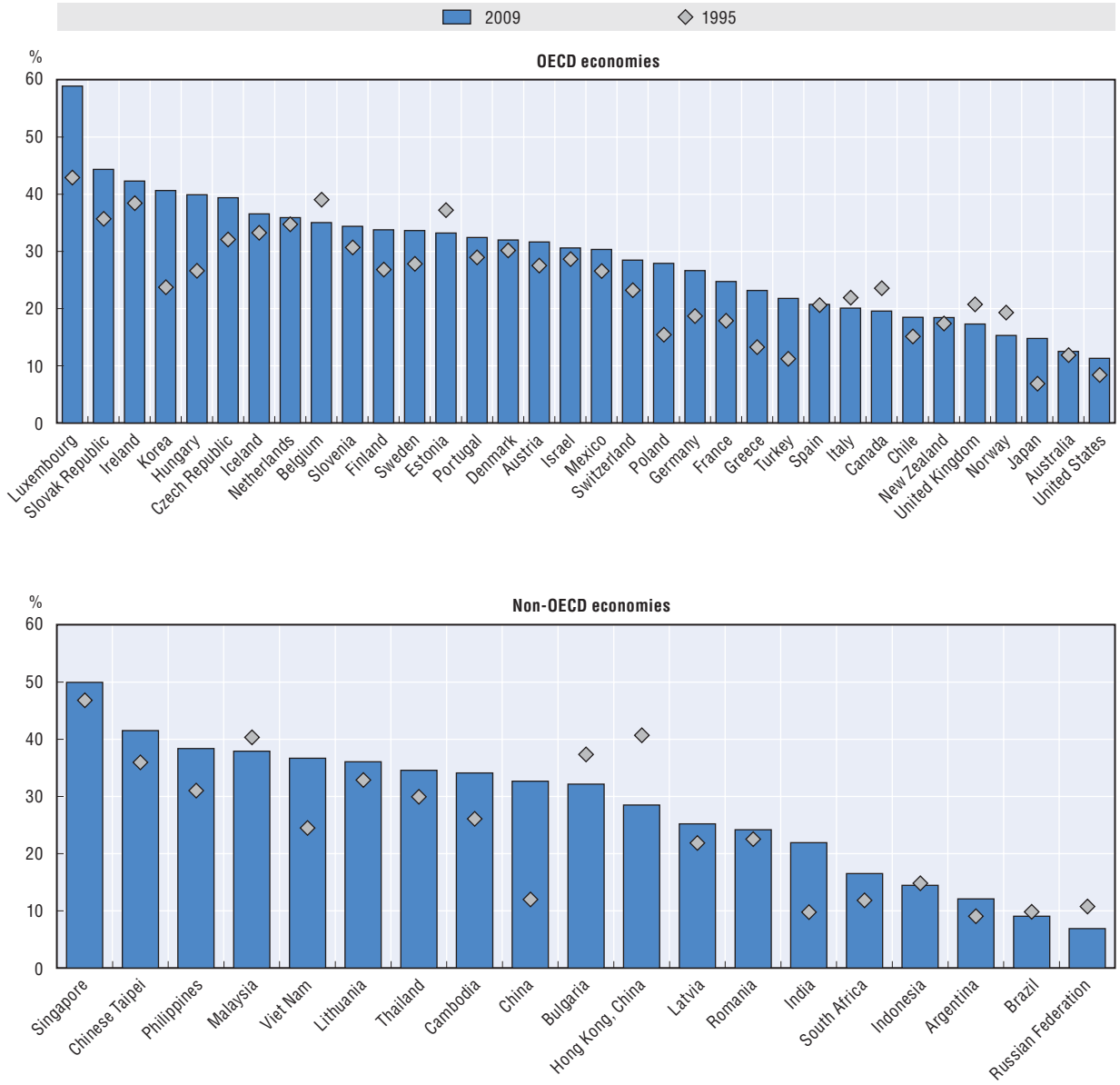
The growing importance of GVCs has raised interest in input-output (I-O) tables, which measure the relationships between the producers of goods and services (including imports) in an economy and the users of the same goods and services (including exports).[3] They can therefore be used to estimate the contribution made by imported intermediates to a country's production and exports. A first indicator of this type is the offshoring index proposed by Feenstra and Hanson (1996), which calculates the share of imported intermediates in total (non-energy) intermediates used by an industry. It shows an increasing trend for almost all economies during the past two decades, which reflects the growing sourcing of inputs abroad. There is more offshoring in manufacturing industries than in services industries (De Backer and Yamano, 2012).

A second, widely used and influential indicator estimates the contribution of off-shored intermediates to the production of goods and services that are exported (Hummels et al., 1998 and 2001). This measure of "vertical specialisation" calculates the direct and indirect import content of exports, but it only captures a part of GVCs. For example, if a computer manufacturer imports certain components (e.g. computer chips) the direct import contribution will be the ratio of the value of these computer chips to the total value of the computer. If the computer manufacturer purchases other components from domestic manufacturers, which also use imports in their production process, those imports should be also included in the calculation to determine the total import content of exports.[4] This indicator has been on a strong upward trend since 1995 across OECD economies, again an indication of the increasing importance of GVCs (De Backer and Yamano, 2012).

The OECD-WTO Trade in Value Added (TiVA) Database links national I-O tables with bilateral trade data to develop inter-country I-O tables that provide a wide range of indicators on GVCs (see Chapter 2). One indicator is the foreign value-added content of exports, which is very close to the vertical specialisation indicator described above. However, Hummels assumed that economies' imports originate entirely from foreign sources; this is not necessarily the case, as domestic value added may return embodied in imports from abroad. Like vertical specialisation, the foreign content of exports has generally increased during the past two decades,[5] but economies differ significantly in this respect (Figure 1.4). Foreign value added clearly depends on economies' size and patterns of specialisation. Smaller economies tend to have higher shares of foreign value added embodied in their exports; larger economies have a wider variety of domestically sourced intermediate goods available and are therefore less reliant on foreign imports of intermediates. Countries with substantial natural resources, such as Australia, have lower ratios of foreign value added in exports as mining activities require fewer intermediate goods in the production process.

Figure 1.4. Foreign value-added content of exports by country, 1995 and 2009

As a percentage of total exports



Note: Caution is warranted when comparing 1995 and 2009 figures for China, since data availability only allows to distinguish between processing and non-processing exports from 2005 onward; this likely affects the results (see Chapter 2).

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

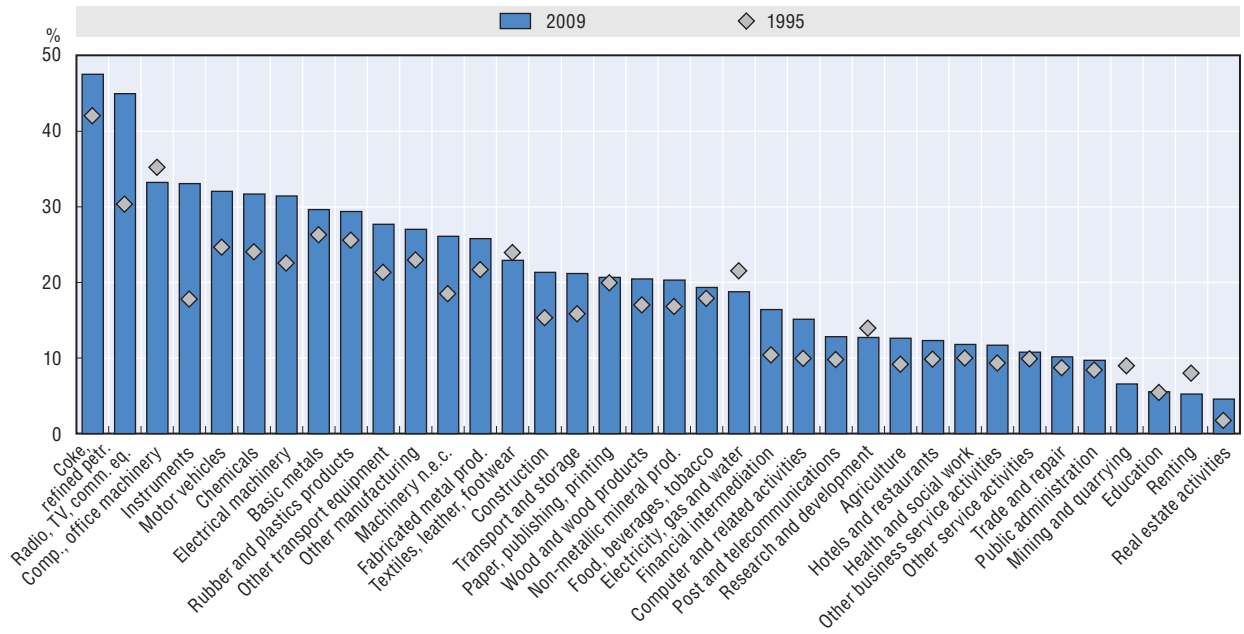
StatLink *http://dx.doi.org/10.1787/888932834378*

The importance of foreign value-added content of economies' exports is also determined by the economic structure and the export composition of countries. A high level of heterogeneity in GVCs exists across products and industries. The fragmentation of production in GVCs is linked to the technical characteristics of products and is far more developed in manufacturing than in services, resulting in important differences across industries.[6] Services are less likely to be sliced up than manufacturing products, particularly when they require face-to-face contact between the provider and the consumer. Foreign value added is very large in basic industries that make heavy use of imported primary goods such as coke and refined petroleum, basic metals, chemicals, and rubber and plastics. Fragmentation is also significant for modular products in high-technology industries. Parts and components are often produced in one country and exported to another in which they are assembled. This international division of labour is found in electrical machinery, radio/television and communication equipment, office, accounting and computing machinery, but also motor vehicles (Figure 1.5).

Modularity is a technical property of a product describing how different components of a product interact with one another (Van Assche and Gangnes, 2007). Non-modular products require components to be specifically adjusted to each other, thereby limiting the separability of production activities. Modular products instead consist of multiple components that interact through codified standards and allow companies to slice up the value chain into separable production stages as needed. The development of international standards for product descriptions and business protocols has contributed to the growing modularisation of products and the codification of transactions and created new kinds of tradable services.

Figure 1.5. Foreign value-added content of exports by industry, OECD average, 1995 and 2009

As a percentage of total exports



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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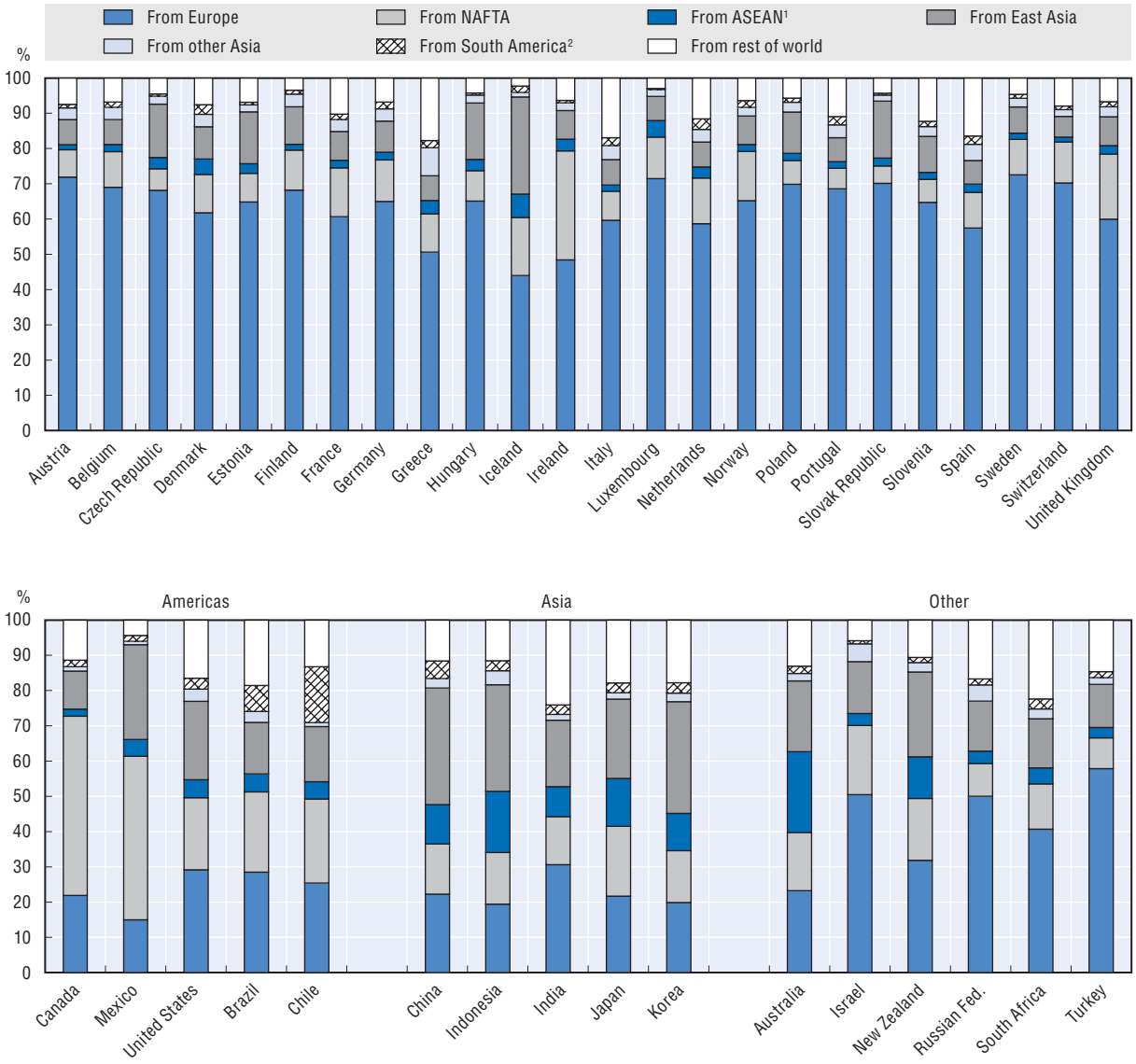
Figure 1.6. Origin of foreign value-added content of exports, by geographic region, 2009



1. Excluding Myanmar and Laos.

2. Argentina, Brazil and Chile.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

StatLink *http://dx.doi.org/10.1787/888932834416*

The regional aspect of GVCs

At the same time, and in spite of their increasingly global character, GVCs still have a strong regional focus: The foreign value added of economies' exports originates largely in neighbouring economies (Figure 1.6).[7] In most European countries, between 60% and 70% of the foreign value content of exports comes from other European countries. Within the NAFTA region, Canada and Mexico are heavily oriented towards the other NAFTA countries, in particular the United States: almost half of the imported intermediates embodied in their exports originates in the NAFTA zone. In Asia also, the majority of the

intermediates embodied in exports are sourced from within the region, reflecting the importance of Factory Asia where (advanced) parts and components are often produced by developed economies such as Japan and Korea and then exported to emerging economies such as China and increasingly Viet Nam and Cambodia where the intermediates are assembled into finished products.

This is related to the role of distance and trade costs in vertical trade because inputs are often shipped multiple times. Although transport costs have consistently fallen, they still matter, particularly for products characterised by a large weight-to-value ratio (Harrigan, 2010; Van Assche, 2012). Hummels (2007) estimated that for the median individual shipment US exporters paid USD 9 in transport costs for every USD 1 they paid in tariff duties. Furthermore, timely deliveries of intermediates are crucial for the smooth functioning of GVCs (Hummels and Schaur, 2012), and Harrigan and Venables (2006) showed that the adoption of just-in-time techniques pushes firms to locate production of time-sensitive components closer to home.

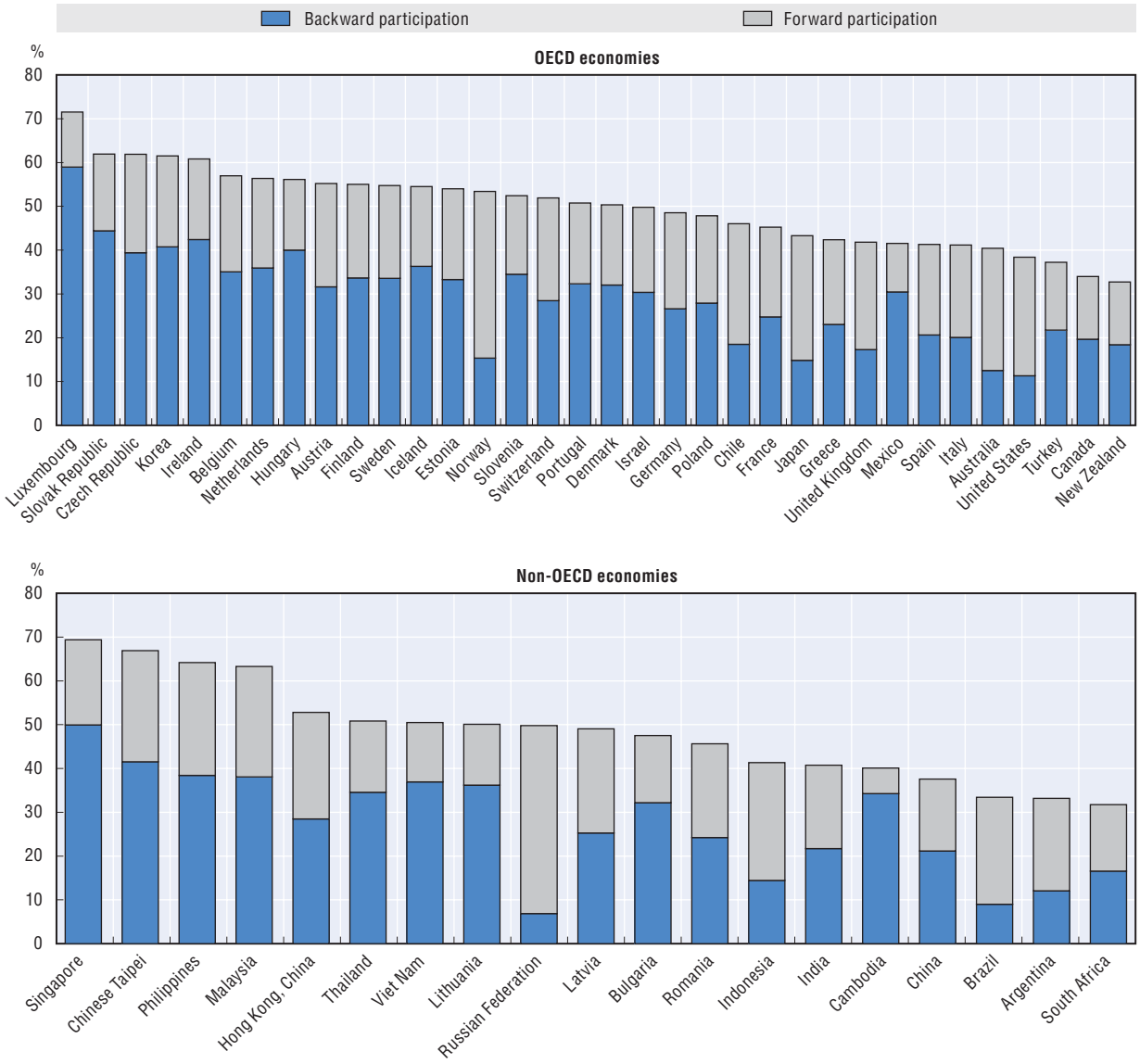
The participation of individual economies in GVCs

Economies participate in GVCs both as users of foreign inputs and as suppliers of intermediate goods and services used in other economies' exports (Koopman et al., 2011). The participation index shown in Figure 1.7 indicates the share of foreign inputs in economies' exports (looking backward along the value chain) and domestically produced inputs used in third economies' exports (looking forward along the value chain). OECD economies show a comparable level of participation in GVCs; however, large economies rely less on international trade and production and small open economies are more integrated in global production networks. Small open economies such as Luxembourg, the Slovak Republic or Belgium source more inputs from abroad and produce more inputs used in GVCs than large economies such as the United States or Japan, where a larger share of the value chain is domestic. Nevertheless, the participation index is less correlated with country size than the foreign value-added content of exports, as it also looks forward at the use of inputs in third economies. For example, the foreign content of US exports is about 15% but US participation in GVCs rises to almost 50% when the use of US intermediates in other economies' exports is taken into account (Miroudot and De Backer, 2013).

Also distance is an important factor determining the smaller participation of economies in GVCs like for example in the case of New Zealand. The degree of participation in GVCs is generally similar in OECD and non-OECD economies. Large economies, such as Brazil, China and India, have a smaller share of exports made with inputs resulting from vertical trade than small economies, such as Singapore or Chinese Taipei.[8]

Economies can be positioned upstream or downstream in GVCs depending on their specialisation and their positions may change over time. Upstream economies produce the raw materials or knowledge assets at the beginning of the production process (e.g. research, design), while downstream economies assemble processed products or specialise in customer services. Where a country is located in the value chain can affect the degree to which it benefits from a GVC; activities such as R&D and design, but also certain services, tend to create more value added than assembly (see Chapter 7). Miroudot and De Backer (2013) discuss the position of OECD and non-OECD economies in individual industries.

Figure 1.7. GVC participation index, 2009



Note: The participation index is calculated as the sum of Hummels (2001) so-called VS (i.e. the share of imported inputs in the overall exports of a country) and VS1 (i.e. the share of exported goods and services used as imported inputs to produce other economies' exports) measures.

Source: Miroudot and De Backer (2013).

StatLink *http://dx.doi.org/10.1787/888932834435*

GVCs: Part of a new economic paradigm?

Diverging perspectives on GVCs

The current process of global integration has triggered debate on the impacts of GVCs on national economies. Some scholars have argued that the increasing importance of GVCs challenges our thinking about economic globalisation and they suggest the need for a new paradigm (Blinder, 2006; Baldwin, 2009; Grossman and Rossi-Hansberg, 2008). Others have argued that GVCs "fits comfortably within the intellectual framework of comparative advantage built on the insights of Adam Smith and David Ricardo" (Mankiw and Swagel, 2006). They consider that the principle of comparative advantage remains valid but needs to be interpreted more in terms of stages, activities and tasks than of products or even industries. This view is supported by (limited) empirical evidence[9] showing that labour-intensive tasks have been largely relocated to emerging countries with abundant labour, while knowledge-intensive activities are still largely concentrated in developed economies (OECD, 2011c; Van Assche, 2012).[10]

Likewise, it has been argued that the effects of GVCs, particularly in terms of productivity and employment, can be understood within existing trade models.[11] The process of economic globalisation, including GVCs and offshoring, has various effects: positive (i.e. benefits) as well as negative (i.e. costs), dispersed as well as concentrated, short-term as well as longer-term[12] (OECD, 2007). The visible negative short-term effects (e.g. employment losses) typically receive the most attention from the media and the public, as they are easily measured; longer-term indirect benefits are much harder to calculate. Short-term costs are often transitory or one-off in nature while long-term gains are frequently lasting. However, the gains from globalisation only indirectly benefit the people whose jobs are lost.

Advocates of open markets typically focus on the productivity gains of GVCs; as companies specialise in what they do best and source non-core tasks from abroad at lower cost, productivity improves, costs come down and improved competitiveness allows output and possibly employment to expand (Lanz et al., 2011). Cline (2004) concluded that an increase of 10 percentage points in the trade-to-GDP ratio will produce on average a long-term increase in labour productivity of between 1.4% and 9.6%. Marin (2010) concludes that higher productivity because of offshoring to Eastern Europe, the Russian Federation and Ukraine has been one of the primary reasons for Germany's strong export competitiveness in recent years. But as Smith (2006) noted: "The people who have jobs as a result of offshoring related economic growth will think their good fortune is due to happenstance, and their own efforts, and has nothing to do with the decisions by companies elsewhere in the economy to offshore jobs."

For their part, globalisation sceptics point to the potential impacts of the globalisation of value chains on employment, in particular the jobs lost to offshoring (OECD, 2007a). Furthermore, since offshoring is no longer limited to manufacturing but increasingly extends to services, affected workers are not only low-skilled production workers but also medium-skilled clerical and service employees (see below; OECD, 2006). Jobs that had generally been considered unaffected by globalisation can also increasingly be offshored.[13] In the public debate, offshoring and relocation are often perceived as the exporting of jobs abroad and a pure loss to the country and its workers (Deardorff, 2005).

Both views are correct in the sense that offshoring improves productivity and leads to shifts in demand for labour, to the benefit of some workers and the detriment of others. The forces operating in GVCs often pull in different directions. Offshoring of activities as

part of GVCs most likely leads initially to short-term employment losses. But these costs have to be balanced against the expected gains, often in the longer term and in other parts of the economy. Moreover, such job losses may occur even in the absence of offshoring: some or all of the offshored jobs may also be lost as a result of other measures (productivity enhancements, automation, etc.) taken in the search for greater efficiency.

On balance, GVCs probably do not require a fundamentally new theory as existing models of trade and MNEs already include many elements that allow a better understanding of (the logic of) GVCs. Also, the effects of GVCs on national economies are generally in line with the impacts of globalisation observed in the past. But there is growing agreement that these models should be expanded to capture the characteristics of GVCs more effectively. By including specific elements of GVCs (e.g. sequential production stages) in international trade models, their inclusion may reveal additional effects on productivity and employment.

Productivity, economic growth and the contribution of GVCs

The literature shows fairly consistently that economic openness is associated with higher GDP and economic growth (for an overview, see Newfarmer and Sztajerowska, 2012). There is ample evidence that more open countries typically grow faster than less open ones and have higher income levels at any given period of time (Dollar, 1992; Sachs and Warner, 1995; Harrison, 1996; Edwards, 1998; Frankel and Romer, 1999). Noguer and Siscart (2005) estimated that a 1% increase in openness is associated with a 1% increase in per capita income. In addition to open goods markets, competitive services are increasingly acknowledged as an important determinant of growth.

While international trade is seen as a key factor in promoting economic growth, reducing trade barriers does not automatically lead to higher growth. Supportive policies (stable macroeconomic policies, adequate property rights, effective regulation, etc.) are necessary to realise the potential gains from trade liberalisation. The policy challenge for many developing economies is to get these policies into place as a corollary to trade liberalisation in order to take full advantage of trade.

Static gains from trade typically arise from the exploitation of comparative advantage and economies of scale. Trade opens foreign markets to goods and services that can be most efficiently produced in the home country, because of technological advantages (Ricardian trade models) or factor abundance (Hecksher-Ohlin models). Furthermore, the wider markets arising from trade may enable firms to take advantage of economies of scale that cannot be achieved when sales are limited to the domestic market, thereby lowering costs (as shown in trade models of imperfect competition). In addition, dynamic gains may be made not only on the level of productivity but also on its long-term growth rate through deepening specialisation, higher returns to investment (capital and R&D), growing competition, processes of technology and knowledge diffusion, and related spillovers (Nordas et al., 2006).[14]

In addition to trade, a rise in FDI and a greater presence of MNEs can also positively affect countries' economic growth through the expansion of productive capacity, job creation, human capital enhancement, innovation and technology diffusion, etc. However, these positive effects depend on the host country's economy and firms (e.g. in terms of human capital: Borenzstein et al., 1998; Alfaro et al., 2010). To benefit from the presence of MNEs, firm-level evidence points to the importance of absorptive capacity by domestic firms (for an overview, see Keller, 2004).

The positive effects of openness to trade and investment on aggregate productivity (growth) are largely felt via the reallocation of resources to higher value-added activities, i.e. to comparatively more efficient industries and to more productive firms.[15] Exporting firms, for example, tend to be larger and more productive because of specialisation and because they achieve economies of scale and scope. Empirical evidence demonstrates the effect of trade liberalisation on firm-level performance; Bernard et al. (2007) show that industries characterised by falling trade costs tend to experience larger increases in productivity, through the (intra-sectoral) reallocation mechanisms and the reduction of x-inefficiencies at the firm level.

Because of the increased trade and FDI that accompany GVCs, these "general" gains from economic globalisation can be expected to apply to GVCs as well. In addition, GVCs may further increase productivity as imports of intermediates can mean less expensive or higher quality inputs; the impact of international trade on productivity has indeed been shown to be dependent on the type of goods. Moreover, imports of capital goods and intermediate goods may increase domestic productivity through embodied technology more than imports of final goods that do not affect the domestic production process (Keller, 2004). Miroudot et al. (2009) show for OECD countries that industries with a higher proportion of imported intermediate goods display on average higher productivity, as foreign inputs embody more productive technology and push the frontier of reallocation of resources towards greater efficiency. Amiti and Konings (2007) find that companies in Indonesia that import any input are on average 9.2% more productive than companies importing no input. In addition, they show that productivity in Indonesia has benefited relatively more from the decrease in tariff barriers for intermediate goods than from a similar tariff decrease for final goods.

Goldberg et al. (2009) report that trade liberalisation has resulted in significant reductions in the prices of imported intermediates (more than of final goods); a large expansion in the range of imported intermediates; as well as increased competitiveness (in terms of sales, productivity and the introduction of new varieties) in the final goods sectors. In more general terms, imports of intermediates may benefit the competitiveness of domestic firms in various ways (Grossman and Rossi-Hansberg, 2008; Fontagné and Toubal, 2010; Cadot et al., 2011):

- A price effect: higher intermediate imports result in stronger competition between producers (including domestic producers) of intermediates, hence lowering the price of intermediates in the domestic economy.
- A supply effect: higher imports bring a larger variety of intermediates to the domestic economy.
- A productivity effect: new intermediate goods may better fit the technology of final goods producers (i.e. greater complementarity of imported and domestic inputs) and/or may spur innovation in the final goods sector because of increased access to foreign knowledge.

Countries that allow firms to access technologically advanced inputs, regardless of where they are produced, will, other things being equal, be more productive than those that do not. These economic benefits may even be realised in industries that enjoy a comparative advantage but in which a country is at a comparative disadvantage for one or more specific tasks. Trade in tasks and intermediates will increase the efficiency and productivity of tasks that are not offshored.

Shifting patterns of employment and the role of GVCs

There has been much research on the link between globalisation and employment; the most important observations are summarised here, based in part on several OECD studies (Box 1.5). A first general finding is that economic globalisation has so far had little, if any, effect on total employment. The empirical evidence broadly shows that globalisation is compatible with high employment rates if the right domestic policies are in place. Employment-population ratios have risen and unemployment rates have fallen in OECD countries during the past decades even as trade and FDI have increased (OECD, 2007b). The shift out of manufacturing and the accompanying job losses, for example, have been compensated by significant job growth in services.

Significantly, aggregate employment performance is no worse in the OECD countries that are the most open to trade or in which trade openness has increased most rapidly. Likewise, there is no obvious systematic association between cross-country differences in trade openness and unemployment rates. The general conclusion is that the overall employment level is determined in the long term by growth in the labour force, macroeconomic variables and labour-market-related institutions rather than globalisation (Hoekman and Winters, 2007).

Box 1.5. Recent OECD work on GVCs, globalisation and employment

The OECD has worked on the relationship between globalisation and employment in the world economy for some time. In the past few years, specific analyses have examined the importance of GVCs for employment. Different OECD reports present the conclusions of these studies:

- The International Collaborative Initiative on Trade and Employment (ICITE) is a joint undertaking of ten international organisations and was launched and co-ordinated by the OECD. The aim of the project was to study how trade interacts with employment, to promote discussion on these issues and to develop policy-relevant conclusions. The main outcomes of the project are bundled in OECD (2012b), *Policy Priorities for International Trade and Jobs*, D. Lippoldt (ed.). The first chapter, "Trade and employment in a fast-changing world", by R. Newfarmer and M. Sztajerowska, summarises the main conclusions. The e-publication is available at www.oecd.org/trade/icite.
- The work of the OECD Directorate for Employment, Labour and Social Affairs is reflected in: OECD (2007), *Employment Outlook 2007*, Chapter 3, "OECD workers in the global economy: Increasingly vulnerable?"; OECD (2007), Policy Brief, "Globalisation, Jobs and Wages"; OECD (2011), *Divided We Stand, Why Inequality Keeps Rising;* OECD (2012), *Employment Outlook 2012*, Chapter 3, "Labour losing to capital: What explains the declining labour share?"
- *OECD Trade Policy Working Papers* No. 117, "Trade in Tasks'", (Lanz et al., 2011) calculating and discussing the task content of international trade.

Second, globalisation appears to affect the composition of the labour market more than the level of aggregate employment. Economic integration changes the international division of labour, with losses in employment in certain industries (e.g. manufacturing) due to the exit and downsizing of less efficient firms and sectors. OECD analysis shows that foreign competition reduces employment in the most exposed industries and that imports from non-OECD countries (mainly inter-industry trade) have a stronger impact on jobs displacement than intra-OECD trade (which is mainly intra-industry) (OECD, 2007b).

The labour market plays a central role in reaping the (potential) gains of globalisation by facilitating the shifting of resources (i.e. jobs) from declining industries or occupations to expanding ones. This adjustment process does not always go smoothly as displaced workers often lack the necessary qualifications for these jobs and/or are located in other regions. Globalisation may have disproportionate impacts on certain types of workers, and impacts are often heavily concentrated. Domestic labour market institutions can facilitate the adjustment process.[16] Effective domestic policies are therefore needed to reduce the adjustment costs borne by displaced workers (OECD, 2007b).

Third, the impacts of GVCs and offshoring on the composition and levels of employment appear to follow these general patterns. The offshoring of certain production stages (e.g. replacing local production by imports of intermediate goods and services) makes production in the relevant industries less labour-intensive and employment decreases accordingly. But, as discussed above, offshoring also raises the productivity and the competitiveness of activities that are not offshored. Lanz et al. (2011) review a number of firm-level studies in different countries and find positive effects (in terms of productivity, innovation, etc.) in firms that are engaged in offshoring and in those that are not. The additional hiring due to improved competitiveness and higher sales appears sufficiently large to offset the job losses due to the fall in labour intensity. Adjustment difficulties may nonetheless result, since skill requirements for the newly created jobs tend to be higher and different from those needed in the jobs that were lost.

Fourth, GVCs, and especially the offshoring of services, nevertheless seem to have specific effects on labour markets. Past discussions of globalisation and employment in OECD countries focused on the deteriorating position of low-skilled workers in the labour market. According to the classical argument, increased specialisation led to higher imports of low-skill-intensive products from lower-wage countries, particularly in more traditional (often low-technology-intensive) industries, resulting in decreasing demand for low-skilled workers. Others have argued, however, that trade made only a relatively modest contribution, as skill-biased technological change was a more important factor.[17] Cheaper computers, for example, lowered demand for low-skilled labour and raised demand for higher-skilled workers.

During the 1980s, the United States clearly demonstrated this polarisation with a shift from low-skilled to high-skilled workers: the higher the skill level, the faster the growth in employment. During the 1990s, however, the share of middle-skilled workers declined, while that of high-skilled workers continued to rise sharply and that of low-skilled workers rose moderately. During the 2000s, the share of medium-skilled workers continued to decline, there was a sharp rise in the share of low-skilled services workers, and the share of high-skilled workers stayed relatively flat (Autor, 2010). Evidence for other countries (e.g. Goos et al., 2009, for Europe) also pointed to this growing polarisation, with employment shares of both high-skill and low-skill jobs increasing at the expense of medium-skill jobs.

Fifth, comparing the tasks performed in contracted medium-skill jobs versus those performed at the expanding high- and low-skill levels reveals the more granular effects of GVCs on labour markets in terms of trade in tasks (Grossman and Rossi-Hansberg, 2008). Medium-skilled workers often have manual or cognitive tasks that lend themselves to automation or codification (e.g. book-keeping, monitoring processes and processing information). Because these tasks can be done by machines or offshored (as services), demand for medium-skilled workers declines as do the returns to their skills. At the high-skill end, workers tend to perform non-routine cognitive tasks that complement information

technology. Demand for high-skilled workers therefore often increases in tandem with investment in information technology. At the low-skill end, non-routine tasks involve services activities such as operating vehicles and assisting and caring for others. As these activities have – thus far – been less affected by trade or technology, employment has shifted to them (Lanz et al., 2012).

The fact that some (medium-skill) jobs can increasingly be automated and offshored has been used to estimate the number of jobs that could be lost owing to (services) offshoring and international production sharing. These estimates have received considerable attention in the public debate as they often represent large numbers; however, jobs that theoretically can be offshored are not always offshored. OECD (2007a) reviews several studies and shows the typically large discrepancies in estimates of "jobs potentially at risk of being offshored", "jobs likely to be offshored" and "jobs effectively offshored". In fact, Lanz et al. (2011) show that companies often find it uneconomical to unbundle specific tasks because of large economies of scope and synergies. Moreover, transactions and co-ordination costs (owing to the importance of tacit information, unforeseen events, contractual problems) would rise significantly if these tasks were offshored.

Wages, income inequality, working conditions and the influence of GVCs

Trade in tasks within GVCs may also explain why skills have become less important as a determinant of wages[18] (Lanz et al., 2012). Recent evidence has shown that wages vary significantly across occupations for a given level of skills as measured by education and experience (Autor et al., 2010). In addition, the return to skills that can be automated or offshored has declined, and declining employment in the middle is therefore accompanied by shrinking relative and even absolute wages in occupations dominated by routine medium-skill manual or cognitive tasks. Finally, it appears that workers who perform tasks that complement tasks at both ends of the skills spectrum that can be offshored have seen their wages rise (Autor, 2010; Firpo et al., 2011).

In general, the impact of economic globalisation on wages has become a hot topic as a result of growing wage and income inequalities in most OECD countries (OECD, 2011d). The share of labour, or of labour compensation (i.e. wages, salaries and benefits), in total national income has declined in almost all OECD countries in recent decades (OECD, 2012b). This decline hides significant differences in earnings groups. On average, income from wages of the top 1% increased by 20% in countries for which data are available; in contrast, despite rising employment at the bottom end of the skills ladder, wages of the least educated have slumped (OECD, 2012b).

It is estimated (OECD, 2012b) that while other factors appear to be the main drivers, at least 10% of the decline of the share of labour in national income is due to increasing globalisation, and in particular to pressures from the relocation of parts of GVCs and from competition from imports from companies that produce in countries with low labour costs. Increased (international) competition not only reduces the size of the rent that employers and workers share, but also decreases workers' bargaining power. The evidence on the role of globalisation in growing (income and wage) inequality in OECD countries is mixed, however.[19] It is in fact very difficult to disentangle technological change from globalisation patterns that also increase the value of skills. Advances in technology, particularly in ICTs, also lie behind the international fragmentation of production and the offshoring of activities within GVCs.

Income inequality is significantly higher in emerging economies than in OECD countries, and is particularly high in South Africa, Brazil and Argentina (OECD, 2011d). While Brazil, Indonesia and, on some indicators, Argentina have made significant progress in reducing inequality over the past 20 years, China, India, the Russian Federation and South Africa have become less equal. This widening inequality seems to be at odds with increasing international specialisation based on comparative advantage; one would expect that low-skilled labour in emerging countries would benefit from the relocation of labour-intensive activities from developed to emerging economies. Some have argued that this is because low-skill work in developed economies may be similar to high-skill work in emerging economies.

Another labour market issue raised in the context of GVCs is the link between globalisation and working conditions. International competitive pressures may encourage countries to compete by reducing labour standards and working conditions. Such a "race to the bottom" does not seem to have been systematic, although cases do arise from time to time (Newfarmer and Sztajerowska, 2012). In fact, aggregate evidence shows that openness is associated with improved working conditions; open economies have significantly better working conditions – fewer hours of work, fewer accidents, etc. – than closed economies (Flanagan, 2006; Flanagan and Khor, 2012).

Foreign-owned and export-oriented companies are also found to be more susceptible to pressure from advocacy groups, with positive effects on working conditions[20] (Box 1.6). Domestic consumers and non-governmental monitoring groups also look at firms' compliance with labour legislation (Newfarmer and Sztajerowska, 2012). Reputation-sensitive MNEs have increasingly adopted codes of conduct to ensure that labour standards and human rights are respected in their affiliates abroad and throughout their supply chain (OECD, 2008c), and there is growing public attention to unacceptable behaviour on the part of MNEs at any stage of their GVCs (Lessard, 2012). The OECD Guidelines for Multinational Enterprises make recommendations on responsible participation in value chains that cover issues such as respect for labour and human rights in addition to protection of the environment, and the fight against corruption. The 44 OECD and non-OECD countries adhering to these guidelines have put in place mechanisms to promote their observance (see also Chapter 4).

Box 1.6. How international companies and NGOs affect local working conditions: The case of Apple in China

Globalisation implies international competition but it also increases the influence of international pressure groups. While global companies may be tempted to cut corners and increase their profit margins, for example by increasing working hours or compromising workers' rights, international non-governmental organisation (NGOs) can make a difference by bringing to light such abuses and influencing reputation-sensitive international buyers. For example, an inspection of Chinese plants making electronic products for Apple recently conducted by the Fair Labour Association, a monitoring group, found widespread violations, mainly in regard to hours worked. Although this is far from unusual in China, these findings made headlines and led to protests and petitions. Several labour rights organisations then began to scrutinise Apple's suppliers. As a result, Foxconn, the manufacturing giant supplying electronic parts to Apple, pressured by its reputation-conscious client, pledged on March 29, 2012, to curtail working hours sharply and increase wages significantly. The move is seen as potentially helping to improve working conditions across China.[1] In a global market where reputation matters, international companies respond to pressure from clients and NGOs have an important role to play in improving working conditions in the local market.

1. Nevertheless, inspections and monitoring still reveal instances of child labour and poor working conditions.

Source: *The New York Times*, 30 March 2012 in Newfarmer and Sztajerowska (2012).

The need for new policy thinking

Although some academics consider GVCs mainly an extension of current (trade) models and thus do not warrant the development of a new theory, the rise of GVCs marks a major shift in policy thinking on international economic integration. Van Assche (2012) suggested that: "While no new paradigm is needed to think systematically about GVCs and trade in tasks, thinking about 'GVCs and trade in tasks' is a paradigm shift by itself." Current policies often still view globalisation through the prism of the first unbundling (Baldwin, 2009): countries export goods and services that are largely produced within their territory; production chains are concentrated in a single country and the impacts of globalisation are mostly felt at the (domestic) industry level. However, the second unbundling significantly changes the rules of the game and increasingly requires rethinking government policies on economic globalisation.

As companies increasingly divide up their production process and locate different value chain activities in many countries, the concept of domestic industry or even domestic firm becomes increasingly diffuse (Box 1.7). In addition, as trade in intermediates and tasks increasingly complements trade in final goods and services, countries' exports increasingly include intermediates sourced from abroad. GVCs therefore change the rationale of government policies in areas related to globalisation, such as trade policy, investment policy, competitiveness, innovation and upgrading. The impact of GVCs on these different policy domains is discussed in more detail in the following chapters; some general policy implications of GVCs are mentioned here.

Box 1.7. What does "domestic" or "national" mean in a world of GVCs?

With the rise of GVCs, national economies have formed links across borders and become part of the global economy. The resulting cross-border linkages among companies increasingly qualify terms such as "national" industries, "domestic" companies, "nationally owned" MNEs, etc.

Who is "us"?

Robert Reich raised this question in 1990 when discussing the role of multinationals in US competitiveness. He made a clear distinction between the competitiveness of the US economy and the competitiveness of US MNEs; the growing importance of GVCs has made this distinction even more pertinent. Because of increasing globalisation, US-owned companies headquartered in the United States are no longer the only means of ensuring US competitiveness. Foreign-owned corporations that invest heavily in US-based production facilities and their workers may even contribute more. In addition, Reich argued that corporate ownership and control is becoming less important; instead workforce skills are crucial and foreign-owned corporations help US workers add value. Slaughter (2013) also explores the importance of "globally engaged" US companies – both US MNEs and foreign affiliates based in the United States – for US competitiveness. Evidence on the importance of foreign-owned companies in several national economies is presented in OECD (2011a).

"Us" versus "them"?

As different countries add value to final goods and import and export intermediate inputs within GVCs, it becomes less straightforward to calculate gains in trade and the benefits of individual countries become more interdependent. In international trade statistics, imports are assigned in their entirety to the last "country of origin" even if these imports include intermediates produced and exported by third countries to the last reporting country. This double or multi-counting of intermediates may bias bilateral trade balances, hide the real economic dimension of bilateral exchanges between countries and give rise to protectionist responses (see Chapter 2). Acknowledging that goods and services are increasingly "made in the world" will change the sometimes binary discussion in trade disputes; who exactly are "them" and "us" once domestic value added in foreign products is accounted for?

Bilateral trade balances expressed in value added instead of gross terms also demonstrate the complexity of the impact of a currency appreciation/depreciation. Other things being equal, it can be expected that the lower the domestic content in a country's exports, the smaller the effect of an appreciation of that country's currency on trade volumes (Koopman et al., 2008). Because of the high import content of exports, currency depreciation will make exports of final goods cheaper but also make imported components more expensive for domestic producers. See Evenett and Francois (2010) for a discussion on the possible effect of a stronger Chinese currency.

A more detailed level of analysis

In his description of the second unbundling, Baldwin (2009) pointed to the arrival of "globalisation with high resolution" in terms of:

- *Stages and tasks instead of industries.* The rise of GVCs changes the notion of what economies do and what they produce; exports no longer represent domestic activities but increasingly include intermediates produced in other countries. The international division of labour no longer takes place at the level of industries but at the level of stages, activities and tasks. The forces driving comparative advantage are still the same but increasingly intervene at the level of individual production stages; companies disperse their value chain internationally to benefit optimally from different location factors across countries.
- *Individuals instead of firms, industries and skills groups.* Globalisation's winners and losers have traditionally been described in terms of industries or skill groups, but GVCs and trade in tasks may affect individuals and firms in the same industry or skill group differently. Some employees and firms may suffer from globalisation if their activities are relocated, while others may prosper. Education and skills no longer seem to be the main factor in determining a strong labour market position because the character, codification and international tradability of tasks have become much more important.[21] Government policies to ease the adjustment costs of globalisation may find it increasingly difficult to differentiate according to simple categories of workers.
- *Unpredictability.* The costs of offshoring tasks depend on factors such as communication and transport costs, possibilities for unbundling tasks, ease of managing tasks abroad, all of which are rather difficult to analyse. As a result, the "tipping point" for international relocation is not clear. Policy makers typically do not possess firm-level information about which activities are best kept together and which can be (easily) offshored. It is therefore difficult to project which activities and tasks will be offshored in the future and in which firm and industry.
- *Suddenness.* Advances in ICTs have drastically decreased co-ordination/transactions costs across geographical locations. The impacts of ICTs vary depending on the tasks and the complexity of the interactions; jobs that are now considered to be largely unaffected by globalisation may later be internationally mobile activities that can be offshored.

The "old" policy thinking is reflected in current statistics on economic globalisation, which are generally only available at the economy and (sub-) industry level. Internationally comparable data at a more granular level are much more limited. This makes it difficult to measure and analyse GVCs. Trade data are available at a highly disaggregated product level but only give the gross value of exported goods and services. They do not allow for distinguishing between imported intermediates and domestic value added in the value of exports. Policy makers increasingly need to understand the effects of GVCs on their national economies. (Chapter 2 discusses in detail how the OECD-WTO TiVA Database provides data on GVCs that can underpin the design of better-informed policies.)

A broader approach to international performance

To assess how globalisation affects their national economies, policy makers would benefit from a broader network approach that takes due account of linkages among countries and their position in GVCs. The international performance of countries is still often evaluated in terms of exports and inward investments, a generally mercantilist view (i.e. performance is assessed on the amount of foreign currency earned). GVCs, however, shift the focus to imports (as exports are largely based on imports) and to outward investment (as activities abroad result in productivity increases at home).

In a world characterised by GVCs, the efficient sourcing of inputs (including services) on a global scale determines a company's competitiveness. The relocation of a production stage that can be performed more efficiently abroad makes domestic industry more competitive. Imports of intermediates do not necessarily imply foreign competition as imported tasks often complement domestic tasks (Van Assche, 2012). Firms and countries no longer rely exclusively on domestic resources to produce and export goods and services; instead, their exports increasingly embody the technology, labour and capital of the countries from which they import intermediate goods.

This has major implications for trade policy because "thicker" national borders complicate the international sourcing of inputs. Trade policy instruments such as import tariffs, rules of origin, anti-dumping, etc., may directly affect the competitiveness of domestic industries. (Chapter 3 considers the need for trade policy to adjust to the rapid changes in international production.)

Like imported intermediates, outward investment may also improve the international performance of countries. To benefit from rapid growth in foreign markets, companies must expand abroad through trade and investment. In addition, depending on the proprietary knowledge involved, companies may prefer to source inputs from affiliates abroad instead of from foreign suppliers. International investment has become crucial to competitiveness and growth; its aims include cost-cutting but also increased efficiency, enhanced access to foreign markets and knowledge, etc. GVCs thus reframe discussions on investment policy, which have long focused on attracting international investment. Inward investment by MNEs is assumed to benefit the host economy by generating additional investments, employment, human capital, and knowledge and technology spillovers.[22]

The benefits of outward investment to home economies are often less well known. Outward investment it is often perceived in terms of the relocation of jobs and capital at the expense of domestic activities. However, evidence for the United States shows that foreign activity by US MNEs complements rather than replaces domestic activity by the same firm, depending on the type of activity offshored and the offshore location[23] (Desai et al., 2005; Hanson et al., 2003; Harrison and McMillan, 2010). Slaughter (2013) reports that in 2009 90% of the production of foreign affiliates of US MNEs was sold abroad rather than imported to the United States. (Chapter 4 discusses the implications of GVCs for investment policies.)

The drivers of competitiveness increasingly include factors outside the scope of national policies. This limits the direct influence of policy on growth and job creation within national borders. There is a growing tension between the truly global character of individual firm strategies, including their GVCs, and "national" government policies that target local jobs and value added (see Box 1.8). (Chapter 6 discusses what GVCs imply for countries' competitiveness.)

New patterns of international competition and interdependence

Economic globalisation has resulted in growing competition at the international level as companies try to get a foothold in foreign markets. Foreign competition through imports and the growing presence of MNEs changes the character and structure of domestic industries, drives international specialisation and results in higher productivity and efficiency. In the present phase of economic globalisation competition has become more global as emerging economies become increasingly important partners. (The position of emerging economies, and China in particular, in GVCs is examined in Chapter 5, which focuses on the implications of GVCs for development policies.)

In addition, GVCs have spawned a type of international competition that is increasingly vertical in nature (Ma and Van Assche, 2010). Earlier phases of globalisation were characterised by growing horizontal competition between individual companies in the same industries. Today, international companies compete vertically with companies located downstream and/or upstream in the same GVC to capture a larger share of the value added and profits. Although some companies find themselves locked into lower-value activities, others are able to capture more value because they occupy a better position in the GVC. (Chapter 7 focuses on "moving up the value chain" and upgrading, and highlights the role of knowledge-based assets in this context.)

In contrast to this growing international competition, there is also a clear trend towards greater interdependence at the international level. GVCs link a growing number of companies, industries (manufacturing and services), activities (distribution, production, R&D, etc.) and countries (OECD and emerging economies) in international production networks. Company performance becomes increasingly dependent on the performance of the international production network; likewise, as different countries add value to final goods and the benefits for individual countries become more interdependent, the gains from trade are less easy to assess. And, as the sometimes binary "us versus them" becomes increasingly blurred, international trade negotiations and disputes will be affected: who exactly are "them" and "us" once domestic value added in foreign products is accounted for?

This increased connectedness often means greater sensitivity to supply and demand shocks originating in other countries. GVCs may well transmit and amplify macro-economic shocks. The greater interdependency that characterises GVCs makes individual actors more vulnerable to new forms of risk. (Chapter 8 examines the link between GVCs and so-called systemic risk, i.e. the risk that the whole system will break down when one part of the system collapses.)

New channels of international integration

While international trade and investment play a central role in international production networks, GVCs clearly push the policy agenda on economic globalisation beyond the traditional trade-investment dichotomy. As GVCs include all of the activities that companies undertake to bring a product or service from its conception to final consumers, they constitute networks in which labour, physical and human capital, technology and knowledge circulate across borders. The second unbundling has clearly heightened the international mobility of managerial know-how. This context calls for a coherent framework across different (international) policy domains, including trade, investment, technology and immigration. An efficient services sector also becomes increasingly important for the competitiveness of companies and countries, as transport, telecommunications and business services allow GVCs to function rapidly and seamlessly.

Economic integration increasingly implies the international transfer of (disembodied) technology; GVCs internationalise the knowledge activities not only of MNE networks (e.g. through the establishment of R&D laboratories abroad) but also among unaffiliated partners (through alliances, partnerships, etc.). Proprietary knowledge has traditionally been an important source of competitive advantage and is likely even more important for GVCs (Globerman, 2011). The effect of these larger international knowledge flows on the national economy is probably not yet clear; the growing internationalisation of knowledge raises concerns about weakened innovative capacity in home countries ("hollowing out of the domestic economy"). However, international connections give companies access to foreign knowledge and allow them to remain competitive and upgrade their GVC activities. The challenge for policy makers is to design policies that support companies in their international knowledge activities while maximising the benefits for the domestic economy.

For countries to benefit from GVCs, international flows of capital, labour, human capital and knowledge must be effectively linked to domestic productive capabilities. The policy agenda of GVCs is therefore not just about so-called "border" policies, as effective "behind-the-border" policies must also leverage international openness. If (emerging) countries are to integrate GVCs' production networks (see Chapter 5), they need to be open, but domestic (economic) policies largely determine which position countries occupy in GVCs and thus what value they are able to create and capture. More than in the past, knowledge and innovation play a crucial role in the competitiveness and long-term economic growth of OECD economies. Developed economies are forced to look for new sources of growth, as they can only grow by inventing new technology, by innovating in products and processes, and by designing new management methods and business models. Products and services that are currently regarded as among the most innovative and experimental will ultimately end up as commodities that can be produced anywhere and by many producers. (Chapter 7 discusses the role of knowledge-based assets, including R&D, design, brand names, software, complex systems integration, management and skills, in successful innovation in GVCs.)

Notes

1. See Cattaneo et al. (2010) for a discussion of GVCs in specific industries in the aftermath of the 2008-09 economic crisis.
2. The broad economic categories classification of the United Nations enables a distinction between intermediate and final goods. In further elaborating this classification, the OECD has recently developed a new database (Trade by Industry and End-Use, www.oecd.org/sti/btd), which distinguishes between different types of goods, including intermediates in international trade on the industry level.
3. An important advantage of I-O tables is that they classify goods according to their use (as input to another sector's production or as final demand). In contrast, classification schemes (like the United Nations BEC classification) divide goods into intermediate and other categories based on their descriptive characteristics. In addition, I-O tables include information on inputs from and in the services sector, thereby allowing for the analysis of the fast-growing category of services trade.
4. The calculation of the import content of exports using I-O information draws on some implicit assumptions; for example, it is typically assumed that the same input-output requirements apply to goods and services that are exported as to those that are destined for final demand.
5. The 2009 decrease in foreign value added content of exports suggests some consolidation in GVCs has taken place during the financial/economic crisis, most likely as a direct result of the huge and simultaneous drop in international trade during the economic crisis (see Chapters 2 and 8).
6. However, information on service industries is typically less detailed; as the indicator of vertical specialisation is affected by the level of sectoral aggregation, this may affect the results to some extent.
7. Johnson and Noguera (2012) show that so-called bilateral value added exports are higher for distant trading partners (i.e. value added exports "travel further" than gross exports); hence intermediates trade is relatively more geographically concentrated. Miroudot et al. (2009) also demonstrate the strong regional concentration of intermediates trade.
8. Figure 1.6 only includes emerging economies; the participation in GVCs is expected to be significantly lower for the least developed countries.
9. Data on trade in tasks, activities and stages are not widely available beyond the case-study evidence for some products and industries (see above).
10. However, the growing offshoring of R&D activities to emerging economies such as China and India may cast some doubt on the relevance of comparative-advantage models since developed countries are still presumed to enjoy a relative abundance of highly skilled scientists and engineers (Manning et al., 2008).

11. Yet theory cannot easily predict employment effects, as models are based on specific assumptions. When more complexity is introduced in these models (in terms of the number of industries and the type of goods), the effects are not determined a priori (Lanz et al., 2012).

12. The globalisation of value chains affects employment, productivity growth, prices, wages, inflation, terms of trade, etc., and the impacts vary across activities, regions and social groups.

13. Markusen (2005) and Bhagwati et al. (2004) argue that tradable services should be analysed in the same way as traded (final and intermediate) goods. The only difference is the means of transport: telephones or the Internet rather than traditional physical transport (2004 US Economic Report to the President, in Mankiw et Swagel, 2006).

14. The literature review by Newfarmer and Sztajerowska (2012) shows the link between openness in trade and additional drivers of growth, such as increasing investment, deepening of human capital and total factor productivity.

15. Recent firm-level models of trade show the importance of the reallocation of resources for raising across-firm as well as within-firm productivity. Melitz (2003) describes how lower trade costs can promote the reallocation of resources to more productive firms, while unproductive firms exit. In addition, the Melitz and Ottaviano (2008) model shows how lower trade costs increase competitive pressures in the domestic market and result in lower mark-ups and lower X-inefficiencies in firms.

16. Job displacement because of increased trade often represents only a fraction of the jobs displaced, however.

17. An interesting debate in the academic literature considered whether skills-biased technological change or trade was the main reason for growing income inequalities at the time. Although there was no consensus, the conclusion seemed to be that technology was the major driving force. See Acemoglu (2002) for a review.

18. This finding challenges, to some extent, the stylised fact that the returns to skilled labour have increased relative to unskilled labour.

19. Some studies argue that beyond regulation and labour market institutions, technology is the principal driver of inequality while others consider that globalisation through trade and especially FDI has a greater effect (OECD, 2011d).

20. Evidence on the impact on working conditions is however not unequivocal: econometric analysis of three developed and two developing countries found that FDI increased wages in foreign affiliates but did not necessarily affect working conditions (OECD, 2008c).

21. Education and training are of course necessary to help workers adapt to changing conditions; while specific knowledge may become quickly out of date, general learning skills are increasingly important.

22. Recent research has qualified to some extent the size of spillover effects to domestic firms, including SMEs, and has demonstrated the importance of absorptive capacity for maximising potential spillovers.

23. For example, results indicate that higher sales by foreign affiliates lead to a rise in labour demand in US parents. However, the job gains are not evenly distributed: low-skilled foreign workers replace US workers.

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Chapter 2

Measuring trade in value added

The increasing international fragmentation of production that has occurred in recent decades has challenged the conventional perception and interpretation of trade. Traditional measures of trade record gross flows of goods and services every time they cross borders. In a world characterised by global value chains (GVCs), this leads to what many describe as "multiple" counting of trade, which may in turn lead to misguided policy measures. The OECD-WTO estimates of trade in value added (TiVA) can better interpret trade in a world of GVCs. The TiVA Database can also act as an impetus for the production of national statistics that better reflect global interdependencies.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

What is trade in value added?

Global value chains (GVCs) are a dominant feature of today's global economy. The growing international fragmentation of production challenges the conventional perception and interpretation of trade statistics and, in particular, the policies that we develop around them. Because traditional measures of trade record gross flows of goods and services every time they cross borders, they may lead to misguided policy decisions.

Various studies that focus on the production process of an individual product have been used to shed light on this issue and are widely referred to throughout this publication. Perhaps the best-known example is that of the Apple iPod (Linden et al., 2009), which showed that of the iPod's USD 144 (Chinese) factory-gate price, less than 10% represented Chinese value added. The bulk of the components (about USD 100 in value added) were imported from Japan and much of the rest came from the United States and Korea (see Chapter 1).

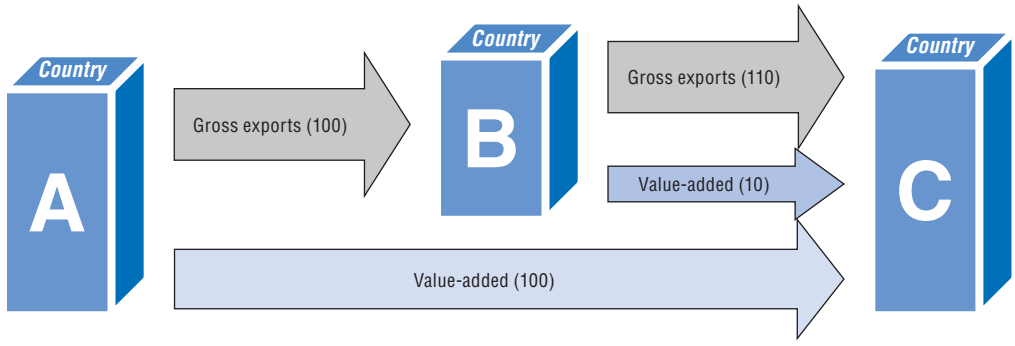
However this stylised approach, frequently referred to as 'screwdriver' economics (see Chapter 1), can generally only be used for specific products and, even then, it only reveals part of the story about who benefits from trade and how global value chains work. Typically it is only possible to show where the various intermediate components were produced, but not how and where the intermediate parts were themselves created, and how the intermediate parts used to produce those intermediate parts were produced, and so on. For example, in the iPod example, the message would be significantly different if the parts imported from Japan to make the iPod themselves required significant Chinese content.

To deal with the bigger picture and understand total economy effects and capture all of the upstream effects, several studies have adopted a macro approach, based on the construction of inter-country or world input-output (I-O) tables (Hummels et al., 2001; Daudin et al., 2009; Johnson and Noguera, 2012; and Koopman et al., 2011). A number of pioneering initiatives by GTAP (the Global Trade Analysis Project), the World Trade Organization (WTO) with IDE-JETRO, and also the WIOD (World Input-Output Database), have helped accelerate improvements in the underlying statistics used to construct the results.

But these studies and initiatives have generally been single efforts and have often required the use of unofficial statistical data. What was lacking was a systematic attempt to mainstream the development of statistics in this area. In response, in March 2012, the OECD and WTO joined forces to develop a database of indicators based on trade in value added (TiVA Database). The first results were released in January 2013.

The Trade in Value Added initiative addresses the double counting implicit in current gross trade flows, as intermediate goods and service cross borders many times (and do so increasingly with the rise of GVCs). Instead it measures flows related to the value that is *added* (labour compensation, other taxes on production and operating surplus, or profits) by a country in the production of any good or service that is exported.

Figure 2.1. A simple schematic for trade in value added



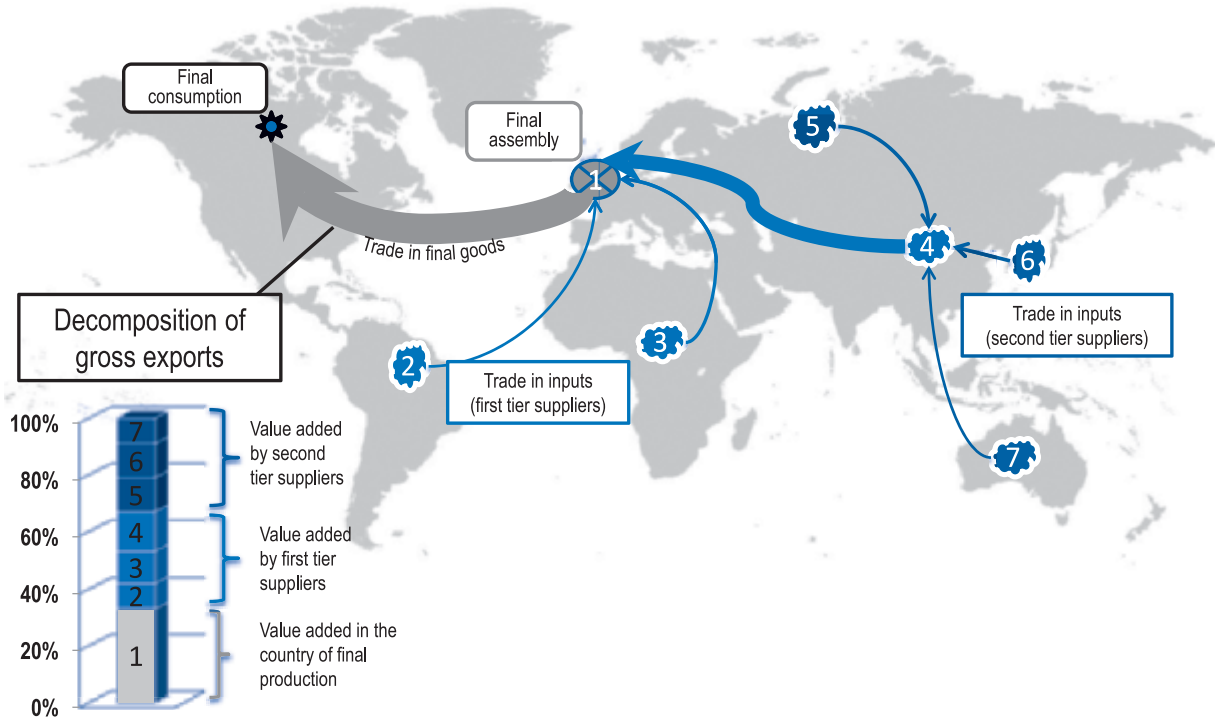
Source: OECD (2012).

The simple example in Figure 2.1 illustrates this. Country A exports USD 100 of goods, produced entirely in A, to country B, which further processes them before exporting them to C where they are consumed. B adds value of USD 10 to the goods and so exports USD 110 to C. Conventional measures of trade show total global exports and imports of USD 210 but only USD 110 of value-added has been generated in their production. Conventional measures also show that C has a trade deficit of USD 110 with B, and no trade at all with A, despite the fact that A is the chief beneficiary of C's consumption.

By tracking flows of value added, one can recalculate C's trade deficit with B on the basis of the value-added it "purchases" from B as final demand. This reduces its deficit with B to USD 10. If the same approach is applied to A's value added, C will have a deficit of USD 100 with A. C's overall trade deficit with the world remains at USD 110. What has changed is its bilateral positions. This simple illustration reveals how output in one country may be affected by consumers in another and by how much (for example C's consumers drive A's output) but it also offers other important insights into global value chains. For example, it shows that B's exports depend significantly on intermediate imports from A, and so reveals that protectionist measures on imports from A may harm its exporters and hence its competitiveness. By providing information at the level of specific industries, it is possible to provide insights into other areas as well, such as the actual contribution of the services sector to international trade, as discussed in Chapter 3.

Figure 2.2 expands on this exposition to consider producers further upstream in global value chains. The figure shows that conventional trade statistics would record gross exports from Europe (1) to North America, gross exports from the Russian Federation (5), Japan (6), and Australia (7) to China (4), and gross exports from China, South America (2) and Africa (3) to Europe. But these flows only tell part of the story and only partly reflect the nature of global interdependencies. From the perspective of North America, the only interactions are with Europe, yet it is demand from North American consumers that drives the output throughout this global value chain. The aim of the trade in value added approach is therefore to identify the nature of these inter-relationships by breaking the value of a given gross export down into its value-added components (by country of origin and industry). A number of indicators follow from this underlying principle, as will be seen below. One simple but important indicator, for example, reallocates gross trade flows across countries on the basis of who finally consumes the underlying value-added embodied in the (gross) export and the origin of each piece of value added, thereby creating bilateral links between consumers and all upstream producers.

Figure 2.2. A simple global value chain



Source: OECD (2012). *Map source:* © ARTICQUE – all rights reserved.

Why measuring trade in value added is important

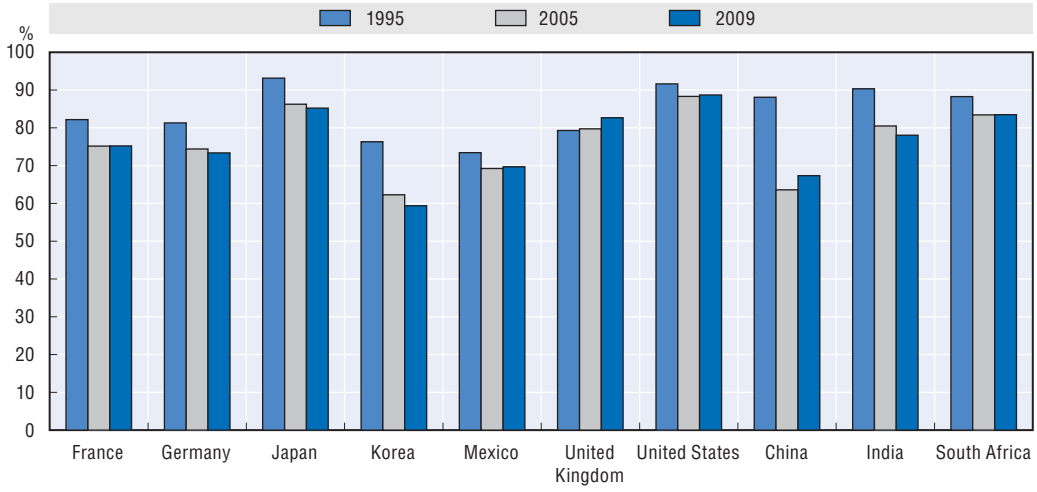
The need for better policy evidence

Policy makers seek better policy evidence to learn if, and to what extent, (national) policies need to change as a result of GVCs. Later chapters use the new results on trade in value added to discuss the impacts of GVCs on a wide range of policy domains.

Understanding how much domestic value added is created by the export of a good or service is crucial for understanding how trade contributes to the economic growth and competitiveness of countries. Some economies have capitalised on global value chains by developing comparative advantages in specific parts of the value chain. For example, much of the People's Republic of China's exports currently involves assembly work with a high level of foreign content, leading to a significant fall in its domestic value added to output ratio between 2005 and 2009. But data for recent years indicate that China may be beginning to move upstream in the value chain Chapter 5). This pattern of increasing international fragmentation of production is not confined to China though (Figure 2.3). The data reveal that access to efficient imports matters as much in a world of international fragmentation as does access to markets. Figure 2.4 reinforces this picture by showing the shares of total intermediate imports that are eventually used to produce goods and services for export.

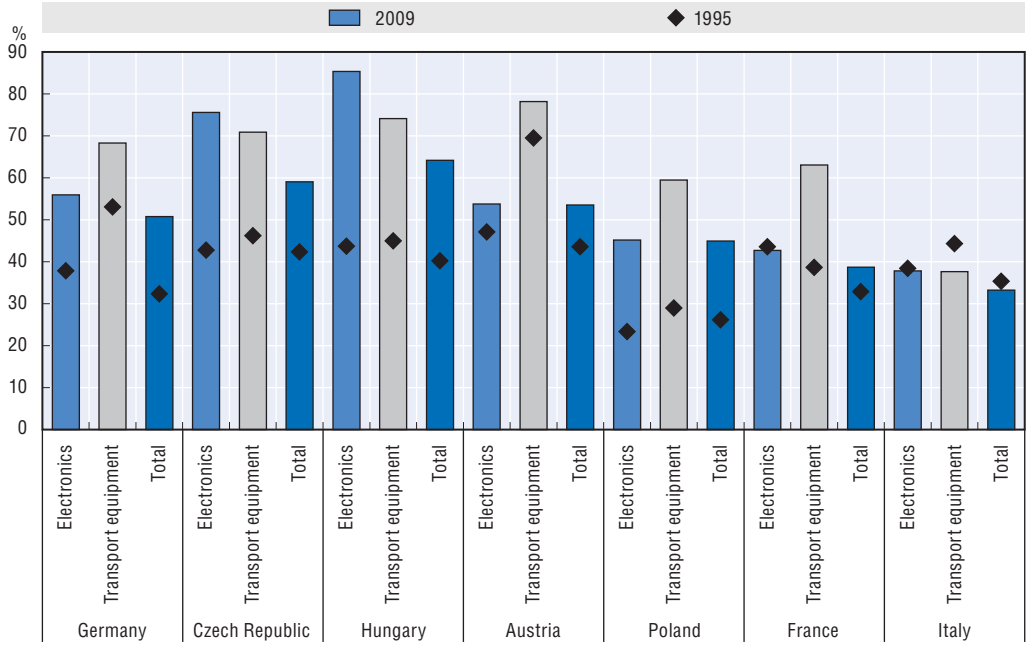
In most economies, significant shares of intermediate imports are destined for the export market. Within the European production hub shares are around 50% for many economies. In Hungary, nearly two-thirds of all intermediate imports are destined for the export market after further processing, with the share reaching 85% for electronic intermediate imports. Similar patterns exist in Factory Asia and in NAFTA.

Figure 2.3. Domestic content of exports (domestic value added in exports, % of total gross exports), 1995-2009



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

Figure 2.4. Intermediate imports embodied in exports, % of total intermediate imports, 1995 and 2009



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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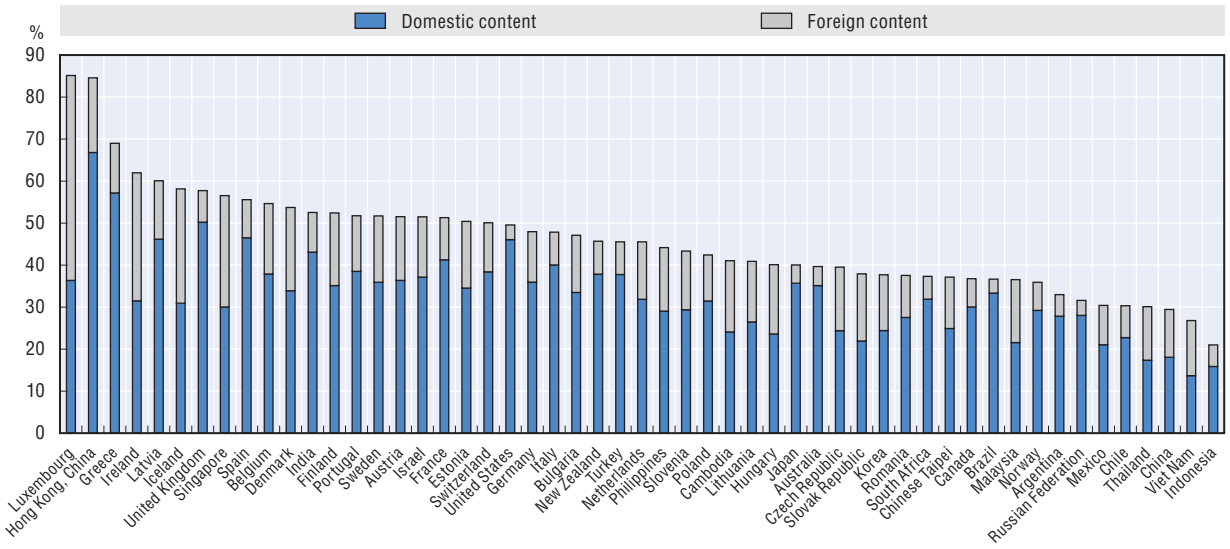
In addition, domestic value added is found not only in exports but also in imports: goods and services produced in one domestic industry may be shipped abroad as intermediates but come back to the domestic economy embodied in the imports of other, and often the same, industries (see Chapter 3). As a consequence, tariffs, non-tariff barriers and trade measures can also impact on the competitiveness of domestic upstream producers (as well as the competitiveness of downstream producers as mentioned above) in addition to foreign producers.

In the United States for example about 5% of the total value of imported intermediates reflects US value added. Moreover, these are prudent estimates. As discussed below, the estimates currently produced under the OECD-WTO TiVA initiative rely on a number of prudent assumptions, so that current estimates of the foreign content of exports, and of returned value added, are likely to be conservative (biased downwards). The United States, for example, exports significant quantities of goods for further processing to Mexico. Better reflecting these flows, and, in particular, better estimating the foreign content of Mexico's exports is likely to increase the US value-added shares of its imports significantly. The OECD is working with national statistics offices to motivate the provision and compilation of data that will improve the quality of the TiVA results and reduce the impact of these prudent assumptions.

Looking at trade from a value-added perspective helps to illustrate how upstream domestic industries contribute to exports, even if they have little direct international exposure. Services comprise about two-thirds of GDP in most developed economies, but gross trade statistics show that less than one-quarter of total global trade is in services. This partly reflects the fact that significant shares of services output are generally not tradable for example government services, many personal services and imputations such as those made in GDP calculations to reflect the rent homeowners are assumed to pay themselves (between 6-10% of GDP in most developed economies). But it also reflects the fact that the services sector provides significant intermediate inputs to domestic goods manufacturers.

Figure 2.5. Services value added, % of total exports, 2009



Note: Part of the explanation for the difference between OECD countries and emerging economies reflects the relatively higher degree of (largely domestic) outsourcing of services by manufacturers in OECD countries in recent decades, suggesting that a similar process could lead to improvements in the competitiveness of emerging economy manufacturers.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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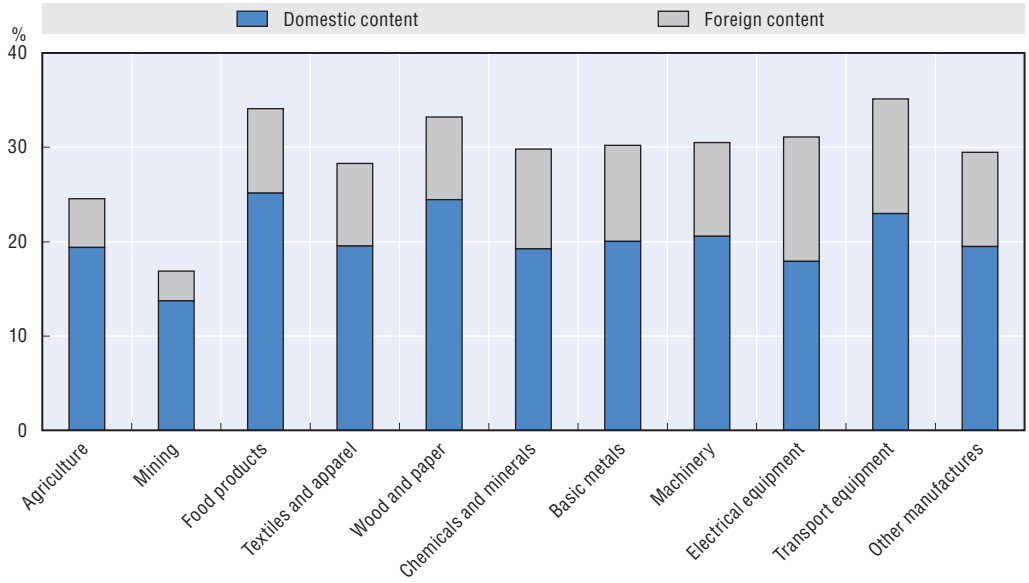
Accounting for the value added produced by the services sector in the production of goods shows that the services content of total gross exports is over 50% in most OECD economies and approaches 60% in the United Kingdom (Figure 2.5 and Chapter 3). Canada, with significant exports of natural resources, which typically have low services content, has the lowest services content of exports in the G7 but even there the share is close to 40%. Typically, emerging economies and other large exporters of natural assets, such as Australia, Chile, and Norway, have the lowest shares of services. But in India over half of the value of its gross exports originates in the services sector.

Goods industries require significant intermediate inputs of services from both foreign and domestic suppliers (Figure 2.6). Looking at trade in value-added terms can reveal that policies to encourage services trade liberalisation and more foreign direct investment, and therefore access to more efficient services, can improve the export competitiveness of goods industries.

Figure 2.6. Services value added, % of total exports of goods, 2009 (OECD + BRIICS)



Note: BRIICS: Brazil, Russian Federation, India, Indonesia, China, South Africa.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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The discussion of trade imbalances therefore changes when trade in value added (specifically trade in intermediate parts and components) and "trade in tasks" are taken into account. While a country's overall trade balance with the rest of the world does not change, the surpluses and deficits with partner countries are redistributed. In gross terms, the deficit with producers of final goods (or the surplus of exporters of final products) is exaggerated because it incorporates the value of foreign inputs. However, the underlying imbalance is in fact, at least partly, with the countries that supply inputs to the final producer. As pressures for rebalancing increase in the context of persistent deficits, there is a risk of protectionist responses directed at countries at the end of global value chains because of an inaccurate perception of the origin of trade imbalances, as shown for China in Figure 2.7.

Figure 2.7. China's value-added and gross trade balances, USD billion, 2009

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

StatLink *http://dx.doi.org/10.1787/888932834530*

In 2009, for example, China's bilateral trade surplus with the United States was over USD 60 billion (one-third) less in value-added terms. This partly reflects the higher share of US value-added imports in Chinese final demand but also the fact that one-third of China's exports contain foreign content – the "Factory Asia" phenomenon. Because significant exports of value added from Korea and Japan pass through China on their way to final consumers, China has significantly smaller trade deficits with these countries but Japan and Korea also have typically higher trade surpluses with other countries. Similarly, the data show that Korea's significant trade deficit with Japan falls in value-added terms.

Trade in value added gives policy makers a better view of the impact of macroeconomic shocks on trade. In the 2008-09 financial crisis, trade collapsed simultaneously in all economies, and the role of global supply chains in the transmission of what was initially a demand shock in markets affected by a credit shortage has been discussed (see Chapter 8). Better understanding of value-added trade flows would help policy makers to anticipate the impact of macroeconomic shocks and adopt appropriate policy responses. An analysis of the impact of trade on short-term demand that is based on gross trade flows is likely to be strongly biased.

The database shows gradual increases in the domestic content of exports around the time of the financial crisis, providing some indication of how global value chains were affected by the unprecedented slowdown in global trade. Clearly, the more the production of a good or service is fragmented, the more likely it was to be affected by the synchronised slowdown in trade and demand that characterised the crisis.

Several studies of the impact of trade liberalisation on labour markets have attempted to estimate the "job content" of trade. Estimates of trade in value added can also help to clarify the link between trade and employment in more detail and to show where jobs are being created. A breakdown of the contribution of each economy, including the domestic economy, to the value of exports can help. Traditional thinking about trade in gross terms typically regards imports as jobs lost and transferred to the countries in which the imports originate. In value-added terms, a different picture emerges. For example, workers may

lose jobs at the assembly stage, but measures based on value added would show where jobs are created as a result of value added (in marketing, design, development, etc.). When comparative advantages apply to "tasks" rather than to "final products", the skill composition of labour embodied in the domestic content of exports reflects the relative level of development of participating countries. Industrialised countries therefore tend to specialise in high-skill tasks such as research and development (R&D), design and marketing, which are better paid and capture a larger share of the total value added.

Another area in which the measurement of trade flows in value-added terms would support policy making is assessments of the environmental impact of trade. Concerns over greenhouse gas emissions and their potential role in climate change have triggered research on how trade openness affects CO_2 emissions. The unbundling of production and consumption and the international fragmentation of production require a value-added view of trade to understand where CO_2 is produced as a consequence of trade. Various OECD studies have found that the relocation of industrial activities can have a significant impact on differences in consumption-based and production-based measures of CO_2 emissions (Ahmad and Wyckoff, 2003).

The need for national statistics to (better) reflect global interdependencies

From their early beginnings in the 1920s and 1930s and the pioneering work of Klark and Kuznets and then Stone in the 1940s, national statistics systems have continuously evolved and significantly improved. Examples include the international standards of the 1953, 1968, 1993 and 2008 Systems of National Accounts and the revisions to the Balance of Payments manuals from the first edition in 1948 to the sixth update in 2009.

These international standards, among others, have been instrumental in improving the international comparability of national statistics, but they essentially remain mechanisms for measuring activity within an economy and with direct trading partners. The increasing tendency for firms, particularly multinationals, to participate in global value chains has raised the question of whether the conventional focus on the national perspective in statistical compilation needs to be modified to deal with this new reality.

Although GDP arguably remains the most important economic aggregate for policy makers (even though it is shifting in some countries towards gross national income because of the growing importance of multinationals), the aggregate is useful only because of its components. From the "output" side, this means knowing which industries provide goods and services and generate profits and employment and how, and from the demand side, this means knowing what consumers purchase and from whom.

When goods and services were entirely produced within national borders, with imports and exports typically final goods, conventional statistics were well equipped to respond to policy needs. However, this is increasingly no longer the case. Generally speaking, when producing and analysing statistics for industries, it is implicitly assumed that all firms allocated to a particular classification will behave in much the same way, i.e. that for a given output they will have similar production functions, productivity, procurement patterns, etc. This of course was always something of a convenient fiction, but the increasing international fragmentation of production means that it is probably even more so today.

Today's business environment is increasingly littered with new types of firms (and an associated lexicon, such as fabless[1] producers, processers) which are complicated for the international statistics community. They bring not only a new language but also great diversity and challenge the classification of businesses on the basis of their (main) final product/activity. Moreover, multinational firms, as is demonstrated throughout this publication, clearly organise their activities differently from purely domestic producers, in particular in the way they source inputs (with significant intermediates imported from affiliates abroad).

Global value chains call for a new perspective on statistical compilation. Faced with providing more detailed breakdowns of firms based on their main activity, it is arguably better to begin to look at breakdowns of broader characteristics, such as ownership (foreign-owned or domestic) and the tasks firms engage in, in a more aggregated industry classification, since it is these characteristics that increasingly create heterogeneity.

These are also the characteristics that provide the basis for understanding how firms engage in global value chains. The evidence referred to throughout this report shows that firms participating in global value chains typically have higher foreign content in their production process, and, therefore, different domestic value-added and employment effects, from firms producing goods and services for domestic markets. However, conventional statistics are not able to reflect this. As will be seen below, because national statistics currently fail to capture this heterogeneity, the foreign content estimates produced in this report are likely to be prudent and biased downwards. Dealing with this heterogeneity is important for improving the analytical capacity of national statistics, but also for international statistics and TiVA indicators.

But one need not look so far ahead to make the case for better national statistics. It has long been known that bilateral trade statistics (in gross terms) between trading partners do not always align. One country's recorded exports to another country rarely align with that country's imports (even after accounting for price differences). Indeed, global exports and global imports do not align. Better understanding of global value chains and international interdependencies can help to resolve these long-standing differences, which are even larger when specific products are examined.

As will be seen, the TiVA initiative resolves these differences by using balancing procedures and assumptions, but it has also drawn attention to the need to resolve differences in official national statistics. The TiVA initiative can thus be seen as creating the momentum for a virtuous circle that will provide increasingly better results, by taking better account of the heterogeneity of firms, particularly those that are engaged in global value chains and those that are not, and through extensions such as trade in income (see Annex 2.A2) and better statistics on multinationals.

Estimating trade in value added

As mentioned, several initiatives have addressed the issue of measuring trade flows in the context of the fragmentation of world production.[2] The most commonly used approach is based on global input-output (I-O) tables, using standard Leontief inverses (for more detail, see OECD-WTO, 2012).

National I-O tables describe domestic interactions between domestic industries and between those industries and drivers of final demand (households, not-for-profit institutions serving households, government, investment and exports). They also show who purchases imports, typically broken down by type of import.

Table 2.1 gives a simple example of an I-O table for an economy with two industries. A_{ij} reflects the intermediate consumption in basic prices of industry *j*'s outputs by industry *i*. Table 2.2 shows how each of the entries for imports can also be split into an equivalent industry origin of the imports.

These national tables form the basis of the global I-O table needed to analyse GVCs. In fact, they can be used on their own as the basis of "screwdriver" analyses that drill down one level to show how output in one domestic industry uses inputs from other domestic industries and also imports. What they cannot show is how the intermediate imports used by these industries are produced and what imports they in turn require. In addition national I-O tables cannot be used to illustrate how much of the reporting country's own value added is embodied in its imports. This requires a global I-O table.

Table 2.3 depicts a global table for two countries and two industries in each country, which can be generalised for all countries. In the current OECD global I-O table the breakdown includes data for 57 economies and 37 industries. The rest of the world (R.O.W) is calculated using data on GDP for economies included in R.O.W and total exports and imports of these economies.

The table follows the same notation as in Tables 2.1 and 2.2 except that A^2_{ij} reflects the intermediate consumption of industry *i* in country 2 of products produced by industry *j*. The notation for other entities follows the same logic. All re-exports (XM in Table 2.1) are eliminated from the global I-O table. Domestic final demand is equivalent to total household final consumption, expenditures of non-profit institutions serving households (NPISH), general government final consumption and total investment.

Because all flows are recorded at basic prices there is an additional row, "taxes less subsidies on product", which reflects the taxes paid and subsidies received by industries and final demand consumers on their intermediate and final purchases. For most industries these entries are in practice relatively minor. In most countries this item reflects VAT, which is mainly paid by final demand consumers, as most firms in most industries can reclaim the VAT paid on their purchases, although industries such as financial services and non-market producers also pay VAT on their inputs, as do firms below VAT thresholds. For convenience all flows recorded as value added in the TiVA database allocate these payments to the value-added estimates of the industries.

Table 2.1. A simplified national input-output table

	Industry 1	Industry 2	Households	NPISH	Government	Investment	Exports
Industry 1	A_{11}	A_{12}	H_1	N_1	G_1	In_1	X_1
Industry 2	A_{21}	A_{22}	H_2	N_2	G_2	In_2	X_2
Imports	M_1	M_2	HM	NM	GM	InM	XM
Taxes less subsidies on products	TP_1	TP_2	HTP	NTP	GTP	InTP	XTP
Value-Added at basic prices	V_1	V_2					
of which							
Operating surplus + mixed income	OS_1	OS_2					
Compensation of employees	COE_1	COE_2					
Taxes less subsidies on production	TPr_1	TPr_2					
Output	O_1	O_2					

Table 2.2. A simplified import flow table

	Industry 1	Industry 2	Households	NPISH	Government	Investment	Exports
Industry 1	M_{11}	M_{12}	MH_1	MN_1	MG_1	MIn_1	MX_1
Industry 2	M_{21}	M_{22}	MH_2	MN_2	MG_2	MIn_2	MX_2

Table 2.3. A simplified two-country (global) input-output table

		Country 1		Country 2		Country 1	Country 2
		Industry 1	Industry 2	Industry 1	Industry 2	Domestic Final Demand	Domestic Final Demand
Country 1	Industry 1	A_{11}	A_{12}	M^2_{11}	M^2_{12}	D_1	MD_1
	Industry 2	A_{21}	A_{22}	M^2_{21}	M^2_{22}	D_2	MD_2
Country 2	Industry 1	M_{11}	M_{12}	A^2_{11}	A^2_{12}	MD_1	D^2_1
	Industry 2	M_{21}	M_{22}	A^2_{21}	A^2_{22}	MD_2	D^2_2
Taxes less subsidies on products		TP_1	TP_2	TP^2_1	TP^2_2	DTP	D^2TP
Value-Added at basic prices		V_1	V_2	V^2_1	V^2_2		
Output		O_1	O_2	O^2_1	O^2_2		

Constructing the global table is a data-intensive process and presents many challenges. The main one is to identify and create links between exports in one country and the purchasing industries (as intermediate consumption) or final demand consumers in the importing country. In this respect the data issues faced by the OECD are similar to those confronted by initiatives such as IDE-JETRO (Asian Input-Output Tables) or the World Input Output Database project, with which (as with the US-ITC) the OECD and WTO are actively engaged in order to share experiences and derive a set of best practices.

The OECD data sources are harmonised I-O tables and bilateral trade coefficients in goods and services, derived from official sources.[3] The model specification and estimation procedures can be summarised as follows:

- Preparation of I-O tables for reference years using the latest published data sources, *e.g.* supply and use tables (SUTs), National Accounts and trade statistics.
- Creation of bilateral trade import matrices:
  - Preparation of bilateral merchandise data by end-use categories for reference years. The published trade statistics are adjusted for analytical purposes (such as confidential flows, re-exports, waste and scrap products, and valuables). Trade coefficients of utility services are estimated based on cross-border energy transfers. Other trade coefficients of services sectors are based on OECD Trade in Services and UN Service Trade statistics. However, many missing flows are currently estimated using econometric model estimates.
  - Conversion of cost, insurance, freight (c.i.f.) price-based import figures to free on board (f.o.b.) price-based imports to reduce the inconsistency issues of mirror trade data (because of asymmetry in reporting exports and imports in national trade statistics, as described above).
- Adjustment (missing sectors, trade with rest of the world, etc.) and minimisation of discrepancy columns using bi-proportional methods.

National input-output tables

The OECD has been updating and maintaining harmonised I-O tables, splitting intermediate flows into tables of domestic origin and imports, since the mid-1990s, usually following the rhythm of national releases of benchmark I-O tables. The first edition of the OECD I-O Database dates back to 1995 and covered ten OECD countries with I-O tables spanning the period from the early 1970s to the early 1990s. The first updated edition of this database, released in 2002, increased the country coverage to 18 OECD countries, China and Brazil, and introduced harmonised tables for the mid-1990s. The database now includes national I-O tables for 57 economies[4] (Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Argentina, Brazil, Brunei, Bulgaria, Cambodia, China, Chinese Taipei, Cyprus[5], India, Indonesia, Latvia, Lithuania, Malaysia, Malta, Philippines, Romania, Russian Federation, Saudi Arabia, Singapore, South Africa, Thailand and Viet Nam).

The I-O tables show transactions between domestic industries but, as a complement, supplementary tables that break down total imports by user (industry and category of final demand) are included. Some countries provide these import tables in conjunction with their I-O tables but others are derived by the OECD.

Table 2.4. OECD input-output industry classification

ISIC Rev.3 code		Description
1+2+5	1	Agriculture, hunting, forestry and fishing
10+11+12	2	Mining and quarrying (energy)
13+14	3	Mining and quarrying (non-energy)
15+16	4	Food products, beverages and tobacco
17+18+19	5	Textiles, textile products, leather and footwear
20	6	Wood and products of wood and cork
21+22	7	Pulp, paper, paper products, printing and publishing
23	8	Coke, refined petroleum products and nuclear fuel
24ex2423	9	Chemicals excluding pharmaceuticals
2423	10	Pharmaceuticals
25	11	Rubber and plastics products
26	12	Other non-metallic mineral products
271+2731	13	Iron and steel
272+2732	14	Non-ferrous metals
28	15	Fabricated metal products, except machinery and equipment
29	16	Machinery and equipment, n.e.c.
30	17	Office, accounting and computing machinery
31	18	Electrical machinery and apparatus, n.e.c.
32	19	Radio, television and communication equipment
33	20	Medical, precision and optical instruments
34	21	Motor vehicles, trailers and semi-trailers
351	22	Building and repairing of ships and boats

.../...

Table 2.4. OECD input-output industry classification *(continued)*

ISIC Rev.3 code		Description
353	23	Aircraft and spacecraft
352+359	24	Railroad equipment and transport equipment, n.e.c.
36+37	25	Manufacturing n.e.c. (include Furniture); recycling
401	26	Production, collection and distribution of electricity
402	27	Manufacture of gas; distribution of gaseous fuels through mains
403	28	Steam and hot water supply
41	29	Collection, purification and distribution of water
45	30	Construction
50+51+52	31	Wholesale and retail trade; repairs
55	32	Hotels and restaurants
60	33	Land transport; transport via pipelines
61	34	Water transport
62	35	Air transport
63	36	Supporting and auxiliary transport activities; activities of travel agencies
64	37	Post and telecommunications
65+66+67	38	Finance and insurance
70	39	Real estate activities
71	40	Renting of machinery and equipment
72	41	Computer and related activities
73	42	Research and development
74	43	Other business activities
75	44	Public administration and defence; compulsory social security
80	45	Education
85	46	Health and social work
90-93	47	Other community, social and personal services
95+99	48	Private households and extra-territorial organisations

The industry classification used in the current version of OECD's I-O database is based on ISIC Rev.3 (Table 2.4). It is therefore compatible with other industry-based analytical datasets, and in particular with the OECD bilateral trade in goods by industry dataset (which is derived from merchandise trade statistics via standard Harmonized System to ISIC conversion keys). In order to maximise cross-country comparability, the database is relatively aggregated. To improve the quality of trade in value added results, however, it will be necessary to differentiate types of companies (particularly exporting and non-exporting companies) in a given sector. One area of future work will use micro-data to explore ways of improving the quality of results (see Annex 2.A2).

Bilateral trade matrices

National statistics offices are generally able to provide most of the blocks required to develop a global I-O table. However, while some countries are able to estimate the overall imports of a given product used by a particular industry, many are not. No country is able to show systematically the source of those imports (by originating country and industry) in the using industry (or final demand category).

The estimation of trade flows between industries and consumers across countries is therefore central to the construction of a global input-output table. However, national estimates of trade (exports and imports) are not coherent across countries (even after adjusting for price differences, c.i.f., f.o.b). The trade flows in intermediate goods and services used in the process of constructing a global I-O table confront this problem directly and are a means of tying together the individual national I-O tables. The work involved in developing a global I-O table therefore helps to reveal the sources of global imbalances. The results and their policy implications reveal the importance that should be attached to reconciling these flows at the national level. This will form an important part of the OECD's work programme, through its Working Party on Trade in Goods and Services, over the coming years.

In constructing the import flows (and export flows) of its global I-O table, the OECD necessarily relies on a number of assumptions. The main assumption used in creating the import matrices is "proportionality", i.e. that the (country) origin share of a given import consumed by a given industry in a given country is the same for all industries in that country. For countries that are unable to provide any "import-flow" matrices (i.e. the intermediate consumption of imports by product or industry by industries, the OECD assumes that the share of intermediate imports in total consumption of intermediates for a given imported product is the same for all using industries (and is equivalent to the overall share of intermediate imports in total intermediates supplied for that product).

In all cases the OECD has been able to improve the quality of the assumptions used by creating a new database of bilateral trade (for goods) that breaks down imports (and exports) according to the nature of the traded product (intermediate, household, investment, other). The Bilateral Trade Database by Industry and End-Use Category[6] (BTDIxE) is derived from United Nations Statistics Division (UNSD) COMTRADE Database, which compiles values and quantities of imports and exports according to product classifications and by partner.

COMTRADE data are classified by declaring country (i.e. the country supplying the information), by partner country (i.e. origin of imports and destination of exports), and by product (i.e. according to the Harmonized System, HS). Trade flows are classed according to the product classification used by the declaring country at the time of data collection. In general, source data are held according to the Standard International Trade Classification (SITC) Rev.2 for 1978-87, the Harmonized System (1988) for 1988-95, HS Rev.1 (1996) for 1996-2001, HS Rev.2 (2002) for 2002-06 and HS Rev.3 (2007) from 2007.

To generate estimates of trade in goods by industry and by end-use category, 6-digit product codes from each version of HS from COMTRADE are assigned to a unique ISIC Rev.3 industry and a unique end-use category, and thus to the System of National Accounts (SNA) basic classes of goods (Table 2.5).

Table 2.5. Current Broad Economic Category (BEC) and System of National Accounts (SNA) classes of goods

		End-use			
		Intermediate	Final demand goods		Other
			Household consumption	Industrial capital goods	
Products characteristics	**Primary products**	Food and beverages (111) Industrial supplies (21) Fuels and lubricants (31)			
			Food and beverages (112)		
	Processed unfinished		Food and beverages (122)		
		Fuel and lubricants e.g. gasoline (32)			
		Food and beverages (121) Industrial supplies (22) Parts and components of transport equipment (53) Parts and components of capital goods (42)			
	Processed finished	Packed medicaments (part of 63)			
			Non-industrial transport equipment (522) Non-durable consumer goods (63) Semi-durable consumer goods (62) Durable consumer goods for households (61)		
			Durable personal consumer goods e.g. personal computers (part of 61) Mobile phones (part of 41) Passenger motor cars (51) Fixed line phones (part of 62)		
				Capital goods (41) Industrial transport equipment (521)	
	Other				Goods n.e.c. (7)

Note: Numbers are BEC codes.

Source: United Nations Statistics, http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=10&Lg=1 (accessed May 2013).

In spite of the known problems relating to the asymmetries that exist in bilateral trade statistics, these bilateral statistics are used to populate the international flows of goods used in the OECD's global I-O table, before balancing (see below).

A similar approach is used for bilateral trade in services statistics. Estimates based on official bilateral statistics are the basis of the original estimates of exports and imports by country. However, the quality of bilateral trade in services statistics is notoriously poor. Therefore, the original partner share coefficients used to populate I-O cells for international trade in services are based on gravity model techniques (Miroudot et al., 2009) and are subsequently balanced within the overall system.

Bilateral trade flows (imports and exports) by partner country are consistent with the corresponding flows shown in their supply and use table (the basis for the creation of national I-O tables) and their national accounts in very few countries. This reflects the fact that, for goods at least, bilateral trade flows follow merchandise trade accounting standards.

Because the value-added flows are consistent with official GDP statistics, they are also consistent with the underlying gross export and import flows recorded in the national accounts. These trade figures will differ (significantly for some countries) from trade statistics based on merchandise accounting standards, and will often differ even more when bilateral trade balances are constructed. Issues at stake in reconciling the differences are:

Producing bilateral trade flows that are consistent with underlying supply-use tables should be a high priority of national statistics offices.

- *Confidential trade.* In some countries disclosure rules suppress 6-digit HS components in COMTRADE and even higher 2-digit HS chapter levels. This should be avoided where possible by adopting other means of preserving confidentiality, such as suppressing another 6-digit category.
- *Re-exports.* Adjustments are required for re-exports, which are significant at major continental trading hubs. Sufficient data are available to adjust for reported trade between China and the rest of the world via Hong Kong but not currently for other major hubs.
- *Identifying used/second-hand capital goods.* HS codes and therefore reported trade in COMTRADE do not differentiate between new and used capital goods (such as second-hand aircraft and ships). Estimating international trade in these flows in a value-added context requires an elaboration of the input-output framework in order to record these flows in a way that aligns with the total global value-added produced in a given period.
- *Unidentified scrap and waste.* Certain types of waste and scrap do not have separate 6-digit HS codes, e.g. PCs and other electrical equipment exported (often to developing countries) for recycling.

For services, countries are encouraged to provide more detail on partner countries and on the type of products (following EBOPS 2012).

Greater efforts are needed to reconcile asymmetries in international trade flows.

Balancing

Notwithstanding the resolution and implementation of the issues, the OECD's global I-O table necessarily balances global discrepancies in trade using a quasi automatic (RAS) balancing procedure, constraining each country's exports and imports to published national accounts totals (whilst also constraining estimates of national GDP). This is a work in progress and efforts to improve the nature of the balancing process are on-going (Ahmad et al., 2013).

It is important to recognise that the indicators presented in the database are estimates. Official gross statistics on international trade produced by national statistics offices give inconsistent figures for total global exports and total global imports; the inconsistencies are magnified when bilateral partner country positions are considered. The global input-output tables from which trade in value added indicators are derived eliminate these inconsistencies, such as those that reflect different national treatments of re-exports and transit trade (*e.g*. through hubs such as Hong Kong, China), to achieve a coherent picture of global trade. For the countries for which data are presented, total exports and imports are consistent with official national accounts estimates.

More work ahead

The OECD-WTO TiVA Database allows for a better understanding of trade in a world increasingly characterised by global value chains. By necessity it requires a number of assumptions that largely reflect the fact that national statistics continue to be produced through a national prism. But this is gradually changing, and the larger statistics community has, in recent years, begun to produce new indicators and launch new initiatives to respond to the challenges raised by global value chains. The OECD-WTO initiative is one element of that overall effort, but it also acts as a stimulus to accelerate these initiatives and as a spotlight to highlight areas in which more can be done.

One of these areas is the need to attach more importance to resolving longstanding statistical issues, such as inconsistent mirror trade statistics. Another is the need to think about national statistics compilation in a way that builds in GVCs from the bottom up rather than as an afterthought or spillover. The OECD is working closely with countries and other international partners to achieve this via a number of initiatives (e.g. capturing and reflecting heterogeneity in supply-use tables, linkages of trade and business statistics at the firm level, better integration of foreign affiliates trade statistics (FATS) data with other core economic statistics). The results will eventually be incorporated into, and improve the quality of, the TiVA Database. In addition the OECD is working closely with its partners to motivate broader improvements in the core official statistics produced in emerging and developing economies, with a view to expanding the country coverage of the OECD-WTO TiVA database beyond its current coverage of 95% of global GDP.

Finally, there are plans to extend the indicators to other aspects of GVCs, in particular what they mean for jobs, and to capture (and re-allocate) income flows generated by foreign affiliates (trade in income). These future plans and initiatives are described in more detail in Annex 2.A2.

Notes

1. Fabless producers keep the design and sale of hardware devices and semiconductor chips while outsourcing the fabrication or "fab" of the devices to a specialized manufacturer.

2. An OECD workshop on "New metrics for global value chains" was organised on 21 September 2010. WTO hosted a Global Forum on Trade Statistics on 2-4 February 2011, in collaboration with Eurostat, UNSD and UNCTAD.

3. Some research-oriented initiatives have used the GTAP Database for international input-output data. This is not however based on official sources of statistics.

4. For more details, see www.oecd.org/sti/inputoutput.

5. Note by Turkey:

   The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

   Note by all the European Union Member States of the OECD and the European Union:

   The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

6. For further detail, see www.oecd.org/sti/btd.

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Annex 2.A1
Indicator descriptions and definitions

Gross trade indicators

Variable name	Variable description	Comments
EXGR	Gross exports by industry, USD million	All variables are consistent with official National Accounts estimates of total gross exports and total gross imports and GDP estimates with adjustments for re-exports included. Estimates by industry are based on the balanced pattern of trade derived within the global input-output database (see below).
IMGR	Gross imports by industry, USD million	
EXGR_GDP	EXGR as a % of GDP	
IMGR_GDP	IMGR as a % of GDP	
TSGR	Bilateral trade balances by partner country, USD million	TSGR is equivalent to EXGR minus IMGR. Bilateral trade positions in TSGR are also shown in the TiVA Database. These bilateral trade balances broadly align with "official" bilateral trade balances produced by NSIs. However there are often differences between TiVA estimates and these "official' estimates". These reflect: • Treatment of re-exports and transit trade, e.g. through Hong Kong, China; Singapore and NAFTA. • Global inconsistencies between exports and imports of trade in goods and services between partner countries, reported in official statistics. • Coverage and quality issues, particularly in official bilateral trade in services statistics, such as missing data. The main focus for bilateral trade balances in the TiVA database should be on differences between TSGR and TSVAFD (see TSVAFD-TSGR).
TSGR_GDP	TSGR as a % of GDP	

Gross trade decomposition (value added embodied in gross trade flows)

Variable name	Variable description	Comments
EXGRDVA	Total domestic value added embodied in gross exports (by industry), USD million	Total domestic value-added content of exports is broken down into three components, described below as EXGR_DDC, EXGR_IDC and EXGR_RIM.
EXGRDVA_EX	EXGRDVA as a % of EXGR (by industry)	This reflects the domestic value added embodied in exports as a percentage of exports. It provides a simple measure that illustrates how much value added is generated throughout the economy for a given unit of exports. The lower the ratio the higher the foreign content and so the higher the importance of imports to exports.
EXGR_DDC	Direct industry value added (by industry), USD million	This reflects the direct contribution made by an industry in producing a good or service for export.
EXGR_IDC	Indirect domestic value added (by industry), USD million	This reflects the indirect contribution of domestic supplier industries made through domestic (upstream) transactions.
EXGR_RIM	Re-imported domestic value added (by industry), USD million	This reflects the domestic value added that was exported in goods and services used to produce the intermediate imports of goods and services used by the industry in question.
EXGR_FVA	Foreign value added share of gross exports, by country of origin (USD million)	This reflects the foreign value added embodied in imports broken down by country of origin.
EXGR_DDCSH	EXGR_DDC as a % of EXGR (by industry).	The share reflects how much value added is generated in an industry per unit of its total gross exports.
EXGR_IDCSH	EXGR_IDC as a % of EXGR (by industry).	The share reflects the value added created in upstream industries providing domestic inputs to the exporting industry.
EXGR_RIMSH	EXGR_RIM as a % of EXGR (by industry).	The share reflects the value added created in upstream domestic industries providing indirect intermediate inputs, via international, as opposed to domestic, value chains to the industry in question. The indicator provides a measure of how protectionist measures may affect domestic industries that provide inputs to imports.
EXGR_FVASH	EXGR_FVA as a % of EXGR (by industry).	This is equivalent to 1 minus EXGRDVA_EX
IMGRFVA	Total foreign value added embodied in gross imports (by industry), USD million	Foreign content of gross imports.

Intermediate imports

Variable name	Variable description	Comments
REI	Intermediate imports embodied in exports as a % of total intermediate imports (by industry).	This reflects the share of intermediate imports used (indirectly and directly) in producing goods and services for export, as a percentage of total intermediate imports (by import category). The indicator provides a measure of the importance of intermediate imports to produce goods and services for export and their role as a source of international competitiveness.

Value added embodied in final domestic demand

Variable name	Variable description	Comments
FDDVA	Domestic value added embodied in foreign final demand, by importing country and exporting (origin) industry, USD million	Value added embodied in foreign final domestic demand shows how industries export value both through direct final exports and via indirect exports of intermediates through other countries to foreign final consumers (households, charities, government, and as investment). It reflects how industries (upstream in a value chain) are connected to consumers in other countries, even if no direct trade relationship exists. The indicator illustrates therefore the full upstream impact of final demand in foreign markets on domestic output. It can most readily be interpreted as "exports of value added".
FDDVASH	FDDVA by importing country and exporting industry as a % of total FDDVA, %	
FDDVA_GDP	FDDVA as a % of GDP, by importing country and exporting industry	
FDFVA	Foreign value added embodied in final domestic demand, by origin country and origin industry, USD million	Foreign value added embodied in final domestic demand shows where foreign value added originates for a final good or service (purchased by households, government, non-profit institutions serving households or as investment). It is the "import" corollary of FDDVA and shows how industries abroad (upstream in a value chain) are connected to consumers at home, even if no direct trade relationship exists. It can most readily be interpreted as "imports of value added".
FDFVASH	FDDVA by origin country and origin industry as a % of total FDDVA	
FDFVA_GDP	FDDVA as a % of GDP, by origin country and origin industry	
TSVAFD	Bilateral trade balances in value added by partner country (FDDVA minus FDFVA), USD million	The bilateral trade position in value-added terms.
TSVAFD_GDP	Bilateral trade balances in value added by partner country (FDDVA minus FDFVA), % GDP	
TSVAFD_TSGR	Difference in trade surpluses (value added in final demand minus gross trade) USD million	This reflects the change in bilateral trade positions.
FDDVA_EX	Domestic value added embodied in foreign final demand to gross export ratio	Also known as the VAX ratio.

Services

Variable name	Variable description	Comments
SERV_VAGR	Total domestic value added of the services sector (only) embodied in gross exports (by industry), % of total exports	This reflects the services domestic value added embodied in exports as a percentage of exports. It provides a simple measure that illustrates the real underlying contribution made by services to exports and can be broken down into three components, described below as EXGR_DDC_SV, EXGR_IDC_SV and EXGR_RIM_SV.
EXGR_DDC_SV	Direct services value added (by industry), USD million	This reflects the direct services value added made by an industry in producing a good or service for export. By definition it will be zero for all non-services industries.
EXGR_IDC_SV	Indirect domestic services value added (by industry), USD million	This reflects the indirect contribution of domestic service suppliers made through domestic (upstream) transactions, for exports.
EXGR_RIM_SV	Re-imported services domestic value added (by industry), USD million	This reflects the domestic services value added exported in goods and services used to produce the intermediate imports of goods and services used by the industry in question.
EXGR_FVA_SV	Foreign services value added share of gross exports, by country of origin, USD million	This reflects the foreign services value added embodied in imports broken down by country of origin.
SERV_VAFD	Domestic services value added embodied in foreign final domestic demand, by origin country and origin industry, as % of total final demand in the importing country.	

Revealed comparative advantage

Variable name	Variable description	Comments
RCA_EXGR	Revealed comparative advantage based on gross exports, manufacturing sector	
RCA_EXGRDVA	Revealed comparative advantage based on domestic value added embodied in gross exports, manufacturing goods	

The following provides an algebraic description of each of the indicators described above:

A: Gross trade indicators

Gross exports:

Country c's gross exports for a given industry i can be directly calculated from OECD's ICIO system by summing up exports in intermediate goods and services and exports in final demand.

$$\mathrm{EXGR}_{c,i} = \sum_{p} \mathrm{EXGR}_{c,p,i} = \sum_{p} (\mathrm{EXGRI}_{c,p,i} + \mathrm{EXGRF}_{c,p,i})$$

$\mathrm{EXGRI}_{c,p,i}$ represents gross exports in intermediates from domestic industry i in country c to p. $\mathrm{EXGRF}_{c,p,i}$ is gross exports in final demand, where c and p $\in$[1,..,N] and c $\neq$ p.

Gross exports as a % of GDP (total value added):

Final demand in OECD's ICIO framework has been benchmarked with each country's GDP from its National Accounts.

$$\mathrm{EXGR_GDP_{c,i}} = \frac{\mathrm{EXGR_{c,i}}}{\mathrm{GDP_c}}$$

Gross imports:

$\mathrm{IMGRI_{c,p,i}}$ is gross imports in intermediates from country c to p in a given industry i; and $\mathrm{IMGRF_{c,p,i}}$ is gross imports in final demand. Total imports of country c are measured as:

$$\mathrm{IMGR_{c,i}} = \sum\nolimits_{\mathrm{p}} \mathrm{IMGR_{c,p,i}} = \sum\nolimits_{\mathrm{p}} (\mathrm{IMGRI_{c,p,i}} + \mathrm{IMGRF_{c,p,i}})$$

Gross imports as a % of GDP (total value added):

$$\mathrm{IMGR_GDP_{c,i}} = \frac{\mathrm{IMGR_{c,i}}}{\mathrm{GDP_c}}$$

Gross trade surplus:

$$\mathrm{TSGR_{c,p,i}} = \mathrm{EXGR_{c,p,i}} - \mathrm{IMGR_{c,p,i}}$$

Gross trade surplus as a % of GDP (total value added):

$$\mathrm{TSGR_GDP_{c,i}} = \frac{\sum_{\mathrm{p}} \mathrm{TSGR_{c,p,i}}}{\mathrm{GDP_c}}$$

B: Gross trade decomposition (value added embodied in gross trade flows)

Gross exports by industry can be broken down into domestic and foreign value added content. Domestic value added content of gross exports can be further split into three components: direct domestic industry value added, indirect domestic value added and re-imports.

Direct domestic industry value added content of gross exports

$$\mathrm{EXGR_DDC_c} = \mathrm{V_c EXGR_c}$$

Indirect domestic content of gross exports (originating from domestic intermediates)

$$\mathrm{EXGR_IDC_c} = \mathrm{V_c}(\mathrm{I} - \mathrm{A_c})^{-1}\mathrm{EXGR_c} - \mathrm{EXGR_DDC_c}$$

where $\mathrm{A_c}$ is the IO coefficient matrix from country c's national IO table and $(\mathrm{I} - \mathrm{A_c})^{-1}$ is the corresponding Leontief inverse.

$\mathrm{B} = (1 - \mathrm{A})^{-1}$, is the global Leontief inverse matrix with NK x NK dimensions, and A is a global IO coefficient matrix. $\mathrm{B_{c,c}}$ is a K x K diagonal block matrix of B, and it represents the total requirements in gross output for one unit increase of country c's demand. $\mathrm{B_{p,c}}$ is also a K x K block matrix, and it represents total requirements in gross output from country p for a one unit increase in country c's demand.

Re-imported domestic value added content of gross exports

$$\mathrm{EXGR_RIM_c} = \mathrm{V_c B_{c,c} EXGR_c} - \mathrm{EXGR_DDC_c} - \mathrm{EXGR_IDC_c}$$

where $EXGR_DDC_c$, $EXGR_IDC_c$, $EXGR_RIM_c$ and $EXGR_ICE_{c,p}$ are K x 1 vectors and K represents the total number of industries.

Foreign value added content of gross exports

$$\mathrm{EXGR_FVA_{c,p}} = u\mathrm{V_p B_{p,c} diag(EXGR_{c,p})}$$

$\mathrm{EXGR_FVA_{c,p}}$ is a 1 x K row vector, representing partner country p's value added in country c's export. *u* is a 1 x K row vector of unity.

$$\mathrm{V_c} = \begin{bmatrix} \mathrm{v_{c1}} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \mathrm{v_{cK}} \end{bmatrix}$$

is a K x K matrix with domestic value added shares of each industry i in country c on the diagonal.

$\mathrm{EXGR_{c,p}}$ is a K x 1 vector of gross export from country c to country p for any given industry i, where c ≠ p. $\mathrm{EXGR_c}$ is total exports of country c.

The four components of gross exports are also presented as a share of total gross exports.

Direct domestic industry value added share of gross exports

$$\mathrm{EXGR_DDCSH_{c,i}} = \frac{\mathrm{EXGR_DDC_{c,i}}}{\mathrm{EXGR_{c,i}}} \times 100$$

Indirect domestic share of gross exports (originating from domestic intermediates)

$$\mathrm{EXGR_IDCSH_{c,i}} = \frac{\mathrm{EXGR_IDC_{c,i}}}{\mathrm{EXGR_{c,i}}} \times 100$$

Re-imported domestic value added share of gross exports

$$\mathrm{EXGR_RIMSH_{c,i}} = \frac{\mathrm{EXGR_RIM_{c,i}}}{\mathrm{EXGR_{c,i}}} \times 100$$

Foreign value added share of gross exports

$$\mathrm{EXGR_FVASH_{c,i}} = \frac{\sum_{\mathrm{p}} \mathrm{EXGR_FVA_{c,p,i}}}{\mathrm{EXGR_{c,i}}} \times 100$$

$\mathrm{EXGR_DDC_{c,i}}$ is the i-th element of the Kx1 vector $\mathrm{EXGR_DDC_c}$, and gives direct domestic value added context of gross export of a given industry i. The same rule applies to indirect domestic value added and re-import shares of gross exports. Foreign value added share of gross exports are summed for all partners.

Domestic value added embodied in gross exports:

$$\mathrm{EXGRDVA_c} = \sum_{\mathrm{p}} \mathrm{EXGRDVA_{c,p}} = \sum_{\mathrm{p}} \mathrm{V_c B_{c,c} EXGR_{c,p}}$$

Foreign value added embodied in gross imports:

$$\mathrm{IMGRFVA_c} = \sum_{\mathrm{p}} \mathrm{IMGRFVA_{c,p}} = \sum_{\mathrm{c}} \mathrm{V_p B_{p,p} EXGR_{p,c}}$$

$\mathrm{EXGRDVA_{c,p}}$ and $\mathrm{IMGRDVA_{c,p}}$ are both K x 1 vectors, representing country c's domestic value added embodied in gross export to country p and country p's value added embodied in country c's import respectively, for any given industry i. Both variables are aggregated for all partners.

Value Added Export Ratio - total domestic value added share of gross exports, %

$$\mathrm{EXGRDVA_EX_{c,i}} = \frac{\mathrm{EXGRDVA_{c,i}}}{\mathrm{EXGR_{c,i}}} \times 100$$

C: Re-exported intermediates

Re-exported intermediates as a % of total intermediate imports

$$\mathrm{REI_{c,i}} = \left(\sum_{\mathrm{p}} \mathrm{A_{p,c} B_{c,c} EXGRF_c}\right)_{\mathrm{i}} / \sum_{\mathrm{p}} \mathrm{IMGRI_{c,p,i}}$$

$\mathrm{A_{p,c}}$ is a K x K off-diagonal block matrix of A giving c's requirements in imported intermediate products sourced from country p per unit of output.

$\mathrm{EXGRF_c}$ is K x 1 vector, representing exports in final demand from c to p for each industry i.

$\mathrm{A_{p,c} B_{c,c} EXGRF_c}$, is also a K x 1 vector and refers to intermediate goods and services absorbed in country c that originated from p for c' total exports. $\left(\sum_{\mathrm{p}} \mathrm{A_{p,c} B_{c,c} EXGRF_c}\right)_{\mathrm{i}}$ refers to the i-th element of the vector, and gives total intermediate goods and services absorbed by country c that originated from all foreign countries in industry i.

$\sum_{\mathrm{p}} \mathrm{IMGRI_{c,p,i}}$ is total intermediate imports of country c from each industry i.

D: Value added embodied in final domestic demand

Domestic value added embodied in foreign final demand

$$\mathrm{FDDVA_{c,p}} = \mathrm{V_c} \sum_{\mathrm{s}} \mathrm{B_{c,s} EXGRF_{s,p}}$$

$\mathrm{FDDVA_{c,p}}$ and $\mathrm{EXGRF_{s,p}}$ are K x 1 vectors. $\mathrm{EXGRF_{s,p}}$ represents final demand produced in country s that is finally consumed in partner country p . $\mathrm{B_{c,s}}$ is the off diagonal block matrix of global Leontief inverse matrix B. When s = p, $\mathrm{EXGRF_{p,p}}$ is final demand in country p.

Domestic value added embodied in foreign final demand – partner shares, % of total domestic value added embodied in foreign final demand

$$\mathrm{FDDVASH_{c,p,i}} = \frac{\mathrm{FDDVA_{c,p,i}}}{\sum_{\mathrm{p}} \mathrm{FDDVA_{c,p,i}}} \times 100$$

$\mathrm{FDDVA_{c,p,i}}$ is the i-th element of the K x 1 vector $\mathrm{FDDVA_{c,p}}$.

Domestic value added embodied in foreign final demand as a % of GDP (total value added)

$$\mathrm{FDDVA_GDP_{c,p,i}} = \frac{\mathrm{FDDVA_{c,p,i}}}{\mathrm{GDP_c}} \times 100$$

Foreign value added embodied in domestic final demand

$$\mathrm{FDFVA_{c,p}} = \mathrm{V_p} \sum_{\mathrm{s}} \mathrm{B_{p,s}EXGRF_{s,c}}$$

$\mathrm{FDFVA_{c,p}}$ and $\mathrm{EXGRF_{s,c}}$ are K x 1 vectors. $\mathrm{EXGRF_{s,c}}$ represents final demand produced in s that is finally consumed in home country c .

Foreign value added embodied in domestic final demand – partner shares, % of total foreign value added in domestic final demand

$$\mathrm{FDFVASH_{c,p,i}} = \frac{\mathrm{FDFVA_{c,p,i}}}{\sum_{\mathrm{p}} \mathrm{FDFVA_{c,p,i}}} \times 100$$

$\mathrm{FDFVA_{c,p,i}}$ is the i-th element of the K x 1 vector $\mathrm{FDFVA_{c,p}}$.

Foreign value added embodied in domestic final demand as a % of GDP (total value added)

$$\mathrm{FDFVA_GDP_{c,p,i}} = \frac{\mathrm{FDFVA_{c,p,i}}}{\mathrm{GDP_c}} \times 100$$

Value added in final demand, surplus

$$\mathrm{TSVAFD_{c,p,i}} = \mathrm{FDDVA_{c,p,i}} - \mathrm{FDFVA_{c,p,i}}$$

Value added in final demand, surplus as a % of GDP (total value added)

$$\mathrm{TSVAFD_GDP_{c,p,i}} = \frac{\mathrm{TSVAFD_{c,p,i}}}{\mathrm{GDP_c}} \times 100$$

Difference in trade surpluses (value added in final demand minus gross trade)

$$\mathrm{TSVAFD_TSGR_{c,p}} = \sum_{i} \mathrm{TSVAFD_{c,p,i}} - (\sum_{\mathrm{i}} \mathrm{EXGR_{c,p,i}} - \sum_{\mathrm{i}} \mathrm{IMGR_{c,p,i}})$$

Value added export ratio - total domestic value added in foreign final demand as % of gross exports

$$\mathrm{FDDVA_EX_{c,p}} = \frac{\sum_{\mathrm{i}} \mathrm{FDDVA_{c,p,i}}}{\sum_{\mathrm{i}} \mathrm{EXGR_{c,p,i}}} \times 100$$

E: Services

Direct domestic service industry value added content of gross exports

$$\mathrm{EXGR_DDC_SV}_{c,i} = V_{c,j}\mathrm{EXGR}_{c,i}$$

Indirect domestic services content of gross exports (originating from domestic intermediates)

$$\mathrm{EXGR_IDC_SV}_{c,i} = \sum_{j\in S} V_{c,j}(I - A_c)^{-1}{}_{ji}\mathrm{EXGR}_{c,i} - \mathrm{EXGR_DDC_SV}_{c,i}$$

Re-imported domestic services value added content of gross exports

$$\mathrm{EXGR_RIM_SV}_{c,i} = \sum_{j\in S} V_{c,j}\left(B_{c,c}\right)_{ji}\mathrm{EXGR}_{c,i} - \mathrm{EXGR_DDC_SV}_{c,i} - \mathrm{EXGR_IDC_SV}_{c,i}$$

Foreign services value added content of gross exports

$$\mathrm{EXGR_FVA_SV}_{c,i} = \sum_{p}\sum_{j\in S} V_{p,j}\left(B_{p,c}\right)_{ji}\mathrm{EXGR}_{c,p,i}$$

$\mathrm{EXGR_DDC_SV}_{c,i}$ represents the direct domestic service industry value added content of country c's gross exports in industry i. $\mathrm{EXGR_IDC_SV}_{c,i}$, $\mathrm{EXGR_RIM_SV}_{c,i}$ and $\mathrm{EXGR_ICE_SV}_{c,i}$ are defined similarly.

$V_{c,j}$ is the value added share of service industry j in home country c, where $j \in S$; otherwise, $V_{c,j} = 0$.

$(I - A_c)^{-1}{}_{ji}$ is the ji-th element of local Leontief inverse matrix.

$\left(B_{c,c}\right)_{ji}$ and $\left(B_{p,c}\right)_{ji}$ are the ji-th element of $B_{c,c}$ and $B_{p,c}$ respectively.

Services value added embodied in gross exports by source country, as % of gross exports

$$\mathrm{SERV_VAGR}_{c,p,i} = \sum_{j\in S} V_{p,j}\left(B_{p,c}\right)_{ji}\mathrm{EXGR}_{c,p,i} \Big/ \sum_{p}\mathrm{EXGR}_{c,p,i}$$

$\mathrm{SERV_VAGR}_{c,p,i}$ represents the share of services value added in gross exports of country c that is sourced from partner country p for any given sector i.

Services value added embodied in foreign final demand, as % of foreign final demand

$$\mathrm{SERV_VAFD}_{c,p,i} = \sum_{j\in S} V_{p,j}\left(B_{p,c}\right)_{ji}\mathrm{EXGRF}_{c,p,i} \Big/ \sum_{p}\mathrm{EXGRF}_{c,p,i}$$

$\mathrm{SERV_VAFD}_{c,p,i}$ represents the share of services value added in export in final demand of country c that is sourced from partner country p for any given sector i.

F: Revealed comparative advantages

Revealed comparative advantage based on gross exports, manufactured goods

$$\mathrm{RCA_EXGR}_{c,i} = \frac{\sum_p \mathrm{EXGR}_{c,p,i} \,/\, \sum_{p,i} \mathrm{EXGR}_{c,p,i}}{\sum_{c,p} \mathrm{EXGR}_{c,p,i} \,/\, \sum_{c,p,i} \mathrm{EXGR}_{c,p,i}}$$

Revealed comparative advantage based on domestic value added embodied in gross exports, manufactured goods

$$\mathrm{RCA_EXGRDVA}_{c,i} = \frac{\sum_p \mathrm{EXGRDVA}_{c,p,i} \,/\, \sum_{p,i} \mathrm{EXGRDVA}_{c,p,i}}{\sum_{c,p} \mathrm{EXGRDVA}_{c,p,i} \,/\, \sum_{c,p,i} \mathrm{EXGRDVA}_{c,p,i}}$$

where i is restricted to manufacturing sectors only.

$\mathrm{EXGRDVA}_{c,p,i}$ is the i-th element of $\mathrm{EXGRDVA}_{c,p}$.

Annex 2.A2
Future improvements

Improving quality

Indicators created via input-output (I-O) techniques are limited by the degree of industry disaggregation provided by the tables. The national input-output tables used by the OECD are based on a harmonised set of 37 industries. In simple terms, therefore, any given indicator for a particular industry assumes that all consumers of that industry's output purchase exactly the same shares of products produced by all of the firms allocated to that industry.

This boils down in practice, but is not the same thing as assuming that there exists only one production technique for all of the firms (and all of the products) in the industry grouping. Obviously, this is not true and different firms, even those producing the same products, will have different production techniques, and therefore different technical I-O coefficients. Also, different firms produce different products and these products will be destined for different types of consumers and markets.

Of chief concern in this respect is the evidence that points to very different coefficients for exports than for goods and services produced for domestic markets, particularly when the exports (typically intermediates) are produced by foreign-owned affiliates in a global value chain. Because exporting firms are generally more integrated into value-added chains they typically have higher foreign content ratios, particularly when they are foreign owned. Generally, therefore, an inability to account for this heterogeneity when producing trade in value-added estimates will generally result in lower shares of foreign content than might be recorded if more detailed input-output tables were available.

It is important to note, however, that more detail does not necessarily translate into more disaggregated industries. What is important for indicators on global value chains is more detail on firms that trade internationally. In this sense, given a choice between doubling the number of industries available in current national I-O or supply use (SU) tables or splitting existing industries into groups of exporting firms and non-exporting firms, the latter may arguably be preferable. The OECD is working with its constituencies of national statistics institutes to introduce changes such as these in official supply-use and/or input-output tables. In a project co-ordinated by the Chinese Ministry of Commerce, in collaboration with the Chinese National Bureau of Statistics and the OECD, an input-output table for China was created that split all of its industrial sectors into three categories - processing firms, other exporting firms, and all other firms (Cuihong, 2013).

Trade in jobs

Looking at trade in value-added terms provides valuable insight into broader notions of competitiveness (in addition to providing insight into trade policies) by illustrating linkages among countries and by revealing the activities (or tasks) that generate the most value. Additional indicators and insights can be gained by considering extensions to the accounting framework.

One immediate area relates to jobs. This requires consistent estimates of employment measures (employment, employers, actual hours worked) with the underlying value-added estimates produced by national statistics offices in their supply-use tables.

Countries have already begun to make improvements in this area, driven by a need to produce coherent productivity estimates (by industry). It is hoped that highlighting the insights that can be gained by looking at trade in jobs will reinforce and support national initiatives aimed at improving coherence. Going a step further, particularly because international fragmentation has meant that industries across countries are less comparable than they used to be (as they increasingly specialise in the stages of the underlying activity in which they have a comparative advantage) it is increasingly necessary to link jobs statistics to skills statistics.

The OECD's ANSKILL Database (forthcoming) provides information on employment and skill composition at the industry level. The database matches industry data at the 2-digit level (classified according to the International Standard Industrial Classification [ISIC] Rev.3) to occupations at the 2-digit level (classified according to the International Standard Classification of Occupations [ISCO] – 88). It also includes an additional proxy for skills, in the form of data on educational attainment of employees (classified on the basis of the International Standard Classification of Education [ISCED-97]). The database covers 26 countries, mostly for 1997-2005 although coverage of seven of the countries is much more limited.

For ANSKILL, the ISCO-88 occupation classification maps to high, medium and low skill levels, as follows:

- Categories 1 (Legislators, senior officials, managers), 2 (Professionals) and 3 (Technicians and associate professionals) are regarded as high-skilled.
- Categories 4 (Clerks), 5 (Service workers and shop and market sale workers), 6 (Skilled agricultural and fishery workers) and 7 (Craft and related trade workers) are regarded as medium-skilled.
- Categories 8 (Plant and machine operators and assemblers) and 9 (Elementary occupations) are regarded as low-skilled.

The ISCED-97 educational classification maps to high, medium and low skill levels in ANSKILL as follows:

- Categories 1 (Primary education) and 2 (Lower secondary/second stage of basic education) are regarded as low-skilled.
- Categories 3 (Upper secondary education) and 4 (Post-secondary non-tertiary education) are regarded as medium-skilled.
- Categories 5 (First stage of tertiary education) and 6 (Second stage of tertiary education) are regarded as high-skilled.

Trade in income

Conventional trade statistics do not always record transactions between affiliates as sales-purchases of goods and services. This is especially the case for intellectual property (IP) products.

Consider for example an affiliate enterprise, recognised in the national accounts of its resident economy as the economic owner of the IP that it uses to produce the goods it sells. The affiliate's value added would reflect in part the return on this underlying asset, realised as profits (operating surplus). These profits would subsequently be recorded as reinvested earnings whether or not any actual flows occur between the parent and its affiliate. Ultimately therefore it is the parent (often the entity that finances the underlying IP) that benefits from the use of the IP (this of course raises questions about how economic ownership of IP should be considered as regards multinationals, an issue that is currently being tackled by the international statistics community).

But the difficulties raised by the current recording of IP in countries' balance of payments and national accounts go beyond this simple example (which correctly records flows in line with current standards and guidelines). Often, for example, the national accounts in the economy of the parent company will record the asset but there will not be any flows related to the transfer the owner makes to its affiliates, often for tax minimisation purposes. The owner may also transfer the asset to an affiliate, such as a special purpose enterprise (SPE), and the parent and other affiliates may make explicit payments to the SPE, again for tax minimisation purposes.

What is clear, therefore, is that flows related to IP require an extension of accounting systems beyond value-added flows in order to understand fully who benefits from trade and indeed from trade liberalisation (and investment). Sometimes these flows will increase value added, sometimes they will not. But in both cases the beneficiary is arguably the same (the parent company).

The flows merely illustrate a wider issue, despite the obvious implications for calculating multifactor productivity. First, they illustrate the distortions that may arise when the scope for transfer pricing manipulations is factored in. Second, they concern more than the conventional set of assets recognised as such in the 2008 SNA. Other knowledge-based assets, such as brands and organisational capital, can also increase an affiliate's value added. Even though these assets are not recognised in the SNA, the profits recorded by the affiliate compensate for their use and eventually flow back to the parent as reinvested earnings flows in the accounts. However, these flows are typically not available on a bilateral partner country basis, let alone a partner country-industry basis, which is needed for an analysis of trade in income analogous to that for trade in value added.

Recording these flows is therefore crucial. Part of the solution lies in producing supply-use tables (or indicators) that capture foreign ownership. By supplementing this with bilateral trade in primary income (from whom-to-whom) statistics, broken down by type of income (in particular, reinvested earnings and interest), it should be possible to create extensions to the trade in value-added accounting framework by treating the primary income flows (and components) as if they were services produced by artificial industries in the host country of the parent company.

Some of the tools to do this exist. Foreign affiliate trade statistics can be combined for example with information in supply-use tables that gives breakdowns based on ownership. There is also scope to link this further to balance of payment data flows. The OECD is looking at developing a more detailed accounting framework and set of recommendations in this area, which could form the basis of estimating flows of trade in income.

To illustrate the potential impact of accounting for these flows between multinationals, consider the following: between 1995 and 2007, Japanese foreign affiliates increased their employment in China from just over 100 000 employees to over 1 000 000 and in Thailand from 300 000 to over 400 000, with similar patterns in countries such as the Philippines, Malaysia and Indonesia. From 1995 to 2009, Japan's primary income trade surplus increased by around USD 100 billion, more than offsetting the USD 50 billion reduction in its gross trade surplus over the same period.

Trade in CO_2 (and other emissions)

One additional extension that follows from the accounting framework for trade in value added (and trade in jobs) is carbon footprints. Carbon footprint calculations are typically estimated using I-O tables (Ahmad and Wyckoff, 2003).

Incorporating capital flows

Other areas in which extensions to the accounting framework would be desirable include the contribution made by capital more generally. Because of the way capital is recorded in the accounting system (as gross fixed capital formation), analyses that look at trade in value added do not fully capture how production across countries is linked and how capital goods (and services) produced in one country contribute to value added in another. For example all the value added exported by Japan in producing machinery for manufacturers in China will be recorded as Chinese imports from Japan. Arguably, the capital service values embodied in the goods produced and exported by China should show Japan as the beneficiary. This requires high-quality capital-flow (and capital-stock) matrices.

Distribution sectors and trade

One final area of work that merits attention concerns the value added by distributors via sales of final imported goods. Estimates of trade in value added do not reveal how cheap imports are important to retailers, which are able to generate domestic value added via sales to consumers. Tariff measures may impose additional costs on these goods and may therefore suppress demand and lead in turn to lower value added in the distribution sectors. The OECD is considering how these estimates could be incorporated into its accounting framework by using, and motivating the development of, margin rates for all products in national supply-use tables.

Chapter 3

Implications of global value chains for trade policy

This chapter describes the challenges that global value chains (GVCs) present for traditional trade policy and the main trade policy implications of the increased fragmentation of production. It aims to clarify concepts, offer new policy insights, and help policy makers to see new issues that require special attention in a context of global production networks.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Effects of global value chains on trade and trade policy

When value chains are global, countries' trade policies become more interdependent and, perhaps more importantly, have more immediate and more pervasive effects. Of course, this interdependence is nothing new. Managing the consequences for one country of another country's policies has been a central part of trade policy and trade negotiations for a long time. What is new is the degree to which and the ways in which global value chains (GVCs) affect trade policy.

In a simpler world, where goods are entirely or largely produced in a single country, international trade can be viewed as competition between domestic and foreign finished goods with their own national character. Obviously even going back in time this is a rather simplistic view of real-world trade – raw materials imports and intermediate goods have been around for a long time – but the world of manufactures trade was closer to that end of the spectrum in the post-war decades. Countries could put in place barriers to discourage consumers from choosing the finished foreign product and the political economy of trade was essentially a question of opposing the gains from domestic producers sheltered from international competition to the losses of consumers who pay a higher price.

If this scenario ever applied, it certainly does not apply in today's world of offshoring and fragmented production processes. As competition increasingly takes place at the level of tasks rather than sectors (Baldwin, 2006a; Grossman and Rossi-Hansberg, 2008), protectionist policies are more harmful than commonly understood or are even counterproductive. The so-called "domestic" producer in fact depends for its efficiency on imports of goods and services (imports that may themselves incorporate prior inputs from the "domestic" producer). When goods (or services) are "made in the world", countries do not engage in "cradle to grave" production. They have a slice of the action and seek to capture a share of the overall GVC income.

This increased interdependence means much less scope for "national" control of competitiveness. National trade policies have, of course, long taken into account the effect of policies in other markets. High tariffs in a target market suppress the demand for exports. Taxes on imported raw materials increase costs of production, including for export. And long before GVCs emerged in their modern form, policy makers understood (although they could not always act promptly on that understanding) that a tax on imports was a tax on exports. As modern supply chains have vastly intensified the speed and scale of this interdependence, even relatively low tariff and other border costs can have significant knock-on consequences for a supply chain.

Furthermore, domestic producers can be affiliates of foreign-owned firms and domestic firms can have affiliates producing inputs in foreign countries. Foreign direct investment (FDI) therefore affects the welfare analysis of trade policy (Blanchard, 2007; Ornelas and Turner, 2008). As a large share of international trade is intra-firm trade, the income of domestic companies established in foreign countries and of foreign-owned companies located in the domestic economy changes the cost-benefit analysis of trade policy. "Domestic" companies are hit by domestic tariffs through their foreign affiliates so that higher trade barriers translate into lower repatriated earnings and a welfare loss. When countries engage in FDI, the optimal tariffs are lower.

What this greater interdependence means concretely for trade policy is not yet clear. Some take the view that GVCs may simply provide new arguments in favour of trade liberalisation, preferably multilateral and uniform across products. However, new issues or old issues may require a different treatment. For example, what are the interactions

between unilateral, regional and multilateral liberalisation when one country's producers depend on trade policies of a succession of countries, down and up the value chain? Is there a case to revisit the old debate on trade creation versus trade diversion in preferential trade agreements, taking into account the conditions under which they help or hurt the expansion of global production networks?

To address these questions, this chapter first discusses how the impact of tariffs has changed with the rising prevalence of GVCs. It then provides an overview of issues related to non-tariff barriers at all stages of the value chain. There follows an analysis of the role of trade agreements in fostering integration in global production networks, and the relative benefits of unilateral, regional and multilateral liberalisation. A final section describes some policy implications.

The impact of tariff barriers on GVCs

A value chain perspective suggests, first, that tariffs still do (and tariff liberalisation still does) matter overall. Although nominal protection rates have been considerably reduced, the effects of a given tariff on competitiveness are compounded in GVCs, hurting both exporters and importers. The way in which tariffs and other protective measures at the border affect value chains needs to be taken into account in policy making and negotiations.

GVCs magnify the effects of protectionist measures

Since the post-war period, tariffs on manufactures have been sharply reduced through successive rounds of multilateral negotiations, regional agreements and autonomous liberalisation. The average applied tariff on manufactured goods was as low as 2.6% for WTO members in 2010.[1] This liberalisation has undeniably eroded the importance of tariff protection worldwide, but it should not lead to the conclusion that tariffs on manufactures have ceased to matter.

That conclusion might be more plausible if trade consisted of nationally produced finished goods crossing a border once for consumption abroad. In GVCs, however, goods are traded across borders many times as intermediates and then as final products. What might appear as a relatively "small" tariff adds up if it is applied several times in a production process (Yi, 2010). The costs of trade barriers are magnified when goods cross borders several times (Box 3.1). Traded intermediate inputs incur tariffs and transport costs every time they are shipped to another country for further processing. The cumulative effect of tariffs can significantly raise prices by the time the finished good reaches final consumers, thereby reducing demand and affecting production and investment at all stages of the value chain.

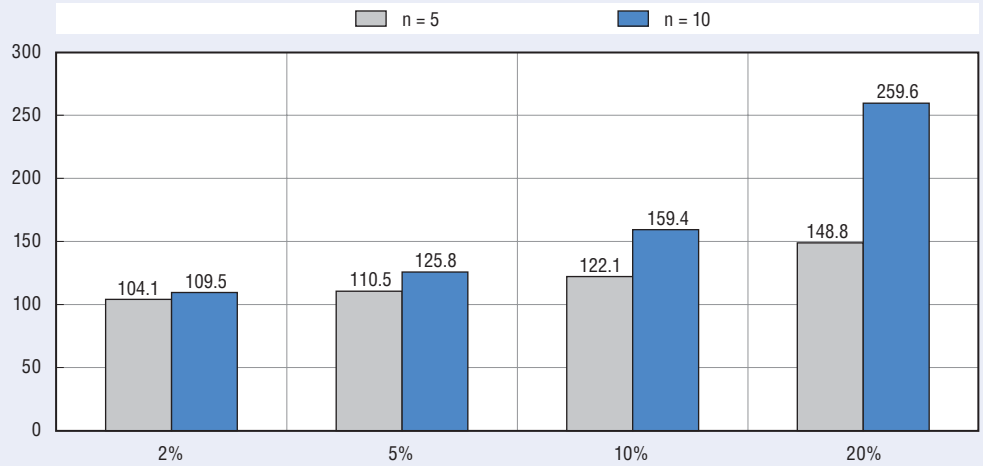
Furthermore, the magnification effect is intensified because tariffs are levied on the gross value of imported goods, rather than on value added. If foreign content accounts for a large fraction of the value of a good, even small tariffs have a sizeable impact on costs. For instance, a vertical production chain in which inputs produced in country A are assembled in country B and re-exported for consumption in A can be discouraged by what might be casually assumed to be a "low" tariff on final goods, even if B has a comparative advantage in assembly. In this example, the tariff is applied to the full value of country A's imports – including previously incurred trade costs – even though most of their value added originates in country A. Multiple border crossings therefore amplify the effect of tariffs on trade flows, so that even small nominal tariff rates can discourage foreign outsourcing (Yi, 2003) and the development of within-firm vertical production networks (Hanson et al., 2005).[2]

Box 3.1. Quantifying the tariff amplification effect

There are two sources of tariff amplification in GVCs: multiple border crossings and the discrepancy between import value and value added in the last country. Suppose, for example, that a good has value added 100, produced in *n* distinct stages, each of which takes place in a different country (the last production stage, e.g. marketing and distribution, is located in the final destination country). Also suppose each stage makes an equal contribution to value added and a uniform tariff is levied at every border.

The figure below shows how the final price of the product varies depending on the number of stages and the value of the tariff. In a highly fragmented production process (*n*=10), seemingly "small" tariffs add up to a high cost: a 5% tariff leads to a 25% increase in the price of the final good – while a 20% tariff would increase the same price by 160%. The larger the number of countries in the value chain, the more the cost of tariffs is compounded. For a 10% tariff, it increases from 22% of value added for five stages to 60% for ten stages.

Tariff amplification due to multiple border crossings: An example



StatLink http://dx.doi.org/10.1787/888932834549

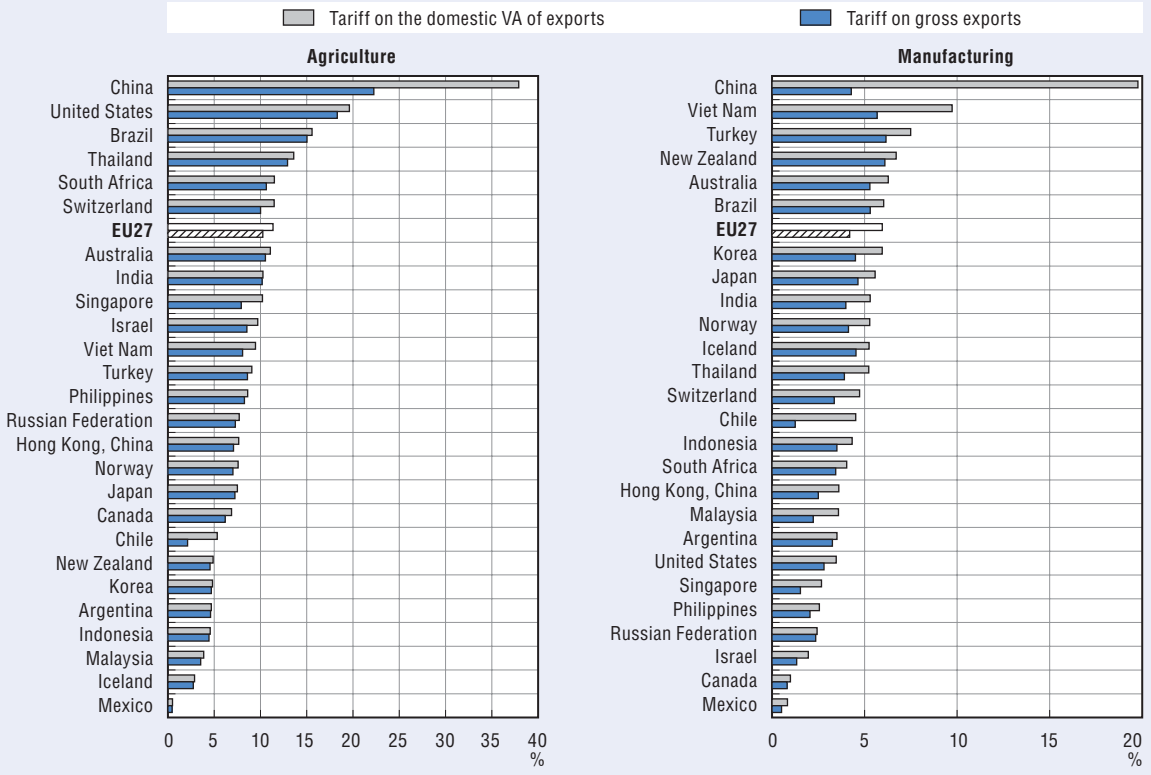
The second source of amplification is the fact that in GVCs, exports often embody a significant share of foreign value added. For a single border crossing at a given point in the value chain, the value-added tariff rate faced by a country's exporters can be defined as the nominal tariff divided by the exporter's share of domestic content (e.g. if the nominal tariff is 5% but the exporter only contributed 20% of total value added, the value-added tariff is 25%). A low nominal tariff can translate into a high value-added tariff if imported inputs account for a large share of value added.

The following figure compares nominal tariffs on gross exports and tariffs on domestic value added, following the methodology of Koopman et al. (2010). It reveals that nominal tariff rates provide an incomplete picture of tariff barriers: taking the foreign content of exports into account significantly raises the extent of measured protection, especially in emerging economies. For instance, the average tariff rate on the domestic value added of manufacturing exports is 19% in the People's Republic of China, 10% in Viet Nam and 5% in Chile, while the corresponding gross tariffs are 4%, 6% and 1%, respectively. In agriculture, the share of domestic content is often larger but effective tariffs can be high as the pace of nominal tariff liberalisation in this sector has been slower. These calculations confirm that the cumulative impact of small tariffs on the chain of inputs can lead to non-negligible costs for firms and consumers.

…/…

Box 3.1. Quantifying the tariff amplification effect *(continued)*

Tariff amplification from foreign content in exports, 2009



StatLink http://dx.doi.org/10.1787/888932834568

Note: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Source: OECD ICIO and UN TRAINS. Applied *ad valorem* equivalent tariffs, weighted by the share of each sector and destination market in the country's agricultural or manufacturing exports.

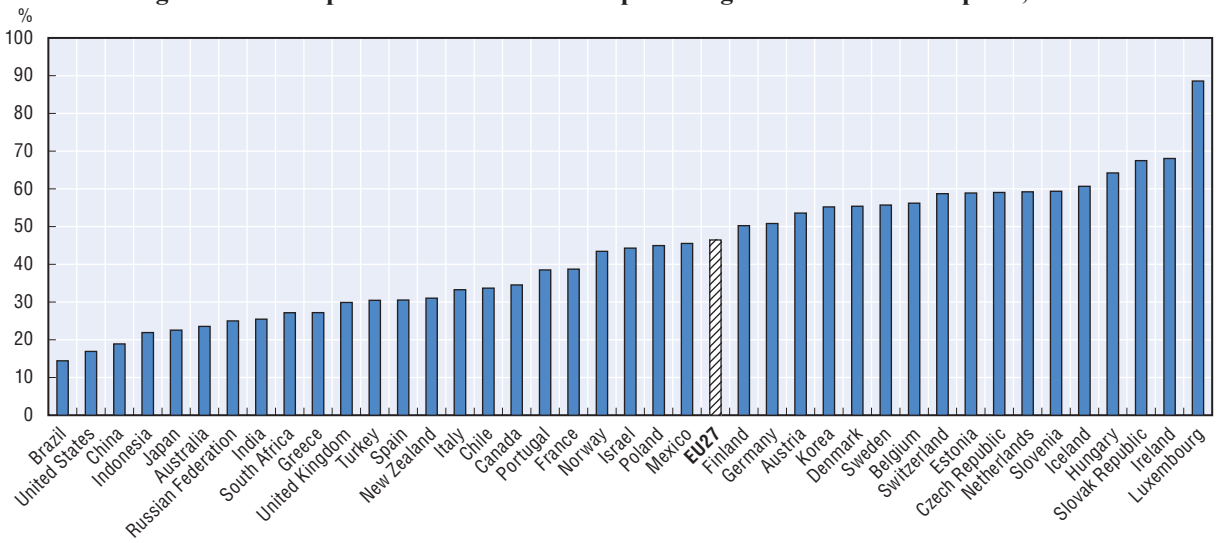
This effect not only concerns tariffs, it applies to all trade costs incurred at every border. These include the costs of non-tariff measures such as fees and delays for inspections and customs clearance. Goods traded many times along the value chain are subject to these costs at every border crossing, with potentially large cumulative effects. As nominal tariff rates decline, the relative importance of non-tariff border costs in GVCs has risen. The benefits of trade facilitation policies to curb such costs and delays are discussed below.

A country's barriers matter for competitiveness

A value chain perspective supports the view that a country's own barriers are costly not only for its consumers but also for its producers and exporters. There may be nothing inherently new in the recognition that a country's capacity to compete in international markets can be diminished as much – or more – by its own cost-raising import barriers as by the tariffs in the target market. For instance, Mostashari (2011) showed that the expansion of developing countries' exports to the United States in the late 20th century is due more to their own trade liberalisations than to cuts in US import duties. But GVCs appear to have intensified the relevance of that recognition, and it is probably also the

case that the relative importance of a country's cost-raising measures has increased. As Figure 3.1 shows, a significant share of imported intermediate inputs is re-exported after being incorporated in the production of goods and services. This share is 46% on average in OECD members and reaches much higher levels in small countries, and shows exporters' need for imports. In a globalised world, export competitiveness hinges more than ever on obtaining high-quality inputs from the most efficient source, and raising import costs through tariffs or non-tariff barriers blunts a country's competitive edge.

Figure 3.1. Re-exported intermediates as a percentage of intermediate imports, 2009



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en, (accessed April 2013).

StatLink *http://dx.doi.org/10.1787/888932834587*

This effect is more intense further downstream in the value chain. Downstream countries (processing and assembly activities) have a larger share of foreign value added embedded in their exports than upstream countries (R&D and design services, but also raw materials). Upstream countries have more indirect exports and value added returning home after transiting through third countries (Koopman et al., 2012). It follows that the further downstream the production stage, the more the exporter's own trade barriers matter for its competitiveness. However, the further upstream a country is located in the value chain, the more imposing tariffs on semi-finished or finished products risks hurting indirectly its producers that contributed value added to imported goods.

This issue has been addressed through the proliferation of export processing zones (EPZs) and the development of duty drawback schemes, which exempt exporting firms from paying import duties on their inputs (Engman et al., 2007). EPZs are a means to promote international trade and employment in countries seeking to participate in GVCs (Chapter 5). They can be a useful step towards country-wide policies of trade and investment liberalisation, regulatory transparency and infrastructure improvement. However, the benefits are larger if favourable conditions for exporters and foreign investors are not durably limited to specific geographic zones. Almost by definition, the benefits of EPZs only concern a fraction of firms with a strong export orientation. They do not extend to firms in other geographical areas or that sell primarily on their domestic market but wish to expand their activity as suppliers for foreign companies. Duty drawbacks are more readily available to all exporters but often have cumbersome documentation and audit requirements (to prove which imported inputs went into the

production of which exported goods). The process may be so complicated for firms selling both in their home market and abroad that they choose to forego this option. More generally, input tariffs raise not only the price of imported intermediates, but also those of domestically produced inputs. As a result of the tariffs imposed on their foreign competitors, domestic producers are likely to adjust their mark-ups upwards. EPZ exemptions or duty drawbacks do not make up for these higher costs for firms purchasing domestic inputs along with foreign ones.

For these reasons, some countries are taking the bolder step of removing barriers on all inputs and capital goods in order to increase their participation in GVCs. While removing tariffs on inputs and maintaining them unchanged on final goods was seen in the past as an essentially protectionist strategy of tariff escalation for "vertical" product competition, the situation is different in a world where, for most manufacturing products, tariffs are very low and where competition lies in the production of and access to specialised inputs. Removing tariffs on intermediate goods lowers the costs and enhances the profitability of domestic firms sourcing inputs from both domestic and foreign suppliers. The unilateral removal by Canada of tariffs on manufacturing inputs and equipment in 2010 is a good example, yet needing further investigation as regards the impact of the tariff elimination on productivity and employment (Box 3.2).

Tariffs are not the only trade policy instruments which, beyond their direct effect on the targeted exporters and importers, can have knock-on effects in other sectors or countries through their GVC linkages. One example is export restrictions. Some countries impose export quotas or export taxes on specific agricultural products and/or raw materials. Such restrictions do not only hurt the targeted exporters. They hurt all downstream sectors abroad when the country imposing the restriction accounts for a significant share of global supply. In particular, the production of some strategic metals and rare earths used in a range of technologically sophisticated products is concentrated in a few countries whose export restrictions have a large impact on world supply and world prices (Korinek and Kim, 2010). For these products, export taxes and quotas can disrupt production and raise costs throughout entire GVCs. The result is more costly semi-processed goods or final imports in all countries, including the ones that impose the export restriction. Export restrictions designed to protect domestic consumers and promote domestic downstream industries may hurt both if intermediate production stages are performed abroad.

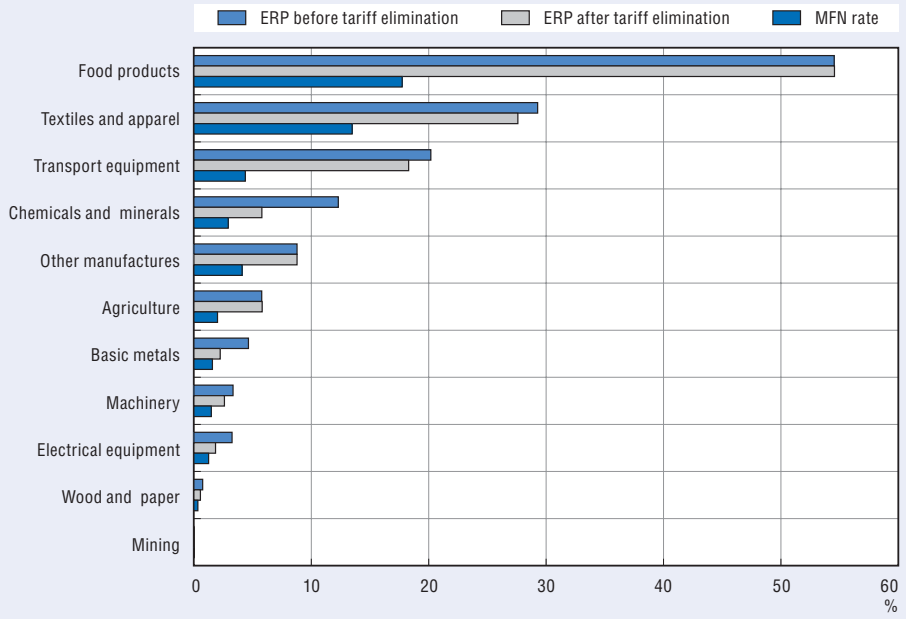
Another example of potentially unintended effects of trade policy on domestic producers can be found in an unbalanced use of antidumping and countervailing measures (National Board of Trade, 2012). As such, the GVC approach does not question the legitimacy of trade defence instruments when domestic firms are hurt by unfair competition, in order to revert to a level playing-field. Yet, most antidumping cases are about intermediate inputs (Vandenbussche and Viegelahn, 2011). For example, in India, which had the highest number of antidumping initiations between 2005 and 2011, more than 90% of cases dealt with intermediate goods. Using firm-level data, Vandenbussche and Viegelahn (2012) show that input-using firms in India are directly affected and tend to change their mix of inputs to avoid the goods affected by antidumping measures. As a result, domestic producers of inputs do not really benefit from these measures and the competitiveness of input-using firms is diminished. Moreover, a value-added perspective on trade flows suggests that a certain percentage of domestic value added may be incorporated in "foreign" products targeted by antidumping or countervailing measures. Thus, a comprehensive assessment of the desirability of such measures, on a case-by-case basis, would take into account both the need to restore fair conditions for competition and the expected impact of the measure on all domestic producers involved in a given value chain.[3]

Box 3.2. Removing input tariffs to improve export competitiveness in Canada

In March 2010, Canada unilaterally decided to eliminate tariffs on a broad range of manufacturing inputs, machinery and equipment. The decision was part of an action plan in favour of jobs and growth. The elimination covers 1 541 tariffs, most of them removed immediately and 381 gradually until 2015. At the end of this period, Canada will be the first G20 economy in which manufacturers operate without tariffs on inputs.

While it is too recent to analyse the impact on the sourcing strategies of firms and Canada's imports of intermediate inputs, the OECD ICIO model can be used to calculate the change in "effective rates of protection" across multiple borders, as a result of changes in tariffs (following the approach proposed by Diakantoni and Escaith, 2012).[1] The effective rate of protection (ERP) calculates the comprehensive effects of a country's trade policy on each sector. It takes into account both tariffs on output, which protect the sector, and tariffs on inputs which are paid by the sector, as well as how much imported inputs are used. Tariffs on an input used by a given downstream industry raise its production costs and can therefore be considered as negative protection for that industry. In the context of GVCs, ERPs provide a useful tool for analysing the cumulative impact of tariffs on different stages of production. In particular they reveal the extent to which an industry is affected by tariffs on its imported intermediate inputs.

ERPs in Canada before and after the elimination of input tariffs (%)



Source: OECD Inter-Country Input-Output (ICIO) and UN TRAINS Database.

StatLink http://dx.doi.org/10.1787/888932834606

Prior to the elimination of tariffs in Canada, there were wide variations in the extent of protection awarded to different manufacturing industries: from small negative ERP rates in mining to 54% in food products (see figure above). Interestingly, these differences are not only explained by nominal rates. Industries that contribute a small share of the value of their output – such as transport equipment or chemicals and minerals – have relatively high ERPs despite low nominal tariffs.

As Canada switches to duty-free imports of manufacturing inputs, most sectors will have lower effective protection, but there are important sectoral differences. In manufacturing sectors, the largest declines in ERPs take place in chemicals and minerals. The output of this industry largely consists of intermediate products used in further stages of production; the new policy therefore exposes it more intensely to the competition of imported inputs.[2] Effective protection on textiles, vehicles and basic metals drops less. However, agriculture and food products are expected to have very slightly higher ERPs. These sectors are closer to final demand and do not compete directly with imported intermediates, but benefit from lower tariffs on their inputs.

Beyond the impact of the reform on the openness of various sectors, its success will hinge on the extent to which it improves the competitiveness of downstream sectors and creates jobs. Estimates of the impact of the elimination of tariffs on productivity and employment are not yet available, but the initiative sets an interesting precedent and will warrant evaluation of its effects in the future. Broadly speaking, there are several sources of potential gains for Canada and its partners:

Box 3.2. Removing input tariffs to improve export competitiveness in Canada *(continued)*

- The immediate effect of the tariff removal is to allow Canadian firms to import cheaper and better-quality intermediate inputs.[3] Prices will fall both on imported and domestically sourced intermediates, as domestic producers of inputs are expected to adjust their prices in a more competitive environment and pass on their cost savings on their own inputs. Access to better-quality inputs also facilitates quality upgrading, reduces the number of defects and improves the efficiency of the production process.
- In the long run, productivity gains will be larger as firms adjust their production structure to the new tariff environment. As long as there is some substitutability between inputs, Canadian firms should rely more on the cheaper imported intermediates in the duty-free categories. Such reallocations will raise the share of tariff-free inputs in the production structure and amplify the gains induced by the policy for firms outsourcing inputs.
- The expected gains can be further boosted by a rise in foreign investment in Canada. The absence of tariffs on imported inputs is likely to encourage firms to locate downstream production sites in Canada to enjoy the cost savings of importing intermediates from non-NAFTA countries. It could become more profitable to open production facilities in Canada to serve not only the domestic market but also the rest of North America.
- Canada will not be the only one to benefit from the policy change. Its partner countries will also gain. On the one hand, foreign input producers supplying Canadian firms directly or indirectly will see their market access increase. On the other hand, the cost savings of the tariff removal will be transmitted down the value chain to foreign firms purchasing intermediate goods from Canadian suppliers (for instance US car manufacturers purchasing basic metal products from Canada) and raise their productivity.

MFN = most favoured nation.

1. OECD data on global input-output (I-O) linkages prior to the reform in 2005 are used, assuming that the production structure stays the same after the policy change (at least in the short run) in order to isolate changes in ERPs due to tariff policy. Canadian tariffs applied to each partner country pre-2010 are drawn from the WTO integrated database and aggregated at the ISIC Rev.3 2-digit level. Owing to lack of data on which imports transit through the Winnipeg free trade zone (Canada's only EPZ), this analysis does not reflect duty deferrals and exemptions in this specific regime.

2. However, as the level of aggregation of the I/O data does not allow for distinguishing varieties at the product level, the calculation is likely to overstate the extent of direct competition between domestic and foreign products.

3. On the contribution of foreign intermediates to productivity and growth see, for example, Amiti and Konings (2007), Miroudot et al. (2009), Shepherd and Stone (2011) and Feng *et al.* (2012).

Tariff policies are more than ever interdependent

Because GVCs lead to greater interdependence of countries and sectors, trade barriers in a given industry affect not only the industry itself but also other sectors and partners to which it is tied through backward and forward linkages. Imposing tariffs on a foreign final product affects the whole chain of suppliers, abroad and at home. In particular, services embodied in goods indirectly pay duties and bear the cost of protectionist policies. Goods and services are intertwined in global production networks and an important policy implication is that barriers in one industry affect others.

Greater interdependence also means more competition between countries to attract foreign buyers and investors, and tariffs are one source of competitive edge. When firms decide on the location of production stages, the relative as well as the absolute level of tariffs matter. When production is fragmented, the choice of where to source inputs is very sensitive to variations in prices and trade costs. The question is not only how high tariffs are but also how they compare with those of other countries. This issue has become increasingly relevant as "trade in tasks" has gained over trade in final goods. Since becoming a successful exporter no longer requires building or replicating an entire value chain, GVCs offer developing countries new opportunities to enter global markets as

components suppliers but also imply fiercer competition to supply foreign firms. The openness of trade policies is a critical component of this competition. The sensitivity of location choices to small differences in trade and transactions costs is also affected by agglomeration effects, such as knowledge spillovers or local supply linkages (FAITC, 2011, Chapter 4).

On a related topic, the establishment of vertical production networks involves long-term contractual relationships with suppliers or fixed costs for setting up plants abroad. The benefits of vertical specialisation therefore hinge on countries' ability to offer foreign firms long-term stability. The importance of a predictable trade regime has risen as trade in GVCs involves more foreign direct investment (FDI) and more relationship-specific investments than trade in final goods. Switching to a different trade partner when the policy environment changes will be more costly, making downstream foreign firms more cautious about where they invest in the first place. Countries able to guarantee not only that tariffs and non-tariff barriers are low, but also that they will remain so in the foreseeable future, are more reliable partners in GVCs and more attractive locations for domestic and foreign investment. Besides the relative level of tariffs, the predictability of the trade policy environment – in absolute terms and relative to neighbouring or similar countries – is therefore crucial for a successful insertion into GVCs.

Non-tariff trade costs along the value chain

This section reviews the types of non-tariff trade costs that affect producers along the value chain and the specific concerns they raise for GVCs. Non-tariff measures (NTMs) encompass a variety of trade impediments and regulations, such as administrative customs procedures, technical regulations and health or safety standards, quantitative restrictions such as quotas and voluntary export restraints, and subsidies. In a broader sense, domestic regulations and limitations on foreign investment that affect the provision of services are also considered non-tariff barriers to trade. These are particularly relevant in global production networks, as the efficient provision of services facilitates cross-border trade in components and final goods. Inefficiencies or lack of competition in key services sectors can act as bottlenecks and effectively prevent successful participation in GVCs. More broadly, trade barriers are found not only in the letter of non-tariff restrictions but also in their implementation. A lack of transparency in the application of trade rules and other procedural obstacles can severely impede trade and compound the impact of NTMs.

Border bottlenecks: Transport and administrative procedures

Fast and efficient administrative procedures at the border are essential to the smooth operation of value chains and demonstrate the importance of trade facilitation measures in boosting competitiveness. Different types of costs in terms of customs and port procedures or clearing processes raise prices for exporters, especially when inputs are traded many times. Like tariffs, administrative costs and delays incurred when intermediate goods cross borders are cumulative in GVCs and act as constraints on domestic exporters that rely on world-class intermediate inputs. Leaving aside inspection and certification requirements related to technical and safety standards, which are discussed below, logistical and administrative procedures, both at the point of departure and in the destination country, slow down the workings of global supply chains (Table 3.1).

Logistical operations rely on the efficiency of port infrastructure but also on the regulatory framework in the destination country. Direct consignment requirements (which prevent goods from being shipped through third countries), requirements to pass through a specified port of customs, and restrictive air, sea or land transport regulations add to exporters' shipping costs. Behind the border, the quality of road infrastructure and the competitiveness of trucking services come into play. Like administrative procedures, technical measures related to customs formalities, including the determination of applicable duties and import clearance, can be unnecessarily cumbersome. Costs incurred for transport and customs procedures are, like tariffs, magnified in GVCs, as goods cross borders many times. The cumulative effect of such barriers raises costs not only in monetary terms but also in terms of delays in delivery. The time required to clear customs and comply with various procedures at the border also forces firms to maintain larger inventories and incur opportunity costs in terms of delayed sales. Exporters are also subject to depreciation costs on immobilised goods stemming from rapid technological obsolescence (e.g. consumer electronics) or physical loss (e.g. fresh agricultural produce). These costs have been estimated as equivalent to a tariff of 0.6% to 2.1% of the value of imported products per day of delay. Trade in components is the most time-sensitive: the cost of an extra day is 60% higher for importers of intermediate goods than for importers of final goods (Hummels and Schaur, 2012).

Table 3.1. Typology of customs and port procedures

	Logistical procedures	Administrative procedures
Departure country	Warehousing	Pre-shipment inspections
	Yard procedures	Licensing or permit requirements to export
	Loading ships	Export tax payment
Destination country	Unloading containers	Inspections for security
	Dispatching the cargo	Inspections for drug enforcement
	Storage of containers	Documentation requirements
Customs	Clearance and release of imports	Determination of applicable duties
		Physical inspections for customs
		Payment of fees and charges

Source: Adapted from Ferrantino (2012).

Uncertainty adds an additional cost to lengthy customs procedures or inefficient border infrastructures. Exporting firms' uncertainty regarding demand is compounded in GVCs. Firms located upstream in the production chain and remote from final demand may not be able to respond to increases in final demand in a timely way if their goods wait days (or weeks) at customs at each subsequent manufacturing stage. For their part, downstream firms may not be able to reduce their orders when final demand contracts if delays force them to place orders early with foreign suppliers. More generally, when shipments are delayed at every border crossing, exporters have to choose the quantity to produce and the precise characteristics of their products before they know whether they are adapted to the destination market. When components travel through several countries in such situations, just-in-time production or fast reactivity to demand shifts are not feasible. Furthermore, upstream firms in GVCs may not know how much time is needed for goods to comply with required procedures and may have difficulties timing their deliveries to downstream firms, with the risk of a slowdown or forced idleness in later production stages. Such risks can only be averted by carrying higher inventories at each production stage, which is costly and inefficient and ties up working capital.

Streamlining import and export procedures and investing in more efficient port and storage equipment takes time and resources in countries seeking to improve access to GVCs. Yet there are ways to start without jeopardising security and customs collection objectives. OECD analysis reveals that the most significant reductions in trade costs for high-income countries are achieved by simplifying procedures through single windows and pre-arrival processing; providing advance rulings on goods classification and applicable duties; and allowing exporters to find information on regulations and complete all procedures on line (Moïsé et al., 2011). Together, such measures can result in a reduction of over 10% of trade costs in OECD countries (Table 3.2). In developing countries, the most effective trade facilitation measures relate to improving transparency and information availability, and harmonising and simplifying documents; while more expensive measures such as single windows could be implemented at a later stage.

Trade facilitation measures are important for making GVCs accessible to small and medium-sized enterprises (SMEs). Obtaining information about various countries' customs formalities, inspection requirements and administrative procedures is a particular hurdle for small firms entering new markets. Complying with the documentation requirements and testing and certification procedures entails high fixed costs; these disproportionately burden SMEs that import and export small amounts. The fixed costs of participating in GVCs can be reduced by making information readily available on line and introducing single windows and simplified clearance procedures for small shipments. To promote the participation of SMEs in GVCs, improving the efficiency of border crossings should be a priority.

Table 3.2. Trade facilitating measures and trade costs in manufacturing

Potential contribution to the reduction of trade costs	
Simplification of customs procedures	5.4%
Advance rulings: share, delays and transparency	3.7%
Automation of customs formalities	2.7%
Fees: level and transparency	1.7%
Border agency external cooperation	1.2%
Number of documents and acceptance of copies	0.2%
Total	14.9%

Source: Moïsé et al. (2011); OECD countries.

Trade facilitation measures can be undertaken unilaterally, with potentially large benefits in terms of exports and job growth for the country investing in more efficient border procedures. Through such measures, domestic firms and local foreign affiliates gain better, more reliable access to high-quality foreign inputs, can raise their productivity by more efficient timing of production, and can export with fewer hurdles. Measures aimed at alleviating administrative burdens and encouraging processing trade can help SMEs take full advantage of GVCs. Inward and outward processing trade regimes and duty drawbacks, in particular, allow exporting firms to save not only on tariffs but also on the costs and delays involved in complying with customs procedures. However, such schemes are usually limited in scale and are only partial substitutes for full-fledged trade facilitation measures, as qualification may entail heavy documentation requirements and such schemes do not benefit firms that import intermediate inputs but sell to their domestic market.

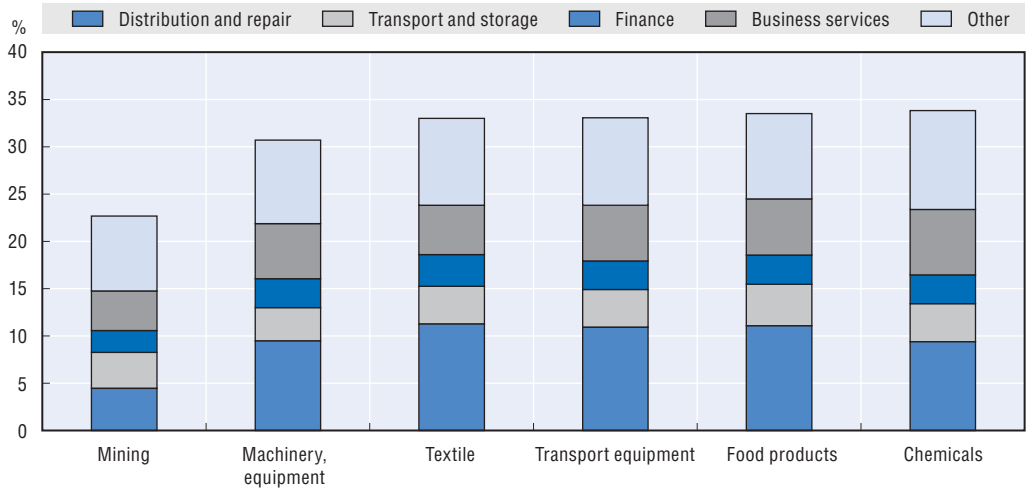
While the benefits for consumers and local firms provide a rationale for unilateral trade facilitation reforms, further progress can be made through concerted efforts at the regional or multilateral level. Firms involved in GVCs are affected not only by costs and delays at their own borders but also by those between third countries upstream and downstream that may disrupt the value chain or significantly raise their costs of operation. If a large number of countries addressed such procedural obstacles together, value chains would be globally more efficient. It would also mean, for countries undertaking costly investments to improve their customs and port infrastructure, that their current or potential trade partners would do the same, giving firms in every country opportunities to participate more in GVCs.

Inefficiencies in services markets

Costs along the value chain are influenced by the quality of the services involved in the logistics chain. Services that complement production span a wide spectrum: most prominent are transport and warehousing, but banking and insurance, business services, professional services, and communication services are supplied at every stage of production. Services involved at both ends of the value chain include R&D and design in the conception stage, distribution networks, advertising and marketing services, or repair and maintenance facilities at the end of the chain.

All together, the value created directly and indirectly by services as intermediate inputs represents over 30% of the total value added in manufactured goods (Figure 3.2). These numbers constitute a lower bound for the contribution of services to manufacturing output, as they only count traded services; services such as R&D are often performed in house. In GVCs, services play a crucial role as "enablers" of trade in goods and act to coordinate production stages and move components efficiently across borders. Although services account for a minor share of world trade in recorded gross flows, their share in value-added flows is significantly higher: around 50% of the value of exports in OECD countries is services value added, and it is to a large extent embodied in gross manufacturing exports (see Figure 2.5 in Chapter 2).

Figure 3.2. Services share of value added in manufacturing exports, world, 2009



Note: The share of distribution does not include distribution services for final goods.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en, (accessed April 2013).

StatLink http://dx.doi.org/10.1787/888932834625

While some of the costs associated with services inputs (in particular transport costs) depend on the quality of infrastructure, facilitating trade in the value chain also requires efficient services markets. Pro-competitive domestic regulations and the liberalisation of services ensure the efficient functioning of the logistics chain. The literature distinguishes between restrictive regulations that discriminate against foreign providers or that apply equally to domestic and foreign firms, and between regulations affecting entry or operations[4] (Francois and Hoekman, 2010). On the latter, what matters for regulatory reform is to identify which limitations are motivated by efficiency or equity concerns (such as correcting a negative externality) and which are purely rent-creating.[5] Barriers to entry and discriminatory measures are rarely justified as a response to efficiency concerns and only restrict competition. Such measures can create inefficiencies in key complementary services and disrupt GVCs that rely on them.

An implication is that gains from trade in GVCs are magnified if the development of global production networks goes hand-in-hand with a liberalisation of services trade. With increased openness, more efficient infrastructure services improve the reliability of import and export flows and thus promote participation in GVCs. A revealing example comes from the transport sector; Deardoff (2001a) identifies several sources of efficiency gains from the cross-border provision of services. Beyond the standard welfare-enhancing forces of comparative advantage, economies of scale and reduced fixed costs, there are gains to be realised from a reduction of border frictions and regulatory costs. These gains are achieved by harmonising regulations applying to domestic and foreign providers, adopting similar procedures and equipment in different countries, and removing inefficient delays (e.g. unloading and reloading trucks at the border). The smooth provision of transport services then lowers the cost of internationally sourced inputs for a wide range of industries.

Similar benefits for export competitiveness arise from the increased openness of business services to trade and FDI. The gains in this area primarily accrue to technology-intensive industries such as machinery, motor vehicles, chemicals and electric equipment (Francois and Woerz, 2008). More open and more competitive telecommunications sectors would also increase the productivity and competitiveness of manufacturing firms, by improving Internet penetration rates and encouraging investments in better information technology (IT) infrastructure. At the same time, they would favour the development of services value chains in sectors such as computer services, finance or tourism.

Distribution services provide another key link in GVCs. The literature identifies "buyer-driven" GVCs for which global retailers organise the supply chain (Gereffi, 1994). Such GVCs are particularly relevant for small-scale agricultural producers, for whom finding international partners, obtaining information about foreign markets and complying with standards and procedures to import and export are among the main obstacles to participation in GVCs. Global retailers are often the most accessible means of entering global markets for these producers as they typically provide assistance to their suppliers on most or all of these concerns. However, the efficiency and competitiveness of the retail and wholesale sector can be hampered by regulatory barriers to entry and foreign investment (Reisman and Vu, 2012). These behind-the-border barriers reduce the gains from trade and fragmentation for agricultural and manufacturing suppliers further up the value chain.

Diversity of standards[6]

In the past decades, technical barriers have largely become the new face of trade policy. With quotas eliminated and tariffs reduced, one of companies' main challenges for entering new markets is meeting mandatory standards for products or processes, especially for exports to high-income countries. In many respects, compliance is more challenging and costly in GVCs as it requires co-ordination of all stages of the value chain. Efforts to address the complexity, and above all the diversity, of standards would significantly enhance the ability of SMEs to participate in GVCs.

Technical barriers to trade (TBT) affect around 30% of all international trade, and sanitary and phytosanitary measures (SPS) over 60% of agricultural trade (Nicita and Gourdon, 2012). As long as they differ from those of the country of origin and in the absence of mutual recognition agreements, technical norms and sanitary standards require exporters to adapt their production processes, provide additional documentation and obtain accreditation. The costs of product certification, product testing and inspection, as well as specific packaging and labelling requirements, can substantially alter the benefits of entering foreign markets for small-scale exporters.

It is worth noting that the expansion of GVCs may well strengthen the case for stringent standards. Although government-imposed standards may conceal protectionist policies, they are often responses to legitimate concerns about consumer health and safety, the environment, or other quality issues. International production networks can increase the information asymmetries that justify adopting safety and quality standards in the first place, for instance by making it harder to track the origin of a defective product and issue a recall. Setting technical requirements and performance measures then implies a trade-off between better consumer protection and restrictions on trade (Fischer and Serra, 2000).

Not all quality standards necessarily involve such a choice. More stringent regulations can also expand trade by boosting consumer confidence in foreign-made products. The net effect of standards on imports is therefore ambiguous, and empirical studies on the effects of TBT/SPS on trade have yielded mixed results depending on the sector and measures involved (Li and Beghin, 2012). Trade in agricultural and food products seems to be negatively affected by standards, while the effect on manufacturing trade is small or even positive. Therefore, if harmonised and efficiently implemented, quality and safety standards may facilitate the entry into global networks of some developing country suppliers, especially large-scale producers able to invest to meet international standards, often with assistance from downstream buyers and retailers, and improve their productivity and reliability.

The main obstacle is that public standards are far from harmonised across countries and involve procedures that limit the ability of upstream suppliers to take full advantage of GVCs. Lengthy and opaque certification processes are unambiguously detrimental to trade, as are substantial differences in the standards imposed by the countries involved in the production of a good. For conformity assessment procedures associated with technical regulations, Chen et al. (2006) estimate that a requirement for testing procedures reduces export shares by 9% (mainly for non-manufacturing firms) and difficulties for obtaining information on standards by about 18%, in a sample of developing countries. Such procedures also reduce the number of destinations to which firms export owing to the duplication of fixed costs and diseconomies of scale involved in producing to meet several sets of technical specifications. The lack of consistent requirements on labelling

and packaging across jurisdictions has similar effects. Without harmonisation, standards and certification costs are a major hindrance to trade for producers supplying downstream firms in several countries or serving consumers in several markets (Box 3.3).

Compliance with a diversity of technical standards is particularly burdensome for firms that participate in GVCs. International production networks raise the costs of TBT or SPS measures for exporters because of the nature of fragmented production processes. If upstream suppliers of inputs do not know what the final export market is, downstream firms may incur adaptation costs in later stages. Alternatively, upstream firms may need to tailor production to each country's requirements and thus lose the benefit of economies of scale.

In food supply chains, compliance with SPS measures typically requires a high degree of co-ordination, monitoring and traceability along the value chain. This is a challenge for fragmented production processes. In this respect, it is useful to distinguish between product standards (e.g. maximum chemical residue), which are tested at the level of the final product, and process standards (e.g. hazard analysis and critical control points – HACCP). For firms in GVCs, compliance with the latter is more difficult and costly, as it requires information on production processes and quality management systems at all stages of the supply chain. The costs involved can effectively preclude small firms' participation in global production networks (Kaplinsky, 2010). The trade-restrictive effects of technical barriers in GVCs can also explain why the import coverage ratios of TBT/SPS measures are lower in intermediate-intensive sectors (WTO, 2012).

Box 3.3. Dealing with diverse standards in order to export: The case of Moroccan farms

In their study of the Moroccan citrus and vegetable sectors, Aloui and Kenny (2005) illustrate the difficulties of complying with a variety of standards in GVCs. The value chain is composed of seeds, fertiliser and pesticide suppliers, mechanical equipment suppliers, farmers, packing houses, export intermediaries, import intermediaries and foreign retailers in the European Union and the United States. Exporters must comply with several sets of food safety and quality control standards at the farm and packing-house stage, both public standards in the destination country (HACCP, ISO 9001, national standards in EU countries) and private standards imposed by consortia of large retailers (EurepGAP [now GlobalGAP], BRC). While not legally mandatory the latter are effectively preconditions for serving a market.

While health and food safety standards are essential for consumer protection and should not be considered barriers to trade as such, the study shows the costs of complying with diverse, and sometimes conflicting, standards in an international agri-food value chain. Compliance with each standard requires significant upfront investments and recurring costs estimated to be at least 8% of the total farm-gate cost. Moreover, participation in the GVC that links Moroccan farmers to pesticide suppliers and retailers in the United States and the European Union typically requires compliance with several standards simultaneously, at the grower's level and at the packing-house level. The main concerns of surveyed farmers are the incompatibility of national standards (e.g. different maximum residue limits for the same pesticide in different importing countries and in different years) and the absence of equivalence agreements between certifying bodies (e.g. certified organic farmers cannot be exempted from EurepGAP certification although the former meet more stringent standards).

The variability of foreign quality control standards regarding pesticide residue raises the most issues. Supplying several countries through co-operatives and export intermediaries usually do not know where the final product will be sold prior to harvest yet some pesticides are allowed in the European Union but not in the United States and vice versa. Discrepancies between SPS requirements raise compliance and certification costs and limit economies of scale for small co-operatives and packing houses. Convergence in standards and certification procedures would clearly facilitate the participation of small-scale agricultural producers in GVCs.

It follows that the increase in trade flows in GVCs amplifies the benefits of regulatory convergence. Policies that promote the convergence of standards and certification requirements, through the adoption of international standards (e.g. ISO, Codex Alimentarius), and mutual recognition agreements alleviate the burden of compliance. They help reduce unnecessary duplication of testing and certification procedures. As such, these policies facilitate integration into GVCs. In particular, insofar as they lower the costs of imported inputs without endangering consumer safety, they improve the competitiveness of exporters who source inputs internationally.

The role of trade liberalisation in the expansion of GVCs

The analysis of trade changes when companies fragment their production across countries. Cheaper inputs become a new source of gain from trade, with an impact on comparative advantage (Deardorff, 2001b, 2005). The role of trade agreements does not fundamentally change: they are still useful for reducing barriers to trade and facilitating companies' participation in GVCs. However, the way trade should be liberalised might be different for three reasons.

First, trade policy is not the only policy affecting the expansion of GVCs. The literature on GVCs highlights the role of the trade-investment-competition nexus in trade costs: trade policy should be part of a coherent strategy for dealing with market access in a broad sense. Second, the debate on the relative emphasis on multilateral, regional and unilateral trade liberalisation might take account of the increased interdependence of trade policies. Third, specific issues related to vertical specialisation and trade may need to be taken into account in the next generation of trade agreements.

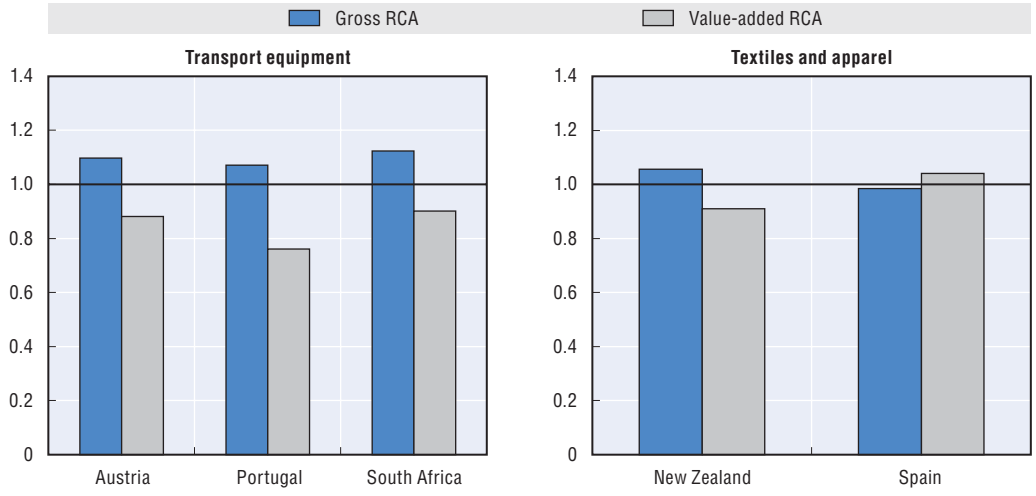
This section first describes what is different for comparative advantage when trade is "vertical" and inputs are traded and then addresses the three main implications for trade agreements in terms of complementary policies, the appropriate level of trade liberalisation and new issues to be considered.

Comparative advantage, trade costs and GVCs

Simply defined, a country has a comparative advantage when it produces a good or a service at a *relative* lower cost. What matters is not the cost of production between, say, country A and country B, but within country A the relative cost of producing good 1 as opposed to good 2 or service 3 (and how it compares with relative costs in country B). When introducing the possibility of trading intermediate inputs, the same logic applies. However, what defines the cost of production is much more complicated than in a world where no trade in intermediates takes place (Deardorff, 2005). The cost of production in A does not depend only on factors of production located in A (e.g. labour costs). It is also a function of the cost of intermediate inputs, a cost that is affected by trade policy: prices of domestic inputs can be raised if imports are made more expensive by trade barriers. Trade patterns therefore become very sensitive to trade costs and comparative advantage is no longer based only on a country's endowment in labour and capital. Prices of intermediate inputs in foreign countries now affect the comparative advantage of the domestic economy.

The revealed comparative advantage (RCA) is an index measuring a country's specialisation in a given industry by comparing the share it represents in the country's exports to the world share of the industry in world exports. By looking at RCA in gross and value-added terms it is possible to see the importance of trade in intermediate inputs for comparative advantage. There is a comparative advantage when the RCA is superior to 1. In gross terms, the calculation uses currently available trade statistics, while new statistics identifying domestic value-added in exports are used for the RCA in value-added terms. In the case of transport equipment, Figure 3.3 shows that some countries have a revealed comparative advantage in gross terms – an RCA above 1 – but not in value-added terms (the transport sector in Austria, Portugal and South Africa). In textiles and apparel, this is also the case of New Zealand, while the opposite is the case for Spain. In gross terms, Spain does not seem to have a comparative advantage but the RCA in value-added terms reveals that in fact it does. To identify countries' comparative advantage, it is therefore important to account for intermediates trade (see Chapter 6 for a more detailed discussion).

Figure 3.3. Revealed comparative advantage (RCA) in gross and value-added terms, 2009



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en, (accessed April 2013).

StatLink *http://dx.doi.org/10.1787/888932834644*

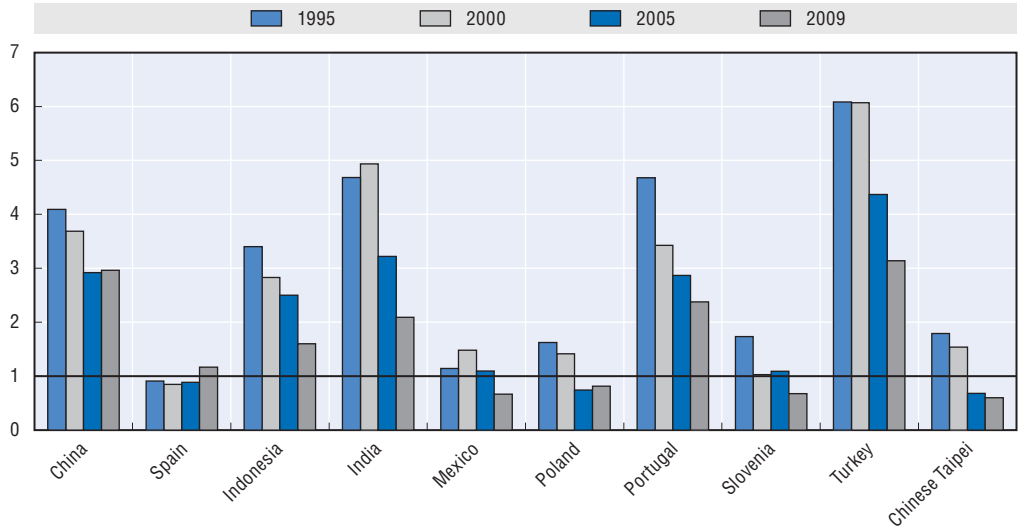
The RCA index can also illustrate the volatility of comparative advantage when trade costs are subject to variations. As Figure 3.4 shows, there are significant changes in the textile and apparel industry even over a short time (between 1995 and 2009). With the WTO Agreement on Textiles and Clothing, further liberalisation in regional trade agreements (RTAs) and unilateral reforms in emerging countries, this is an industry in which trade costs have varied significantly in the last decade. Figure 3.4 shows that countries' specialisation has varied as well. For example, Spain had an RCA below 1 in 2005 but a comparative advantage three years later.

A concrete implication is that, more than before, trade policy can drive comparative advantage and the competitiveness of domestic firms. When barriers to trade are removed, there is the traditional gain from trade in terms of increased real income because consumers pay less for final products; but there is, in addition, a new gain. By providing access to cheaper inputs, the cost of production is lower and further specialisation can occur in the value chain, increasing the overall gain. For example, country A may have had has a

comparative advantage in car manufacturing. In the absence of trade in intermediate inputs, however, country A had to produce all the parts and components before assembling the cars. What was a comparative advantage in terms of "car industry" becomes a stronger comparative advantage when the country specialises in a specific segment of car manufacturing. There is at least one segment where the cost of production will be *relatively* lower and this is an opportunity for further gains from specialisation.[7]

Moreover, this new comparative advantage will be directly affected by trade policy since the relative cost depends on the price of inputs (including foreign inputs). Trade policy makers therefore have a new responsibility when production is vertically fragmented. Any cost advantage that was previously defined on the basis of the labour and capital available in the economy becomes less "sticky" and is directly affected by trade policy and other policies that affect trade costs.[8]

Figure 3.4. Revealed comparative advantage (RCA) over time in textiles and apparel in value-added terms, selected economies



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en, (accessed April 2013).

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Trade in intermediate inputs is of course not a new phenomenon. But a few decades ago, it was possible to ignore it and to assume that most products were manufactured in one place, with only raw materials traded as intermediate inputs. The increased fragmentation of production since the mid-1980s now makes it impossible to disregard trade in inputs and the implications for comparative advantage. The rest of this section therefore examines the concrete implications for the negotiation of trade agreements.

How can trade agreements help companies increase their global productivity and boost job creation?

Trade agreements can play a positive role in reducing trade costs and enabling firms to engage in vertical specialisation to increase their overall productivity. An often-cited example is the role played by the WTO Information Technology Agreement (ITA) (Baldwin, 2006b; Kimura and Obashi, 2011). It is no coincidence that GVCs are particularly strong in the industries covered by the agreement (Box 3.4). Removing tariffs for most products in the same value chain can have a significant impact and the fact that

the agreement is based on the most favoured nation (MFN) principle and covers 97% of world trade in IT products ensures that there is no magnification effect (see Box 3.1) across countries.

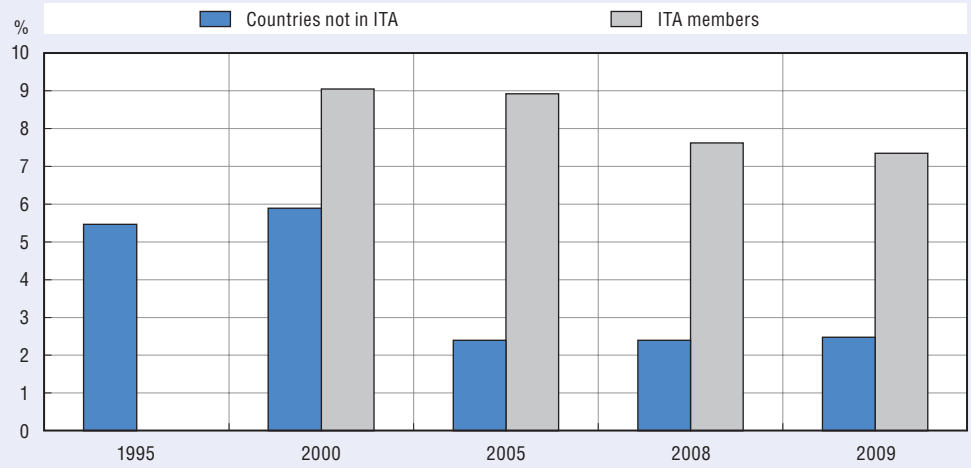
However, the ITA only covers goods and tariffs and as such does not address all barriers in the value chain or all segments. Services are also important for IT products and are not covered by the agreement. Beyond trade policy, investment barriers or competition issues can hinder trade in IT products. Taking complementarities with other policy areas into account can be an important policy implication arising from the increased fragmentation of production.

Box 3.4. The Information Technology Agreement (ITA) and the IT value chain

The ITA is a multilateral agreement that removed tariffs on key technology and telecommunications products, initially for 29 signatories and now for 75 countries (covering 97% of world trade in IT products). The benefits of the agreement apply to all WTO members because it is based on the MFN principle. GVCs are particularly strong in the industries covered by the agreement. Electrical and optical equipment, the industry covering most IT products, is, with transport equipment, the industry in which the length of value chains increased the most between 1995 and 2008.

The expansion of IT GVCs coincided with the entry into force of the ITA in 1997 (Anderson and Mohs, 2011). The figure below does not provide evidence of a causal link but ITA members are more involved in GVCs than non-signatories. The participation rate is calculated as a percentage of gross exports and accounts both for the import content of exports and for exports of domestically produced intermediates used in third countries' exports. Before the agreement, the average participation rate for all countries was about 5%. The first members of the ITA had a higher participation rate in 2000 (above 8%) and, despite a slight decrease as new members join, the participation rate remains much higher than for non-members.

ITA membership and participation in IT GVCs: Participation index as a percentage of gross exports



Source: OECD (2012).

StatLink http://dx.doi.org/10.1787/888932834682

More complementarities between trade, investment and competition policies

The relative cost of producing goods and services is also influenced by labour, capital and knowledge flows in GVCs. What gives a comparative advantage to a firm in country A can change if another firm invests in country B, if some high-skilled workers move to this new location and if technology is imported. Comparative advantage can shift from country A to country B through foreign investment decisions or partnerships between firms. In addition to trade policy, investment and competition policies shape relative production costs and hence comparative advantage.

The greater volatility of comparative advantage is therefore also due to the flows of labour, capital and knowledge in GVCs. In the past, stocks and endowments determined productivity in a given location and evolved slowly over time. As firms are able to shift resources within GVCs, flows now shape comparative advantage (Henderson et al., 2002). Investment affects the availability of capital directly and affects productivity indirectly through knowledge spillovers. Competition policy helps ensure that firms have the right incentives (including with respect to intellectual property) and that foreign companies are not creating rents but lowering prices and giving domestic firms incentives to increase their productivity.

The most recent theories of capital flows emphasise complementarities between trade and investment. According to the classical view, capital goes to where it is scarce and consequently better remunerated. However, most capital is going to developed countries rather than emerging economies. A driving force of capital flows appears to be export specialisation in capital-intensive sectors (Jin, 2012) and this is more in line with actual capital flows. There are strong links between trade and the movement of capital. A compartmentalised approach to policy making is not sustainable when firms define their strategies on the basis of production costs that are affected by several types of regulations and their interactions across countries.

Facilitating investment and job creation

Ideally, trade agreements would cover all dimensions of market access and would deal with complementarities among policies that affect trade costs. While abolishing tariffs on inputs offers companies new trade opportunities, the value chain requires efficient services as well as the possibility to move people, capital and technologies across countries. Trade agreements covering trade in services, investment, intellectual property and the temporary movement of workers and dealing with domestic regulations or specific competition issues are more likely to lead to an environment that deals with all the obstacles encountered by firms when building their supply chains.

Companies doing business abroad and building long-term relationships with suppliers and customers do not only need access to the market. They also need rules that facilitate their establishment, enable them to share their knowledge and technologies without infringement of their property rights, allow them to repatriate profit and to move key personnel, and ensure fair treatment and protection against anti-competitive practices. Countries with a good regulatory environment and efficient infrastructure services increase the opportunities for their firms to join global production networks. Ensuring the same conditions for domestic companies abroad is beyond the scope of domestic regulation. International disciplines and consistent rules across countries can facilitate the organisation of international supply chains. This goes well beyond a concept of reciprocal trade liberalisation as the negotiation of mutual "concessions". When trade agreements are instruments to increase the competitiveness of domestic firms within value chains, their main objective is mutually supportive outcomes that facilitate investment and job creation (Baldwin, 2012). This approach is already apparent to some extent in the "deep" RTAs negotiated since the middle of the 1990s, starting with NAFTA. Deep integration is an important characteristic of the recent wave of RTAs for several reasons (WTO, 2012). One is the fact that countries are looking for governance on a range of regulatory issues that are essential to GVCs. Moreover, given firms' concerns about attracting new jobs or encouraging job creation in more competitive sectors, deep integration can help deal with some of the complementary policies that are needed for labour adjustments to take place smoothly.

Finally, to reduce distortions and let firms choose the best strategy to access foreign inputs and foreign markets, trade agreements ideally need to pursue some kind of neutrality across modes of access. In fact, the literature emphasises the diversity of firms' decisions (Bernard et al., 2007). For example, some companies prefer to establish foreign affiliates while others serve markets through arm's-length trade (Antràs and Helpman, 2004). In the case of services, the same neutrality could be sought with respect to modes of supply (cross-border trade versus commercial presence for example). Efficiency considerations should drive firm strategies, and productivity gains are higher when firms choose the least costly strategies.

Unilateral, multilateral or regional trade liberalisation?

The past two decades have seen an acceleration of the fragmentation of production and slow progress in multilateral trade negotiations. Most negotiated trade liberalisation has taken place through RTAs but the benefit for GVCs is debatable. First, most of these agreements are bilateral (WTO, 2011) and do not reach all of the countries potentially involved in GVCs. While there is a reasonably high degree of liberalisation for trade in goods (Crawford, 2012), the evidence also suggests that preferential margins are modest and that companies do not always use preferential tariff rates (Francois and Manchin, 2011). Moreover, RTAs often correct for negative relative preference margins: they offer partner countries treatment equivalent to the more favourable treatment already accorded to third countries (WTO, 2011). In the area of services and investment, WTO-plus commitments do not always mean more market access. There is "water" in commitments (Borchert et al., 2010) – meaning that actual regulations are more liberal than commitments and most trade liberalisation has taken place unilaterally and on an MFN basis (Francois and Hoekman, 2010).

This new landscape of trade agreements is consistent with the idea that removing barriers to trade offers benefits on the import side; it can increase the competitiveness of domestic firms and encourage further specialisation in the value chain. There is no need to wait for other countries to do the same; in fact, there are distinct advantages for "first movers". The first to access foreign inputs at a cheaper cost can increase their market share, position themselves on international markets with economies of scale and scope and make it more difficult for subsequent entrants to compete. GVCs seem to have weakened the case for "reciprocal trade liberalisation".

Does this mean that trade agreements are no longer useful? The practice in terms of bilateral and regional deals suggests the opposite. Trade agreements can still be useful for long-term commitment and for dealing with issues such as the harmonisation of standards or the recognition of qualifications that require co-operation among countries. Such topics may be easier to treat at the regional level, with a limited number of partners, than in a multilateral setting. This would explain the success of RTAs, and they may be useful steps to a first-best solution for multilateral trade liberalisation.

When RTAs cover economies that are part of a regional bloc and introduce deep integration provisions in the area of services, investment and competition, they may play a positive role in the development of GVCs. For example, Altomonte and Rungi (2008) point to the role of EU enlargement in the increased fragmentation of production across Europe. NAFTA is also described as being at the origin of some North American GVCs. In Asia, instead, the literature suggests that global production networks developed before the negotiation of RTAs and that these were not among the main drivers of the recent expansion of Asian value chains (UNESCAP, 2011). Box 3.5 provides some evidence on

the relation between regional production networks and RTAs. Asia and Oceania appear as the two regions in which the consistency is greatest (in 2008). It may be because RTAs were negotiated after the expansion of GVCs in Asia that they follow more closely the structure of vertical production networks.

The increased activity in terms of negotiation of regional trade agreements in parallel with the development of global production networks remains a paradox. The fact that trade policies are much more interdependent in GVCs should, in principle, encourage multilateral trade agreements (such as the ITA). The more international the value chain is, the broader should be the group of partner countries in agreements. This of course pleads for multilateral rather than bilateral negotiations.

Box 3.5. Global production networks and regional trade agreements

To assess the extent to which the "spaghetti bowl" of regional trade agreements matches global production networks, two simple indexes are calculated. The first is a network trade index (Ferrarini, 2011). For a given pair of countries, it is calculated as the share of the partner in the reporter's imports of intermediate inputs, weighted by the share of the industry in total final exports of the reporter. Both goods and services industries are included in the calculation. This index has a value of zero when there is no connection between countries in the value chain and a value of one when the connection is the strongest (i.e. when all inputs used in the reporter's exports are sourced from this partner). The second index is based on information collected on regional trade agreements by Miroudot et al. (2010). The index has a value of zero when no regional trade agreement has entered into force between two countries, a value of 0.5 when a RTA exists and covers only goods and a value of 1 when it covers goods and services.

The table below provides correlation coefficients between the network trade index and the RTA index for broad regions (an average calculated on the basis of all bilateral relationships between countries in the region and all their trade partners in the world). The higher the value, the closer the network of trade agreements to the production networks. Concretely, it means that countries have signed RTAs with their main vertical trade partners, those from which they source their inputs.

The match between global production networks and the network of regional trade agreements, 2008

	Asia	Europe	North America	Oceania	South America
Correlation between the trade network index and RTA index	0.33	0.16	0.19	0.43	0.16

The table shows that Asia and Oceania are the two regions in which the network of trade agreements is most aligned with existing production networks. In Europe, North America or South America, there is on average a weaker correlation; this indicates that partner countries in RTAs matter less for the connection to GVCs.

In the value chain, it is not only the barriers put in place by direct trade partners, but also barriers further down, that matter. Similarly, access to cost-efficient resources can be blocked by barriers upstream between raw material suppliers and intermediate input producers. Because trade costs are cumulative and magnified in the value chain, multilateral and uniform trade liberalisation (i.e. on all types of inputs and final products) would more than ever be the first-best solution. Multilateral trade negotiations may eventually have to catch up with the new business reality of GVCs.

With the deadlock in the Doha round negotiations at the WTO, there is a risk that countries will slow the process of trade liberalisation. Unilateral reforms have been successful in the past decade when trade negotiations did not provide companies other opportunities to enter GVCs. There is no reason to abandon such strategies, as they can complement efforts to reach mutually supportive outcomes. Moreover, further multilateral trade liberalisation may also take the path of sectoral agreements. What consideration of GVCs suggests is the need to cover as many countries and industries as possible and

precisely those involved in a specific value chain. The ITA, for instance, has a broad sectoral coverage that is consistent with the IT products value chain and is signed by countries that cover 97% of world trade for these products. While it lacks a link with services and investment, it has another advantage: its non-discriminatory MFN nature eliminates concerns related to rules of origin. In addition, with tariffs at zero, potential distortive impacts on trade are reduced.

New issues and old issues that require a new look

While the rise of GVCs does not introduce radically new concerns for trade policy makers it puts a new emphasis on issues pertaining to trade in intermediate inputs and the magnified impact of trade barriers. An area that is new and specific to vertical specialisation, however, is the relationship between buyers and suppliers. At this stage, it is difficult to say that this should be a new area for disciplines in trade agreements, but offshoring certainly encourages policy makers to look closely at the difficulties of setting contracts between companies across countries (Antràs and Helpman, 2008; Antràs and Staiger, 2012).

New competition issues also arise from the possibility for firms to set vertical contracts that restrain a supplier's provision of inputs to other companies (OECD, 1999). There is also a risk of under-investment and missed trade opportunities when inputs are tailored to the buyer's needs and lack an alternative use. The buyer is then in a position to extract most of the profit from the supplier, but this can discourage the supplier from entering into the contract in the first place. The international contracting environment can be a determinant of trade in the context of vertical specialisation.

With respect to vertical restraints, i.e. restrictions that one level in a vertical chain imposes on another, the effects on competition are complex (Slade, 2008). Firms use vertical restraints for a variety of reasons. Some of them may increase efficiency when the objective is to reduce the externalities generated by decisions of upstream and downstream firms or to allocate risk along the value chain. However, vertical restraints can also be used to raise barriers to entry for competitors. International vertical co-ordination could in theory give firms strategic trade advantages similar to those generated by export subsidies (Hamilton and Stiegert, 2000), but there is very little empirical literature on this topic.

The costs associated with rules of origin for goods are an old trade policy issue, which has become more topical for regional trade agreements (see above). In the case of services, liberal rules of origin soften the impact of preferential regimes on global production networks (Miroudot et al., 2010). For goods, however, strict preferential rules of origin might prevent companies from otherwise benefitting from a preferential access to the cheapest inputs because they do not meet the requirements for originating materials. In addition, administrative costs are incurred given the necessity to document the contribution of each country to value added and obtain the certificate of origin. The costs of compliance may even outweigh the trade-creating benefits of an RTA (Brenton and Manchin, 2003; Brenton and Imagawa, 2005).

Rules of origin are inherent to an approach where countries grant preferences to specific partners through RTAs, and GVCs have no reason to question their existence. But the fragmentation of production makes it difficult to design effective rules of origin because it is difficult to identify clearly the origin of products that incorporate inputs from many different countries within and outside the RTA. In new RTAs, and when bilateral agreements are consolidated at a broader regional level, rules of origin that do not

discourage efficient sourcing by producers within the free trade area are more GVC-friendly, for example by allowing for cumulation or relaxing the percentages of non-originating materials (National Board of Trade, 2012).

Key policy implications

GVCs are the consequence of and depend upon open markets. This chapter has argued that the fragmentation of production in GVCs requires at least a change in emphasis in trade policy, taking into account the growing interdependence of the policy stances of exporters and importers. It has emphasised the amplification of trade costs for all suppliers along the value chain. Lastly, it has shown that ambitious trade agreements covering all dimensions of market access (including access to key inputs) can help countries maximise the gains from production sharing. The main policy implications are as follows:

- Despite low nominal rates, tariffs can add up to significant trade costs when goods cross borders many times. In addition, non-tariff measures accentuate the magnification effect of tariffs along the value chain. This effect strengthens the case for open markets and calls for pursuing the elimination of tariffs at the multilateral level.
- There is considerable potential for efficiency gains from streamlining administrative and customs procedures at the border. Procedural reforms that improve information about administrative requirements and reduce the time required to inspect and process shipments yield large gains for importers of intermediate goods. They enable upstream suppliers to save on the cost of delayed sales, and allow for better inventory management and the smoother operation of supply chains.
- Meeting technical standards has become one of the main barriers to entry into foreign markets. Efforts towards harmonisation or mutual recognition agreements should therefore be pursued with respect to technical specifications and certification procedures. More uniform product standards can enhance the ability of small-scale exporters to participate in GVCs as components suppliers.
- Global production networks rely on the logistics chain, which requires efficient network infrastructures and competitive complementary services. Reaping the full benefits of participation in GVCs requires liberalisation of domestic services markets to alleviate the burden of domestic regulations on the provision of inputs such as transport, finance and business services when they are more restrictive than necessary for meeting legitimate regulatory policy objectives.
- Trade agreements can reduce trade costs and maximise productivity gains from production sharing when they facilitate not only the movement of goods but also services, people and capital, through chapters on trade in services, investment, competition and the temporary movement of business persons. Trade policy should remain neutral with respect to firms' strategies for accessing foreign inputs and markets, i.e. it should not favour one mode of access over others.

- More than before, the case for multilateral trade liberalisation remains the best way, analytically, to maximise the gains from trade, as barriers between third countries upward or downward in the value chain matter as much as the barriers put in place by direct trade partners. Regional trade agreements can help if they cover a sufficient number of economies, are consistent with regional production networks, do not introduce distortions with third countries and are progressively multilateralised. Unilateral liberalisation nonetheless remains a potent option. It would be better if co-ordinated with others. If this is politically impossible, unilateral liberalisation remains a means of advancing.
- New issues such as vertical relationships between buyers and suppliers could be covered in trade agreements through provisions on enforcement of international contracts and mechanisms to deal with vertical competition issues. Other disciplines already found in trade agreements could be re-assessed in the context of GVCs. In particular, rules of origin could be updated to take into account the increasing fragmentation of production across countries and become more "GVC-friendly".

Notes

1. *Ad valorem* equivalent tariffs were 1.9% for high-income countries, 4.3% for low- and middle-income countries and 10.3% for least developed countries, down from 4.6%, 26.1% and 88.4%, respectively, in 1989 (UN TRAINS database).
2. Note, however, that the empirical relationship between the share of foreign content in production and the effect of tariffs on trade flows has not yet been directly tested. An estimation of the magnitude of this trade-reducing effect would warrant further analysis.
3. This approach is already adopted in some jurisdictions, as in the European Union as part of the Community interest test.
4. Examples of measures affecting entry are a limit on the total number of mobile phone licences (non-discriminatory), or a maximum share of foreign equity allowed (discriminatory). Examples of measures affecting operations are price controls (non-discriminatory) or specific taxes on foreign firms (discriminatory).
5. New indicators measuring the openness of services trade policies will be available in the near future through the OECD Services Trade Restrictiveness Index.
6. Only government-imposed mandatory standards are considered here. Company codes of conduct and private standards (on quality, safety, labour, environment, etc.) imposed by global brands or industry groups on their suppliers as part of "buyer-driven" value chains are not analysed as they are outside the scope of public policy.
7. There is no further comparative advantage when the relative cost is the same across all remaining segments; this sets a limit on fragmentation and specialisation.
8. Moving up the value chain and policies affecting countries' specialisation are discussed in Chapters 5 and 6.

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Chapter 4

Global value chains and international investment

International investment is one of the building blocks of global value chains (GVCs). Multinational enterprises continuously shift resources across borders and restructure their activities geographically through international investments and divestments. During the past decades there has been a trend towards a closer focus on core activities in business investment. In addition, governments have become increasingly important actors in international investment in GVCs. These structural changes in international investment have raised a number of (new) policy issues, including the design of appropriate investment policies.

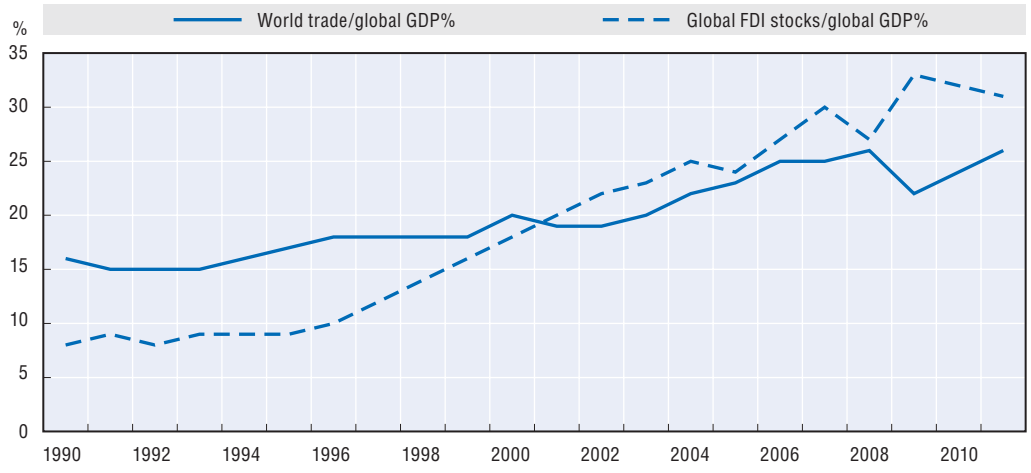
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The link between multinationals and global value chains

International investment is a basic building block, along with trade, of global value chains (GVCs). One of the reasons for the interest in this relationship is its implications for economic development, competitiveness (of firms and nations), technology and innovation, and jobs, among others. Foreign direct investment (FDI) provides channels for trade in goods and services (both intra-firm and arm's length), as well as in intangible assets, which are used by multinational enterprises (MNEs) to create value.

The stock of MNEs' FDI reached USD 22 trillion in 2011 and global trade exceeded USD 18 trillion. FDI has grown faster than global GDP over the past 20 years. In 1990, the value of global FDI stocks was less than 10% of global GDP and the value of global trade was around 15% of GDP. By 2011 these ratios had increased to 31% and 26%, respectively (Figure 4.1).

Figure 4.1. FDI and trade: Twin drivers of economic globalisation



Source: OECD FDI Statistics Database (www.oecd.org/investment/statistics.htm), IMF, World Economic Outlook Database, and World Trade Organization Statistics Database.

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Interest in GVCs is not only due to the fact that they have grown larger and more pervasive. In recent years, their rapid growth has been accompanied by qualitative changes in their nature. Many of these changes originate in changes in the international investment landscape. Emerging countries such as the People's Republic of China and India have become major new outward investors and governments have become important players in certain GVCs through their sovereign wealth funds and state-owned enterprises (SOEs). In addition, MNEs have rationalised their international architecture through outsourcing and offshoring. Gereffi et al. (2005) see this last development as one of the most important changes in the relationship between international investment and GVCs, having led to "the vertical disintegration of transnational corporations, which are redefining their core competencies to focus on innovation and product strategy, marketing, and the highest value-added segments of manufacturing and services, while reducing their direct ownership over 'non-core' functions".

The theoretical literature on international investment (in GVCs) has two main strands: transaction cost and internalisation theories; and a somewhat eclectic group of strategic, behavioural explanations. The common thread between these different schools of thought is the idea that FDI takes place when conducting an international transaction within the firm generates more value for the firm than conducting the transaction in the market (e.g. through trade or licensing).

Transaction cost and internalisation theories

At the heart of transaction cost theory is a distinction between markets and hierarchies (Coase, 1937; Williamson, 1975, 1979). Firms exist because certain economic transactions can be conducted more efficiently through hierarchies than at arm's length through the market. The choice of hierarchy over market is motivated by market imperfections, including those associated with information costs (Arrow, 1974).

Transaction cost theory underscores the role of international investment in overcoming the many market imperfections that are absent or less pronounced in a purely domestic setting. These include, among others, the high costs of collecting information across geographic and cultural distances, the difficulty of protecting intellectual property rights (IPR) across different jurisdictions, impediments to arm's-length international trade such as tariff and non-tariff barriers, and the structural characteristics of markets that can give rise to first-mover advantages.

A specific version of transaction cost theory to explain FDI, known as internalisation theory, was first elaborated by Buckley and Casson (1976) and Rugman (1981). Once a domestic firm has developed a monopolistic or oligopolistic position based upon some combination of technology, cost, financial or other advantages, it will be motivated to maintain such advantages in international markets by conducting transactions through hierarchies rather than through markets. By doing so, it can maintain control over the barriers to entry that allow it to earn monopoly rents in its home market.

Internalisation theory predicts that firms will engage in FDI when they enjoy some form of advantage that can be more efficiently exploited through hierarchies (i.e. within the organisational structure of the firm) than at arm's length through markets. This situation arises when market imperfections mitigate against conducting international transactions through trade, licensing or any other form of economic transaction that does not involve the ownership of foreign resources. Internalisation theory motivated a considerable body of research that focused on two key factors: ownership advantages and market imperfections. With respect to the former, the focus has been on factors such as superior technology (Johnson, 1970; Magee, 1977), better capabilities for product differentiation (Caves, 1971) and managerial capabilities (McManus, 1972; Wolf, 1977).[1]

With respect to market imperfections, one of the most important contributions is the research on the risk diversification advantages of MNEs (Aliber, 1970; Agmon and Lessard, 1977; Adler, 1981). The central argument in the risk diversification hypothesis is that MNEs offer equity investors opportunities for diversifying their investment portfolios in ways not otherwise possible owing to various imperfections in international capital markets.

Strategic and behavioural explanations of international investment

In one of the first contributions that dealt explicitly with the strategic nature of the FDI process, Vernon (1966) sought to explain the US post-war FDI in Europe in terms of the product cycle. The product cycle is the process whereby a product "matures", production becomes more standardised, and "the need for swift and effective communication on the part of the producer with customers, suppliers, and even competitors" is reduced. Concurrently, the early technological advantages of innovating firms dissipate as the associated production-related knowledge becomes increasingly public in nature. As this dissipation takes place, profitable production comes to depend increasingly on lowering production costs and firms are motivated to anticipate potential competitive threats from lower-cost overseas producers through FDI.

According to Vernon, the main impetus for FDI in the context of the product life cycle is the natural maturing process that particular production-related knowledge undergoes. Managers undertake FDI initially as a defensive response to potential new sources of low-cost competition as their "new products" become "standard products".

Following in the footsteps of Vernon, Knickerbocker (1973) examined the apparent tendency of US MNEs to make their investments more or less in lock step and Vernon's observation that, under conditions of limited information about production costs in different foreign locations, MNEs might logically match their competitors' FDI in a relative gains type of game (i.e. you are winning even if you lose money, as long as your competitor is losing more). Graham (1978) extended this line of analysis with the concept of "exchange of threats" FDI and elaborated a game theory model in which he demonstrated that even if a firm is not the lowest-cost producer in a particular market, FDI can be the optimising choice in an industry with oligopolistic characteristics (Graham, 1998).

Another strand of the strategic/behavioural literature on international investment and GVCs emphasises the role of FDI in providing MNEs with information about market conditions. For example, Boddewyn (1983) finds that the logic behind the decision to divest foreign assets might be different from the logic underlying the original FDI decision. Whereas FDI decisions are by definition motivated by the perception of some sort of positive gain, the reverse is not necessarily true (foreign divestment is not necessarily associated with losses or negative conditions).

In reference to Vernon (1966), he suggests that "divestment decisions are not limited to the decline phase. Instead, they coincide with the transition from any one phase to another because the firm usually needs new resources (capital, entrepreneurial and managerial skill, etc.) at each turning point. In fact, many 'strategic' FD decisions reflect such a situation…This is different from a 'crisis divestment' situation where a multinational firm loses its competitive advantages or faces a politically antagonistic environment, and therefore decides to divest." (Boddewyn, 1983).

Kogut (1985) summarised as follows: "The design of international strategies is based upon the interplay between the comparative advantages of countries and the competitive advantages of firms. These two advantages determine the answer to the two principal questions in international strategy: *1)* Where should the value-added chain be broken across borders? and *2)* In what functional activities should a firm concentrate its resources?"

Horizontal and vertical investment in GVCs

Horizontal international investment involves the establishment by an MNE of affiliates in different markets with similar business functions (see also Chapter 1). From the internalisation theory perspective, it involves the internalisation of the same activity within the boundary of the firm in different markets. International investments by service providers are usually horizontal in nature. Multinational service providers tend to make investments that serve the domestic market and tend to be relatively autonomous *vis-à-vis* other affiliates. For example, a multinational retailer's stores in Germany will have few if any operational linkages to its stores in China. Most multinational telecom companies organise their operations as largely distinct, autonomous national providers.

The manufacturing sector is more mixed. It tends to have more vertical international investment but there are examples of horizontal investment as well. Even in an industry such as automotive production, with significant vertical integration, MNEs engage in horizontal investment, for example, when they establish assembly plants to produce the same model in different countries. A significant amount of international investment in the extractive industries is also horizontal in nature.

In the case of service providers and extractive industries, horizontal investments often contribute simultaneously to several GVCs. The retail sector is a good example, with diversified MNE retailers such as Walmart and Carrefour serving as the final distribution stage for thousands of GVCs. At the other end of the value chain, most extractive industries also participate in multiple GVCs. The output from an international investment in an iron ore mine could find its way simultaneously into reinforcing steel bar (rebar) for construction, steel plate for shipbuilding, and casings for Swiss watches.

Horizontal FDI often takes place when an economic activity is location-bound, i.e. access to a particular market requires physical presence. A retailer needs to be close to customers and a miner needs to be close to minerals. However, horizontal FDI also serves other functions for the firm, including risk diversification (e.g. the establishment of alternate sources of supply for key intermediate inputs) or a way of leveraging and protecting intangible assets, such as brands and proprietary know-how.

Vertical FDI involves the "internalisation" of value-adding steps of a GVC within the boundaries of the firm (see also Chapter 1). As in the case of horizontal FDI, the extent to which firms engage in vertical FDI is highly industry-specific but is also sensitive to strategic and policy factors. The reason is that vertical FDI entails additional risks and complications associated with managing and co-ordinating different lines of business within the GVC across different countries.

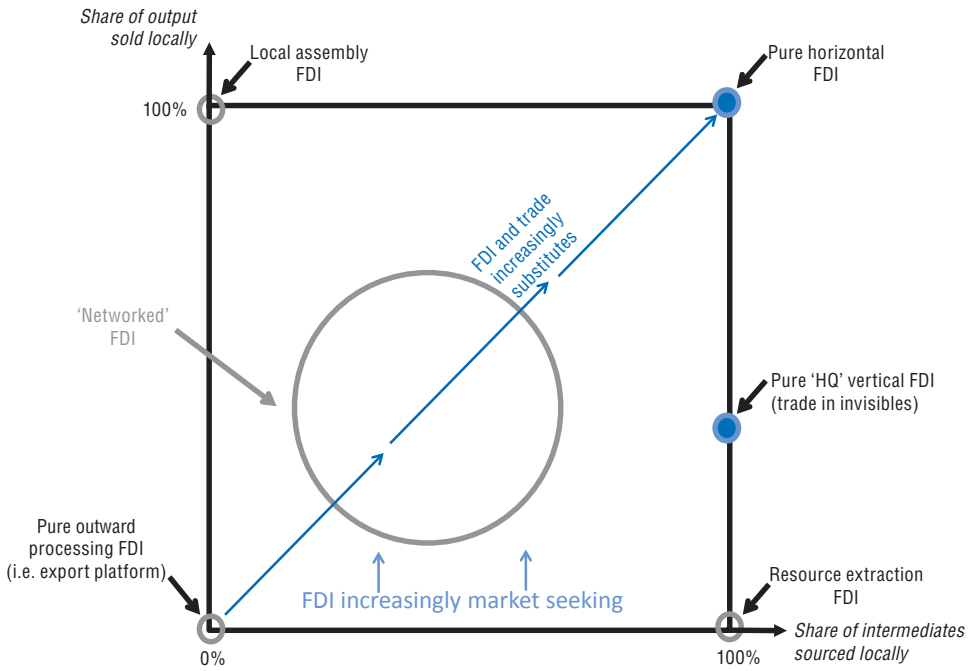
Vertical FDI is the main source of intra-firm trade – trade between foreign affiliates. To give an example, Royal Dutch Shell, one of the world's largest oil and gas companies, has extensive upstream activities (exploration, recovery, transport) and downstream activities (refining, chemicals, marketing, retail). Over half of the revenue generated by the firm's upstream businesses comes from intra-firm sales to its own downstream businesses.

In contrast with horizontal FDI, which tends to focus on relatively narrow functions of GVCs (and often spans many GVCs), vertical FDI tends to cover segments of GVCs and, in some cases, entire GVCs (e.g. Shell's consumer fuels business). One of the interesting characteristics of GVCs created by vertical FDI is that they are directly governed by the firm (in contrast with GVCs based primarily upon arm's-length trade between unrelated parties).[2] The policy implications of this "governance" dimension of vertically integrated GVCs are discussed below.

In sum, horizontal and vertical international investment contributes in different ways to the development of GVCs. Indeed, it is difficult to conceptualise an example of an international investment by an MNE that does not somehow contribute to the development of GVCs. Horizontal FDI has links to GVCs through arm's-length upstream and downstream commercial relationships and also serves to internalise intangible assets that can be shared across the firm's operations and bring value to the GVCs in which the firm participates. Vertical FDI directly creates GVCs (or sub-segments of GVCs), which are linked through intra-firm trade. An interesting feature of vertically integrated GVCs is that they are governed by the firms that create them.

In reality, most MNEs engage in both horizontal and vertical FDI. In addition, given the different types of trading relationships that can be associated with horizontal and vertical international investment, they can combine to create a wide variety of different linkages in the host economy. Figure 4.2 provides a useful illustration of the different possible sourcing linkages for an MNE affiliate and how these relate to horizontal and vertical FDI.

Figure 4.2. The sales/sourcing box diagram



Source: Baldwin and Okubo (2012).

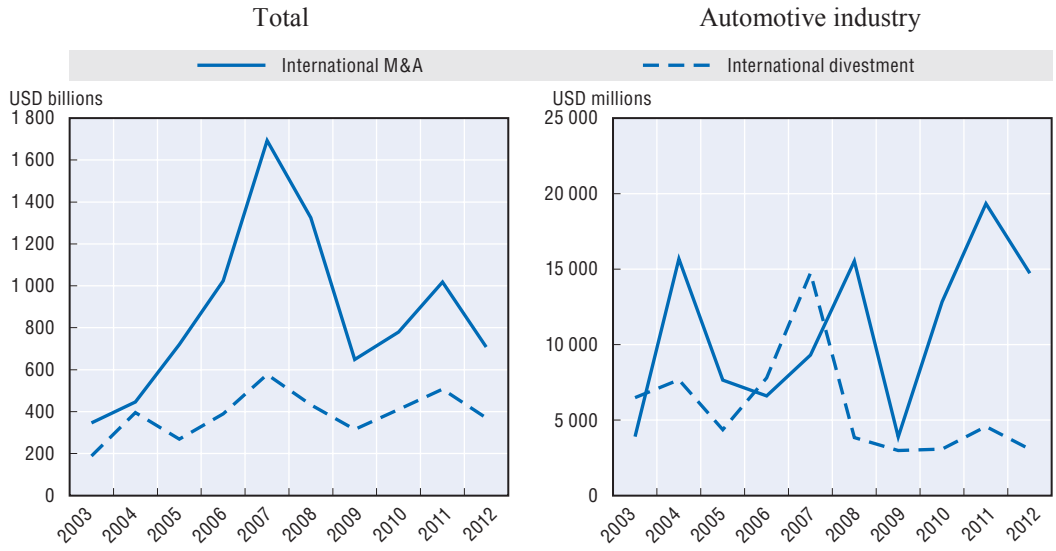
Trends in international investment in GVCs

Investment in GVCs: A churning sea

As MNEs continuously expand and restructure their international operations, they engage in simultaneous investments and divestments (Figure 4.3). In 2012, international divestment was about half the value of international investment; an interesting feature of this relationship has been the relatively constant level of international divestment activity. Turbulence in international investment can be more pronounced at the industry level (Figure 4.3). International investments through international mergers and acquisitions

(M&A) in the automotive industry during 2003-12 were on average higher than international divestment (USD 11 billion versus USD 6 billion, respectively). However, international divestment exceeded international investment in 2003, 2006 and 2007 (the large difference between international M&A and international divestment in 2007 was largely due to the USD 7.5 billion divestment of Chrysler by DaimlerCrysler AG). This sort of variability is also observed at individual country level.

Figure 4.3. International investments through mergers & acquisitions and investments, world, 2003-12



Source: Dealogic M&A Analytics, OECD calculations.

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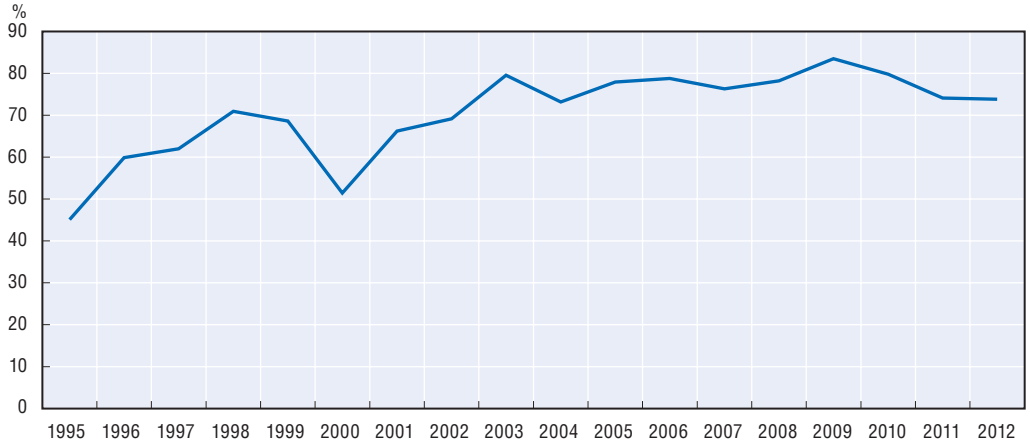
The "vertical disintegration" of MNEs

International M&A data suggest that international investment by MNEs has focused more on their core lines of business over time (Figure 4.4).[3] During the first half of the period covered, the share of international M&A by MNEs in their core lines of business (i.e. automotive in automotive, chemicals in chemicals) steadily increased from a low of just under 50% in 1995 to 80% in 2003. Since then it has remained relatively steady, averaging just under 80%.

The changed focus of international M&A during the second half of the 1990s and the early 2000s is consistent with many of the explanations for the growth in GVCs, including trade and investment liberalisation, major advances in ICTs and the emergence of China and other emerging markets as efficient production locations. These changes seem to have reduced the need for MNEs to establish ownership of broad parts of their GVCs through international investment in order to control, among other things, costs, the quality of inputs, timely delivery, protection of IPR, and so on. However, this is not to suggest that international investment is becoming less important for GVCs. Indeed, as Figure 4.1 showed, the value of cross-border linkages through international investment continues to grow. Rather, international investment flows would seem to have both grown and became more specialised (at the level of the firm).

Figure 4.4. Share of international mergers & acquisitions in core business, world, 1995-2012



Source: Dealogic M&A Analytics, OECD calculations.

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Governments as new actors investing in GVCs

Over the past decade, governments have become significantly more important participants in the global economy as international investors, principally through sovereign wealth funds and state-owned enterprises. Among the largest 500 companies in the world as ranked by revenues, state-owned enterprises (SOEs) now account for around 20% of economic activity across a range of measures, up from around 7% in 2000 (Table 4.1).[4]

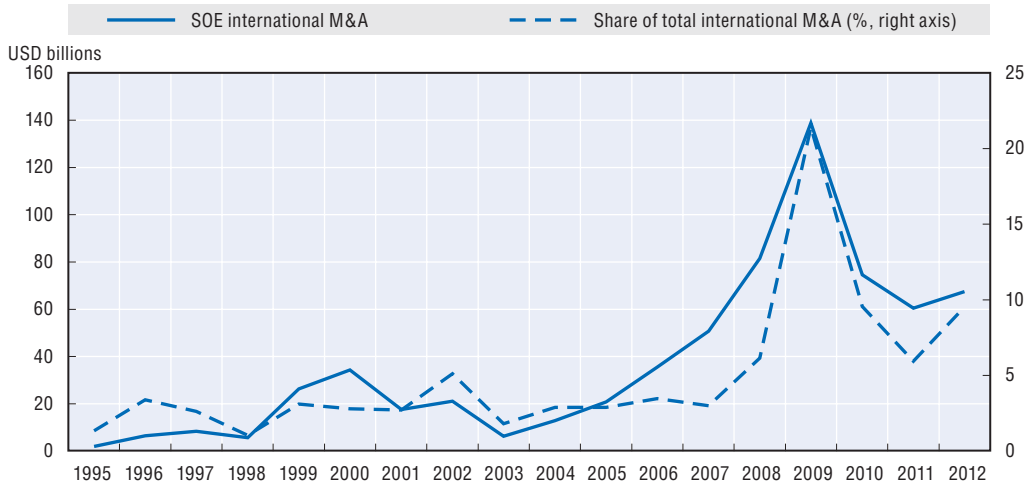
Table 4.1. Representation of state-owned enterprises in 2000 and 2011, Fortune Global 500 (shares)

	2000	2011
Number of SOEs	7%	19%
Average assets	8%	19%
Average revenues	6%	20%
Average profits	7%	22%
Average stockholder equity	9%	21%
Average number of employees	19%	30%

Source: *Fortune Global 500 2012*, OECD calculations.

Figure 4.5 presents the growth in international M&A by SOEs from 1995 through 2012 in terms of absolute values and as a share of total international M&A activity. International investment by SOEs has been growing steadily since the early 2000s but accelerated sharply at the start of the global financial and economic crisis in 2008. China has been the largest source of such investment, accounting for around a third of all international investment by SOEs.

Figure 4.5. International mergers & acquisitions by state-owned enterprises, world, 1995-2012



Source: Dealogic M&A Analytics, OECD calculations.

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Two aspects of the growth in international investment by government-controlled entities are relevant from a GVC perspective. The first is that this investment is highly concentrated in a limited number of sectors. Excluding finance, insurance and various special purpose financial entities, Table 4.2 shows that 97% of international investment by SOEs is in extractive industries, oil and gas, utilities and energy, mining, and metal and steel.

Table 4.2. The industrial composition of international investment by state-owned enterprises (SOEs), world, 2012 (USD billion)

Acquiring industry group	Total international M&A	SOE international M&A	Share of SOE total (%)
Oil & gas	61 814	20 869	61
Utility & energy	40 339	7 577	22
Mining	42 963	3 000	9
Metal & steel	34 318	1 701	5
Professional services	9 315	411	1
Machinery	18 085	486	1
Agribusiness	3 972	65	0
Total	542 517	34 202	100

Source: Dealogic M&A Analytics, OECD calculations.

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The second characteristic concerns the destinations of this investment. Table 4.3 lists the top ten recipients of SOE international M&A investment in 2012. These ten countries received 87% of all international M&A by SOEs. International investment can be quite "lumpy" in the sense that individual deals can be so large that they influence a country's overall flows. As a result, the SOE share of overall inflows can be quite high for some countries, especially small developing economies.

For example, in 2012, 100% of Sierra Leone's inward investment came from SOEs (a USD 1.7 billion investment in an integrated iron-ore project, including the building of a new port and railroad). This example highlights the extent to which SOEs can represent important sources of capital, including for countries that have not traditionally been attractive locations for foreign investors. However, it can also generate financial imbalances and inflationary pressures, and can create a situation in which a country's main link to GVCs (as an upstream producer of raw materials in this case) is controlled by a single firm or small group of firms. In the five years preceding this investment, Sierra Leone received on average USD 73 million in inward FDI annually. The SOE investment in Sierra Leone in 2012 represented a 23-fold increase in the country's inward FDI over 2011.

Table 4.3. Top 10 targets for international mergers and acquisitions by state-owned enterprises, 2012 (USD millions)

Target nationality	SOE international M&A	Total international M&A	Share of country inward international M&A
Australia	13 436	49 332	27%
Brazil	7 975	38 069	21%
Canada	6 808	49 239	14%
France	1 591	18 106	9%
Norway	3 255	11 930	27%
Portugal	3 526	6 414	55%
Sierra Leone	1 500	1 500	100%
Switzerland	9 044	17 574	51%
United Kingdom	5 831	93 264	6%
United States	7 363	139 969	5%
Total	69 491	425 398	16%

Source: Dealogic M&A Analytics, OECD calculations.

StatLink *http://dx.doi.org/10.1787/888932835214*

Policy implications

Policies towards GVCs are relatively new and the literature is just developing. One of the main reasons is that the traditional "units of account" around which international policies have been developed have been countries (e.g. the OECD Declaration on International Investment and Multinational Enterprises, regional and bilateral integration agreements), industries (e.g. traditional investment promotion, industrial policy), and firms (e.g. commercial codes and regulations). The idea of formulating investment policy with GVCs in mind is relatively new. A number of policy issues and questions that governments might need to focus more attention on include the following.

Is the international investment policy architecture keeping up with developments in GVCs?

Global value chains are, by definition, a multilateral phenomenon. Individual chains can span dozens if not hundreds of countries and involve thousands of firms, from SMEs to global MNEs. Lowering investment barriers is one of the most direct ways for countries to become more deeply integrated into GVCs through international investment. Bilateral and regional agreements can also be useful for facilitating trade and investment flows between key partners.

However, the complexity of the current international investment policy architecture, which includes thousands of bilateral and regional investment agreements, may be creating uncertainty and thus holding back international investment in GVCs. Multilateral co-operation is necessary to maintain the open and predictable international investment climates that have supported international investment in GVCs to date. The recent crisis, and a number of instances of de-globalisation that it has engendered, have served as a reminder that GVCs are not inevitable and that policies do matter for their development.

Policies for economic activities, not industries

The shift towards more industrially focused international investment strategies on the part of MNEs suggests that government investment promotion and facilitation policies should likewise take a more focused approach than attracting entire industries. Conversely, governments need to remain mindful of the dangers of incentive wars. Although different parts of GVCs can be described as generating more value than others, investing in infrastructure and human resource development will bring more sustainable, longer-term benefits from GVCs than offering incentives for international investment. OECD (2011) discusses how GVCs have changed policies to attract international investment across countries.

Governments also need to recognise the fluid nature of international investment in GVCs. International divestment has been an integral part of the growth of international investment in GVCs, not simply the result of cyclical downturns. From an investment promotion and facilitation perspective, this fluidity underscores the importance of after-care services for investors once they have made an initial investment. A significant proportion of international investment takes the form of "follow-on" investments to build up an initial investment project once it proves valuable to the firm.

Given the broad welfare implications of GVCs, governance issues matter

Large MNEs, including in some cases SOEs, have become prominent players in certain upstream parts of GVCs through international investment. This has given rise to policy concerns about the effects on competition and markets further downstream. More generally, given the broad welfare implications of GVCs, governments and other stakeholders need to remain mindful of their respective roles and responsibilities with respect to the governance of GVCs.

Different governance structures of GVCs will require different policy and regulatory approaches. They also have implications for the distribution of the benefits associated with GVCs, especially for developing countries. As Gereffi et al. (2005) put it, "the governance of global value chains is essential for understanding how firms in developing countries can gain access to global markets, what the benefits of access and the risks of exclusion might be, and how the net gains from participation in global value chains might be increased".

GVCs can be a channel for responsible business conduct

On a related topic, GVCs can serve as a channel for best practices with respect to responsible business conduct, including on environmental issues. Indeed, to the extent that MNEs have become sensitised to the negative impact of non-responsible behaviour (or even association with non-responsible behaviour), suppliers, and perhaps even countries, that do not live up to societal expectations might find it difficult to participate in certain GVCs. The OECD Guidelines for Multinational Enterprises and the OECD Due

Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas are examples of policy instruments that specifically address the issue of promoting responsible business through GVCs (Box 4.1).

Box 4.1. Reducing emissions through the supply chain: General Motors in China

General Motors took part in and supported a pilot project (the China Greening Supply Chain Pilot Project), involving eight top-level suppliers. The project was implemented by Shanghai General Motors (SGM) and the World Environment Center (WEC). After a short training course, suppliers were able to identify actions and investments that ultimately resulted in a combination of net financial savings and improved environmental performance, including: replacing electric-powered utilities with wind-powered utilities; eliminating or reducing electric lighting by installing transparent roofing and walls, dimmer switches and lower wattage lighting; eliminating leaks in air and water systems; reducing the need for emergency deliveries and the energy necessary to complete them; and installing sensors on conveyor belts that turn off power when no parts are present. These improvements, among others, resulted in net savings of over USD 200 000 and the reduction of over 1 800 tons of CO_2, as well as important savings in water consumption.

Source: World Environment Center, www.wec.org/programs-initiatives/capacity-building from OECD (2010), *Transition to a Low-Carbon Economy: Public Goals and Corporate Practices*, OECD Publishing.
doi: 10.1787/9789264090231-en.

Where is international investment in GVCs creating value?

More analysis is needed to explore the creation and appropriation of income in the context of GVCs, including the role that income from knowledge-based capital plays in GVCs (e.g. income from royalties, licensing and other knowledge-based assets). Such analysis could develop more accurate measures of where international investment actually goes and how it is being financed in order to gain a better understanding of where and how it is creating value (see also Chapters 2 and 7).

Notes

1. For a comprehensive review of this literature, see Dunning and Lundan (2008).
2. Gereffi et al. (2005) and Moran (2001) provide case study analysis of different governance structures of GVCs involving international investment in different industries. Gereffi et al. identify five types of GVC governance: hierarchy, captive, relational, modular and market.
3. The data cover ten industries: chemicals, consumer products, automotive, food and beverage, telecommunications, computers and electronics, machinery, oil and gas, transport, and utilities and energy.
4. Employment is an obvious exception to this generalisation, but its share has also grown.

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Chapter 5

The role of global value chains in economic development

Emerging economies, and the People's Republic of China in particular, play a growing role in today's global economy. This is partly due to global value chains (GVCs), which have allowed countries to integrate the global economy faster than in the past. The search for cost savings and cheap labour as well as market size/growth have led companies to relocate large parts of their value chains to emerging markets. The increasing global engagement of emerging economies has contributed to rapid growth in exports, employment and economic growth in these countries. Integration in GVCs is only one, albeit an important, stepping stone for economic development. Given their specialisation in labour-intensive and low-cost activities, emerging and developing countries increasingly seek to move up the value chain.

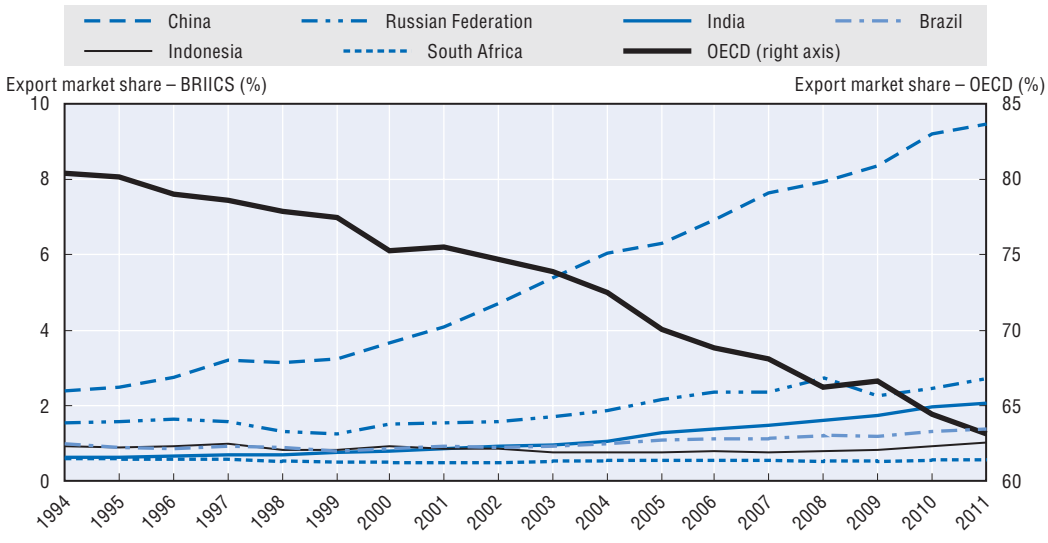
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The shifting geography of economic globalisation

Over the past decades, a growing number of countries have integrated the world economy, led by the so-called BRIICS (Brazil, the Russian Federation, India, Indonesia, the People's Republic of China and South Africa). Other countries are also increasingly important actors in the global economy: OECD countries such as Chile, Korea, Mexico, Poland and Turkey, and non-OECD countries such as Argentina, Malaysia, the Philippines and Thailand (O'Neill, 2011; Hanson, 2012). Behind these larger emerging economies, many (often smaller) countries have already built a strong position in specific industries, often through their connection to global value chains (Costa Rica and Viet Nam, but also the Czech Republic, Hungary and the Slovak Republic in central Europe). Yet many developing countries participate little, if at all, in the global economy.

From peripheral players, emerging economies have become major centres of global trade (IMF, 2012). OECD countries have gradually lost market share in international markets, while the BRIICS have increasingly built a strong export base (Figure 5.1). In fact, China rapidly became the world's largest exporter. China is also an important market for the exports of other BRIICS countries; exports from Brazil and the Russian Federation are partly driven by growing demand for natural resources as China and India have rapidly industrialised and urbanised.

Figure 5.1. Export market shares (goods and services)



Source: IMF, Balance of Payments Database.

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Emerging countries, and the Asian region in particular, have also attracted growing amounts of international investment. Foreign direct investment (FDI) flows to China and the rest of Southeast Asia leapt from an average of about USD 50 billion a year in 1995-99 to about USD 150 billion a year in 2005-09 (Figure 5.2), and China is now the second recipient of FDI after the United States. The BRIICS countries have also become important investors abroad: average outward flows from China increased nine-fold between the early and late 2000s, and outward flows from India increased more than seven-fold.

There are various reasons for the growing economic integration of emerging economies. First, as they largely shifted their industrial strategies from import-substitution to export-led development, they went through several rounds of trade liberalisation. Tariff barriers were significantly reduced through unilateral trade reforms as well as trade agreements with other countries (bilateral, regional and multilateral).[1] Hanson (2012) reports that between 1994 and 2008 the average tariff applied across all goods (weighted by imports) declined from 12% to 4% in 15 middle-income countries[2] and from 29% to 8% in China. In more developed economies, tariff barriers were on average already lower so that further reductions were quite small.[3]

Figure 5.2. Outward FDI flows from EU, Japan and the United States to BRICS countries, annual average, 2003-09

USD billion at current exchange rates

Note: BRICS: Brazil, the Russian Federation, India, China and South Africa.

Source: OECD (2011a); *Map source:* © ARTICQUE – all rights reserved.

International investment has increasingly been liberalised as well, making it easier for multinational enterprises (MNEs) to establish affiliates in emerging economies. While several multilateral agreements have relaxed restrictions on FDI (e.g. the Agreement on Trade-Related Investment Measures [TRIMs] and the General Agreement on Trade in Services [GATS]), liberalisation of investment has often taken place at the bilateral and regional level. According to UNCTAD (2012a), the number of bilateral investment treaties grew from 385 in 1990 to 3 164 in 2011; more recently, regional initiatives have increased, such as the Trans-Pacific Partnership (TPP) Agreement and the Association of South-East Asian Nations (ASEAN) Agreement, which include several emerging countries. In transition countries, liberalisation of trade and investment was also an explicit part of the move from a centrally planned to a more market-oriented economic system. Changes in so-called border policies were typically accompanied by macro-economic stabilisation policies, restructuring and privatisation programmes and legal and institutional reforms.

The second important factor is the rise of global value chains (GVCs), which have drastically changed the patterns of international trade and investment. The development of GVCs has contributed to strong shifts in the global economy and a more prominent role for emerging countries (see Chapter 1).

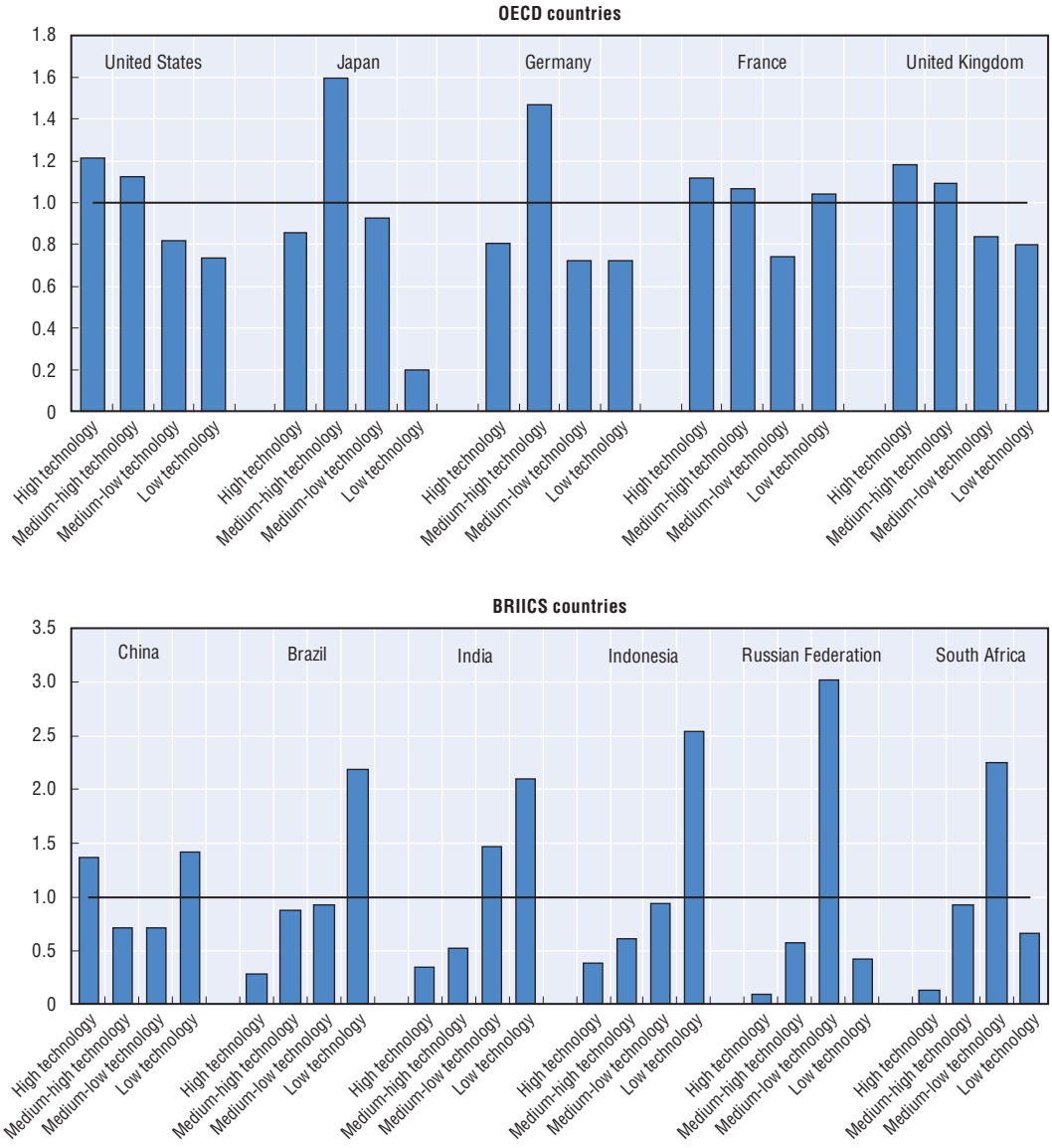
The relocation of productive activities and the growing trade between emerging/developing and developed economies (North-South trade) has rekindled interest in comparative advantage (Hanson, 2012). The dominance of trade by developed countries in the 1980s and 1990s was generally explained by the existence of scale economies and product differentiation; this so-called North-North trade took place between industrial countries with similar incomes and endowments. However, comparative advantage as a source of trade means that countries specialise in the activities they do relatively better (Eaton and Kortum, 2012); differences in factor endowments (Hecksher-Ohlin trade models) and/or technology (Ricardo trade models) explain much of the increasing export performance of emerging economies.

The more production can be split up globally on the basis of comparative advantage, the more emerging and developing countries can participate in GVCs (Dean et al., 2011). For example, BRIICS countries specialise in low-technology activities because of their large supply of labour, while developed economies specialise in high-technology industries (Figure 5.3). China seems to be an exception, as it has strong specialisation in high- as well as low-technology industries. In GVCs, however, comparative advantage increasingly has to be assessed at the level of activities/stages/tasks rather than of industries. China therefore specialises both in labour-intensive activities and in tasks in higher-technology industries (see below).

The growing integration of emerging economies has also resulted in a rise in South-South trade (i.e. among emerging/developing economies). UNCTAD (2012b) estimated that South-South exports represented 23% of total world exports in 2010 (12% in 1995) and 54% of total exports of emerging/developing countries (43% in 1995).[4] The majority of South-South trade takes place within Asia: 80% of all South-South exports are from Asia, of which 74% is intra-Asia exports. The strong economic integration of Southeast Asia is the result of Asia's growing vertical specialisation within GVCs, as the international fragmentation of production has resulted in growing trade flows in intermediate goods among Asian partners, especially in the manufacturing sector.

Figure 5.3. Revealed comparative advantage, exports of goods, selected OECD and BRIICS countries, 2010

RCA index



Note: 1) Revealed comparative advantage is calculated as RCA(X)) of total exports; calculated as $(X_{i,c}/X_{i,world})/(X_{economy,c}/X_{economy,world})$

where $X_{i,c}$ and $X_{i,world}$ are respectively exports in industry i by country c and the world, while $X_{economy,c}$ and $X_{economy,world}$ are economy-wide exports by country and the world.

2) Annex 5.A1 presents the OECD classification of high-, medium-high-, medium-low- and low-technology-intensive industries.

Source: OECD (2010b), "STAN Bilateral Trade Database 2010", STAN: OECD Structural Analysis Statistics (database), doi: 10.1787/data-00028-en, accessed May 2013.

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Emerging economies, manufacturing and GVCs

Manufacturing is increasingly global

Manufacturing has increasingly globalised over the past decade, as emerging economies have become important partners in GVCs especially in manufacturing industries.[5] Products often conceived and designed in developed countries are manufactured and assembled in countries such as China, with intermediate inputs sourced from other countries. Asia and Latin America account for most of the manufacturing in emerging countries, with growth in Asia four to five times faster than in Latin America during the past decade (Figure 5.4). China accounted for 19% of world manufacturing value added in 2010 and has become the world's leading manufacturer. China aside, Asian countries accounted for about 12% of global manufacturing in 2010, and South/Central America accounted for about 5.6%. Africa only accounted for 1.6% of manufacturing value added in 2010, a sign that it remains largely excluded from GVCs.

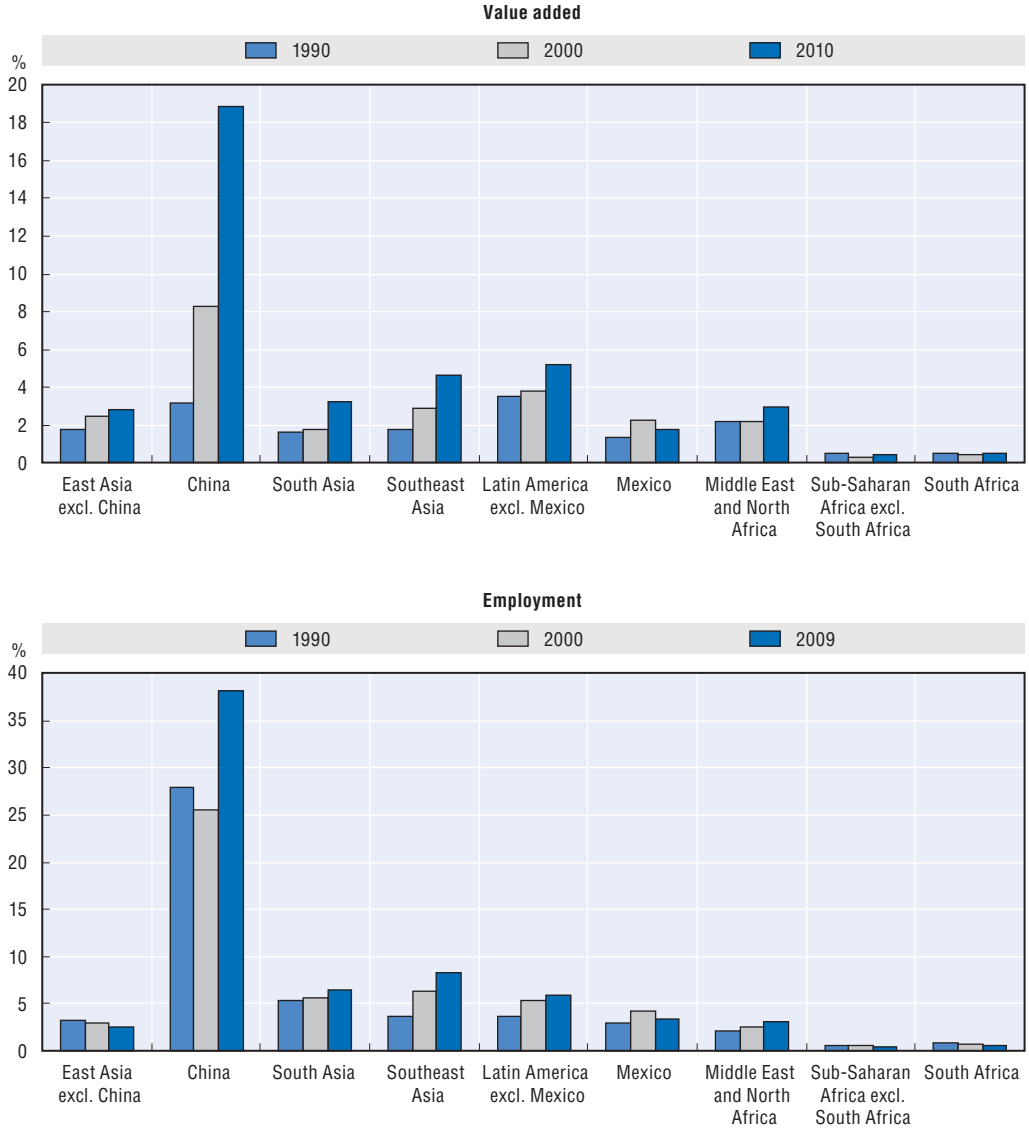
Emerging countries are attractive locations for labour-intensive activities, as their labour costs are lower than those of more developed economies (Pilat et al., 2006). Although labour costs account for only a fraction of total production costs (with considerable differences across industries), it is an important factor in firms' choices of locations.[6] Emerging regions have also increased their share in value added, especially in traditional industries such as food and beverages, textiles and apparel, leather and footwear, paper, etc. (Hepburn, 2011). As labour-intensive, low-value-added activities have been relocated, manufacturing jobs in emerging countries have expanded strongly (Figure 5.4). This growth is sometimes perceived to have come at the expense of (significant) losses of jobs in OECD manufacturing industries. It is argued that companies from OECD countries move manufacturing plants to China only to take advantage of the low labour costs, thereby hollowing out their national manufacturing industry and building up China's competitiveness. It is in fact hard to dispute that GVCs have accelerated the loss of manufacturing jobs in developed economies in lower-technology and labour-intensive industries.

However, the discussion on the future of manufacturing (and manufacturing jobs) is complex. Research has shown that the process of de-industrialisation that characterises most developed countries is mainly driven by falling demand for manufactured goods relative to services (as countries develop and consumers become richer) and by higher productivity in manufacturing relative to services (Pilat et al., 2006). Although offshoring is often viewed negatively, it may benefit the home country significantly in terms of productivity, innovation and competitiveness. Companies that offshore labour-intensive jobs to low-cost countries can help save domestic jobs when offshoring strengthens their international competitiveness; the tasks that are moved offshore increase the productivity of activities that are not relocated (see also Chapter 1).

Moreover, in spite of its decreasing importance in terms of (direct) employment and (nominal) value added, manufacturing still occupies a central position in OECD economies; in 2010 OECD countries still accounted for about 60% of world manufacturing value added. Some restructuring has also taken place among OECD countries, with Mexico and eastern European countries (the Czech Republic, Hungary, Poland and the Slovak Republic) attracting sizeable manufacturing activities.

Figure 5.4. Share of major emerging regions in world manufacturing

In percentage of world manufacturing



Note: **East Asia excl. China** includes Hong Kong Special Administrative Region (China), Macao Special Administrative Region (China), Mongolia, Korea and Chinese Taipei; **South Asia** includes India, Iran, Nepal, Pakistan and Sri Lanka; **Southeast Asia** includes Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam; **Latin America excl. Mexico** includes Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Suriname, Uruguay, Venezuela, Costa Rica, Guatemala, Honduras and Panama; **Middle East and North Africa** includes Algeria, Egypt, Morocco, Tunisia, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, Syria and Turkey; **Sub-Saharan Africa excl. South Africa** includes Botswana, Cameroon, Eritrea, Ethiopia, Gabon, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Niger, Senegal, Swaziland, Uganda, Tanzania and Zimbabwe.

Source: United Nations Statistics Division.

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The role of export processing zones: Importing to export

In emerging economies, manufacturing activities often take place in areas with special administrative and regulatory status, the aim of which is to promote trade and investment (WTO and IDE/JETRO, 2011). The term most widely used to designate these areas is "export processing zone" (EPZ); it is defined by the International Labour Organisation as "industrial zones with special incentives set up to attract foreign investors, in which imported materials undergo some degree of processing before being re-exported" (ILO, 2011). These areas increasingly include logistic centres, finance zones and high technology/science parks in addition to assembly and simple processing operations.

Export processing zones (EPZs) have become an integral part of the export-led development strategies of emerging and developing economies; the latest estimates point to 3 500 EPZs operating in 130 countries and providing jobs for 68 million people (Boyenge, 2007). The Asia and Pacific region account for 61 million jobs (Table 5.1); other regions with EPZ employment above 1% of the national workforce are the Americas (especially Mexico and the Caribbean region), the Middle East and North-Africa (MENA). Outliers include Mauritius, where EPZs account for 24% of the national workforce, the United Arab Emirates (25%) and Tunisia (8%).

Table 5.1. Direct employment in export processing zones (EPZs), 2007

	Direct employment (millions)	% of national employment
World	68 441	0.21
Asia & Pacific	61 089	2.30
Americas	3 084	1.15
Western Europe	0.179	0.00
Central and Eastern Europe and Central Asia	1 590	0.00
Middle East and North Africa	1 458	1.59
Sub-Saharan Africa	1 040	0.20

Source: The World Bank (2008).

Foreign investors have been attracted to EPZs because of the low costs and the ease of importing and exporting; low or zero tariff barriers and minimum administrative requirements allow companies to source intermediates from abroad efficiently for assembly into final products, which are then exported. Emerging and developing countries have used EPZs with variable success to become involved in GVCs. Farole (2010) shows that the success of EPZs depends more on the quality of infrastructure and logistics than on low labour costs. EPZs have not taken off in many African regions; under conditions of poor governance and political instability, EPZs are generally considered to offer foreign investors insufficient protection. In some countries EPZs have also been used as a "shortcut" to more comprehensive structural reforms (elimination of red tape, corruption, high tariffs and taxes, etc.) that were not deemed feasible.

According to WTO and IDE/JETRO, about one-fifth of the exports of emerging and developing economies originate from EPZs (Figure 5.5). The growing importance of Asia as a manufacturing hub in GVCs is largely linked to EPZs. China has five special economic zones and accounts for almost 70% of world exports from EPZs. EPZs have been instrumental in promoting countries' exports; almost half of Chinese exports are

estimated to originate in EPZs and the corresponding figure for Mexico is 40%. EPZs have clearly stimulated exports and created employment in emerging countries; however, their performance is less strong in terms of value added owing to the high import content of the exports (see below).

Figure 5.5. Economies with export processing zones

EPZ exports as % of total exports of countries

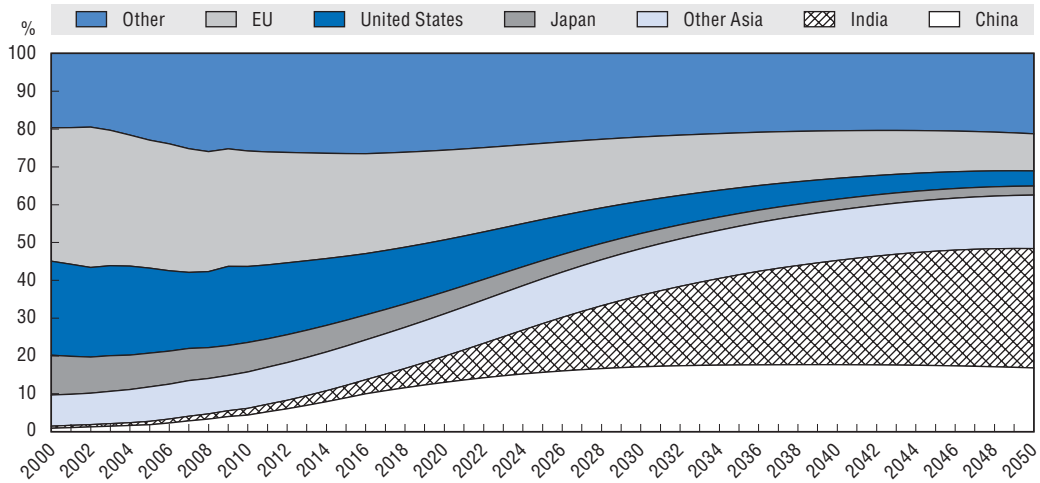
Source: WTO and IDE/JETRO (2011); map source: ARTICQUE© - all rights reserved.

Production activities go where the markets are

Cost savings and cheap labour are important drivers of the growth of production in emerging markets, but they are not the sole, or even the most important factors; market size and growth are the main reasons for international investment (OECD, 2011b). The attractiveness of Brazil, China, India and South Africa depends greatly on their large and rapidly growing home market. Brantstetter and Foley (2007) show that until 2006 US firms mainly located plants in China to gain access to the Chinese market: almost 75% of the sales of these US affiliates were directed to the Chinese market and less than 10% was exported to the United States. The room for growth in emerging markets is substantial; several Asian, Latin American and African countries boast burgeoning middle classes, whereas markets are often saturated in OECD countries.

China and India are the world's most populated countries and have high GDP growth rates. They are quickly becoming important markets for firms in many industries. While global consumer demand had previously been concentrated in (rich) OECD economies, a new middle class[7] is emerging in China and India (Figure 5.6). While the middle class worldwide could rise from 1.8 billion to 3.2 billion people by 2020 and to 4.9 billion by 2030, almost 85% of this growth is expected to come from Asia. In 2000, Asia (excluding Japan) only accounted for 10% of the global middle-class spending; this could reach 40% by 2040 and almost 60% in the long term (Kharas, 2010).

Figure 5.6. The global middle class, by country, 2000-50



Source: Kharas, 2010.

The emergence of new growth centres will significantly shift the world's centre of economic gravity eastwards (Quah, 2011). Kharas (2010) located the global economic centre of gravity in 1965 in Spain, at the mid-point of Europe, the United States and Japan. Since then, the economic centre has been moving to the southeast, close to the axis connecting Washington, DC, and Beijing. India, China, Indonesia and Viet Nam are expected to pull the centre of economic gravity further to the east.

China as the factory of the world?

"Made in China" is largely "Made in Asia"

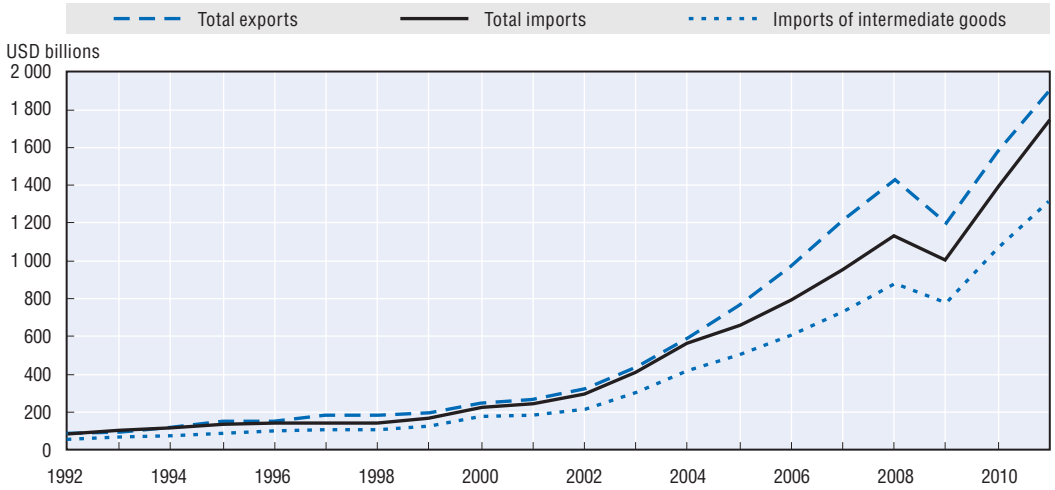
China's strong export performance has attracted much attention worldwide amid claims that China has become the factory of the world. China is not only a large exporter of low-cost, low-technology manufactures (toys, textiles, footwear) but also, increasingly, of sophisticated products (electronics, computers) (see Figure 5.3). In a world of GVCs, however, aggregate export figures hide the role of intermediates sourced from abroad in final products. Exports are no longer entirely produced by the exporting country but also include the production activities of countries from which intermediates are imported.

In GVCs, countries increasingly specialise in specific production stages, activities and tasks. The export success of China largely reflects its assembly activities: it imports large volumes of raw materials and intermediates from other countries and exports almost 40% of its output, far more than other large economies (Koopman et al., 2008). In the 2000s, China has become not only a large exporter but also a large importer; its imports closely track its exports, with some divergence in recent years (Figure 5.7).

A large part of the assembly activities in China takes place through processing trade,[8] often in EPZs. Companies can import intermediates without paying custom duties provided that these inputs are used solely for the production of final goods destined for third markets. The share of processing trade in China's exports increased rapidly in the late 1980s to mid-1990s and remained near 50% as its volume grew by an average annual rate of 17% between 1991 and 2010 (Figure 5.8). Processing trade has given rise to a triangular pattern of trade, with parts and components produced by more developed Asian

countries (e.g. Korea and Japan) and other advanced countries, and then exported to China where the different intermediates are assembled into finished products. Almost 80% of China's processing imports, including high-technology intermediates, originate from other East Asian economies (Chang et al., 2008). The assembled final products are either exported back to Asian countries or exported to developed countries/regions such as the United States and Europe where they may undergo additional processing (packaging, marketing, etc.).[9]

Figure 5.7. Exports and imports of goods, China, 1992-2011



Source: OECD (2010b), "STAN Bilateral Trade Database 2010", STAN: OECD Structural Analysis Statistics (database), doi: 10.1787/data-00028-en, accessed May 2013.

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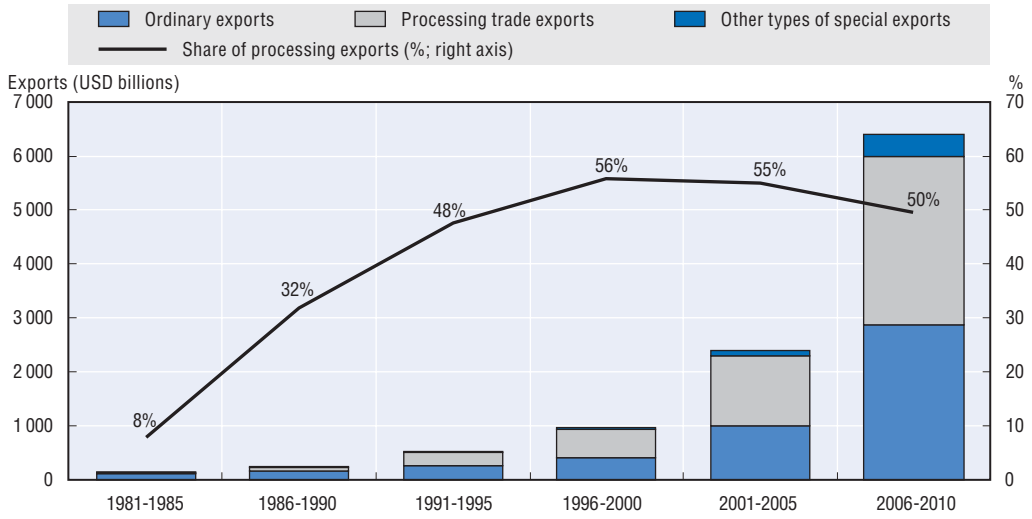
Clearly, the economic development of China is closely linked to processing trade and to the development of GVCs in the Asian region. GVCs have facilitated the vertical division of labour in Asia as Japan and industrialised economies such as Korea, Hong Kong (China), Singapore and Chinese Taipei have gradually moved their low-cost activities to overseas export platforms in low-wage countries in Asia. This has helped economies that industrialised early to upgrade their industrial capacities and exports, and, at the same time, has allowed economies that are industrialising later, such as China, to develop a comparative advantage in manufacturing.

Foreign-owned companies have played a leading role in China's strong export performance. Originally attracted by low labour costs and favourable treatment in EPZs, foreign firms moved their labour-intensive manufacturing plants to China to reduce production costs. The share of foreign-invested enterprises in processing trade rose rapidly during the expansion of processing trade as a share of China's exports: from 39% in 1992 to nearly 70% at the end of 1990s and to 85% in 2008 (Figure 5.9). Brantstetter and Foley (2007) reported that most of the 200 largest exporting firms are from other Asian economies, primarily Chinese Taipei, Hong Kong (China) and Korea.[10]

Foreign companies' involvement in GVCs is not limited to processing trade. The share of foreign affiliates in non-processing exports has also risen, from only 5% in 1992 to 29% in 2008 (Figure 5.9). This suggests that the activities of foreign-owned companies in China, as well as China's involvement in GVCs, no longer simply involve the assembly of imported inputs but increasingly include local procurement and other interactions with Chinese industries beyond the processing trade regime.

Figure 5.8. China's processing and non-processing exports, 1981-2010



Source: Pilat et al. (2012).

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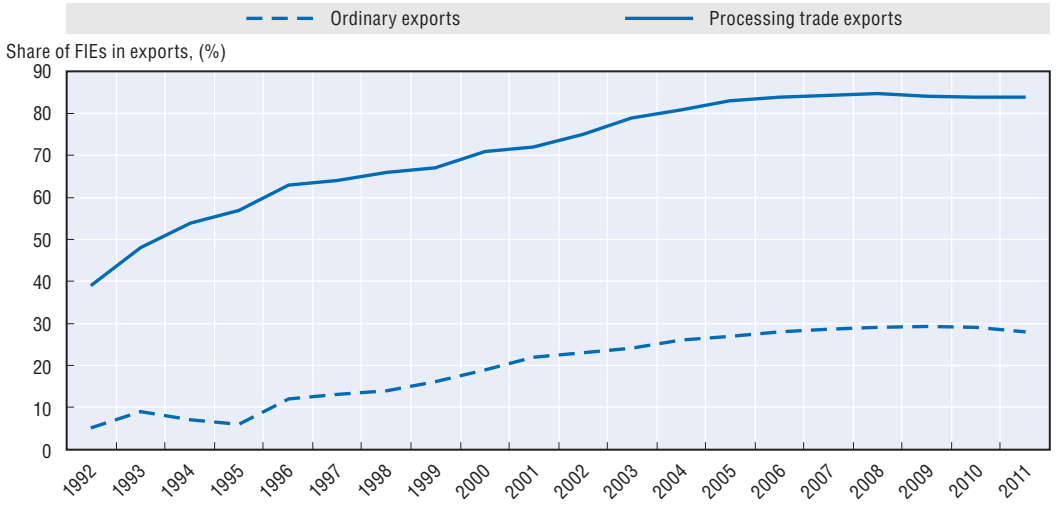
Figure 5.9. Foreign-owned enterprises (FIE) and China's exports, 1992-2011



Source: Pilat et al. (2012).

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Domestic value added in Chinese exports is relatively small but growing

Processing trade largely determines how much value is created in China; assembly activities typically represent only a small part of the value of final goods and services. The strong position of (emerging) countries in GVCs, as reflected in export figures, does not necessarily mean that a country such as China creates and captures a large share of the value generated by GVCs. This was first illustrated in the often-cited study of the Apple iPod (Linden et al., 2009). Although the final product was exported from China, the value added in China represented only a fraction (USD 4) of the factory cost (USD 144, exported from China to the United States) and of the final retail price in the United States (USD 300).[11]

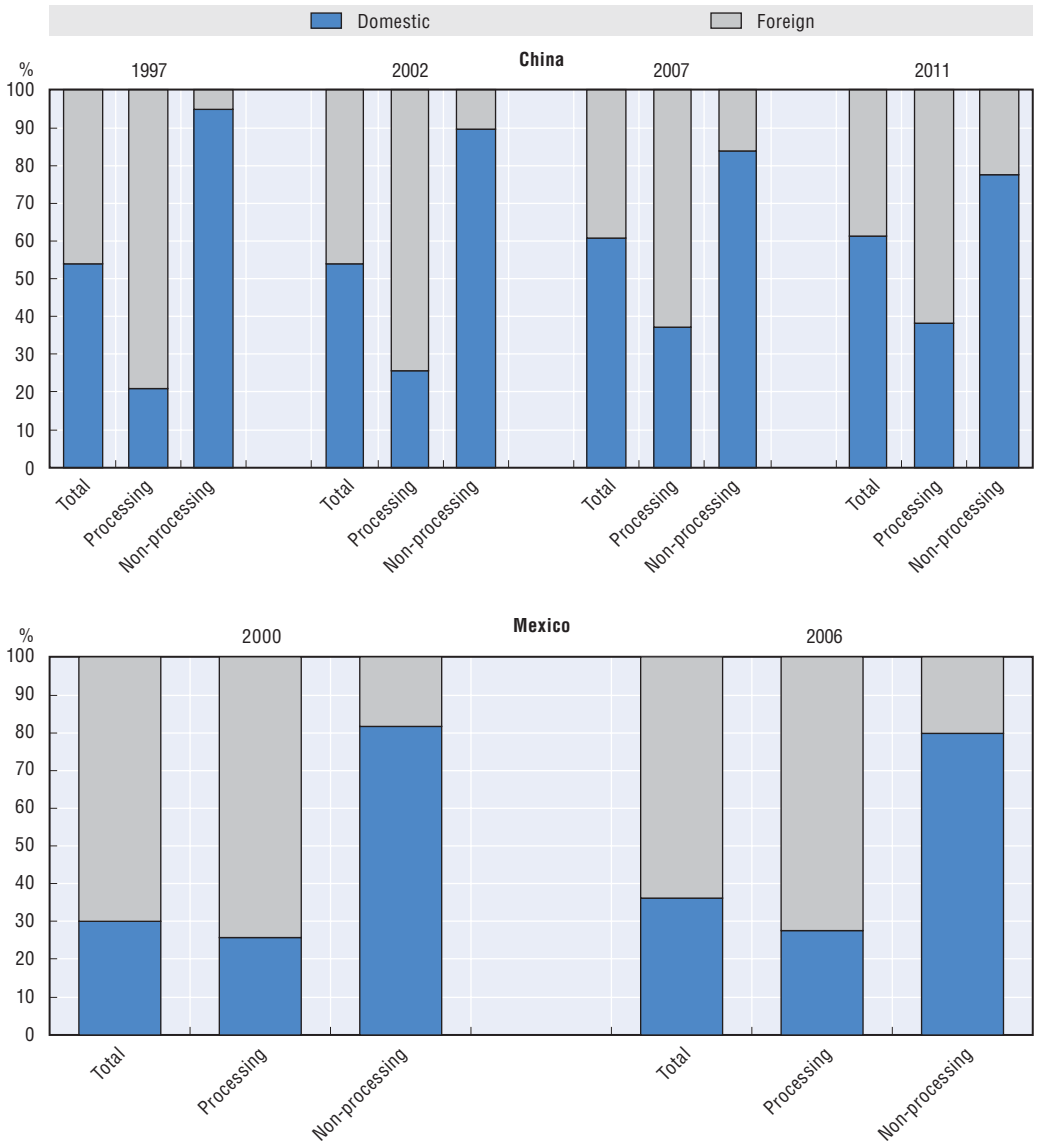
Aggregate results for China showed that the share of foreign value added in total Chinese manufactured exports was about 40% in 2007 (Koopman et al., 2008). In comparison, the share of foreign value added for the whole world is estimated at 25% (Johnson and Noguera, 2012). Certainly, the iPod is not representative of the average product exported by China, but it does show the importance of foreign value added embodied in Chinese exports. This share rises to 62.7% for China's processing exports, which suggests that the rest of the exported value is related to (assembly) activities in China (Figure 5.10).[12] Important differences in foreign content exist across industries; foreign value added is highest in electronics and low to moderate in textiles (Dean et al., 2011; Koopman et al., 2008). Non-processing exports of China have significantly higher domestic value added: in 2007, 84% of the export value was created in China.

Similar results have been reported for Mexico, another country with large and growing volumes of processing trade originating in EPZs (e.g. the maquiladora and PITEX[13] programmes) (De La Cruz et al., 2011). Around 72% of the value of processing exports from Mexico comes from intermediates sourced abroad, especially from the United States (Figure 5.10). The share of foreign value added in non-processing exports is much lower but still constitutes 20.2% of the exported value. Given the importance of processing exports in total Mexican exports (larger than for China), almost two-thirds of Mexico's total exports represent foreign value added through inputs imported from abroad. Only one-third of the export value derives from value-adding activities in Mexico.

The domestic content of Chinese exports has increased over time; estimates show that domestic value added reached 66.2% of total exported value in 2011.[14] In contrast, the share of domestic value-added for the world as a whole is decreasing as a result of growing international fragmentation (Johnson and Noguera, 2012). A first explanation for the rise in Chinese domestic value added is the decreasing importance of processing trade (see Figure 5.8) with its high levels of foreign content. Second, the domestic value added of processing exports has increased significantly, suggesting that domestic activities in processing zones are now creating more value added. Chinese firms in EPZs have increasingly moved from simple contract assembly to "full-package" manufacturing, with Chinese firms controlling all stages from material procurement to product design (Pilat et al., 2012). In contrast, foreign value added is increasing in non-processing exports, a sign of increased sourcing of intermediates from abroad.

The higher levels of domestic content in Chinese exports suggest that China is upgrading its activities and role within GVCs. Recent research shows that labour-intensive activities are being shifted from the Chinese mainland to countries such as Cambodia, the Philippines and Viet Nam. China has also become a larger exporter of intermediate goods (particularly parts and components) and capital goods and is thus engaging in higher value activities, alongside its specialisation in assembly (OECD, 2011a). This is also pushing the vertical division of labour in East Asia further as other countries take over lower-value activities. The metaphor of the flying geese (Akamatsu, 1961; Ozawa, 2008) has often been used to describe industrial upgrading in East Asia. One economy (e.g. Japan), like the first goose in a V-shaped formation, leads other economies (e.g. Korea) toward industrialisation, passing older technologies down to followers as it moves into newer ones. This process still seems to be happening, with countries such as Bangladesh, Cambodia and Viet Nam picking up textile and garment business from China.

Figure 5.10. Total domestic value added, processing and non-processing exports, China and Mexico



Note: Estimates for Mexico are upper-bound estimates with maquiladora and PITEX both counted as processing trade.

Source: Koopman et al. (2008); De La Cruz et al. (2011); Chinese Academy of Sciences (2012).

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GVCs and industrial development

Joining a value chain instead of building one

Until the 1980s, industrial development in many emerging and developing countries focused on import substitution: replacing foreign imports with domestic production and reducing foreign dependency. Government intervention played a crucial role in creating an internal market and developing manufacturing capabilities through protectionist policies such as high tariff barriers, subsidies to key industries, nationalisation, etc. Because they did not succeed, these strategies were gradually abandoned in the 1980s and 1990s and development strategies became increasingly export-led. Countries in Southeast Asia followed a dual path by combining import substitution to create new industries (the infant industry argument) with the development of export platforms (Baldwin, 2011).

To gain export competitiveness in international markets, emerging/developing countries had to develop a strong industrial base and build up their value chains. Foreign direct investment was promoted to the extent that MNEs brought in external knowledge; local content requirements were set to ensure that domestic companies would learn from foreign expertise. This was relatively straightforward for light manufactures such as clothing and footwear, but much more difficult for capital-intensive and knowledge-intensive manufacturing, because of economies of scale, knowledge spillovers and agglomeration economies. Industrial policy played an important role in overcoming problems of lumpiness and complexity in these industries; interventionist policies were used to reach a critical mass domestically in order to become competitive in international markets (Rodriguez-Clare, 1996; Rodrik, 1995).

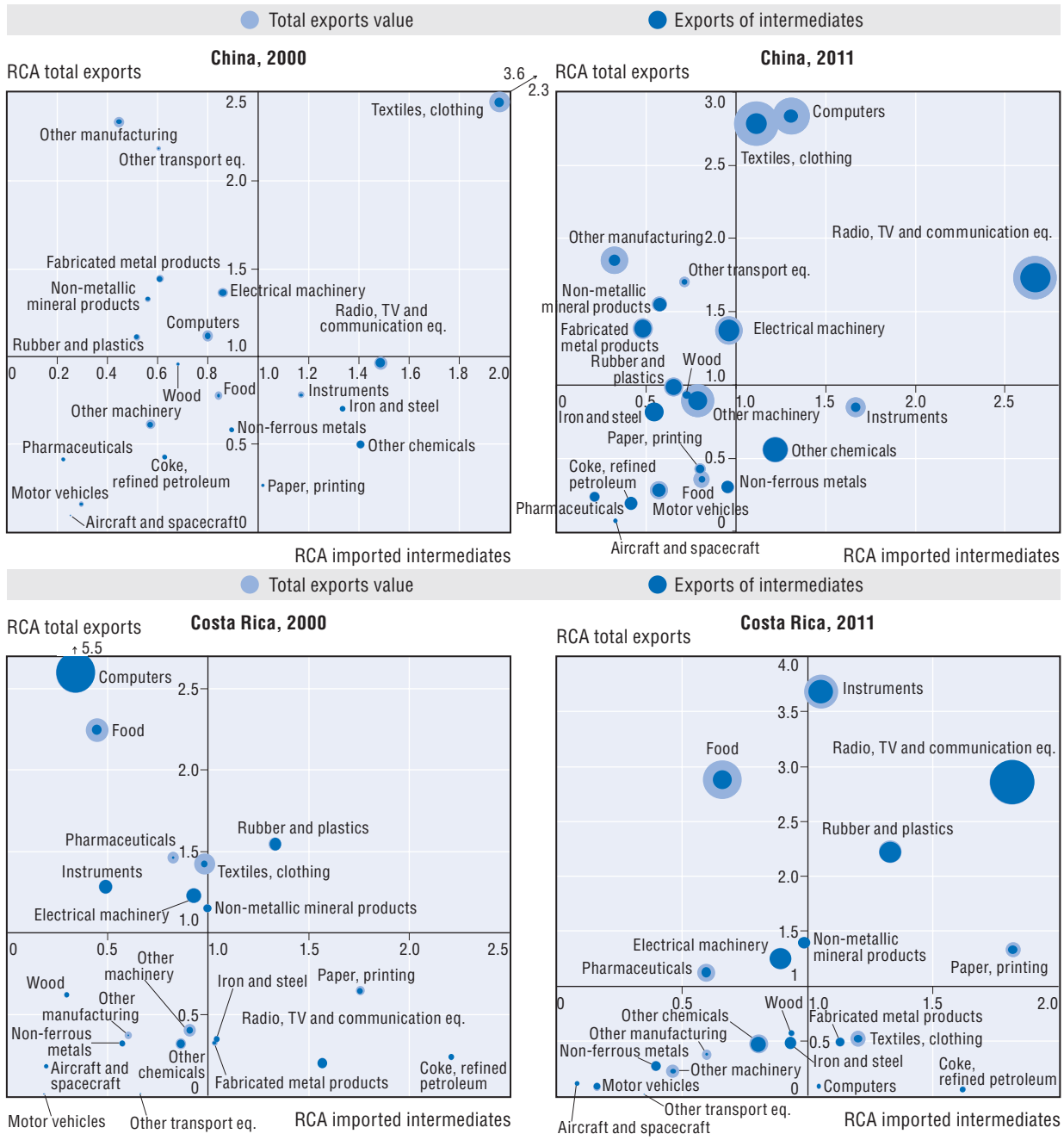
In a world of GVCs, countries can now seek to join a global value chain and start to export more quickly and at lower cost.[15] Instead of industrialising by developing vertically integrated industries (and producing both intermediates and final products), industrialising countries can become export-competitive by specialising in specific activities. As discussed, China has specialised in the assembly of final products in the electronics industry and has become the largest exporter of information and communication technology (ICT) products (OECD, 2010a). Other countries have specialised in the assembly of intermediates (e.g. sub-systems for motor vehicles in Mexico) or the production of simple parts and components.

Countries export different types of goods at different stages of development, with low-income countries typically producing a narrow range of goods. As countries grow, they diversify their export portfolio until they re-concentrate at higher income levels (Imbs and Wacziarg, 2003). Export growth is achieved largely along the intensive margin (through the growth of existing trade flows) while growth along the extensive margin (through trade flows of new products and/or to new destinations) contributes to the diversification of countries' exports (Cadot et al., 2011a). Recent OECD work shows that the international fragmentation of production has accommodated the emergence of new competitors in intermediate products (Beltramello et al., 2012). Emerging economies have displayed relatively stronger growth along the extensive margin by diversifying their export portfolio of intermediate goods.[16] One explanation may be the large sunk investments required to begin exporting final products (e.g. R&D, branding, other forms of knowledge capital). Another explanation is that trade in intermediates depends less on the size of the market or the "home bias" than trade in final goods (Miroudot et al., 2009).

Figure 5.11 (China and Costa Rica) and Annex 5.A2 (the Czech Republic, Mexico and Thailand) present the export performance of five emerging economies that have successfully integrated in GVCs in a number of industries. The evolution of their exports clearly shows that GVCs have contributed to their sometimes remarkable export success. Export competitiveness is measured by the widely used indicator of revealed comparative advantage (RCA) (Balassa, 1965), while integration into GVCs has been proxied by imports of intermediate inputs. Ng and Yeats (1999) argued that a Balassa indicator calculated on the basis of imports instead of exports, specifically for intermediate inputs, shows whether a country has a comparative advantage in *assembly* in a given industry. The reasoning is that intermediate inputs have no general use in themselves but are traded for further assembly. Above-average import shares of intermediates can indicate a comparative advantage in assembly operations. An analysis of the export portfolios of these emerging countries between 2000 and 2011 shows that:

- In a relatively short time, large countries (China, Mexico) but also smaller countries (Costa Rica, the Czech Republic, Thailand) have increased their export volumes exponentially (as reflected in the expansion of the bubbles in the figure between 2000 and 2010); this has resulted in strong export competitiveness in a number of industries (RCA(X) > 1).
- The production and assembly of intermediates account for a large share of export performance (as reflected in the size of the dark bubbles); intermediates exports have become increasingly important in the export industries of these five countries.
- Export competitiveness of countries, in final as well as intermediate products, has become closely linked to imports of intermediates; the correlation is especially clear in industries that have become internationally fragmented, such as modularised industries (e.g. electronics).
- Integration in GVCs has drastically changed these countries' specialisation. They have moved from more traditional industries (e.g. food, textiles) towards higher-technology-intensive industries (e.g. computers, TV, radio and telecommunications equipment). This pattern is at odds with the view of comparative advantage that sees emerging countries specialising in more traditional industries while developed countries specialise in more technologically advanced industries and products.
- Traditional measures of export competitiveness (such as revealed comparative advantage based on gross exports) may misrepresent the actual export competitiveness of countries. Export success is increasingly linked to imports of intermediates produced in earlier production stages and may especially demonstrate the competitiveness of foreign activities embodied in imported products. It does not indicate what value has been created in the domestic economy: estimates for China and Mexico are given above. The domestic content of exports for the Czech Republic is 61% and for Thailand 59% (see Chapter 1) while the domestic content of Costa Rican exports is about 36% (Costa Rica, 2011).

Figure 5.11. Export competitiveness and GVCs, China and Costa Rica, 2000 and 2011



1) The vertical axis represents the index of revealed comparative advantage (RCA(X)) of total exports; calculated as $RCA(X)_{i,c} = (X_{i,c}/X_{i,world})/(X_{economy,c}/X_{economy,world})$ where $X_{i,c}$ and $X_{i,world}$ are respectively exports in industry i by country c and the world, while $X_{economy,c}$ and $X_{economy,world}$ are economy-wide exports by country and the world; horizontal axis represents the index of revealed comparative advantage (RCA) of imports of intermediates and is calculated as $RCA(M)_{int\text{-}i,c} = (M_{int\text{-}i,c}/M_{int\text{-}i,\ world})/(M_{int\text{-}economy,c}/M_{int\text{-}economy,world})$ where $M_{int\text{-}i,c}$ and $M_{int\text{-}i,world}$ are respectively the imported intermediates of industry i by country c and the world, while $M_{int\text{-}economy,\ c.}$ and $M_{int\text{-}economy,world}$ refer to total intermediates imported by country c and the world.

2) The size of the bubbles is proportional to countries' total exports and should only compared within and not across countries.

3) See Annex 5.A2 for Mexico, Thailand and the Czech Republic.

Source: Calculations based on OECD (2010b), "STAN Bilateral Trade Database 2010", STAN: OECD Structural Analysis Statistics (database), doi: 10.1787/data-00028-en, accessed May 2013.

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Are emerging economies competing head-to-head with developed economies?

While countries traditionally move up the quality ladder (in production and exports) as their incomes rise over time, the rapid increase in the export competitiveness of emerging countries, and particularly that of China in high-technology industries, has attracted much attention. In a widely cited article on "what you export, matters", Hausmann et al. (2005) demonstrated the high level of sophistication of China's exports for a country at its level of development[17] (see also Rodrik, 2007). Schott (2008) showed a growing overlap between Chinese and OECD exports to the United States; while China previously competed with other Asian economies, its export portfolio is rapidly converging with that of countries like Germany, Japan or the United States. In general, export structures of emerging countries are increasingly similar to those of developed economies (IMF, 2012).

At face value, this suggests that China increasingly competes with OECD economies and that Chinese exports have become close substitutes of exports of developed economies, even for advanced products such as ICT equipment. Not surprisingly, this has raised concerns in developed economies about the impact of this "new" competition on OECD labour markets.[18] However, the apparent sophistication of Chinese exports is to some extent a statistical artefact, as exports of emerging countries include significant imports of intermediates, often from developed economies, particularly in more technology-intensive industries. Processing trade in China, for example, accounts for only 30% of low-technology exports but up to 90% of high-technology exports.

The upgrading of China's export mix largely disappears when processing trade is omitted (Van Assche and Gangnes, 2007). Foreign affiliates (from OECD countries, but not from Chinese Taipei and Hong Kong [China]) have been responsible for much of China's growing export sophistication through their processing trade activities (Xu and Lu, 2010). In fact, China's exports may reflect growing vertical specialisation rather than increasing sophistication (Dean et al., 2011); China's and OECD exports differ significantly across export destinations but the similarity increases as the foreign content of China's exports increases. This shows that the skills content of China's exports largely reflects the skills content of the imported intermediates (Amiti and Freund, 2010). It suggests that China can export sophisticated ICT products because it imports the necessary high-value-added parts and components from other countries (Brantstetter and Lardy, 2006).

While competitive pressures have increased in high-technology industries as a result of growing exports by emerging economies, the increasing similarity between emerging and developed countries' exports also reflects their greater complementarity (IMF, 2012). Because of the heightened offshoring of labour-intensive production to lower-cost countries, emerging economies have moved towards the low-skill activities (e.g. assembly) of higher-technology industries. In GVCs, comparative advantage increasingly applies at the level of individual production stages rather than at the level of whole industries and products, i.e. emerging economies specialise in unsophisticated stages of production for products or industries classified as sophisticated or technology-intensive.

Another perspective on the growing exports of emerging economies in higher-technology industries shows that while countries may export the same products, they may export different varieties of it. Recent empirical evidence indicates that even in the same product category, trade specialisation and competition increasingly take place on varieties and market segments. Emerging economies may export mainly to lower market segments at a lower quality and lower price, while developed economies target the top segments of

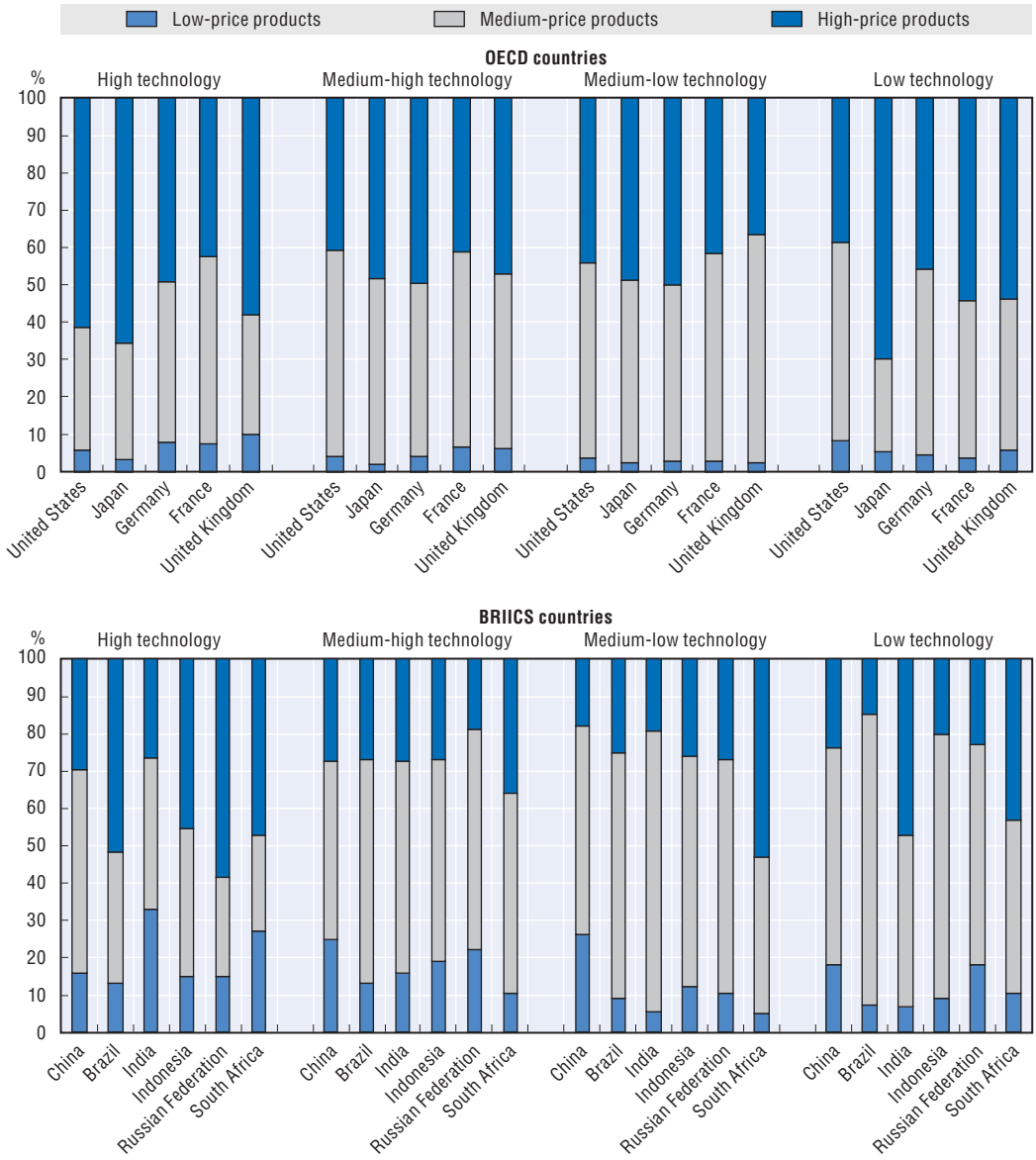
the market. Analysing the price or unit value of exports (calculated as trade in value divided by trade in volume) can offer further insights.[19] The idea here is that countries exporting at higher unit values offer higher "quality" products and can sell identical products at a higher price (marketing, advertising, quality) or specialise in higher-priced segments (Aiginger, 1997).

Aggregate results indicate the existence of a quality ladder in the exports of emerging and developed economies; the unit value of exports of BRIICS countries is significantly lower than that of exports of developed OECD economies for every technology category (Figure 5.12). For its high-technology exports,[20] China mainly exports goods at a low or medium price, while developed OECD economies export around half of their products at a high price. While China's export bundle thus overlaps those of more developed countries (China exports the same products), the unit values of Chinese exports are significantly lower (China specialises in lower price/quality products).

The fact that Chinese products overall are sold at a discount suggests that developed countries compete on terms other than price and that China's competition with developed countries on exports might be less intense than is sometimes asserted (Rodrik, 2007; Branstetter and Lardy, 2006; Schott, 2004 and 2008). This does not mean of course that individual US and Chinese companies may not compete head-to-head on specific products, but these results generally suggest a different level/kind of competition (price versus quality).

As mentioned in the discussion of the domestic content of exports, China's position in GVCs is evolving rapidly. It is clearly climbing up the quality ladder. The share of high quality/price products in China's exports increased significantly between 2000 and 2010, particularly in high-technology industries (Figure 5.13). GVCs seem to play a role in these export dynamics; China's ranking in terms of export quality is highest in industries in which processing trade is pervasive (Pula and Santabarbara, 2011). Figure 5.13 also shows that China is increasingly importing from abroad high-quality intermediates for high-technology industries. GVCs and foreign activities (through imported intermediates and foreign MNES) have thus helped drive China's export performance (in terms of size, composition and quality) (Box 5.1). The process of upgrading in China also increasingly involves domestic sources (Pilat et al., 2012).

Figure 5.12. Exports by technology and price level, selected OECD and BRIICS countries, 2010



Note: Bilateral trade flows of countries have been classified into three broad quality ranges defined on the world level. The highest quality products are assumed to be the most expensive (i.e. to have the largest unit value). Following Fontagné et al. (2008), the world unit value $UV_{i,\ world}$ is calculated for each HS-6 product as the median of the unit values of all bilateral transactions UV_{ijk} (i being product i, j the exporting country and k the country of destination) for that product. The three quality ranges are defined as follows:

- High quality: UV_{ijk} in the last nine deciles of $[1.25xUV_{i,\ world}; \max(UV_{ijk})]$;
- Medium quality: UV_{ijk} in the interval $[0.75xUV_{i,\ world}; 1.25xUV_{i,\ world}]$ and in the first decile of $[1.25xUV_{i,\ world}; \max(UV_{ijk})]$ and in the last decile of $[\min(UV_{ijk}); 0.75xUV_{i,world}]$;
- Low quality: UV_{ijk} in the first nine deciles of $[\min(UV_{ijk}); 0.75xUV_{i,world}]$.

The use of the median and intervals takes account of the sometimes high variability of unit values; the medium range is defined more broadly in order to capture a significant share of trade.

Source: OECD calculations based on CEPII BACI database.

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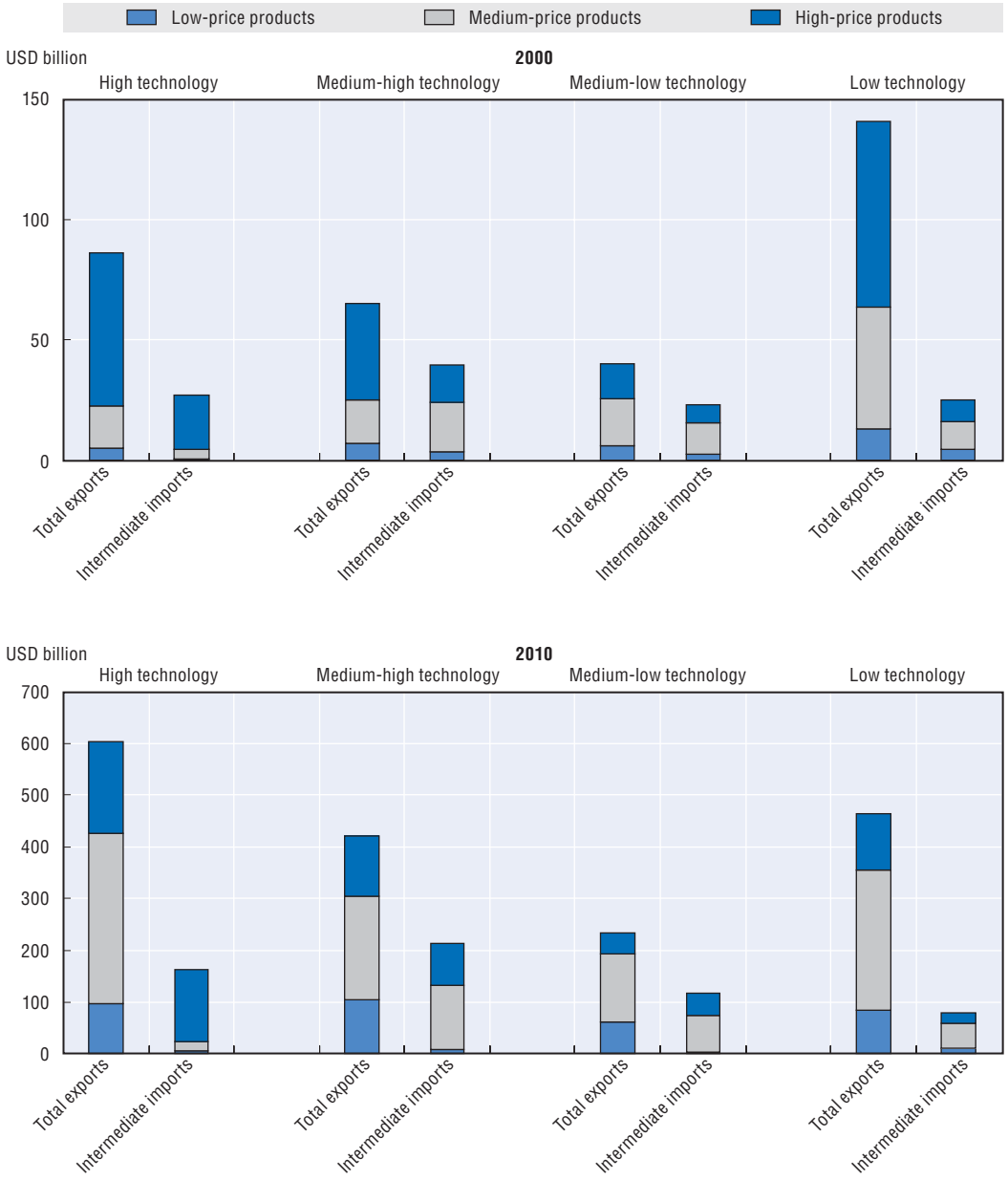
Figure 5.13. Total exports and intermediates imports by technology and price level, China, 2000 and 2010



Note: See Figure 5.12 for an explanation of the methodology.

Source: OECD calculations based on CEPII BACI database, September 2012.

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Box 5.1. What explains China's climb up the quality ladder?

By analysing information on the type of trade (processing versus ordinary [i.e. non-processing]) and on exporter/importer (foreign affiliates, private domestic firms, state-owned enterprises) on the product level, it is possible to gain further insight into what drove the rising unit values (as a proxy for quality) of imports and exports in China between 2001 and 2009. The first results indicate that:

- The largest increases in exports' unit value are recorded in processing trade. Foreign affiliates in particular, but also state-owned enterprises, have significantly increased the unit value of their exports. In the electronics industry, for example, foreign MNEs have pushed up the quality of Chinese exports.
- The unit value of imports into China has increased most strongly in processing trade. The increased quality of Chinese exports is thus explained to some extent by the higher quality of imported intermediates.
- Activities of foreign affiliates (and state-owned enterprises) seem to add more value to processing exports, since the increase in the unit value of imports is significantly smaller than the rise in unit value of Chinese exports.
- In the category of ordinary trade, state-owned enterprises have raised the quality of their exports; the unit value of the exports of private domestic firms and foreign MNEs have also increased but to a lesser extent.
- The rise in the unit value of exports is larger than that of imports (in ordinary trade), again suggesting that activities in China increasingly add value.

Source: On-going analysis by De Backer, Van Assche and Ma.

GVC policies for emerging/developing economies

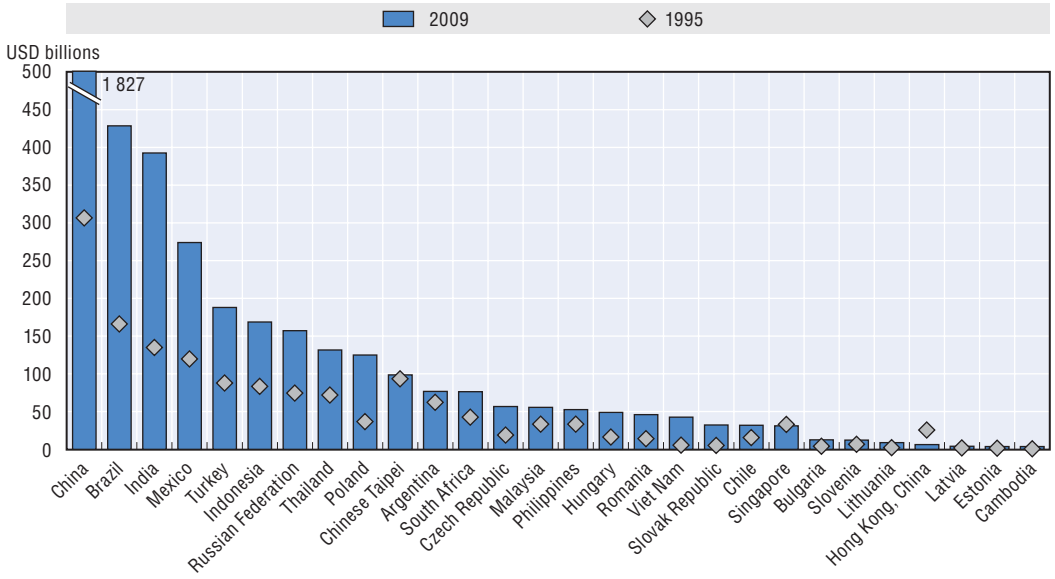
Engagement in GVCs supports economic development

Countries' prosperity largely depends on their participation in the global economy, which is now largely dependent on their role in GVCs (Gereffi and Lee, 2011). Global engagement opens up new markets, provides access to better information and creates opportunities for rapid technological learning and acquisition of skills (Sturgeon, 2013). Participation in GVCs can offer a fast track to development and industrialisation. The offshoring of activities previously carried out in developed countries has driven investment in new productive capacity, stimulated export performance and created jobs in emerging and developing countries. The rise of GVCs has therefore helped to drive economic growth in these economies even when their exports have relatively low domestic content, as rapid growth in exports results in strong growth of domestic value added and thus of GDP.

A new metric calculated from the TiVA Database estimates the value added that economies earn from their GVC activities by producing manufactured goods (final, capital and intermediate goods) that are sold worldwide (Timmer et al., 2012; see Chapter 6). As Figure 5.14 shows, GVC value added in emerging and developing economies is rising because of their increased engagement in manufacturing GVCs. China's GVC income increased by a factor of five between 1995 and 2009. In Brazil, India, the Russia Federation, Mexico, Turkey and Indonesia GVC income grew less rapidly but nevertheless significantly.

Smaller economies such as the Czech Republic, the Slovak Republic, Hungary and Viet Nam have also benefitted from their participation in manufacturing GVCs, largely to meet final demand abroad, owing to the small size of their domestic markets. China's manufacturing industry is also strongly oriented towards foreign final demand, as almost two-thirds of China's domestic value added goes to markets abroad. In contrast, the GVC income of other large emerging economies in manufacturing is more dependent on the domestic market: India generates almost half its manufacturing GVC income for the domestic market, Brazil even 65%.

Figure 5.14. Value added created/captured in manufacturing GVCs, selected emerging and developing economies, 1995 and 2009



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en, (accessed April 2013).

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Openness and integration in GVCs

Motivated by the successful participation of these emerging economies in GVCs, other economies seek to become part of international production networks. But even with advantages in terms of (labour) costs, such economies may be disadvantaged in other respects. A new global dataset of bilateral trade costs developed by the World Bank and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) shows that developing economies face higher trade costs and larger constraints in terms of connectivity which increase the costs of offshoring to these countries. Trade costs include tariff- and non-tariff barriers, logistics, transport costs, etc., but also geographical and cultural distance, and are negatively related to per capita income (Arvis et al., 2013). Participation in GVCs also depends greatly on the ease and costs of international flows of goods, services, capital, knowledge and people, etc. Table 5.2 represents various connectivity constraints for middle- and low-income economies.

While firms are the main actors in GVCs, governments play an important role in creating appropriate framework conditions and a conducive business environment. Raising firms' participation in GVCs requires effective policies at the border and in the domestic economy. As structural reforms to eliminate barriers typically require time, emerging and developing economies have sometimes taken more pragmatic approaches, such as EPZs or technology parks, to overcome obstacles (Box 5.2). This section draws attention to policy areas likely to require further efforts.

First, favourable border policies for participation in GVCs include lower trade barriers (see Chapter 3). Trade barriers depend on the level of tariffs and the existence of non-tariff barriers; the efficiency of border processes and customs practices are also an important determinant of the costs and time required to export and import (Table 5.2). Trade costs play a large role in GVCs because goods cross borders several times before reaching the final consumer (Yi, 2003; Ma and Van Assche, 2010). Domestic regulations and trade-related bureaucracy are also important cost factors, because of the importance of operating in a timely manner (WTO and IDE/JETRO, 2010).

Table 5.2. Some determinants of offshoring costs in high-, middle- and low-income countries

	High-income countries	Middle-income countries	Low-income countries
Quality of transport infrastructures			
Quality of Airport, Index 0-7 (2005)	5.9	4.2	3.3
Quality of Port Infrastructure Index 0-7 (2005)	5.5	3.5	2.9
Paved Airports per 1 000 sq km (2006)	2.6	1.2	0.1
Quality of communication infrastructures			
Telephone mainlines, per 1 000 people (2005)	499.6	210.1	36.7
Mobile phone per 1 000 people (2005)	837.8	376.7	76.5
Internet users per 1 000 people (2005)	523.4	114.3	44
Faults, per 100 fixed line (2005)	8.4	16.8	40.5
Quality of institution for doing business			
Rule of Law, index between -2.5 and 2.5 (2006)	1.2	-0.2	-0.9
Time to enforce a contract, days (2006)	548.2	629.1	625
Procedure to enforce a contract, number (2006)	34.2	38.2	40.8
Cost to enforce a contract, % of claim (2006)	20	28.7	53.6
Time-related barriers			
Time to start a business, days (2006)	22.2	51.3	58.3
Time to deal with license, days (2006)	162.6	217.7	265
Export documentations, number (2006)	4.8	7.2	8.6
Time for Export, days (2006)	11.3	25	41
Time for Import, days (2006)	12.9	29.3	49.6

Source: WTO (2008).

Box 5.2. Technology parks in high-technology industries: Saigon High-Tech Park, Viet Nam

Developing economies have increasingly established technology parks to connect to high-technology GVCs, especially if such industries are not yet part of the national economy. Technology parks may help to address – on a limited scale – the infrastructure challenges that these countries face. By providing the parks with state-of-the-art physical, communication and social infrastructure, policy makers hope to attract FDI in high-technology sectors (Infodev/Worldbank, 2008).

The Saigon Hi-Tech Park (SHTP) illustrates the opportunities and challenges afforded by this approach. Established in 2002 with the strong support of the Ho Chi Minh (HCM) City government and the Vietnamese government, SHTP boasts a number of foreign companies, including Intel, Nidec (Japanese producer of computer motor fans) and Sonion (Danish producer of micro-acoustic parts for cellular phones). As of 2012, SHTP hosted 61 local and foreign companies, employed more than 17 000 people and had registered investment of USD 2 billion.

SHTP has been quite successful in integrating Viet Nam in knowledge-intensive GVCs. The transport infrastructure features harbours and airports within a half-hour drive, which lowers the cost of accessing export markets. In addition, it has an adequate skill endowment; the park is located near downtown Ho Chi Minh City and its universities. SHTP has targeted skill enhancement through the creation of an on-site training and research centre, where newly recruited employees of tenant companies receive job-preparation courses. SHTP has also established research laboratories with funding from the Ho Chi Minh City government to invest in technical infrastructure and equipment. The research laboratories are managed as business units that receive contracts from the government and tenant companies. Finally, institutional improvements have been instrumental in facilitating SHTP's integration into value chains: the government grants SHTP companies a "one-stop-shop" to ease business transactions and channel tax incentives.

The SHTP has been effective in attracting foreign companies, stimulating economic activity, including employment, and integrating Viet Nam in GVCs. There is some debate, however, about the extent to which SHTP has helped shift Viet Nam's industrial structure towards higher-value-added and skill-intensive sectors. This is one of the government's goals and an important reason why the SHTP was originally set up. Many tenant companies continue to concentrate on lower value activities (even in higher-technology industries). Technology parks that are isolated from the developmental challenges affecting the rest of the economy may be too limited a tool. For example, the SHTP's advanced training centre and research laboratories contrast sharply with the level of human resources and technological capabilities found elsewhere in the country.

Second, lower barriers to investment facilitate the integration of economies in international production networks because they facilitate investments by lead (MNE) firms (see Chapter 4). Beyond specific rules or restrictions on investment, a broad range of policy areas determine how attractive economies are for international investment: investment policy, trade policy, competition policy, tax policy, human resources, infrastructure, corporate governance, responsible business conduct, public governance, promotion and facilitation (Box 5.3).

Box 5.3. FDI-led strategies for integrating GVCs in Costa Rica

Costa Rica offers a clear example of how policies can help facilitate the insertion of an economy in GVCs. From the 1980s, the country shifted from an import-substitution model of economic development towards a model based on integration in international trade and diversification of exports towards knowledge-intensive industries. FDI has played a fundamental role in this strategy with foreign affiliates linking the Costa Rican economy to GVCs in high-technology industries.

Costa Rica has been very successful in attracting international investment. First, it is politically stable and has enjoyed democratic rule since the mid-20th century. Second, its high levels of secondary and tertiary education rates have formed a labour force with an attractive skill-cost mix. In addition, Costa Rica developed an efficient and supportive FDI policy framework in 1982 when it established a dedicated Investment Promotion Agency (CINDE) to provide services to investors. It also established a free trade zone (FTZ) with fiscal incentives for companies investing in the country, including fiscal credits for non-traditional exports. In 1986, the Ministry of Foreign Commerce (COMEX) was charged with co-ordinating investment promotion and trade policies, and another agency (PROCOMER) was established to promote Costa Rica's exports. Finally, Costa Rica has preferential trade agreements with 54 nations, as well as numerous bilateral investment treaties. Monge-Arino (2011) describes how 11 trade agreements negotiated by Costa Rica with 42 countries have strongly supported Costa Rica's participation in GVCs, in industries such as electronics, medical devices, automotive and aeronautics/aerospace.

FDI flows responded well and have come to play a critical role in the economy. Costa Rica's FDI stock is currently 37% of GDP, second only to Chile in Latin America. A turning point was Intel's decision in 1990 to manufacture microprocessors in Costa Rica; since then HP, P&G, Baxter, IBM and over 200 others have invested in Costa Rica (Costa Rica, 2011). The country's insertion in advanced manufacturing value chains has led to a dramatic shift in its trade profile; from being a primary exporter of bananas and coffee, it has become an important exporter in high-technology industries such as electronics, medical devices and business services. Most of the growth of these non-traditional exports takes place through Costa Rica's FTZ regime, which accounts for 50% of total exports.

While Costa Rica has been very successful in upgrading by attracting FDI, the challenge today is to upgrade the (domestic) value chain and to translate its integration in GVCs into domestic value added. However, the country suffers from a low level of market "thickness" which hampers the formation of linkages between local firms and foreign GVC leaders in knowledge-intensive sectors. There is a shortage of appropriate domestic suppliers, but also of professionals with the required technical qualifications, particularly at the PhD level. This small internal market combined with relatively low investments in R&D (around 0.4% of GDP) limit the development of domestic technological capabilities.

Third, the quality of infrastructure is increasingly a determinant of success in international production networks. A high-quality transport infrastructure with major international gateways and corridor infrastructures such as airports, harbours, railways and highways facilitates economies' participation in GVCs. Gateway ports, hubs and inland transport connections are crucial for the international transfer of goods, services and people. Maritime transport has greatly benefited from containerisation: standardisation, automation and inter-modality of freight have resulted in faster movement of intermediate and final goods through GVCs. Air transport is especially important for the (international) transfer of high-value and low-volume products, and for goods that are time-sensitive goods for just-in-time production and other lean production processes.

Speed and flexibility are crucial not only for exchanging physical goods/services but also for information flows. Adherence to international standards has become increasingly important for the exchange of information across borders. GVCs crucially depend on seamless and uninterrupted information flows across companies and economies; ICT networks channel business information and the data needed for the efficient co-ordination of activities across locations. A well-developed ICT infrastructure (communication, broadband, etc.) is necessary to connect economies' value chain activities across countries. Overall, reductions in transport and communication costs can be seen as equivalent to trade liberalisation for reducing the costs of trade and enhancing trade between countries (Globerman, 2011).

Fourth, beyond investments in "hard" transport and communication infrastructure, a "soft" infrastructure (facilitating policies, procedures and institutions) is at least as important for integration in GVCs. The quality of the institutional framework can be a source of comparative advantage (Grossman and Helpman, 2005). Since GVCs involve many activities involving different companies (MNEs, independent suppliers), contract enforceability is crucial for their smooth functioning. Countries with good legal systems export more in more complex industries (Costinot, 2009; Levchenko, 2007). Moreover, tasks that require more complex contracts (e.g. R&D, design, branding, etc.) are conducted more cheaply in economies with well-functioning contractual institutions (Acemoglu, 2007). Economies characterised by bad governance and political instability, e.g. some economies in Sub-Saharan Africa, have failed to attract foreign investors to export processing zones in spite of promises to shelter them from local rules (Farole, 2007; Cadot et al., 2011b).

Fifth, competitiveness in GVCs is critically dependent on efficient services inputs, including in manufacturing (see Chapter 3). Embedded services are the "glue" between economies' infrastructure and companies' activities in the GVC trade-investment-services nexus. Investments in logistics services (which move goods from one country to another) can enhance trade through efficient organisation and management of international shipment operations and effective tracking and tracing of shipments. High-quality logistics affect trade relatively more than less policy-dependent factors such as distance and transport costs; recent OECD results indicate that every extra day needed to ready goods for export and import reduces trade by around 4% (Korinek and Sourdin, 2011). Likewise, the development of communication and information services as "enablers" of GVCs leverages economies' integration in GVCs; these services may also transform emerging/developing economies into centres for offshore services (e.g. India and Mauritius).

Finally, the supply capacity of domestic firms (often SMEs) affects economies' integration in GVCs. In their search for independent suppliers in foreign markets companies are attracted to "thick" markets, as a large market makes it easier to find the right supplier and to find alternatives if necessary (WTO, 2008). Some economies have initiatives to increase opportunities for links between local firms and international partners; they involve the provision of information and building awareness, training facilities and courses, capacity-building programmes, upgrading activities, etc. (UNCTAD, 2006; OECD, 2008).

Creating and capturing value in GVCs: Upgrading and moving up the value chain

Participation in GVCs facilitates the engagement of emerging and developing economies in the global economy, but it is only a first step towards economic development. Engaging in GVCs has benefited many economies at the lower end of the development ladder but economies approaching middle-income levels increasingly need to upgrade their activities and move up the value chain.[21] The use of imported technologies in labour-intensive and low-cost/low-value activities of GVCs typically results in rapid economic growth in the first stage (see Figure 5.15). However, the gains and productivity growth from sectoral reallocation (from agriculture to manufacturing) and technological catch-up eventually diminish and rising wages make labour-intensive activities less competitive. Consequently, many economies have experienced a slowdown in growth and have fallen into what has sometimes been called the "middle-income trap" (Agénor et al., 2012; Eichengreen et al., 2013). It then becomes necessary to switch to higher value-added activities for further economic development (see Box 5.4).

Box 5.4. Malaysia's new economic model: Leveraging GVCs for structural transformation

Malaysia's new economic model (NEM) largely relies on GVC upgrading to achieve structural change. The plan, unveiled in 2010, aims to bring the country into the high-income group by 2020, while ensuring that growth is inclusive and sustainable. Many middle-income economies face similar development challenges: after a relatively rapid rise to middle-income status, Malaysia's growth has slowed since the Asian crisis. GDP growth averaged 4.2% between 1998 and 2010, a rate that falls short of rates in many emerging markets, notably in Asia.

A key element of the NEM is to improve Malaysia's specialisation in higher value-added activities in GVCs. An important factor in its poor growth performance in recent years has been a consistent slowing of labour productivity. However, the viability of its specialisation in low value-added segments of manufacturing has come under pressure as lower-income economies, particularly China, increasingly undertake the same activities. Malaysia can no longer compete with these economies on the basis of a high-volume, low-cost strategy.

The NEM is implemented through the Economic Transformation Programme (ETP) which identified 12 economic areas which are expected to deliver almost three-quarters of the growth in Malaysia's GDP over the next decade. Based on a broad consultation involving representatives from government, research institutions and the business sector, 11 sectors and one geographical area (Greater Kuala Lumpur/Klang Valley) were selected. An "economic lab" was created for each of the economic areas to develop an action plan, set specific targets (job creation and contribution to GDP) and determine the required resources (skills, funding, etc.).

For the areas closely involved in GVCs, the labs identified the most important challenges raised by Malaysia's specialisation in low-value-added activities. For the electronics industry the lab identified: i) excessive concentration in low-value assembly operations; ii) increasing competition from China; iii) a decreasing contribution to exports; and iv) a focus on too broad a broad range of subsectors. Four subsectors (semiconductors, LED, solar, and industrial electronics and home appliances) were then selected as most attractive in terms of growth and size; specific actions were formulated for each subsector to move Malaysia up the value chain.

Complementing these targeted actions at the subsector level, there are a number of horizontal policies:

- Promotion of private investment and fiscal support to attract domestic and foreign investment.
- Enlarging human capital through investment in vocational education, stimulating the return of Malaysians currently working abroad, and better immigration rules to facilitate the arrival of foreign talent in desired areas.
- Improvements in the business environment to encourage private investment and entrepreneurial activity: liberalisation of certain industries, easing the setup of business operations, reduction of administrative costs for SMEs and a more effective institutional setting for interaction between government and private agents.
- Investment in infrastructure, particularly in broadband and logistics.

In addition, policy makers often want to see the global connectedness of their country result in broader benefits at the national level. An important policy objective is to derive (larger) economic benefits from GVCs to enable more inclusive growth and development (OECD, 2012). The links between economic and social upgrading are important but do not happen automatically; a key challenge in emerging and developing economies is to improve the position both of domestic firms and of workers in GVCs.

The fact that participation in GVCs often takes place through affiliates of foreign MNEs makes it somewhat risky for host economies, as MNEs are increasingly footloose and can readily shift production to other economies. Thus, while GVCs help to plug into the global economy, host economies increasingly acknowledge that there is also a significant risk of being "plugged out". Furthermore, foreign investors are often located in EPZs, which can remain isolated pockets of production pockets with limited spillovers to the domestic economy. The policy challenge is to ensure that the export activities of GVCs create value and (higher-skilled) jobs that tend to "stick" to host economies. Policies to encourage co-operation and strengthen links with foreign firms can stimulate the development of spillovers from GVCs. Costa Rica, Malaysia and Morocco, among others, have programmes to foster interaction between MNEs and domestic producers (OECD, 2013a).

Because MNEs can bring advanced technologies to a country, they can be catalysts for structural change. Attracting FDI therefore remains an important focus of "industrial" policy, although domestic entrepreneurship and the creation of start-ups are increasingly promoted to help economies upgrade and diversify. There has also been renewed interest in old and new forms of industrial policy in emerging and developing economies since the early 2000s (OECD, 2013a) as governments increasingly adopt targeted approaches to foster economic development. Emerging and developing economies follow different approaches to industrial policy, reflecting their institutional capabilities, endowments and strategic choices.

Upgrading and transformation are difficult, however, and possibly more so than before. GVCs tend to "compress" the development path of developing economies, as the traditional stages (from natural resources to manufacturing/assembly, to R&D/innovation, to services) increasingly overlap, so that a linear process of catch-up is very difficult (Sturgeon, 2013). Late developers traditionally have a second-mover advantage as they learn from early developers by absorbing knowledge created elsewhere; they can leapfrog early developers by emulating good practices while avoiding policies and approaches that did not work elsewhere. However, emerging economies wanting to catch up and move to higher-value-added activities (e.g. R&D and innovation) typically chase a moving target as (newly) developed economies invest heavily in the same areas (Whitttaker et al., 2008). Gradualist rather than maximalist approaches may be more effective for upgrading and economic development. Moreover, upgrading is not without risks as the necessarily large, often sunk investments are undertaken in a context of intense competition, shortening product life cycles and rising R&D investments.

In the past, economic development often meant moving up from light industries (e.g. apparel, textiles, etc.) to more capital- and knowledge-intensive industries (automotive, ICT, etc.). Today, the challenge is to move from low-value-added to high-value-added activities within or across industries. Domestic firms and economies can create and capture more value in GVCs and "move up the value chain" in several ways. Upgrading processes through more efficient GVC activities and upgrading products (i.e. switching to higher-value-added products in the same activity) are generally

considered the easiest (UNIDO, 2004; see also Chapter 7). Other types of upgrading include functional upgrading, i.e. taking on functions in the GVC that create higher value added, and chain upgrading, i.e. moving from one value chain to another. These are much harder to achieve, especially for smaller firms, since they often require significant investments.

Some economies have successfully undertaken sequential value chain upgrading (in processes, products, functions and chains); a growing number of companies from emerging economies have introduced global brands and expanded their operations abroad: Lenovo, TLC and Huawei Technologies are examples from China. Successful examples in other industries include Tata (India, automobiles) and Embraer (aircraft, Brazil). Other companies have been less successful: companies from Chinese Taipei were able to upgrade from key suppliers to original equipment manufacturers (OEM), but have not (yet) succeeded in becoming original brand manufacturers since they would have competed directly with their customers (the lead firms in computer GVCs).

In addition, there is a risk that specialisation in production and assembly activities will lock economies into low-value activities if firms do not feel the need to develop capabilities in product design, development, logistics, etc. Until recently the Chinese electronics industry had been caught in a so-called "modularity trap"; despite significant increases in labour productivity, Chinese companies were operating in low-value niches and activities without any possibility to upgrade their capabilities (Song, 2007).

The possibilities and patterns of upgrading are largely determined by the governance structure of GVCs and the strategies of lead firms, which are often based in developed economies: large retailers and merchandisers in buyer-driven GVCs and large manufacturers in producer-driven GVCs (see Chapter 1). Lead firms typically control the core technologies, design, branding, etc., which allows them to accrue the largest rents; they therefore also control many of the mechanisms for learning, innovation, knowledge transfer and industrial upgrading. It is not completely clear when, and under what conditions, lead firms allow or encourage lower-tier suppliers to move up the value chain. In some GVCs lead firms tap the resources of developing economies but do not transfer any knowledge or offer real upgrading prospects (Cattaneo and Miroudot, 2013).

In general, when lead firms establish affiliates abroad to govern local suppliers in developing and emerging economies, these economies' upgrading opportunities are rather limited. When lead firms opt for FDI, they often want to protect their proprietary knowledge as much as possible and undertake higher-value-added activities themselves. The scope for upgrading may also be limited when lead firms use arm's-length transactions to buy inputs from local suppliers; these are typically low-technology, low-value intermediates (Gereffi et al., 2005).

Other governance structures allow in principle for more co-operation and knowledge transfer and thus tend to be more conducive to supplier upgrading if the supplier firms have a sufficient level of absorptive capacity. Technology transfer from the lead firm to so-called captive suppliers is often confined to a narrow range of tasks and activities; functional upgrading will be difficult if not impossible in this case. In relational and modular GVCs (Gereffi et al., 2010), however, local suppliers have more responsibility and can benefit from exchange of knowledge and mutual learning (Gereffi et al., 2010). Process and product upgrading is easier under this governance structure and there may be more scope for functional upgrading. In the automotive and electronics industry, for example, suppliers in developing economies have been able to move up the value chain (see above).

Lead firms often adopt standards to ensure quality throughout the chain. Stringent and costly requirements in terms of product specifications, delivery times, etc., may make compliance difficult and limit the scope for further upgrading. However, standards may also stimulate participation in higher value-added chains (often in niche markets), thus offering possibilities for upgrading (Gereffi and Lee, 2012; Humphrey, 2008).

The growing importance of South-South trade and the rise of lead firms from developing economies are expected to increase upgrading possibilities for local suppliers in these economies. Demand for less sophisticated products, in terms of quality and variety, may also decrease entry barriers to specific GVCs. This would benefit suppliers in developing economies. Building on their knowledge of the local market, they could engage in higher-value-added activities, including development, design and branding (Kaplinsky et al., 2011). However, if they focus on low-income markets, local suppliers run the risk of becoming locked into lower-quality and lower-margin activities where competition is often intense (Brandt and Thun, 2011).

The industry composition of emerging and developing economies also plays a role as possibilities for upgrading differ significantly across industries. In natural resources for example, the scope for upgrading (in particular functional and chain upgrading) is often limited because of specific requirements in terms of capabilities and investments along the value chain. Copper, for example, requires very different competencies for extraction and for manipulation. It is therefore difficult to move from extraction to derivative products; upgrading mainly involves process or product improvements.[22] In agricultural value chains as well, the possibilities for upgrading are often smaller than in manufacturing and services.

Upgrading therefore depends on many factors, only some of which can be affected by government policies. Where the value is being created will differ across industries and value chains, suggesting there is no one-size-fits-all approach to upgrading. A favourable business climate will help; most of the border and behind-the-border policies that have been effective for integrating GVCs will also help in upgrading economies. Investment in advanced infrastructure, in particular high-speed communication networks, can help economies escape the middle-income trap. But framework policies need to be complemented with capability-enhancing policies to strengthen the domestic business sector. Skilled workers and trained personnel are an important, if not the most important, factor in attracting and developing higher-value-added activities, hence the need to invest in education and human capital. Labour market reforms may also be needed if there is a misallocation of talent (Agénor et al., 2012). Better protection and enforcement of (intellectual) property rights can also strengthen incentives to engage in higher-value-added activities such as innovation and design. Innovation and knowledge diffusion not only lead to new initiatives but also help improve the absorptive capacity of domestic companies.

The risk of exclusion from GVCs

Since GVCs offer new opportunities to engage in production processes with relatively low levels of initial investment, barriers to entering the global economy have been lowered. In economies as diverse as Samoa and Cambodia, specialisation in tasks such as assembling automobile parts has made it possible to engage in GVCs in ways that would not have been possible just a decade ago. Rwanda is looking to develop agro-foods and has undertaken an assessment of value chains in five staple crops to improve the value and/or the volume of staple foods produced and marketed in Rwanda and in the region.

But while various emerging and developing economies have been able to participate in GVCs, many low-income economies remain excluded. The reasons include a geographical location removed from existing trade networks, lack of natural resources to facilitate basic insertion in GVCs, lack of the necessary infrastructure or skills, or a business environment that does not provide some of the necessary conditions for investment. Non-market factors related to the rule of law (contract enforcement, intellectual property rights and investor protection), corruption, and political instability are particularly important in poor economies.

The recent consolidation of GVCs following the economic crisis may also leave economies behind. Only the developing economies able to offer an appropriate "bundle of tasks" will remain suppliers in consolidated GVCs (Cattaneo and Miroudot, 2013). In the textile sector, for example, global brands and retailers request a full package from their providers, which includes services such as design, marketing or shipping. Economies with capacities limited to manufacturing that could once participate in GVCs risk no longer being able to capture the benefits of trade.

The challenge for developing economies is to adopt a broad strategy that tackles the key barriers to integration and upgrading in GVCs. Capacity building can help developing economies address some constraints but may be difficult for the poorest among them. Development co-operation, when supported by appropriate policies, can help developing economies take advantage of value chains. Support from the donor community through "aid for trade" initiatives can help reduce the thickness of borders and develop adequate infrastructure. In addition, these programmes can help producers meet public and private standards and promote the development of the private sector (Box 5.5). Nevertheless, complementary public policies are needed to create competitive sectors and overcome internal constraints, especially in small-scale economies.

One of the main objectives of aid for trade is to link developing countries to major value chains and production networks. Many of the projects are intended to upgrade the quality of traditional exports or to reduce specific trade costs that hinder connection to value chains (OECD/WTO, 2011). This includes projects in Cameroon to improve bananas and plantain, in West Africa to improve cotton and rice, in Rwanda to improve the quality of tea, in Ethiopia and in Tanzania coffee, in Bangladesh to upgrade quality in the garment sector, in Guatemala to improve organic crops, in Honduras to improve oriental vegetables, in Grenada to improve fisheries, in Peru to improve milk quality, in Mozambique to revive processed cashew exports, in Tonga to control fruit flies, and in Indonesia to improve dairy livestock. Several projects financed by donors aim to help producers meet quality standards in their home and export markets. Examples include EU assistance for fish production in Fiji, for fisheries in Honduras and Mozambique, and for palm oil in Ghana.

In addition, donors seek to strengthen developing countries' private sector through support to the agriculture sector but also to industry, banking and tourism and provided over USD 16 billion a year between 2008 and 2011. Donors aim to help developing countries create a business-friendly environment in terms of macroeconomic strategies, governance issues, and policy, legal and regulatory frameworks.[23] Aid for the private sector also covers activities to address market failures, overcome information asymmetries and provide business development services. Some donor activities target individual enterprises with technical assistance, information and advisory services and finance. Until now, only a few evaluations of the long-term impact of donor activities have been undertaken.

Box 5.5. Aid for trade and GVCs

The 2013 Aid for Trade Donor Questionnaires launched by the WTO and OECD indicate that value chains are increasingly influencing donor programming (OECD, 2013b).[1] While Ireland reported to have "no applicable experience", other donors increasingly prioritise value chains in the support they provide. For Denmark value chain development has been a strategic priority since 2010. New Zealand's Aid for Trade focus aims to help the Pacific Islands enter the value chain and to encourage greater access to the New Zealand market. Germany's priority is to improve the integration of the local private sector in developing economies in regional and international value chains and strengthen compliance with social and environmental standards (BMZ, 2011, p. 6). Germany also helps SMEs and small-scale farms to improve their export and marketing capabilities and to use value chains at the micro level to achieve higher levels of value added.

The OECD Development Assistance Creditor Reporting System (CRS) provides details on projects of donor programmes based on commitments and disbursement of official development assistance. The CRS shows that donors such as the United States and the United Kingdom have various programmes that are directly linked to the issue of value chains. For instance, the United States, through its Agriculture Development Value Chain Enhancement Program (ADVANCE), has set up a USD 32 million programme for 2009-13 to improve the competitiveness of key agricultural commodity value chains in Ghana's domestic and regional markets, with a focus on the three northern regions. The Africa Free Trade Initiative (AFTi) is supported by the UK Department for International Development (DfID); it aims to help 3 million more people to benefit directly from value chains by 2015 through the Africa Enterprise Challenge Fund (AECF), which has various projects to help people benefit from agribusiness value chains in Africa.[2] The World Bank (2011) describes, with examples of multinational corporations such as Walmart and United Parcel Service (UPS), the role the private sector can play in building capacity, incorporating producers into GVCs, improving quality and safety standards, and facilitating trade. Evaluations show that these programmes are achieving results.[3] DfID's interim monitoring results from value chain activities and aid for trade projects show improved incomes, working conditions and employment for developing country workers. The Netherlands recently evaluated its value chain programmes for tea, cotton and cocoa. The main positive attributable impacts included an increase in household income and sustainability.

1. The 2013 WTO/OECD report, *Aid for Trade at a Glance*, will focus specifically on GVCs.

2. www.aecfafrica.org.

3. The DAC Evaluation Resource Centre (DEReC) has a database with evaluation reports from donor agencies to facilitate learning and provide evaluators with evidence of what works and what does not in different sectors and countries.

Notes

1. Recent years have seen a proliferation of regional trade agreements.
2. In order of market size: Brazil, Korea, Mexico, the Russian Federation, Argentina, Turkey, Indonesia, Poland, South Africa, Thailand, Egypt, Colombia, Malaysia, the Philippines and Chile (Hanson, 2012).
3. Hummels (2007) reported that the average import tariff for all countries worldwide dropped from 8.6% to 3.2% between 1960 and 1995.
4. South-South trade includes trade of countries that are members of the Group of 77 and China plus other countries that claimed a developing country status in the framework of the World Trade Organization (WTO) and other developing territories that are reported to UN Comtrade.
5. However, India has become an important exporter of services, as companies have outsourced a range of knowledge processes, business processes and information technology operations to India (Fernandez-Stark et al., 2011).
6. Labour costs should be considered relative to a country's level of productivity. Countries accept high labour costs if they coincide with high levels of labour productivity; countries with low labour costs typically have low levels of labour productivity.
7. The global middle class is defined as all those living in households with daily per capita incomes of between USD 10 and USD 100 in PPP terms (Kharas, 2010).
8. Processing trade is defined as "business activities in which the operating enterprise imports all or part of the raw and ancillary materials, spare parts, components and packaging materials, and re-exports finished products after processing or assembling these materials/parts".
9. For example, 45% of the final products assembled in processing zones in China are exported to Europe and the United States.
10. MNEs from the United States, Japan and the EU accounted only for 11% of the 200 largest exporters. This seems to suggest that it is especially the Chinese market that is important for these MNEs.
11. Other studies have applied similar methodologies for other products. The iPod can also stand for other electronic industries characterised by high modularity (Chapter 1); other industries show higher domestic value added (Chapter 2).
12. The firms active in processing zones are foreign-owned, which raises the question of whether the remaining value added remains in the Chinese economy (through labour compensation) or is repatriated to MNE headquarters.
13. Programa de Importacion Temporal Para Producir Articulos de Exportacio.
14. Mexico has recently also increased the domestic value added of its exports from 30% to 36.2%.

15. Baldwin (2011) suggests that the rise of GVCs might have played a role in the decline of import-substitution strategies as the second unbundling took off at the time when import substitution disappeared as a viable strategy.

16. Exports of emerging countries typically grow faster along the extensive margin as they have more room to diversify their export portfolio. However, China's export growth took largely place along the intensive margin (see also Amiti and Freund, 2010).

17. The PRODY index measures the implied technological sophistication of goods. It is calculated as the weighted average of the income of countries that export a good; the traditional measures of comparative advantage (Balassa, 1965) are used as weights. This index is then used to calculate the income/sophistication level associated with a country's export specialisation pattern; the idea is that a good mainly exported by developed countries will have a higher technology and quality content.

18. As discussed in Chapter 1, the effects of globalisation on national economies are diverse and complex. In the public debate, China's growing exports of high-technology products are believed to affect significantly national labour markets, and increasingly high-skilled workers. Some argue that the effects should be limited since Chinese exports are not close substitutes of products developed in developed economies (because of vertical specialisation, differences in quality, etc.) (Edwards and Lawrence, 2008; Schott, 2008). Krugman (2007) argues that the impact on low-skilled labour may be greater than in the past as Chinese exports have a high labour content even in higher-technology industries.

19. Some caution is needed in interpreting unit values as indicators of quality since differences in unit values may not only reflect vertical attributes (Fontagné et al., 2008; Silver, 2007; Schott, 2008). Hallak and Schott (2011) note that exchange rate misalignments or differences in production costs may lead to differences in unit values. Alternative approaches take into account not only prices or unit values but also quantities and market shares (Hallak and Schott, 2010; Khandelwal, 2010; Berry et al., 1995; Pula and Santabarbara, 2011).

20. The large share of high-quality products in high-technology industries in Brazil, Indonesia and the Russian Federation is due to some specific products, as they have a very small share of high-technology exports.

21. The term "moving up the value chain" is somewhat ambiguous, as this can be realised by moving downstream in the value chain. There is evidence, e.g. for the electronics industry, that a large part of the value in GVCs is created both upstream and downstream; "moving up the value chain" therefore implies higher-value activities either upstream or downstream.

22. The experience of firms participating in the copper value chain led by BHP Billiton in Chile is an example. For a detailed analysis, see OECD (2013a).

23. It has been argued that private-sector development policies are mostly shaped by the nature and interests of the private sector in the donor countries themselves and incorporate a high proportion of tied aid (De Velte et al., 2008). Recent studies seem to suggest, however, that business support services through donor programmes have improved in recent years.

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Annex 5.A1
Technology classification of industries

Manufacturing industries are classified according to technology intensity using the ISIC Rev. 3 breakdown of activity. The classification is based on a ranking which uses data on R&D expenditure divided by value added, and R&D expenditure divided by production for 12 OECD countries during the period 1991-99.

High-technology:

- Pharmaceuticals (ISIC 2423)
- Office, accounting and computing machinery (ISIC 30)
- Radio, television and communication equipment (ISIC 32)
- Medical, precision and optical instruments, watches and clocks (ISIC 33)
- Aircraft and spacecraft (ISIC 353)

Medium-high-technology:

- Chemicals excluding pharmaceuticals (ISIC 24 less 2423)
- Machinery and equipment not elsewhere classified (ISIC 29)
- Electrical machinery and apparatus not elsewhere classified (ISIC 31)
- Motor vehicles, trailers and semi-trailers (ISIC 34)
- Railroad equipment and transport equipment not elsewhere classified (ISIC 352 plus 359).

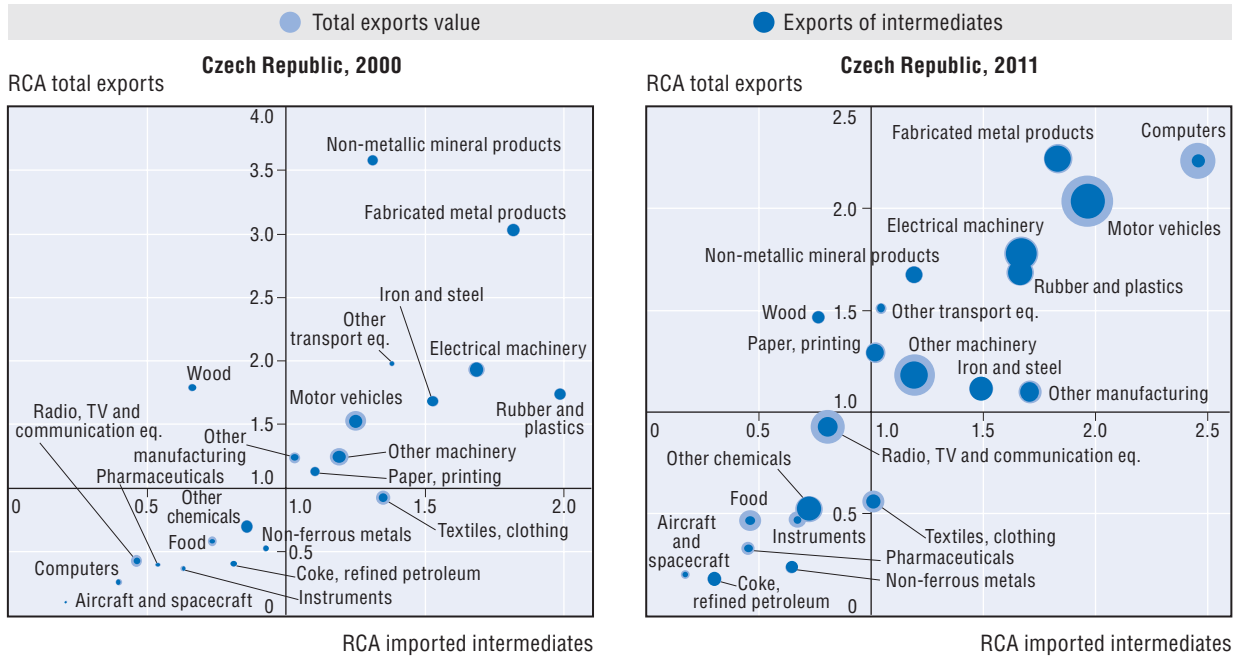
Medium-low-technology:

- Coke, refined petroleum products and nuclear fuel (ISIC 23)
- Rubber and plastics products (ISIC 25)
- Other non-metallic products (ISIC 26)
- Basic metals and fabricated metal products (ISIC 27-28)
- Building and repairing of ships and boats (ISIC 351)

Low-technology:

- Food products, beverages and tobacco (ISIC 15-16)
- Textiles, textile products, leather and footwear (ISIC 17-19)
- Wood and products of wood and cork (ISIC 20)
- Pulp, paper, paper products, printing and publishing (ISIC 21-22)
- Manufacturing not elsewhere classified and recycling

Annex 5.A2
Export competitiveness and GVCs: Mexico, Thailand and the Czech Republic, 2000 and 2011



1) The vertical axis represents the index of revealed comparative advantage (RCA(X)) of total exports; calculated as $RCA(X)_{i,c} = (X_{i,c}/X_{i,world})/(X_{economy,c}/X_{economy,world})$ where $X_{i,c}$ and $X_{i,world}$ are respectively exports in industry i by country c and the world, while $X_{economy,c}$ and $X_{economy,world}$ are economy-wide exports by country and the world; horizontal axis represents the index of revealed comparative advantage (RCA) of imports of intermediates and is calculated as $RCA(M)_{int\text{-}i,c} = (M_{int\text{-}i,c}/M_{int\text{-}i,\ world})/(M_{int\text{-}economy,c}/M_{int\text{-}economy,world})$ where $M_{int\text{-}i,c}$ and $M_{int\text{-}i,world}$ are respectively the imported intermediates of industry i by country c and the world, while $M_{int\text{-}economy,\ c.}$ and $M_{int\text{-}economy,world}$ refer to total intermediates imported by country c and the world.

2) The size of the bubbles is proportional to countries' total exports and should only compared within and not across countries.

Source: Calculations based on OECD (2010b), "STAN Bilateral Trade Database 2010", STAN: OECD Structural Analysis Statistics (database), doi: 10.1787/data-00028-en, accessed May 2013.

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Chapter 6

Global value chains and competitiveness

As companies and countries become embedded in international networks of production the global value chains (GVCs) they create challenge prevailing policy thinking about competitiveness. The growing upstream and downstream interconnections in GVCs increase the interdependence of countries' competitiveness policies and limit the effectiveness of national policies. Yet there have been calls for "new" industrial policies in many countries, often to support specific industries, in particular manufacturing. Defensive policies to protect domestic industries or firms are increasingly ineffective in a world of GVCs, however, whereas outsourcing and offshoring enhance the export competitiveness of countries by providing access to cheaper, more differentiated, and better quality inputs.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Competitiveness in interconnected economies

Growing interdependencies

Because an internationally competitive economy drives growth and employment, competitiveness is high on the policy agenda in most countries. Although the debate on how to define and measure the competitiveness of countries continues,[1] there is a growing consensus that productivity and attractiveness are important aspects. For example, the United States has been defined as a competitive location "to the extent that companies operating in the United States are able to compete successfully in the global economy while supporting high and rising living standards for the average American" (Porter and Rivkin, 2012). A country's competitiveness is based on its long-term productivity – the extent to which it produces valuable goods and services from its factors of production (capital, labour, natural resources, etc.) – which is also a determinant of its average living standards (Baily and Slaughter, 2008). In a global economy, companies can locate and/or expand their operations is a wide range of possible locations. This means that national economies need to be internationally attractive.

With companies and countries now embedded in international networks of production, GVCs increasingly challenge policy thinking about competitiveness. Today's economies no longer rely exclusively on domestic resources to produce and export goods and services; instead, their exports increasingly embody the technology, labour and capital of the countries from which they import intermediate goods. As a result, the competitiveness of national economies increasingly depends on the competitiveness of their partners. Policy makers need to understand these patterns and to know how concentrated or diversified this international sourcing is.

This policy intelligence must encompass more than the geographic origin of the intermediates imported by companies, as this would only take account of the last country from which intermediates are imported. These intermediates most likely also include foreign value added, i.e. they are produced using intermediates from third countries. A complete view of the sources and interdependencies of the export competitiveness of economies will require information on the geographical origin of all of the value embodied in intermediates.

Table 6.1 presents the matrix of international sourcing on the economy-wide level in terms of value added. Each cell in the matrix shows the share of foreign value added from column countries embodied in row country's exports. For example, the exports of the Czech Republic include 9% value added from Germany; other major suppliers of intermediates to the Czech Republic are China, France, Italy, Japan, Poland, the Russian Federation, the United States (foreign value added content above 2%). The cells on the diagonal represent the domestic value added of countries' exports (61% in case of the Czech Republic). All together the geographic distribution of the value added content of exports shows the interdependencies of the Czech Republic with other countries in terms of competitiveness. Annex 6.A1 presents similar results for electronics, transport equipment (including automotive) and business services.

Table 6.1. Foreign value added and domestic content of gross exports, total economy, 2009 (in %)

Area	Country	Total gross exports[1]	Austria	Belgium	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Luxembourg	Netherlands	Poland	Portugal	Slovak Republic	Slovenia	Spain	Sweden	United Kingdom	Iceland	Norway	Switzerland	Russian Federation	Israel	Turkey	Canada	Mexico	United States	Chile	Brazil	Australia	New Zealand	Japan	Korea	China	India	Indonesia	South Africa	Rest of the World
	Partner		EU																					Other Europe				Middle East		North America			South America		Oceania		Other Asia						
EU	Austria	100	68	1	1				1	9		1		2		1	1				1		1			2	1					2					1		1	1			3
	Belgium	100		65					4	4			1	1		4					1	1	2		1		1					3					1		1				4
	Czech Republic	100	1	1	61				2	8		1		2		1	2		1		1		1			1	3					2					2	1	2				4
	Denmark	100		1		68			1	4				1		1	1				1	2	2		2		1					3					1		1				5
	Estonia	100					67	2	1	3				1		1	1					2	1		1		5					2					1	1	1				7
	Finland	100		1		1		66	1	5				1		1					1	2	2		1		6					4					1		2	1			3
	France	100		1					75	4				2		1					1		1		1	1	1					3					1		1				4
	Germany	100	1	1	1				2	73			1	2		1	1				1	1	2		1	1	1					3					1		1				3
	Greece	100							1	1	77			1		1					1		1				3		1			2					1						6
	Hungary	100	2	1	1				2	8		60		2		1	1		1		1		1				3					3					2	1	2				5
	Ireland	100		1					2	2			58	1		3					1		6		1	1	1					12					1		1	1			5
	Italy	100							2	3				80		1					1		1			1	1					1							1				4
	Luxembourg	100	1	5					3	9			2	3	41	2					2		7			6	1					7							1	1			7
	Netherlands	100		2					2	5				1		64					1		3		2		3					4		1			1		1				6
	Poland	100	1	1	1				1	5				2		1	72				1		1				3					2					1	1	1				3
	Portugal	100		1					2	4				2		1		68			7		1		1		1					2		1			1		1				5
	Slovak Republic	100	1	1	3				2	7		1		2		1	1		56		1		2				7					2					2	3	2				4
	Slovenia	100	2		1				2	5				4		1	1			66	1		1			1	2					2					1		1				6
	Spain	100							2	2				1		1					79		1				1					2							1				5
	Sweden	100		1		2		1	2	4				1		1	1				1	66	2		3		3					3					1		1				3
	United Kingdom	100							1	2				1		1					1		83		2		1					3							1				2
Other Europe	Iceland	100				1			3	4				1		1						1	1	63	1		2					6		1			2		2				8
	Norway	100				1			1	2				1								2	1		85		1					2											2
	Switzerland	100	1						2	7			1	2		1					1		2			72	1					3					1		1				3
	Russian Federation	100								1																	93					1											2
Middle East	Israel	100		1					1	2			1	2		1							2			2	1	69	1			5					1	1	2	1			4
	Turkey	100							1	2				1							1		1				4		78			2					1		1				5
North America	Canada	100								1													1							80		9					1		1				3
	Mexico	100								1																				1	70	13					2	2	3				4
	United States	100								1													1							1	1	89					1		1				3
South America	Chile	100								1													1									4	82	1			1	1	1				6
	Brazil	100								1																						2		91									3
Oceania	Australia	100								1																						2			87		1		1		1		4
	New Zealand	100							1	1													1									2			3	82	1	1	1				4
Other Asia	Japan	100								1																						2			1		85	1	2		1		5
	Korea	100							1	2													1				1			1		5			2		5	59	5	1	1		14
	China	100							1	2													1				1			1		4		1	1		4	3	67	1	1		10
	India	100								1													1			1						2			1		1	1	2	78			8
	Indonesia	100								1																						2					1	1	1		86		5
	South Africa	100							1	2													1									2					1		1			84	6
	Rest of the World	100	1	1		1		1	3	6	1		1	3		2	1				2	1	4		1	1	6	1	1	1	1	18	1	3	3		12	5	12	4	3		

Note: Darker shading shows higher shares of foreign value added; shares below 1% are not represented. 1. Rest of the world: domestic value added is not available.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en, (accessed April 2013).

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This table suggest a number of more general observations: [2]

- At the economy-wide level, most intermediates are sourced in the domestic economy, and foreign value-added content is generally higher in smaller countries (see Chapter 1). Foreign value-added content is significantly higher in manufacturing industries such as electronics and transport equipment, where it can reach 50-60%. In contrast, domestic value-added content is much higher in business services' exports.
- International sourcing has a strong regional dimension, as intermediates are mainly sourced within the regional blocs of the European Union, North America and Asia (also see Chapter 1). The importance of distance is confirmed by the marked bilateral sourcing between neighbouring countries (including smaller ones). Regional sourcing is particularly important in the transport equipment industry: high transport costs make intercontinental shipping very costly, especially downstream (e.g. complete cars or subsystems). In addition, political pressures may also motivate lead firms to locate production close to end markets; the high cost and visibility of automotive products risk creating a political backlash if imported vehicles represent too large a share of the vehicles sold. There is also pressure for supplier co-location in regional production systems for operational reasons, such as just-in-time production, design collaboration and the support of globally produced vehicle platforms (Van Biesebroeck and Sturgeon, 2010).
- Each regional block has a number of clusters (again especially in manufacturing). They concentrate around larger countries: Germany, France, Italy and the United Kingdom in the EU; the United States in North America, and Japan and China in Asia. For example, Germany has bilateral linkages with the Czech Republic, Hungary, Poland and the Slovak Republic; it supplies intermediate inputs to these countries and also sources intermediates from them. In Asia there is strong bilateral sourcing between China, Indonesia, Japan and Korea.
- The importance of a number of these hubs clearly goes beyond the region as some countries supply intermediates worldwide. In electronics and transport equipment, China, Germany, Japan and the United States produce significant inputs for almost all countries. France, Italy, Korea, the Russian Federation and the United Kingdom are primarily regional suppliers of manufacturing intermediates; in business services there are fewer world (the United States) and regional (Germany, Japan and the United Kingdom) suppliers.
- China clearly takes the lead among emerging economies in manufacturing GVCs. It is a major supplier of intermediate inputs to all other BRIICS countries (Brazil, India, Indonesia, the Russian Federation and South Africa), but it sources relatively few inputs from them.

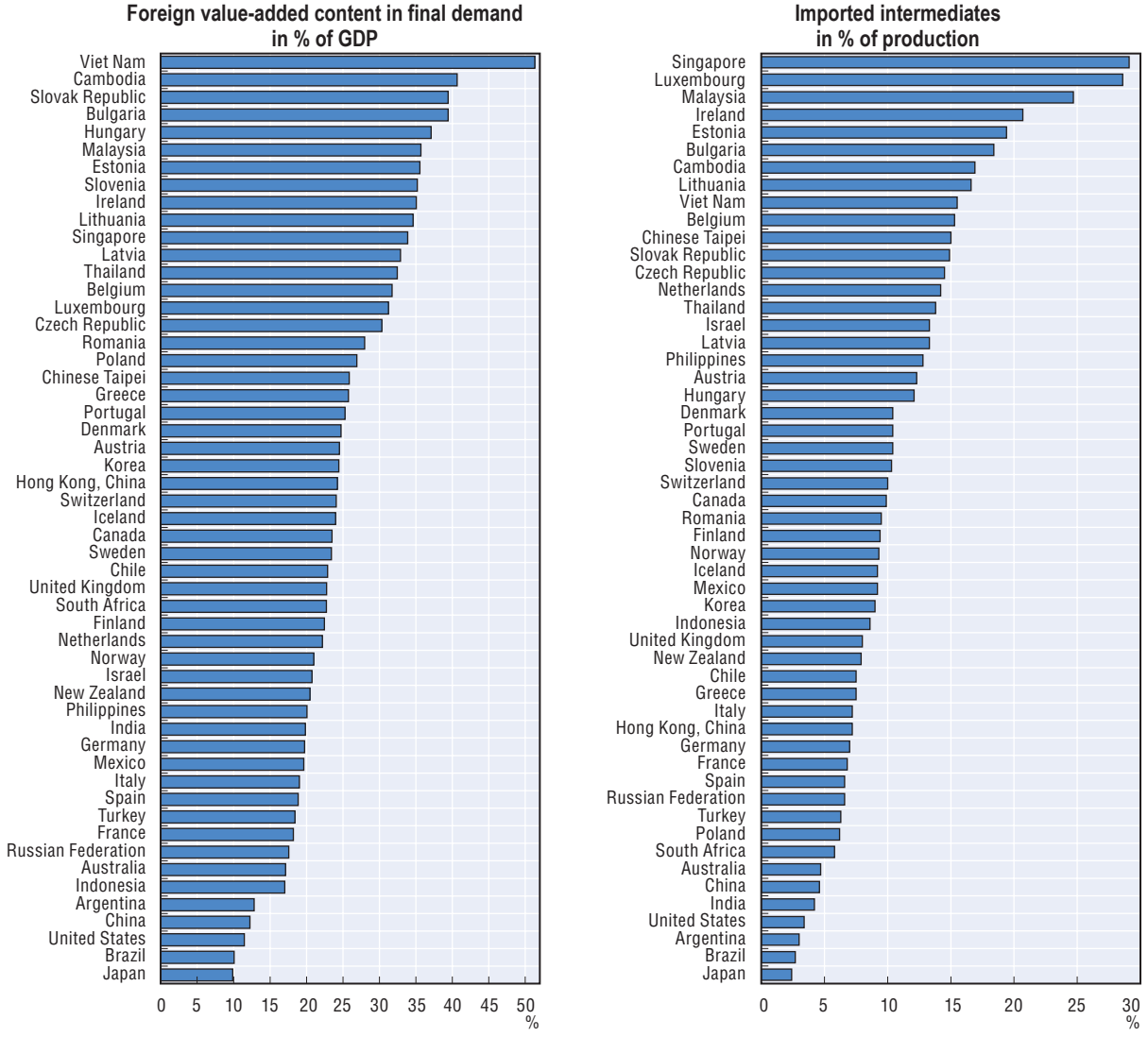
Growing limits to national policies

This growing interdependence implies that the drivers of competitiveness increasingly include factors beyond the scope of national policies. This limits the degree to which policy makers directly influence growth and job creation within their national borders. Nevertheless, there has been renewed interest in industrial policy in OECD and emerging economies in recent years. In the aftermath of the economic and financial crisis of 2008-09, policy makers in OECD economies are seeking new sources of economic growth and employment. Some countries are concerned that their economic growth trajectory is not

sufficiently balanced. In others, there are calls for industrial policies to strengthen specific sectors, technologies or areas of economic activity, such as advanced manufacturing, knowledge-intensive business services or the "green" economy in order to tap into new sources of economic growth. Emerging economies use industrial policies as part of their longer-term economic development strategies (Warwick, 2013).

It is not easy to design and implement effective industrial or competitiveness policies in a GVC landscape of fragmented and dispersed activities. For example, policies that promote domestic activities can have spillover effects in other countries via participation in GVCs. Policies that target domestic demand may be ineffective because of the large foreign value-added content in final demand (Figure 6.1). This was an important policy concern during the 2008-09 economic crisis, when policy measures were adopted to stimulate domestic consumption. Some countries introduced conditionality criteria to increase the benefits of stimulus packages in the domestic economy.

Figure 6.1. Foreign dependency of final demand and production, 2009



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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The situation is similar for measures to promote domestic production and output because of the growing shares of imported intermediates in an economy's production; measures taken in one country will also benefit the production of intermediates abroad (Figure 6.1). The spillovers may even be greater if domestic companies cannot find enough domestic suppliers and have to revert to international sourcing to satisfy demand.

Instead, policies increasingly focus on domestic factors of production to ensure that national policy measures affect the domestic economy. However, with the rise of GVCs, some factors of production have become increasingly footloose, and firms move activities and resources across countries. Therefore, rather than promote activities and factors that are potentially highly mobile, it is increasingly important to focus on factors that "stick" to the domestic economy (Baldwin, 2012): human capital and skills, high-quality infrastructure, well-developed industry-university linkages, sound institutions, etc.

All this reflects the growing tension between the truly global character of the strategies of individual firms that participate in GVCs and "national" policies that target local jobs and value added. In an era in which some multinational enterprises (MNEs) are larger than some national economies[3], it is not easy to pinpoint the contribution of domestically owned firms to the national economy. Moreover, as companies themselves become increasingly global through their international sourcing, their connections to their "home" country have weakened. Promoting the competitiveness of the domestic economy is therefore no longer the equivalent of promoting the competitiveness of domestic companies (see Chapter 1).

The growing complexity of the global economy requires smart (industrial) policies that strike a balance between stimulating economies' international orientation on the one hand and harnessing the local benefits of GVCs on the other. Concerns about the effectiveness of national policies and potential spillover effects to other countries are rising as policy makers in countries faced with serious budgetary constraints look for more effective and lower-cost policy interventions. Moreover, industrial policies with a strong national focus may curtail local companies' international engagement and negatively affect their competitiveness. Defensive policies aimed at retaining industries at home ignore the reality of today's global economy: in a world characterised by GVCs, firms require imports from abroad and may need to offshore some of their activities to remain competitive at home. Relocating some activities abroad leads to important productivity increases that can support job creation throughout the economy. Protection of a specific activity in the domestic economy can create cost disadvantages with upstream and downstream effects throughout the economy and eventually weaken the competitiveness of the whole value chain.

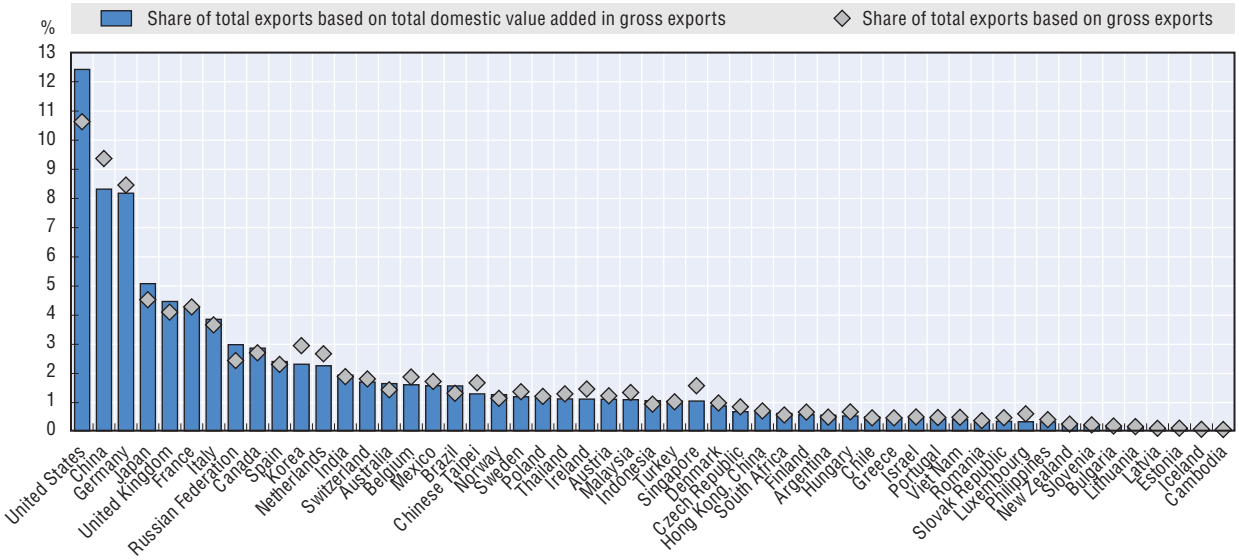
International sourcing, export specialisation and competitiveness

GVCs increasingly challenge traditional (export) competitiveness measures

International competitiveness is typically assessed on the basis of export market shares and indicators of revealed comparative advantage (RCA).[4] The emergence of GVCs raises questions about such measures of competitiveness, as countries' export specialisation increasingly reflects imports of intermediates from abroad. Instead, using export flows expressed in value-added terms allows to capture countries' capacity to add value across activities. For example, on the basis of the domestic value added embodied in exports, the United States was still the largest exporting economy in 2009, which it was not on the basis of gross exports (Figure 6.2). Economies heavily engaged in global value chains,

such as China, tend to have significantly lower shares of total exports based on domestic value added than they have in terms of gross exports. Economies such as the United States, Japan and the United Kingdom, but also the Russian Federation and Brazil, have higher shares based on domestic value added than on gross exports.

Figure 6.2. Export shares, 2009



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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In a world of GVCs, comparative advantage increasingly reflects strengths at the level of activities, tasks and production stages. Competitiveness should no longer be assessed (solely) at the level of industries or products, but also in terms of activities ("What you do matters more than what you sell"; The Conference Board, 2012). Indicators based solely on export data (in gross terms) may misrepresent the real specialisation of countries: they may simply reflect the fact that a country is specialised in the final assembly of a good but imports all the necessary intermediate inputs and adds little or no value to the good itself. Koopman et al. (2011) have shown that RCA measures based on export flows in terms of value added give a more accurate indication of economies' competitiveness, in particular in industries and countries where GVCs are pervasive. For example, they report that the ranking of China and India, which have significant assembly activities (characterised by low value added), significantly drop in value-added rankings, while developed economies typically move up.

Figure 6.3 presents RCA measures in gross and value-added terms for "Basic metals and fabricated metal products" and for "Electrical and optical equipment". It also presents a more detailed breakdown by industry level for Germany and the Slovak Republic. It shows significant variations in both the ranking and size of RCA measures both across and within countries. While positions in the rankings change, the rankings also show a relatively high degree of stability.[5] Not surprisingly, industries that involve a high level of international sourcing show on average larger dissimilarities between the two RCA measures. RCA measures based on value added also provide new insight into the international specialisation of countries. In general, larger countries generally show smaller dissimilarities between the two RCA measures, as they are less dependent overall on international sourcing. Annex 6.A3 presents more results on dissimilarities in RCA measures on the country and industry level.

Figure 6.3. RCA based on gross exports and value-added exports, two industries and two countries, 2009

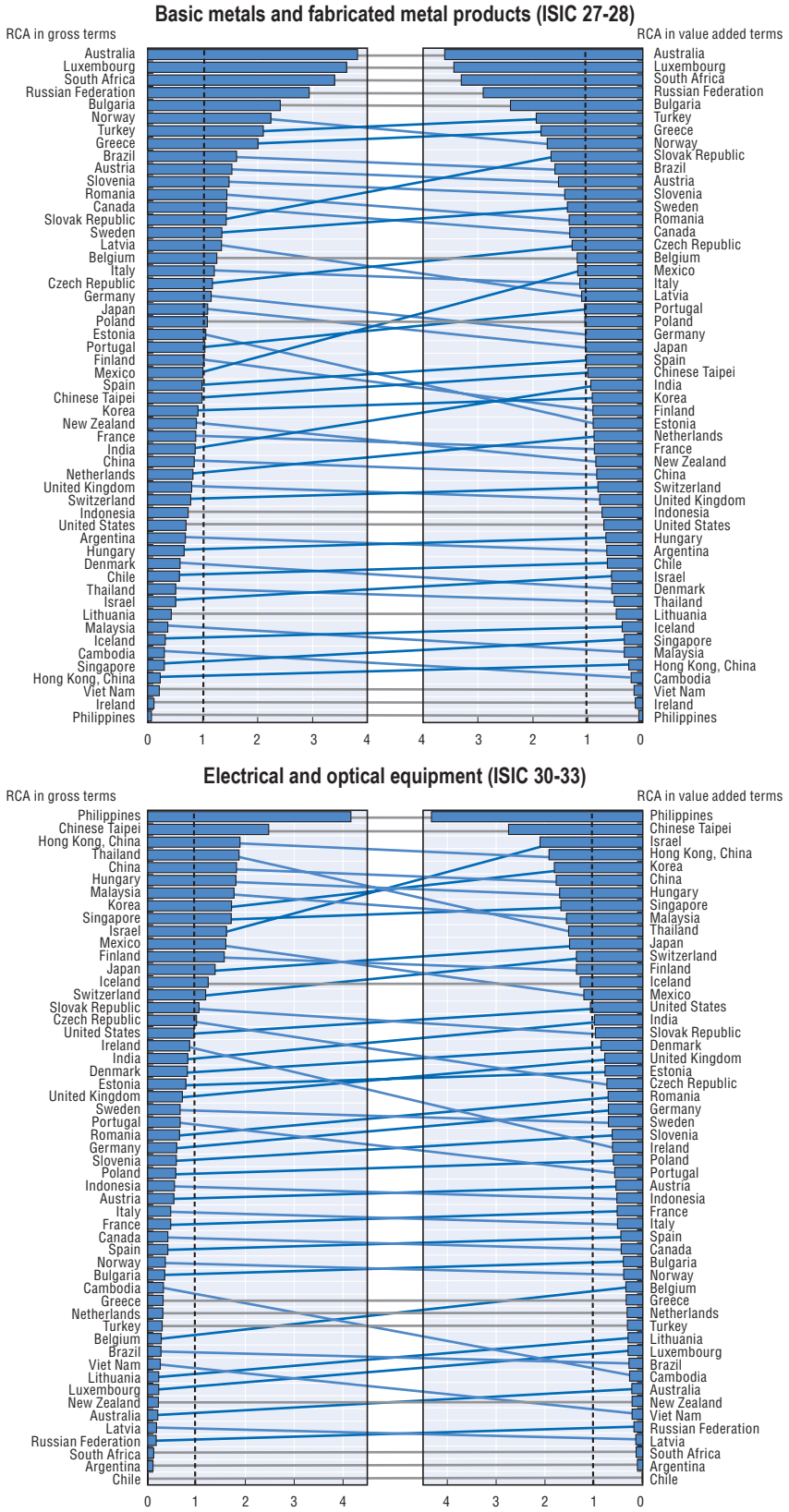
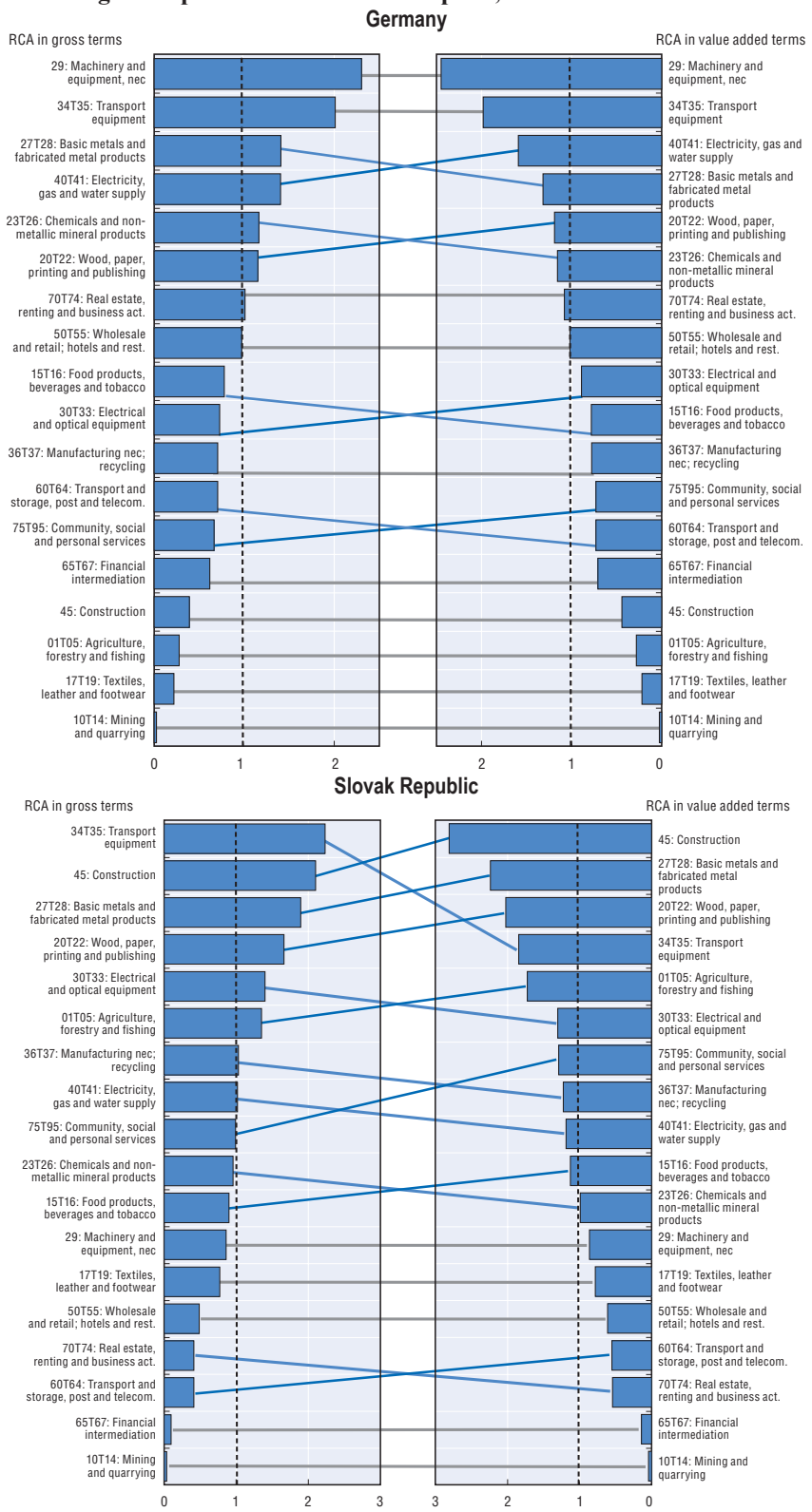


Figure 6.3. RCA based on gross exports and value-added exports, two industries and two countries, 2009 *(cont'd)*



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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(International) sourcing enhances export specialisation and competitiveness

The international sourcing of intermediates in GVCs helps firms to lower costs, acquire higher-quality inputs, and improve productivity and (export) competitiveness. While many studies have documented the strong connection between imported inputs and firm productivity (see Chapter 1), only recently have a number of studies reported on the positive effect of international sourcing on export performance (Bas and Strauss-Kahn, 2011; Bas, 2012; Feng et al., 2012; Aristei et al., 2013). Moreover, the effects of offshoring go beyond improved export performance on the firm level; offshoring also matters for countries' export specialisation and competitiveness.

Extending the traditional analysis of countries' comparative advantage[6] shows that GVCs positively affect the international specialisation of countries by enlarging the sourcing possibilities both within the domestic economy and abroad. The empirical model in Table 6.2 adds interconnectedness through offshoring to the existing framework of determinants of export specialisation. The analysis includes external economies of scale, the country's capital endowment (dependent on capital intensity at the industry level; Romalis, 2004) and high-skilled labour endowments (dependent on high-skill intensity at the industry level) as variables to capture the more traditional explanations of international trade.

Export specialisation or competitiveness are measured in RCAs in gross as well as value-added terms, reflecting the limitations of traditional RCA measures in the presence of GVCs. Deardorff (2012) describes how RCA measures can be used, together with other data, as a guide to what causes actual patterns of trade between countries and whether these are driven by the traditional explanations of comparative advantage or by other factors.[7] Annex 6.A4 gives detailed information on the development of the model, the construction of variables (including fixed effects) and the sample (which includes OECD and non-OECD economies).

Increased sourcing of intermediates is captured through outsourcing and offshoring on the industry level to reflect the choices companies face when sourcing inputs for their production processes. Outsourcing indicates a change in the boundaries of the firm that assigns the production of the intermediate input to an independent supplier; this is captured in the variable "intermediates use intensity" at the industry level (i.e. the cost of intermediate inputs as a share of total output). Offshoring relates to the location of production and involves the firm moving production of the intermediate input abroad; this is proxied by the variable "intermediates import intensity" (i.e. the share of imported intermediates in total intermediates used by that industry). Both variables are expressed relative to world averages in the same industry and therefore point to intensities that deviate from technological norms of production for either of the two activities.

Rather than test the traditional explanations of international specialisation, the results for the control variables confirm the core determinants of specialisation formalised in international trade theory: physical and human capital endowment favour export specialisation in industries that use these factors of production intensively. Large market size is also found to drive export competitiveness and points to the importance of (external) economies of scale across industries. Overall, despite significant qualitative differences between the results for gross exports and value added, the direction of the impact of the various determinants remains unchanged.

Table 6.2. The effects of outsourcing and offshoring on the export competitiveness of countries

	RCA in gross exports (symmetric)						
Variables	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**
Domestic demand index	0.079***	0.077***	0.081***	0.081***	0.072***	0.079***	0.074***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Physical capital endowment × Physical capital intensity	0.001***	0.001***	0.002***	0.001***	0.002***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
High-skill endowment × High-skill intensity	1.828***	1.849***	2.057***	2.104***	1.724***	1.866***	1.807***
	(0.253)	(0.251)	(0.251)	(0.249)	(0.247)	(0.254)	(0.249)
Outsourcing Index (broad definition - intermediate use intensity)		0.165***		0.154***			
		(0.020)		(0.019)			
Offshoring Index (broad definition - imported intermediates intensity)			0.097***	0.097***			
			(0.006)	(0.006)			
Outsourcing Index (narrow definition - intermediate use intensity)					0.058***		0.065***
					(0.004)		(0.004)
Offshoring Index (narrow definition - imported intermediates intensity)						0.006***	0.008***
						(0.001)	(0.001)
Observations	18639	18612	18603	18603	18612	18603	18603
R-square	0.192	0.197	0.209	0.212	0.205	0.197	0.211

	RCA in value added (symmetric)						
Variables	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**
Domestic demand index	0.077***	0.075***	0.079***	0.078***	0.071***	0.077***	0.072***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Physical capital endowment × Physical capital intensity	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
High-skill endowment × High-skill intensity	1.963***	1.961***	2.124***	2.151***	1.858***	1.992***	1.935***
	(0.255)	(0.254)	(0.254)	(0.254)	(0.250)	(0.257)	(0.252)
Outsourcing Index (broad definition - intermediate use intensity)		0.098***		0.088***			
		(0.020)		(0.019)			
Offshoring Index (broad definition - imported intermediates intensity)			0.075***	0.074***			
			(0.007)	(0.006)			
Outsourcing Index (narrow definition - intermediate use intensity)					0.057***		0.063***
					(0.004)		(0.004)
Offshoring Index (narrow definition - imported intermediates intensity)						0.006***	0.008***
						(0.001)	(0.001)
Observations	18639	18612	18603	18603	18612	18603	18603
R-square	0.191	0.193	0.2	0.202	0.203	0.195	0.208

Note: Robust standard errors are reported in parentheses. Significance levels are indicated by: *** at 1%, ** at 5%, and * at 10% level.

Source: OECD calculations.

More importantly, the empirical results lend broad support to the hypothesis that outsourcing and offshoring in the context of GVCs enhance countries' export specialisation and competitiveness. The positive relationship between offshoring and RCAs in gross terms partly reflects the fact that exports expressed in gross terms increasingly include (imported) intermediates; hence, it implies that outsourcing and offshoring benefit competitiveness. The positive effect on RCAs in value-added terms, however, clearly signals the significant impact of increased sourcing on the export specialisation and competitiveness of countries. Greater use of intermediates sourced both domestically and abroad clearly allows countries to increase their value added in export activities.

The impact of sourcing is also positive when outsourcing and offshoring are restricted to the sourcing of intermediates within the industry ("narrow definition") instead of from any source ("broad definition").[8] Better use of intermediates allows firms and countries to specialise in industries and activities according to their comparative advantage, i.e. where they are more efficient than other firms and countries. The provision of cheaper, more differentiated, and better-quality inputs boosts productivity and allows firms to compete successfully in world markets.

The fact that offshoring and outsourcing have positive effects on competitiveness not only on the level of firms but also of countries has important policy implications. While outsourcing and offshoring typically have negative connotations, because they are associated with firm closures and job losses, importing of intermediates, including offshoring, actually increases countries' ability to export. Policy interventions intended to limit such competitive effects, often aimed at protecting individual firms or industries, may have an effect opposite to the desired one and thus reduce competitiveness.

Manufacturing competitiveness

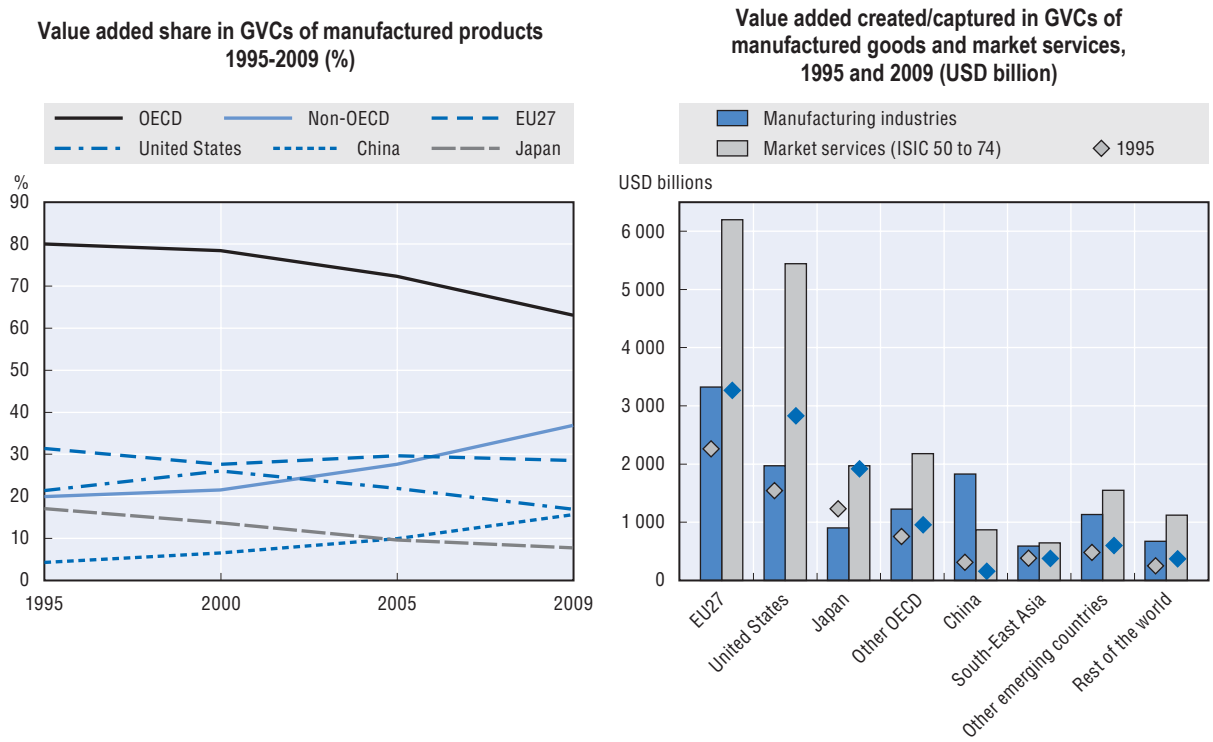
Does manufacturing still have a future in developed economies?

GVCs have dramatically reshaped patterns of manufacturing competitiveness during the past decades. As OECD countries have lost significant export market shares, doubts have arisen about the current and future competitiveness of mature OECD economies in global manufacturing (see Chapter 5). However, as discussed above, export market shares do not reveal the competitiveness of countries when GVCs are pervasive. Indeed, the loss in (export) market share seems at odds with the many case studies (such as that of the iPod) that find that European, Japanese and US companies still capture much of the value in manufacturing value chains, because they specialise in higher value-added activities such as branding, design, etc.

Looking at the distribution of value added inputs within manufacturing GVCs shows that developed economies still create and capture much value added and are still competitive in manufacturing (Figure 6.4). A new indicator based on the TiVA database shows the value added that countries earn from their participation in global manufacturing. The measure decomposes worldwide sales of manufactured products and identifies the value added inputs from different countries and industries; countries add value by producing final manufactured goods and the intermediates (goods and services) that are included in these manufactured goods (Timmer et al., 2012).[9] The value added created and captured by a country provides better insights in the competitive strength of that country when production is organised within GVCs. Like RCA measures based on trade in value added (see above), this indicator gives a more accurate picture of competitiveness when economies specialise not only in different products but also in different activities.

Furthermore, the indicator reflects economies' ability to compete in both domestic and global markets; one dollar gained abroad is equal to one dollar gained at home (Timmer et al., 2012). Annex 6.A2 presents GVC income in more detail.

Figure 6.4. Value added created/captured by selected economies and regions in GVCs of manufactured goods and market services, 1995-2009



Note: Other emerging countries include Argentina, Brazil, India, the Russian Federation and South Africa; Southeast Asia includes Brunei, Cambodia, Chinese Taipei, Hong Kong (China), Indonesia, Malaysia, Philippines, Singapore, Thailand and Viet Nam.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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The strong and rapid rise of emerging countries in manufacturing is reflected in the growing share in value added (inputs) in manufacturing GVCs of non-OECD economies; emerging countries such as Brazil, China and India have significantly increased the value added they create and capture in manufacturing GVCs through their growing participation in global manufacturing (see Chapter 5). Among OECD economies, Japan in particular has seen its share in manufacturing value added fall; the United States strengthened its contribution to manufacturing in the early 2000s mainly owing to the IT boom but has lost ground in recent years. Europe has maintained its overall position in manufacturing but this hides significant restructuring: manufacturing activities in the Czech Republic, Hungary, Poland and the Slovak Republic have expanded strongly following the eastward shift of European GVCs. Korea, Mexico and Turkey are among the OECD countries that have gained significantly in terms of value added.

Although their overall share is decreasing, OECD economies still add a great deal of value to manufacturing products; in fact, more than 60% of the world sales of manufactured products in 2009 represented value added inputs created in the OECD area. The value added derived from manufacturing GVCs by Europe and the United States is still larger than that

of China. A first reason for this is that OECD economies are specialised in higher-value, more technology-intensive products ("what you export matters") as well as in higher value-added activities ("what you do matters") in manufacturing. Second, the high value added of mature economies in manufacturing is also due to the growing use of services as (differentiated) inputs in manufactured goods (see below).

The specialisation in higher value-added activities and products has allowed mature economies to increase their value added from manufacturing GVCs between 1995 and 2009, although manufacturing value added in GVCs decreased significantly in Japan. Hausmann and Hildago (2011) discuss how advanced knowledge and capabilities contribute to the manufacturing competitiveness of mature economies as they allow to pursue fragmented specialisation into complex products. Emerging economies are generally specialised in more labour-intensive and low-cost assembly activities that create less value added. In general, however, both mature and emerging economies benefit from participation in manufacturing GVCs. Globalisation is not a zero-sum game in which one country only advances if others lose.

In addition to their large and rising value added in manufactured products, OECD countries also derive growing value added from their participation in services GVCs (Figure 6.4). This reflects to a large extent their shift to more services-oriented economies. Emerging economies create substantially lower value added inputs in market services GVCs; their activities in GVCs in market services are also much less extensive than in manufacturing. In parallel, gains in value added within GVCs between 1995 and 2009 in China, Southeast Asia and other emerging economies are larger in manufacturing than in services.

These far-reaching changes in competitiveness patterns have launched discussions on "making things instead of making ideas"[10] given that manufacturing competitiveness is no longer accompanied by large-scale domestic employment. Timmer et al. (2012) show that low-skilled and medium-skilled labour have captured ever smaller shares of GVC income in mature economies over the past decade, as OECD countries have increasingly moved towards producing ideas, concepts and services rather than physical goods. This has led in some countries to policy proposals that would discourage (manufacturing) companies from relocating activities abroad. However, the creation of new manufacturing jobs in developed economies is likely to remain modest, owing in part to the continuing technological progress that enables further productivity growth. Policies to protect existing jobs only take part of the GVC reality into account. This risks being short-sighted and may harm the domestic economy's competitiveness.

Another rationale for advocating a "new industrial policy" to support manufacturing is the fear that when emerging economies upgrade in GVCs (sometimes with the support of important policy interventions) the long-term manufacturing competitiveness of developed economies will be threatened. This argument suggests that the loss of core manufacturing activities may set off a reaction that will erode upstream and downstream activities in the value chain, including activities related to innovation and design, all of which could eventually weaken the competitiveness of OECD countries (Pisano and Shih, 2009, 2012). An implication is that high-income countries may struggle to retain innovative, R&D-based and higher value-added activities: ceding capacity in manufacturing might result in the loss of R&D and design capabilities in the longer term.

In a number of countries this has resulted in policy measures that foresee implicit support for the manufacturing sector. Yet old-style industrial policies characterised by industry-specific support policies or national champions have no role to play in a world of

GVCs. They distort international competition and the efficient operation of value chains and run the risk of an international subsidy war, with tax payers the main losers. More fundamentally, targeted support or subsidies are not the way to encourage long-term investment and the building of capabilities.

This is not to say that governments cannot play a useful role in maintaining manufacturing capabilities. Strategies and policies that support the building of new capabilities including skills, infrastructure and research, provide a way forward for ensuring the future of manufacturing in developed economies. Recent technological advances, such as the emergence of 3-D printing, may enable manufacturing firms to engage in tailored production – with the efficiency of mass production – close to their markets. Labour costs will be less important in these new products and production processes and will curb the need to offshore manufacturing activities to regions with low labour costs. It is not clear whether this would result in extra jobs given the limited role of labour (costs) in these production processes. Furthermore, given the high level of technological intensity,[11] most new jobs would likely be concentrated at the high skill end.

The growing importance of services for manufacturing

The character of manufacturing is profoundly changing and the distinction between manufacturing and services is increasingly blurred; recent empirical evidence shows the growing "servitisation" of the manufacturing industry.[12] Manufacturing firms increasingly use and produce services as inputs in their products (Nordas, 2010), and services have taken on greater importance for manufacturing competitiveness. Manufacturing today is much broader than the pure production of goods and includes service-related activities both upstream and downstream. The value of manufactured products increasingly reflects service inputs, as services as sold together or embodied with the goods. Services represent, for example, a growing share of the sales of Swedish manufacturing companies (Kommerskollegium, 2012).

Likewise, manufacturing exports include significant value added in service industries, a further indication of the importance of services for export competitiveness in manufacturing (Figure 6.5). OECD as well as non-OECD countries show significant shares of service inputs in their manufacturing exports; smaller countries source relatively more service inputs from abroad.

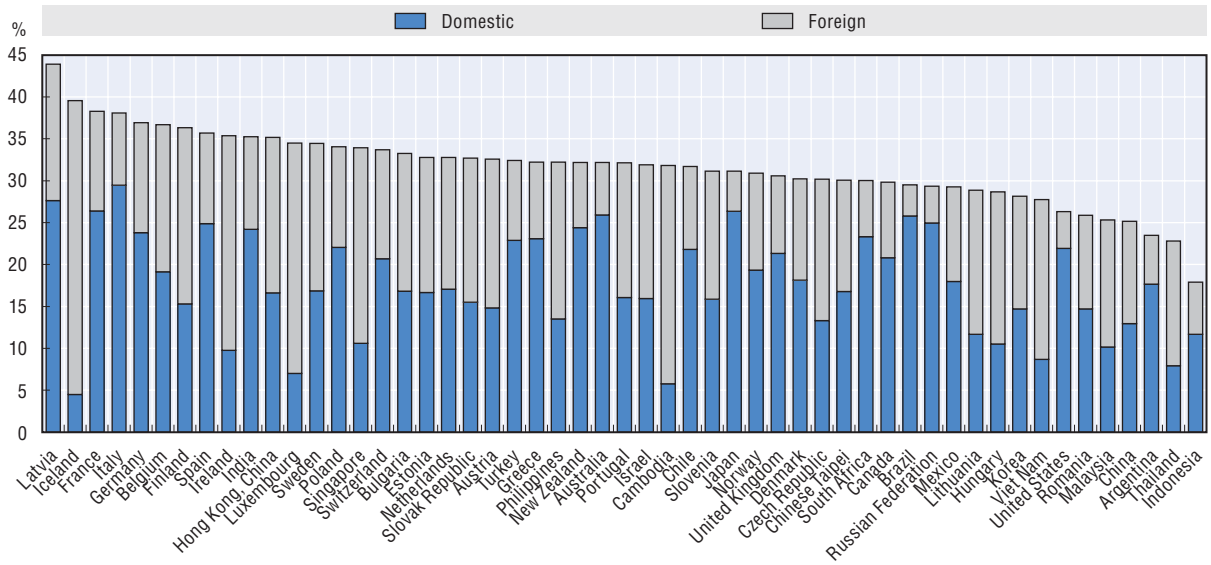
Services have become more important for manufacturing for a number of reasons. First, logistics, communication services, business services, etc., facilitate the efficient functioning of GVCs as they help to transfer goods, data, technology and (managerial) know-how across borders and to co-ordinate dispersed activities quickly and smoothly. Transport and communications networks are the backbone of GVCs and services provided to these networks, often by specialised suppliers (domestically or internationally), directly benefit manufacturing activities (see Chapter 3).[13] Several of these (supporting) services show a sticky character to the location where they are produced.

Second, manufacturing firms increasingly use services to gain a competitive advantage. Services help not only to raise productivity but also to differentiate, customise and upgrade products and develop closer, more longstanding relationships with customers (Kommerskollegium, 2012). Service activities (developed in house or bought in) promote the export activities of manufacturing companies in Sweden (Lodefalk, 2012). As GVCs increasingly allow for the unbundling of business functions and as pure production activities are increasingly located in emerging economies, manufacturers in OECD countries rely more on complementary non-production functions to create value.

Manufacturing companies no longer sell goods alone, but instead sell bundles that include design, development, marketing, warranties and after-sales care. A company like Rolls Royce does not simply sell cars but offers "solutions, outcomes or experiences" to meet customers' needs and differentiate itself from competitors. Xerox has restructured into a "document solution" company that offers advanced printer systems but also services such as document management and consulting; in fact, services represent around 40% of Xerox's turnover and are soon expected to represent 50% (Benedettini et al., 2010). In classifying the activities of manufacturing companies as "manufacturing" and/or "services", Neely et al. (2012) report the growing importance of combined manufacturing-services activities across countries. A large part of the future growth in manufacturing is expected to come from so-called "manu-services" which combine advanced manufacturing with a range of services (Sissons, 2011).

Policies that focus exclusively on manufacturing may ignore the growing importance of services for value creation in GVCs, including for the production of manufactured goods. An integrated view of manufacturing and services is needed and should explicitly take into account their complementary character. Furthermore, as services are still – at least for now – less susceptible to relocation abroad, turning innovation and knowledge into jobs may be more likely to occur in services than in manufacturing, although a strong manufacturing sector is needed to underpin job creation in services.

Figure 6.5. Services value-added content of gross manufacturing exports, 2009



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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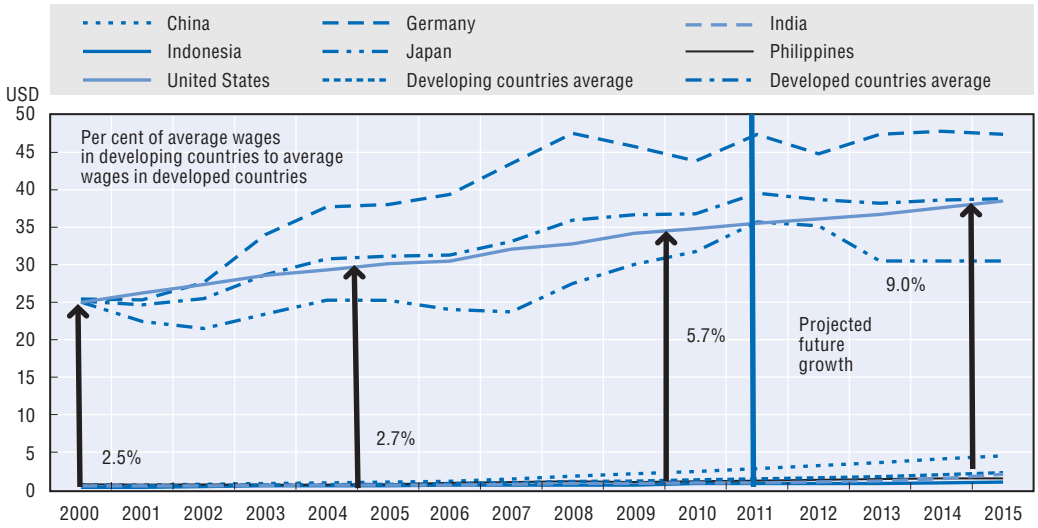
Is there a trend towards back-shoring on the horizon?

GVCs are very dynamic and will continue to evolve as costs increase, technologies continue to change, and firms reconsider their operations. Will the offshoring of manufacturing to emerging countries slow down and will GVCs turn back to developed economies? A number of companies (especially in the United States) have been reported to consider bringing activities they offshored to China back to the United States. Analysis by the Boston Consulting Group (2011) suggests that this trend towards "back-shoring" (also called "on-shoring" or "re-shoring") could lead to a manufacturing "renaissance" in the United States.[14]

Back-shoring is becoming more attractive since the cost structure of production is changing in emerging countries and is narrowing the cost gap between emerging and developed economies. In China, for example, average hourly wage increases of 15-20% a year have eroded the country's cost advantage in labour-intensive activities. India, Indonesia, the Philippines, and others have also experienced strong wage increases as the middle classes have grown (see Chapter 5). The average hourly wage in emerging economies was estimated at around 2% of the US average in 2000 and is expected to reach 9% in 2015 (Figure 6.6). As productivity differences narrow and the share of labour in total production costs shrink, savings from offshoring become much smaller. Companies respond to these rising labour costs by increasingly automating factories in emerging countries, relocating production to other emerging countries where labour costs are still low, and/or eventually back-shoring specific activities.

Figure 6.6. Average hourly wages in emerging and developing countries



Source: Deloitte analysis, Economist Intelligence Unit data; published in World Economic Forum (2012).

Another explanation for the trend towards back-shoring is that certain hidden costs were not fully taken into account in the offshoring decision (Porter and Rivkin, 2012). There is often too much focus on labour costs and too little on other costs when establishing production processes overseas. A 2011 study by Ernst & Young showed that for more than one-third of US manufacturers, entering high-growth markets such as Brazil, China and India resulted in higher than expected total costs. Indirect costs may be unexpectedly high because of the need for additional monitoring and training, travel and personnel costs, transport costs, higher obsolescence and inventory costs, or unanticipated loss of intellectual property. Products manufactured in emerging countries but destined to the home market might then be produced at higher "total landed costs".

Back-shoring is also related to firms' strategies to balance cost savings and risk dispersion in GVCs. Natural disasters such as the recent Japanese earthquake/tsunami and the floods in Thailand led to global disruptions of GVCs and halted the worldwide supply of products and intermediates in several industries (see Chapter 8). Just-in-time models, lean structures and the absence of redundancy in a chain imply that a breakdown in one part of the chain may quickly have detrimental effects throughout the value/supply chain. In order to diversify the risks inherent in their complex supply chains, companies

increasingly consider alternative GVCs for the same product. In addition to GVCs in low-cost countries, companies set up (often shorter) GVCs in higher-cost countries close to their major markets.

A final reason to bring manufacturing activities back home is the greater operational flexibility it offers companies. The organisation of long and complex GVCs that cross several countries limits companies' ability to adjust the production process to market signals. Negative shocks to final demand are not always easily incorporated in GVCs' scheduled production runs; the global financial crisis of 2007-08 demonstrated how a slowdown in downstream activities amplifies the reduction in the demand for inputs upstream. Closer to home, specific customer needs ("manufacturing on demand") can be met more rapidly as developers, engineers, manufacturing and operating staff are closer together. Physical distance often results in less efficient co-operation and co-ordination of the different production stages.

Technological advances are expected to support this trend: digital manufacturing that relies on clever software combined with novel materials and new production techniques (e.g. nanotechnology) is expected to reshape production processes in manufacturing. While mass-produced products will continue to be manufactured according to more traditional – albeit more automated and flexible – methods, new ways of manufacturing will increasingly result in smarter products and smarter production processes (World Economic Forum, 2012). Digital technology will lower the cost of producing smaller batches of a wider variety; as scale economies decrease, "manufacturing on demand" is expected to become (more) economically feasible. Additive manufacturing such as 3-D printing, for example, builds products from successive layers of material and allows for tailoring products to individual customers' needs.

In spite of back-shoring's growing appeal, there is no consensus on how big this has or will become. It is expected that offshoring to emerging countries will remain an important strategy even though costs are on the rise in these countries. Emerging countries offer large and rapidly growing markets for manufactured products given their growing middle classes. Back-shoring to developed economies might become more prevalent in technological and quality products characterised by fast product cycles and for which market feedback is important. The mass production of labour-intensive, commoditised products will most likely remain concentrated in emerging economies where production costs, including labour, are lower.

Notes

1. Krugman (1996) famously noted that while we can refer to the competitiveness of firms, we cannot speak about the competitiveness of countries. If a corporation is not performing and its business positition is unsustainable, i.e. if it is uncompetitive, it will eventually go out of business. It is much harder to say when a country is uncompetitive.

2. Individual countries not presented in the table are grouped in the category "rest of the world"; this explains the large size of the percentages in the corresponding column. Future work on the OECD-WTO TiVA Database will extend the geographical coverage of the estimates.

3. Such comparisons should be interpreted with care as MNE sales/production (which is a gross concept) is often compared with countries' GDP which is a value-added concept.

4. Empirical measures of comparative advantage go back to the seminal work of Balassa (1965). The shares of a given sector in a country's exports are compared to that sector's share in world exports. A value larger than 1 is said to show that a country possesses a comparative advantage and is specialised in that industry, while a value smaller than 1 points to a comparative disadvantage. Measures of comparative advantage suffer from a number of shortcomings, however (for an overview, see Sanidas and Shin, 2010).

5. This is to some extent explained by the relatively high level of industry aggregation in the OECD-WTO TiVA Database; more disaggregated industries will typically show greater dissimilarities between RCA measures in gross and value added terms.

6. The question of where comparative advantage originates is as old as the study of international trade. There have been many attempts to identify the economic conditions that determine comparative advantage. Ricardo (1772-1823) attributed specialisation to technological differences between countries, Ohlin (1933) focused on country endowments of factors used relatively intensively in the production of certain goods, and more recently Krugman's New Trade Theory (1979) adds imperfect competition and economies of scale to the determinants of international specialisation. In all these theories, comparative advantage in a broad sense reflects a lower opportunity cost of production and motivates international trade.

7. Most studies have used export flows to study determinants of international competitiveness; only a few have used RCAs in econometric models (Dalum et al., 1998; Sleuwaegen and DeBacker, 2001).

8. Endogeneity issues may arise between offshoring broadly defined and export specialisation as offshoring intensity is structurally associated with the RCA index; these issues are not very important when the narrow definition of offshoring is used.

9. Worldwide, global expenditures on manufacturing goods represent global value added in manufacturing activities. As Timmer et al. (2012) note, this does not necessarily hold on the country level as current account imbalances will result in value added produced higher/lower than final consumption in a country.

10. Discussions on "made in the United States/Japan, etc." contain similar arguments.

11. This high-technology manufacturing would not be limited to more technology-intensive industries. It could also concern more traditional industries (e.g. embedded software on advanced computer chips in clothing).

12. Other terms used are servicification, servicisation (Kommerskollegium, 2012).

13. The increasing use of services in manufacturing is also some extent a statistical artefact. Many services activities were previously provided in house but are now increasingly outsourced and offshored by manufacturing companies (Pilat et al., 2006; Rowthorn and Ramaswamy, 1998; *The Economist*, 2011).

14. The Boston Consulting Group estimates that in areas such as transport, computers, fabricated metals and machinery, 10-30% of the goods that the United States now imports from China could be made at home by 2020, boosting American output by USD 20-55 billion a year.

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Annex 6.A1. Foreign value added and domestic content of gross exports, 2009 (%)

Foreign value added and domestic content of gross exports, electrical, and optical equipment (ISIC 30 to 33), 2009 (in %)

Area	Country	Total gross exports[1]	Austria	Belgium	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Luxembourg	Netherlands	Poland	Portugal	Slovak Republic	Slovenia	Spain	Sweden	United Kingdom	Iceland	Norway	Switzerland	Russian Federation	Israel	Turkey	Canada	Mexico	United States	Chile	Brazil	Australia	New Zealand	Japan	Korea	China	India	Indonesia	South Africa	Rest of the World
	Partner		EU																					Other Europe				Middle East		North America			South America		Oceania		Other Asia						
EU	Austria	100	56	1	1				2	13		1		3		1	1				1	1	1			2	1					3					2		2	1			4
	Belgium	100		67					3	5			1	1		3					1	1	2			1	1					3					1		1				3
	Czech Republic	100	1	1	37				2	11		1		2		3	2		1		1		2			1	2					4					7	2	8	1			9
	Denmark	100		1		71			1	6				1		1	1				1	2	2		1		1					2					1		1				3
	Estonia	100		1			56	2	2	5				1		1	1				1	4	2		1	1	2					4					3	1	3				7
	Finland	100	1	1		1	1	46	1	9				1		1	1				2	3	4		1		2					9					2	1	5	2			4
	France	100		1					70	5				3		1					2		1			1	1					3					1		2				4
	Germany	100	1	1	1				2	75				1		1	1				1		1			1	1					3					2	1	2				3
	Greece	100		1					2	3	68			3		1					1		1			1	3		1			2					1		1				6
	Hungary	100	2	1	1				3	11		46		2		2	1		1		1		2			1	1					4					3	3	5				8
	Ireland	100		1					2	3			38	1		4	1				1	1	7		1	1	1			1	1	15					2	1	4				10
	Italy	100		1					2	4				77		1					1		1			1	1					2					1		1				3
	Luxembourg	100	1	5	1				5	14			1	2	41	3					1	1	3		1	1	2					4					4	1	2	1			4
	Netherlands	100	1	3				1	2	8			1	1		49					2		5		1	1	1					8					2	1	3	1			5
	Poland	100	1	1	1				2	5				2		1	66				1	1	1				2					2					2	2	3				4
	Portugal	100		1					4	11				3		3		46			13		2		1	1	1					2		1			1	1	2				4
	Slovak Republic	100	1	1	3				2	8		1		2		1	2		43		1		5				2					3					3	7	4				8
	Slovenia	100	2	1	1				2	6				5		1	1		1	59	1	1	1									3					2	1	2				7
	Spain	100		1		1			2	4				2		1		1			72		2			1	1					2					1		1				4
	Sweden	100		1		1		1	2	6			1	1		2	1				1	57	3		2	1	1					5					1	1	2	1			4
	United Kingdom	100		1					1	4			1	1		1					1		75		1		1					4					1	1	2				3
Other Europe	Iceland	100		1		3			3	5			1	1		2	1				1	2	2	49	3		1					5					3	1	4				10
	Norway	100		1		2			1	3				1		1	1				1	2	2		68		1			1		3					2	1	2				4
	Switzerland	100	1						2	8				3		1					1		2			68	1					3					1		1			1	3
	Russian Federation	100							1	2																	88					1					1	1	1				2
Middle East	Israel	100		1					1	2				1		1							2			1	1	73				6					1	1	2				4
	Turkey	100							2	3				2							1	1	1			1	2		70			2					2	1	3				5
North America	Canada	100							1	1				1									1							69	1	14					2	1	2				4
	Mexico	100							1	2				1									1							1	43	20					6	4	8				8
	United States	100								1																				1	1	87					2	1	2				3
South America	Chile	100																														1	95										1
	Brazil	100								1																						3		85			1	1	2				3
Oceania	Australia	100								1													1									3			81		2	1	2				5
	New Zealand	100							1	2				1									1									4			3	73	3	1	3				4
Other Asia	Japan	100								1																						3			1		82	1	3		1		5
	Korea	100							1	2				1									1				1					6			1		7	53	9	1	1		14
	China	100							1	2													1				1					5	1		1		6	5	57	1			15
	India	100								1													1			2	1					2			2		1	1	1	78			8
	Indonesia	100							1	1																						3			1		4	1	3	1	72		8
	South Africa	100							1	3				1									1				1					3			1		2	1	3			73	7
	Rest of the World	100	1	1					3	6			1	2		1					1	1	3		1	1	2	1		1	1	19	1	1	2		17	10	18	2	2		

Note:darker shading shows higher shares percentages of foreign value added; shares below 1% are not represented. 1. Rest of the World: domestic value added is not available.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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Foreign value added and domestic content of gross exports, transport equipment (ISIC 34 to 35), 2009 (in %)

Area	Country	Total gross exports[1]	Austria	Belgium	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Luxembourg	Netherlands	Poland	Portugal	Slovak Republic	Slovenia	Spain	Sweden	United Kingdom	Iceland	Norway	Switzerland	Russian Federation	Israel	Turkey	Canada	Mexico	United States	Chile	Brazil	Australia	New Zealand	Japan	Korea	China	India	Indonesia	South Africa	Rest of the World
	Partner		EU																					Other Europe				Middle East		North America			South America		Oceania		Other Asia						
EU	Austria	100	48	1	1				2	19		1		4		1	1		1		1	1	2			2	1					4					1		1	1			3
	Belgium	100	1	52	1				4	9			1	2		3	1				2	2	4		1	1	1					4					2	1	1				4
	Czech Republic	100	1	1	51				3	13		1		3		1	4		2		1		1			1	2					2					2	1	2				4
	Denmark	100	1	1		65		1	2	7				2		1	1				1	3	2		1		1					4					1		2				3
	Estonia	100					67	2	2	4				1		1	1					2	1		1		4					3					2	1	1				6
	Finland	100	1	1		1	1	57	2	9				2		1	1				1	3	2		1	1	4					4					1		2	1			3
	France	100		1					60	8				3		1	1				2	1	2			1	1					8					1		2				4
	Germany	100	2	1	1				3	66		1		3		1	1				1	1	3			1	1		1			4					1		1				3
	Greece	100		1					1	3	81			2		1					1		1				1		1			2					1		1				3
	Hungary	100	2	1	1				3	14		51		3		1	2		1		1		2			1	1					3					2	1	2	1			5
	Ireland	100	1	1					4	6	1		20	3		6	1				1	1	5		1	2	1				1	23					2	1	3				14
	Italy	100	1						2	4				77		1	1				1		1			1	1					2					1		1				3
	Luxembourg	100	1	6				2	8	11			1	2	42	5					1	1	3		1	1	1					3					1		1	1	1		5
	Netherlands	100	1	2	1				2	10				2		55	1				1	1	3		1	1	1			1		5					2	1	2				4
	Poland	100	1	1	1				2	9		1		4		1	61		1		1	1	1			1	2		1			3					2	1	2				3
	Portugal	100	1	1	1				5	12		1		4		1	1	41			13	1	2		1	1	1		1			2		1			2		1				4
	Slovak Republic	100	1	1	5				6	15		1		3		1	2		42		1		2			1	2					2					2	5	2				4
	Slovenia	100	2	1	1				6	7				5		1	1		1	52	2		1			1	1					2					1	1	1				8
	Spain	100		1	1				4	6				2		1	1	1			69		2			1	1					2					1		1				3
	Sweden	100	1	2	1	2		1	3	9				2		2	2				1	52	3		2	1	1					4					1	1	2	1			3
	United Kingdom	100		1					2	5				2		1	1				1	1	69		1		1			1		6					1		1				3
Other Europe	Iceland	100				1			2	3				1		2						1	1	62	2		1					9					2	1	3				5
	Norway	100				1		1	2	5				2		1	1				1	3	2		62	1	1			1		8					1		1				3
	Switzerland	100	1	1	1				3	11				4		1					1		2			60	1					6					1		1			1	2
	Russian Federation	100			1				1	3				1					1								79					1					2	2	1				4
Middle East	Israel	100							1	2				1		1							1			1		74				9					2	1	1				3
	Turkey	100							3	3				2			1				1		1			1	3		70			3					1	1	2				5
North America	Canada	100							1	1				1									2							64	1	20					2	1	2				3
	Mexico	100								2																				1	67	16					2	1	3				3
	United States	100							1	1				1									1							1	1	83					2	1	2				3
South America	Chile	100							1	2				1							1		1							1		8	71	2			2	1	2				4
	Brazil	100							1	1				1																		3		86			1		1				3
Oceania	Australia	100							1	1				1									1									1			80		2	1	2				5
	New Zealand	100							1	3				1									1									5			4	65	3	2	4				5
Other Asia	Japan	100								1																						3			1		86	1	2		1		4
	Korea	100							1	2				1									1				1					5	1		1		7	64	4		1		8
	China	100							1	3				1									1				1					4		1	1		7	3	67	1			6
	India	100							1	1													1			2	1					3			2		1	1	1	76			8
	Indonesia	100								1																						2					3	1	2		83		5
	South Africa	100							2	6				2		1					1	1	2				1					5		1	1		2	1	3	1		62	7
	Rest of the World	100	1	1					4	7		1		3		1	1				1	1	3		1	1	3		1	1	1	22	1	6	2		19	3	8	2	2		

Note: darker shading shows higher shares percentages of foreign value added; shares below 1% are not represented. 1. Rest of the World: domestic value added is not available.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

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Foreign value added and domestic content of gross exports, business services (ISIC 70 to 74), 2009 (in %)

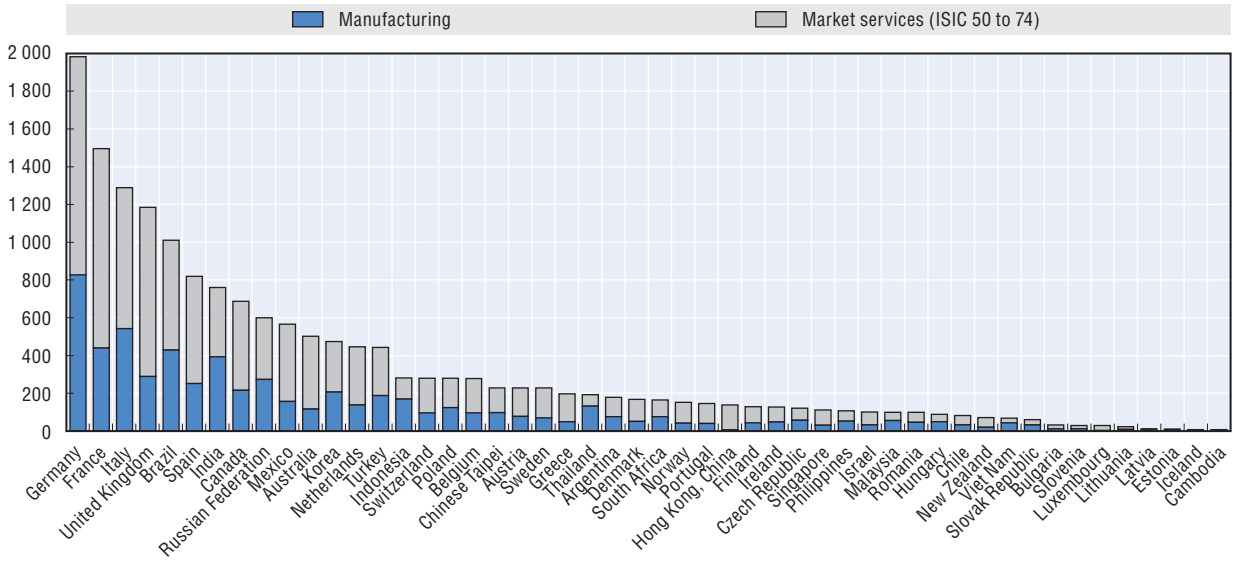
Area	Country	Total gross exports[1]	Austria	Belgium	Czech Republic	Denmark	Estonia	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Luxembourg	Netherlands	Poland	Portugal	Slovak Republic	Slovenia	Spain	Sweden	United Kingdom	Iceland	Norway	Switzerland	Russian Federation	Israel	Turkey	Canada	Mexico	United States	Chile	Brazil	Australia	New Zealand	Japan	Korea	China	India	Indonesia	South Africa	Rest of the World
	Partner		EU																					Other Europe				Middle East		North America			South America		Oceania		Other Asia						
EU	Austria	100	84	1					1	5				1							1		1									2							1	1			1
	Belgium	100		82					2	2			1	1		1					1		2									2											2
	Czech Republic	100	1		83				1	3				1			1		1				1				1					2					1		1				2
	Denmark	100				87				2												1	1									2							1				2
	Estonia	100					83	1	1	2												1					2					2					1		1				3
	Finland	100						84		2												1	1				1					2							1				1
	France	100							92	1				1							1		1									1											1
	Germany	100							1	91				1							1		1									1											1
	Greece	100								1	89			1									1				1					2											2
	Hungary	100	1						1	3		82		1		1							1				1					3							1				2
	Ireland	100	1	1					3	3			44	2		4					1	1	4			1	1				1	18					1	1	2				10
	Italy	100							1	1				92																		1											1
	Luxembourg	100		5					2	8				2	55	1					3		7			1						6							3	2			2
	Netherlands	100		1					1	2						89							1									2											1
	Poland	100							1	2				1			88						1				1					1							1				1
	Portugal	100							1	1								88			3		1									1											1
	Slovak Republic	100	1		1				1	2				1			1		85				1				1					1						1					2
	Slovenia	100	1						1	2				2						85							1					1					1		1				3
	Spain	100							1	1				1							90		1									1											1
	Sweden	100		1		1		1	1	3				1		1					1	80	2		1		1					3							1				2
	United Kingdom	100								1											1		94									2											1
Other Europe	Iceland	100							2	3						1						1	1	73	1		1					6					1		1				5
	Norway	100				1				1											1	2	1		86							2							1				1
	Switzerland	100							1	3				1									1			88						1											1
	Russian Federation	100								1																	96																1
Middle East	Israel	100								1													1					90				3											1
	Turkey	100								1																	1		91			1											1
North America	Canada	100																												93		4											1
	Mexico	100																													93	4											1
	United States	100																														96											1
South America	Chile	100								1																						3	90						1				3
	Brazil	100																														1		96									1
Oceania	Australia	100																														1			93		1						2
	New Zealand	100							1	1													1									2			1	89	1		1				2
Other Asia	Japan	100																														1					96						1
	Korea	100								1																						2					1	89	1				3
	China	100								1																						1			1		2	1	89				3
	India	100								1													1									3							1	86			3
	Indonesia	100								1																						2					1		1		87		3
	South Africa	100								1													1									1							1			90	2
	Rest of the World	100	1	2				1	4	6	1		2	3		2					2	3	7		1	1	2	2		1		22		1	2		8	3	14	5	1		

Note:darker shading shows higher shares percentages of foreign value added; shares below 1% are not represented. 1. Rest of the World: domestic value added is not available.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

StatLink *http://dx.doi.org/10.1787/888932835252*

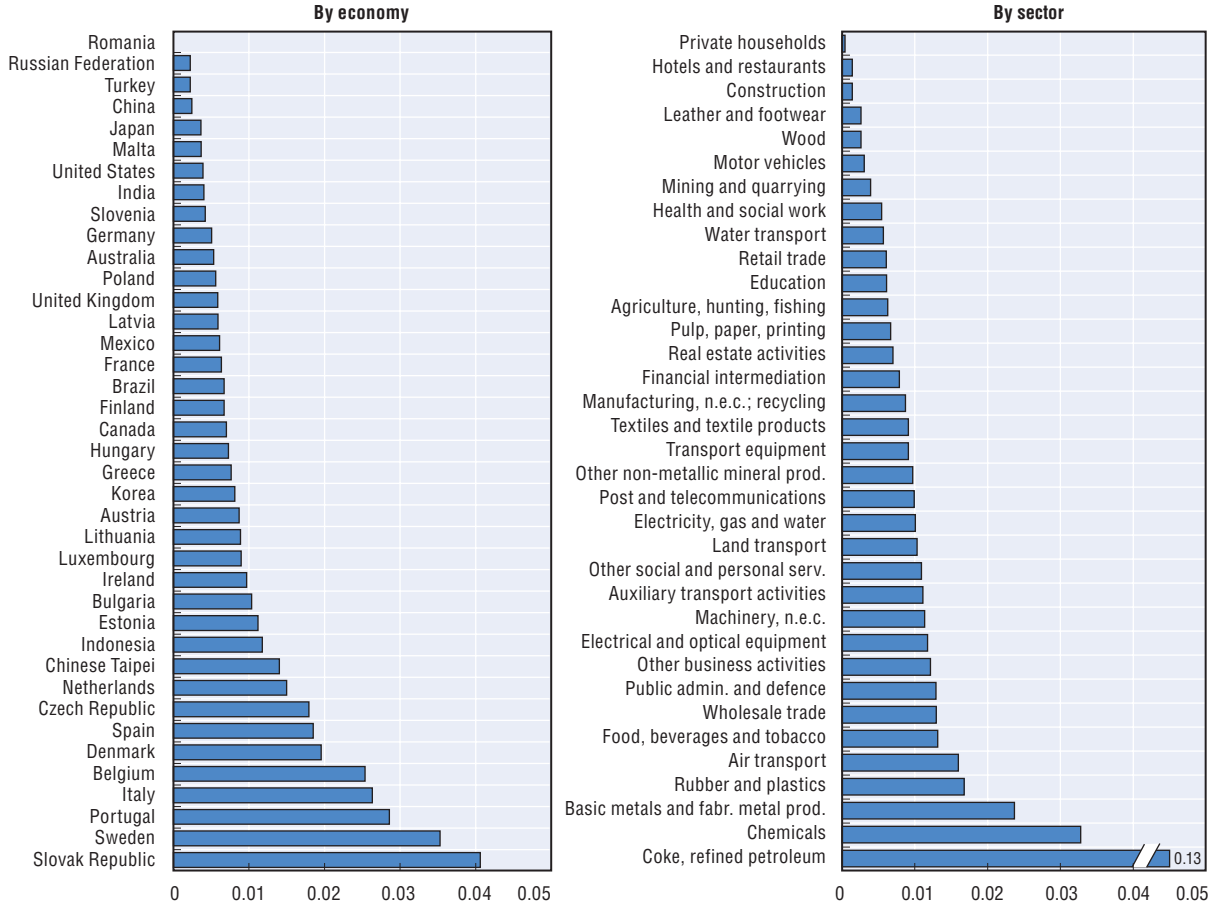
Annex 6.A2
GVC income, manufacturing and market services, 2009, USD billions



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

StatLink *http://dx.doi.org/10.1787/888932835100*

Annex 6.A3
Dissimilarity of RCA measures in gross and value-added terms by country and industry (2009)



Note: Indicator is (1 minus Spearman Coefficient) between Gross Exports and Value Added.

Source: Calculations based on World Input-Output Database.

StatLink *http://dx.doi.org/10.1787/888932835119*

Annex 6.A4
Description of data and sample – econometric model

Economies: Austria, Germany, Netherlands, Canada, China, Belgium, Greece, Poland, United States, India, Bulgaria, Hungary, Portugal, Japan, Ireland, Romania, Korea, Czech Republic, Italy, Slovak Republic, Latin America, Australia, Denmark, Latvia, Slovenia, Brazil, Chinese Taipei, Estonia, Lithuania, Spain, Mexico, Turkey, Finland, Luxembourg, Sweden, Indonesia, France, Malta, United Kingdom, Russian Federation.

Years: 1995-2009.

Industries: ISIC Rev.3 sectors AtB, C, 15t16, 17t18, 19, 20, 21t22, 23, 24, 25, 26, 27t28, 29, 30t33, 34t35, 36t37, E, F, 50, 51, 52, H, 60, 61, 62, 63, 64, J, 70, 71t74, L, M, N, O, P.

Regressors

Domestic demand index: The index is introduced as a control for external economies of scale (capturing factors such as a developed infrastructure, the availability of cheaper inputs, or a history of growth). Domestic demand is calculated as the sum of final demand by households, NGOs and the government (*Source:* WIOD) in a given country-sector-year. The specification is similar to RCAs: Share of the sector in total domestic consumption, relative to the share in total world consumption.

Capital endowment × industry intensity: The impact of capital endowment at the country level is captured conditionally in an interaction term with the industry's capital intensity. Capital endowment is recorded relative to the size of the labour force (capital stock divided by the number of hours worked in the country to take into account part-time employment). Capital intensity is calculated at the industry level as expenditure shares in value added averaged over 15 years. Reference country: United States.

Skilled labour endowment × industry intensity: The impact is captured by an interaction between high-skill intensity at the industry level and abundance of high skills at the country-level. Endowment is measured at the country-level as hours worked by high-skilled workers relative to total hours worked in the economy. High-skill intensity at the industry level is calculated as expenditure shares in total labour compensation averaged over 15 years; Reference country: United States.

Outsourcing index: Intermediate use intensity (intermediates expenditure excluding expenditure for energy as a share of gross output) relative to sectoral average of the same ratio across all countries in the same year.

Offshoring index: Import intensity in intermediate use (share of imported intermediates in total intermediates) relative to sectoral average of the same ratio across all countries in the same year.

*Country × year fixed effects and sector fixed effect*s: Included to capture systematic deviations of RCAs across sectors in a certain country, as well as across countries in certain sectors. A sector might systematically score low RCAs across countries because a single country dominates world production and exports; that asymmetry will be absorbed by the sectoral fixed effect. Similarly, a country's exports might be very little diversified and dominated by few sectors; the average RCAs across sectors will therefore be low, an outcome that will be absorbed by the country fixed effect interacted with year to ensure that variation across time of this structure is suppressed.

Notice that as both the independent and dependent variables are index numbers, normalised for various types of asymmetries, the level of the coefficients in the results is not directly interpretable. Coefficients for the same regressor can nevertheless be compared in an ordinal way between two sets of regressions, adding some insights to the discussion.

Chapter 7

Upgrading in global value chains: The role of knowledge-based capital

Knowledge-based capital has become a driver of success in global value chains (GVCs). 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. 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 structures. Knowledge-based capital also allows companies to shape the architecture of a GVC in order to capture a larger share of the value created. Policy makers in OECD countries and in many emerging economies therefore increasingly focus on investments in knowledge-based capital so as to upgrade to higher-value segments of GVCs and improve their position in the value chain.

This chapter links the work on GVCs to the OECD work on Knowledge-Based Capital; it is based on the same background material used for Chapter 5 of the publication 'Supporting Investment in Knowledge-based Capital, Growth and Innovation' (OECD, 2013)

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Innovation and upgrading in global value chains

Patterns of upgrading

Innovation, through the introduction of a new or significantly improved product (good or service), process or method, has long been viewed as central to economic performance and social welfare.[1] The empirical evidence confirms the links between innovation, value creation and economic growth (OECD, 2010). In the global value chain (GVC) framework, innovation has often been discussed in terms of (economic) upgrading and the efforts of companies and (developing and emerging) countries to increase the value they create and capture in GVC activities (Gereffi, 1999). Four types of GVC upgrading have traditionally been identified (e.g. Kaplinsky and Morris, 2002):

- *Process upgrading* is achieved when firms can undertake tasks with significantly greater efficiency and lower defect rates, and process more complex orders than rivals. An example is Hon Hai precision, the world's largest original equipment manufacturer (OEM), renowned for its ability to carry out large-scale production under short deadlines and rigorous specifications for major electronics brands such as Apple, Dell, Samsung and Sony.
- *Product upgrading* is achieved when firms can supply higher value-added products than rivals owing to their superior technological sophistication and quality and also introduce novel products faster than rivals. Examples are ASUSTek, an inventor of netbooks that captured the demand for low-cost, easy-to-use portable PCs (Kawakami, 2012), or Toyota, which introduced the first mass-produced hybrid vehicle, the Prius.
- *Functional upgrading* is achieved when firms can provide competitive products or services in new segments or activities of a GVC which are associated with higher value added. For firms previously specialised in production, this means becoming competitive in upstream or downstream activities such as design or marketing. For example, Lenovo acquired sophisticated R&D capability and the recognised ThinkPad brand through its acquisition of IBM's PC branch. For its part IBM upgraded from a PC manufacturer to a provider of technology and consultation services. Li and Fung, a Hong Kong-based intermediary of consumer goods upgraded its function as a supply chain management firm by acquiring product development, marketing and branding functions.
- *Chain upgrading* is achieved when firms are able to participate in new GVCs that produce higher value-added products or services, often leveraging the knowledge and skill acquired in the current chain. Recent examples are Samsung, the world's largest semiconductor producer, which decided to invest USD 20 billion over ten years in new industries such as solar panels, light-emitting diodes (LEDs) and electric-car batteries, and Nestlé, the food industry giant that has invested intensively in health-oriented processed food associated with higher profit margins and larger room for disruptive innovation than conventional packaged food (*The Economist*, 2009; 2011).

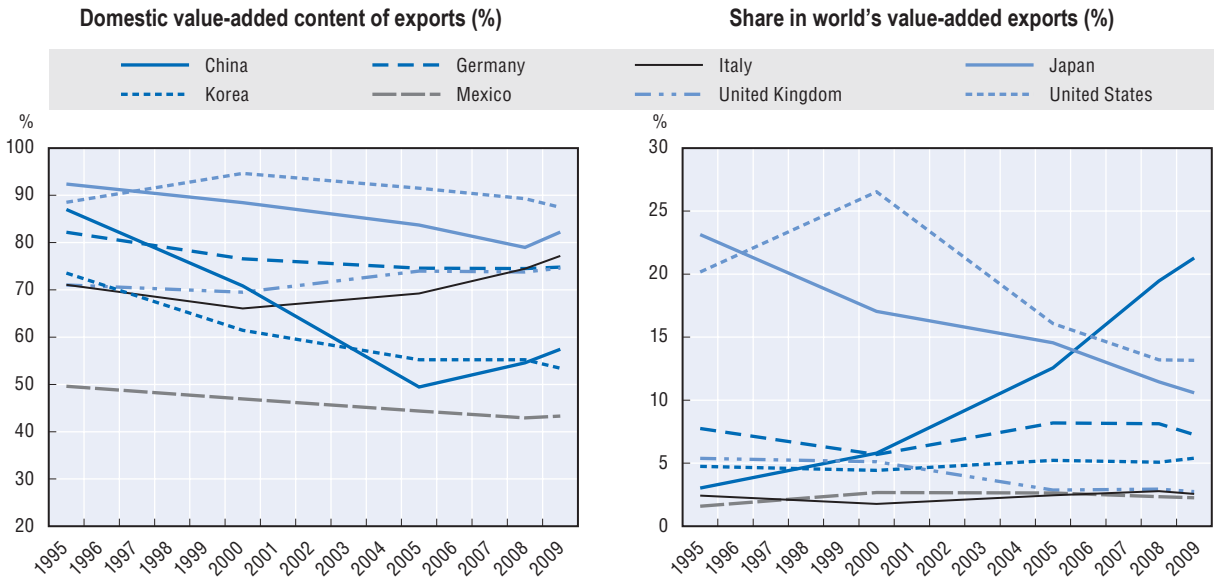
Fernandez-Stark et al. (2012) also distinguish "end-market upgrading" which involves moving into new higher-value end market segments (in terms of geographical location or industry), such as textile suppliers moving from manufacturing apparel to reaching customers in the medical, defence or construction industries. In addition, integration in GVCs is sometimes considered the first step in economic upgrading in developing countries (see Chapter 5).

Process upgrading is often considered to be the first stage in upgrading, as it is based on learning by doing (Gereffi, 1999). Later, as firms build up technological capabilities, they become competitive in more sophisticated products (product upgrading). Functional upgrading is achieved when firms become able to design new products or establish their own brand. Finally, chain upgrading occurs when firms have sufficient technological background and business know-how to expand their activities to new and more profitable industries.

Successful upgrading depends on a company's acquisition and/or development of capabilities to explore new and original features and varieties in each segment of the value chain. When a critical mass of a country's firms has been able to upgrade the economy also upgrades (Fernandez-Stark et al., 2012). Emerging countries often mainly want to move up the value chain and create and capture more value and broader economic benefits through their activities in GVCs (see Chapter 5). For developed countries, the question is how to retain their competitive advantages (and develop new ones), especially in higher value-added activities, and how to continue to compete in the global economy. As the growth potential of sources such as capital accumulation and technological imitation is exhausted, innovation becomes the most important source of economic growth.

Process, product, functional and chain upgrading are all undertaken to create and capture more value from GVC activities. Upgrading trajectories and innovation dynamics at the country level become apparent when looking at the (domestic) value-added content in countries' exports. This indicator provides insights into how much value an economy creates from its exports and is basically the result of the different upgrading strategies of the firms located within its borders. Figure 7.1 shows the evolution in the domestic value added content of exports in the electronic and optical machinery industry between 1995 and 2009 for a number of countries.

Figure 7.1. Upgrading and value creation in GVCs, electrical and optical machinery (ISIC30-33), 1995-2009



1. Some caution is warranted in comparing figures for China before and after 2005, since data availability only allows for distinguishing between processing and non-processing exports from 2005 onwards. This likely affects the results (see Chapter 2).

2. Estimates only available for 1995, 2000, 2005, 2008 and 2009; in-between years are interpolated.

Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

StatLink *http://dx.doi.org/10.1787/888932835138*

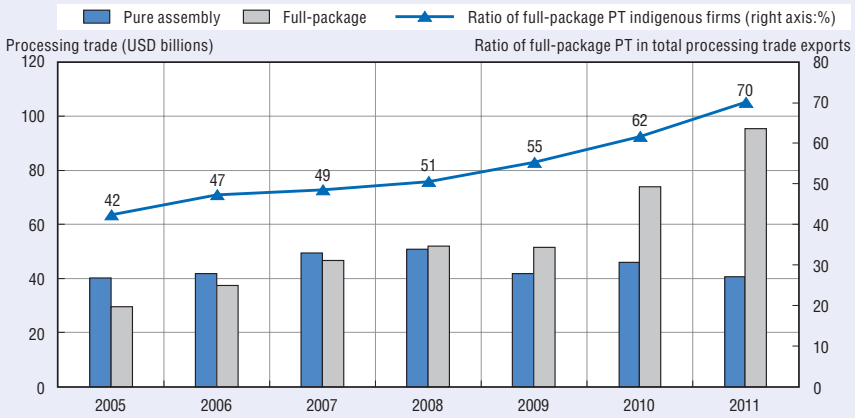
The figure largely confirms that developed economies generally specialise in higher value-added products and activities in this industry. The domestic value-added content of exports of the People's Republic of China and Mexico but also Korea are significantly lower than those of Germany, Japan and the United States. Moreover, the domestic value-added content of exports decreased between 1995 and 2009 as a result of the growing importance of imported intermediates and GVCs (Johnson and Noguera, 2012). Finally, in contrast to other countries, China shows a significant variation in the domestic value-added content of exports over time. Between 1995 and 2005, the domestic value added content of China's electronics exports dropped significantly, most likely because of fast-growing non-processing trade of low value added (see Chapter 5). Since 2005, however, China has succeeded in upgrading its electronics exports in various ways (Box 7.1) and the domestic value-added content of its exports has risen. In fact, China now accounts for nearly 25% of the world's total value added generated by electronics exports.

Box 7.1. China: Upgrading in GVCs

China's participation in GVCs has helped to make it the world's largest exporter. Through processing trade and the attraction of multinational enterprises (MNEs), China has been able to tap into advanced technology that was not available in domestic markets (Breznitz and Murphree, 2011). Upgrading has been an important policy priority for China for several years, and a range of evidence suggests that this is indeed under way.

Process upgrading: China's processing trade is shifting from simple contract assembly to "full-package" manufacturing, with Chinese firms controlling processes from material procurement to product design. Chinese firms now import parts and components and decide on the quantity, price and specification of products to be exported to foreign firms. This upgrading of processing exporters into more autonomous multi-functional service providers has been also observed in other Asian economies and is an important early stage of GVC upgrading.

The composition of processing trade by domestic Chinese firms



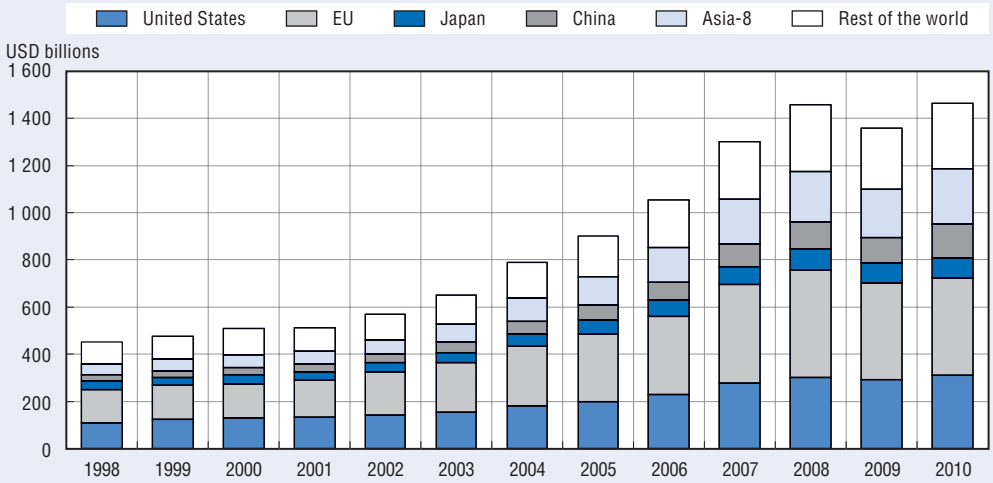
Source: China Customs Statistics.

Functional upgrading: from assembler to parts provider. China's share in world exports has increased not only in final products but also in parts and components. From 1995 to 2007, China's share in world exports of parts and components increased by 9.2%, while those of Japan and the United States dropped by 7.1% and 6.3%, respectively. A substantial share of China's exports in radio, television and communication equipment, electronic machinery and office, accounting and computing machinery involves intermediate goods, indicating that China has become a key supplier of parts and components.

A new role in the knowledge-intensive segments of GVCs? China is now the world's second largest spender on R&D after the United States (OECD, 2011b). The business sector accounted for 73% of China's R&D investments in 2009. Triadic patents[1] held by Chinese residents increased at an average annual rate of 29% between 1999 and 2009. However, Chinese firms' patents, especially in the United States, are largely held by a handful of export-oriented firms in computer, communication and consumer electronics industries, such as Foxconn, Huawei and ZTE (Eberhardt et al., 2011). China's exports of commercial knowledge-intensive services (business, financial and communication services) have also expanded. While the United States and the EU still account for half of these exports, China had increased its share to nearly 10% of the world total by 2010.

Box 7.1. China: upgrading in GVCs *(continued)*

World exports of commercial knowledge-intensive services (USD billion)



Note: Asia-8 includes Chinese Taipei, India, Indonesia, Korea, Malaysia, Philippines, Singapore, and Thailand. EU excludes Cyprus[2], Estonia, Latvia, Lithuania, Luxembourg, Malta, and Slovenia. China includes Hong Kong.

Source: Science and Engineering Indicators 2012, National Science Foundation.

The future of China's upgrading: China's upgrading may differ from that of other Asian emerging economies. First, its large and fast-growing domestic market facilitates the upgrading of GVC activities with an eye to the domestic market. While Chinese firms absorb advanced knowledge by participating in foreign MNEs' GVCs, they can use this knowledge to develop new capabilities and new products for the domestic market. This enables them to upgrade their functions within GVCs. Second, China was able to leverage its large market to attract foreign investments embodying the latest technology and develop a rigorous cycle of imports, digestion, absorption and innovation. This allowed Chinese firms to improve their capabilities and keep up with the world's technological frontier (Breznitz and Murphree, 2011). Knowledge spillovers contribute not only to production but also to Chinese firms' innovation capability (Ito et al., 2011). Collaboration and competition with foreign MNEs are likely to remain important for China's upgrading, as MNEs are expected to localise more segments of their GVCs as they seek to penetrate the Chinese market (Brandt and Thun, 2010). Third, competition with MNEs in the domestic market gives Chinese firms incentives to invest in technology and other knowledge-based assets. The concentration of investments in state-owned-enterprises and other state-controlled enterprises is partly due to strong existing capabilities (Zhang et al., 2009), but raises some concerns that this may lessen the efficiency of China's upgrading by preventing profit-oriented deployment of knowledge and investment. China's upgrading efforts will certainly continue. According to a recent policy report, "China sees itself building its future prosperity on innovation in which everyone's creative potential is tapped. Its success will lie in its ability to produce *more value, not more products*, enabling it to move up the value chain and compete globally in the same product space as advanced countries." (World Bank and the Development Research Centre of the State Council of People's Republic of China, 2012, p. 15).

1. Triadic patents are a set of patents taken at the European Patent Office, the Japanese Patent Office and the US Patent and Trademark Office.

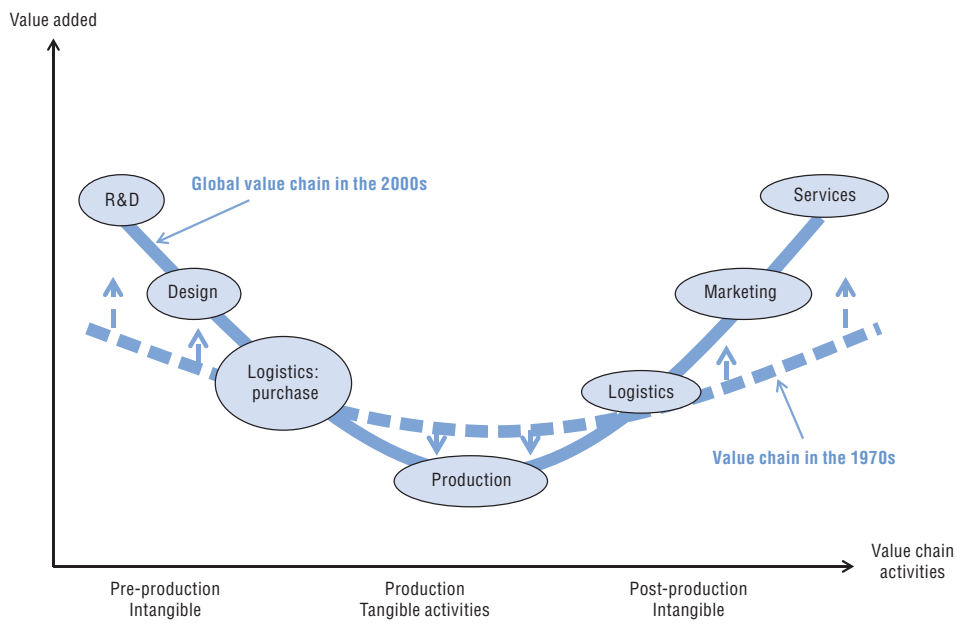
2. Note by Turkey:
The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".

Note by all the European Union Member States of the OECD and the European Union:
The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

Functional upgrading as a (new) way to create more value in GVCs

Case studies of specific products, often in the electronics industry, have demonstrated that value creation in a GVC is often unevenly distributed among activities (Linden et al., 2009; Ali-Yrkkö et al., 2011). The most value creation in a GVC is often found in upstream activities, such as the development of a new concept, R&D or the manufacturing of key parts and components, or in downstream activities, such as marketing, branding or customer service. Certain value chain activities create more value added when a company innovates to differentiate its products and services from competitors. Final assembly, which is generally offshored, often to emerging economies, represents only a small part of value generation. In general, activities that can be offshored tend to be commoditised and create relatively less value added. Moreover, activities that involve well-established standards and high modularity, such as final assembly of electronics or machinery, can be carried out by many competing firms, again lowering costs. This is the basic idea behind the so-called "smiling curve", originally used in 1992 by Acer's founder Stan Shih to illustrate the problems of IT manufacturers in Chinese Taipei that were then specialised in manufacturing activities (Figure 7.2).

Figure 7.2. The smiling curve: Value added along the GVC



Source: Based on Shih (1992), Dedrick and Kraemer (1999), and Baldwin (2012).

Some consider that there has been a tendency in OECD countries for the "smiling curve" to deepen, moving from relatively flat (value all along the chain) to U-shaped, with fabrication and assembly accounting for a much lower share of value added (e.g. Baldwin, 2012). The offshoring of labour-intensive activities (often in manufacturing and assembly) to low-wage economies has in fact decreased the cost of these stages. When companies that offshore these activities use their advanced technologies in these countries, the cost of these activities decreases further. The distribution of value added along the value chain does not necessarily follow the smile curve, however. Seppälä and Kenney (2013) show, for a number of products in the precision metal industry, that manufacturing activities still capture a large part of the value added.

Moreover, in practice, advanced economies still compete in many parts of the value chain, including in resource-intensive sectors such as agriculture, mining and food processing and in segments of low-technology industries including textiles. Italy, for example, continues to have a strong revealed comparative advantage in the production of textiles and clothing. Typically, this reflects specialisation in niche activities, continuous innovation, high productivity and high quality and enables firms in advanced economies to compete with firms in emerging economies with much lower costs. The generation of value here depends on the ability to supply sophisticated and hard-to-imitate products or services.

Position in the value chain is thus an issue of interest to many policy makers. Emerging economies for example find that they do not create/capture a lot of value from their large manufacturing activities. GVCs have changed the nature of global competition as companies and countries no longer only compete for market share in high value-added industries but increasingly also for high value-added activities within GVCs. Countries often see functional upgrading as the most direct way to increase the benefits they obtain from their participation in GVCs. Functional upgrading allows firms and countries to move to industries and activities that create more value added. But clearly there is no one-size-fits-all approach to upgrading since where the value is being created will differ across industries and value chains.

Functional upgrading can feed back into process and product upgrading. Sophisticated R&D, design or marketing allows firms to enhance the efficiency of their production processes and introduce new products. For example, electronics manufacturing firms in Chinese Taipei upgraded from original equipment manufacturers (OEM) to original design manufacturing (ODM) when they started to provide pre-production services such as R&D and design. This functional upgrading allowed them to engage in product upgrading with the invention of netbooks and a range of quality improvements in own-brand notebook PCs such as Asus and Acer (Sturgeon and Kawakami, 2010; Kawakami, 2012). However, functional upgrading requires heavy investments in knowledge-based capital. The specialisation of developed economies in higher value added activities largely reflects the larger endowment of these countries in human and knowledge-based capital. Policies supporting functional upgrading going against the principle of comparative advantage risk being unsuccessful.

Knowledge-based capital as driver for innovation and upgrading in GVCs

Higher value-added activities are often concentrated in parts of the value chain that make intensive use of human capital and knowledge-based capital, also known as intangible assets or knowledge-based assets. These assets involve tacit, non-codified knowledge in such areas as R&D, branding, design and the complex integration of software with organisational structures. The tacit properties of those activities make them difficult to imitate or reproduce. Knowledge-based capital is also at the heart of the manufacturing competitiveness of more mature economies (see Chapter 6). It is the source of the advanced knowledge and capabilities needed to develop sophisticated and complex products. More advanced capabilities also allow for greater (product) upgrading possibilities (Hausmann and Hildago, 2011; Tacchella et al., 2012). To move to higher value-added activities and enter higher-value segments of GVCs requires more knowledge-based capital. Policy makers in OECD and many emerging economies understand that knowledge-based capital is an important source of value creation in GVCs.

What is knowledge-based capital?

Knowledge-based capital, generally called intangible assets in the business sector, is the stock of investments in knowledge-based assets. While policy has often focused on R&D, human capital and software, the range is considerably broader. Its three main categories are computerised information, innovative property, and economic competencies (Corrado et al., 2005). Table 7.1 shows their outcomes in terms of capabilities and resources.

Table 7.1. Classification of knowledge-based capital and generated value

Knowledge-based capital	Type of investments (expenditure)	Stock of competencies (resource)
Computerised information		
Computer software	In-house development or acquisition of software	Computerised process, information and knowledge management system
Computerised database	In-house development or acquisition of database	Dataset assisting corporate strategy including new product development, marketing
Innovative property		
Scientific R&D	Science and engineering research (measured by in-house or outsourced R&D in manufacturing and selected industries)	Knowledge and intellectual property rights (IPR) leading to new or higher-quality products and production processes (see Box 7.2 for a discussion of innovative property in the pharmaceutical value chain)
Creative property	Development of entertainment or artistic originals (measured by non-scientific R&D: development cost in entertainment and book publishing industries)	Knowledge and IPR leading to sophisticated artistic and cultural creation
Design	Physical appearance, quality and ease of use of products and workspace layout (measured by outsourced architectural and engineering designs, R&D spending in social science and humanities)	Knowledge and IPR leading to better commercial appeal, product differentiation, improved efficiency
Economic competencies		
Brand equity	Spending on advertising and market research (measured by outsourced advertising and market research)	Reputation, image, customer recognition and relationship
Firm-specific human capital	On-the-job training, tuition payment for job-related education	Firm-specific and tacit manufacturing, processing and managerial skill
Organisational structure	Spending on organisational change (measured by outsourced management consulting services, etc.)	Flexible and competitive business organisation, network with other firms, universities, government, etc.

Source: Based on OECD (2012a).

Investments in knowledge-based capital differ from investments in physical capital in various ways (OECD, 2012a):

- *Lack of visibility*. By definition, knowledge-based capital lacks physical embodiment. This makes it difficult to assess the stock of specific knowledge-based capital based on past investment flows.
- *Non-rivalry*. Much knowledge-based capital can be used simultaneously by many users without creating scarcity or diminishing its basic usefulness. Examples include software or new product designs.

- *Partial excludability*. Owing in part to its virtual nature, property rights to some types of knowledge-based capital cannot be as clearly defined and enforced as they can be for tangibles. Insofar as they cannot preclude others from enjoying the benefits of these assets, owners may fail to fully appropriate the returns to their investment.
- *Uncertainty and perceptions of risks*. Investment in knowledge takes place throughout the innovation process, but particularly in the early stages of basic research, invention and experimentation. Sunk costs can be large, and failure is frequent (Lev, 2001).

Box 7.2. The role of scientific knowledge and networks in the pharmaceuticals value chain

The pharmaceutical sector is a highly globalised, innovation-driven industry with extensive co-operation and competition between large and small companies. The pharmaceutical value chain activities range from the exploration of new treatments to testing and approval processes to production, marketing and distribution. Biotechnology firms increasingly carry out upstream activities, such as basic research and acquisition of patents for new discoveries. These firms are often spin-offs from universities or other research institutions and conduct focused research. Traditional pharmaceutical companies – often referred as "Big Pharma" – commercialise these new discoveries as own-brand drugs. They take these discoveries through testing and approval by national authorities such as the US Food and Drug Administration (FDA). They acquire patents and commercialise the drug through their global sales and marketing network. In contrast, generic drug companies, another group of key players in the industry, generally do not conduct R&D but produce drugs with the active ingredients contained in the brand-name drugs once the patents have expired. Biotechnology firms, Big Pharma and generic drug companies compete in different areas: biotechnology firms in diagnosing new problems and providing innovative solutions; Big Pharma in identifying market potential and relevant discoveries, then building systems to commercialise new technologies; generic firms in terms of cost efficiency in production based on established technologies.

Haanes and Fjeldstad (2000) discuss the kinds of knowledge-based capital that support the competitive advantage of these three players in the pharmaceutical value chain. The competitive advantage of biotechnology firms depends on advanced technological knowledge. This knowledge is built up not only through basic research but also through formal and informal collaboration on R&D with universities, other biotechnology firms and other actors with relevant technological competencies. A rich research network is thus a crucial asset of successful biotechnology firms. Big Pharma's capabilities for identifying commercially promising breakthroughs stem from knowledge of the latest technologies and market environments and of networks of biotechnology firms and other actors able to produce novel solutions, as well as a reputation as a reliable collaborator. Big Pharma companies' ability to commercialise breakthroughs swiftly is supported by its experience in laboratory testing and regulatory approval procedures. Finally, large networks of customers and recognised brand names are important for marketing their drugs globally. Generic drug companies that thrive on the basis of cost competitiveness rely on efficient procurement networks to reduce material costs and a wide network of customers.

Knowledge-based capital is crucial for upgrading in GVCs. Indian pharmaceutical firms such as Ranbaxy or Dr Reddy's first participated in GVCs as cheap suppliers of generic drugs for the Indian market, then upgraded to generic drug suppliers in advanced economies. More recently, they have become pharmaceutical firms with capabilities to invent and develop patented drugs. Bower and Sulej (2005) argue that this upgrading was supported by advanced technological knowledge obtained through research alliances and joint ventures with firms from advanced economies and by an array of business-related skills and distribution networks obtained through the acquisition of Western firms.

Investment in knowledge-based capital has been rising since the 1980s. In the United States and the United Kingdom, investment in knowledge-based capital now exceeds investment in physical capital. The intensification of competition (due to the reduction of regulatory barriers to entry and greater openness to foreign trade and investment) and the advent of information technology are considered factors in the growing importance of knowledge-based capital. Other potential drivers include the rise in educational attainment, which facilitates the production and effective use of knowledge-based capital, as well as the fact that many household products are more knowledge-intensive and increasingly dependent on software-based technologies. While these trends are present in

most advanced countries, the share of business investment in knowledge-based assets differs across economies (OECD, 2012a; 2013), as does its composition.Knowledge-based capital contributes significantly to labour productivity growth in several developed and some emerging economies. For instance, it contributed between 24% and 30% of annual labour productivity growth in Germany, the United Kingdom and the United States between 2000 and 2006 and 16% in China in the same period (Hulten and Hao, 2012).[2]

Knowledge-based capital as a resource for upgrading GVC activities

Patterns of upgrading in GVCs are largely determined by different types of knowledge-based capital. For example, value creation through superior productivity and processing capabilities (i.e. process upgrading) is supported by computerised information in the form of software and systems that enable the management of efficient and more accurate production. Process upgrading can also be based on innovative property, such as use of know-how to design efficient production lines, or on economic competencies, such as competitive procurement networks. The different types of knowledge-based capital favour complementary forms of process upgrading. For instance, Procter & Gamble uses computerised information in the form of modelling and simulation programmes to design efficient factory and production line layouts (Siemens, 2011).

Product upgrading is supported by computerised information in the form of computer-aided-design (CAD) software to enhance design capability or by databases on customer preferences or product sales that enable firms to develop new products or services that capture customer needs. Large retail firms such as Amazon, Tesco or Zara leverage their supply chain network to collect data on consumer preferences in order to introduce new products faster than rivals (McKinsey, 2010a). Product upgrading to raise quality and add sophisticated functions is also supported by innovative property, such as advanced technology. Design also plays a significant role in product upgrading, especially in industries with mature technology or in which firms rely on similar technology (Box 7.3 discusses the importance of design in the textiles industry). Finally, economic competencies such as marketing skills, distribution networks and brand image are important for the rapid introduction of new products.

Functional upgrading requires non-production capabilities in the upstream and far-downstream segments of GVCs, such as new concepts, basic R&D and product design, as well as branding and marketing. This broad range of capabilities can be collectively regarded as a firm's innovative property, as successful commercialisation of new ideas is as important as cutting-edge technology for a successful innovation (Corrado and Hulten, 2010). Superior innovative capability relies on the integration of many forms of knowledge-based capital. For example, Apple upgraded from an electronics manufacturer to innovator and retailer on the basis of core technology, good product design, favourable brand image and its i-store network.

Chain upgrading requires superior managerial skills and flexible organisational structures; successful firms are often able to respond rapidly to potential opportunities or threats. They are also exceptionally able to co-ordinate and reconfigure their physical assets and knowledge-based capital in order to shift core competences to new areas. Firm-specific management skills and flexible organisational structures facilitate the necessary reallocation of internal resources.

Box 7.3. Design and value added in the value chain

Design is increasingly recognised as an important knowledge-based asset for a firm's competitive advantage. It is not only an essential input for new product development, along with R&D and marketing (Hertenstein et al., 2005), but can itself ensure a firm's competitive edge by strengthening an emotional connection with customers and establishing corporate identity and brand (Kotler and Rath,1984; Noble and Kumar, 2008). For some products, brand and design are inseparable. Design helps firms to differentiate their products and move away from cost-based competition. For example, design enabled Sony to charge 25% more than its competitors for its Walkman (Czarnitzki and Thorwarth, 2009). Design has a positive effect on corporate performance and innovation; expenditure on design is associated with productivity growth in UK firms (Cereda et al., 2005) and with Dutch firms' sales of new products (Marsili and Salter, 2006). Incorporating design into the early stage of new product development also improves financial performance (Gemser et al., 2011).

Design may also affect how value added is distributed among participants in a GVC. Vervaeke and Lefevre (2002) illustrate this for the textile industry in the Nord-Pas de Calais region of France, an area traditionally known for textile design. Until the 1960s this was a sub-function of the engineering section of manufacturing firms. Design was the work of mostly anonymous in-house designers or purchased from drawing shops in Paris and refined by in-house designers. As mass production began, manufacturers set up specialised design sections with stylists directing and defining the trends for collections and draughtsmen/women making up patterns and working out designs. Control over design allowed manufacturers to establish their brands and increase value added in new product development.

However, since the mid-1990s, chain stores, supermarkets and mail-order firms have been expanding their own design capabilities and brand strategy. Distributors as lead firms in buyer-driven GVCs started controlling product design by prescribing styles to manufacturers and leveraging their access to consumers, As a result, many manufacturers lost their design capability and became subcontractors. Although they still engage in intermediate stages between design and manufacturing, such as the production of prototypes, much of the value added related to product development has shifted from manufacturers to distributors. Some manufacturers maintain their own collections and mostly specialise in top-end products under registered trademarks. While this strategy enables them to profit from their design investments, it requires strong capabilities in design, production of top-end products and marketing.

Non-replicability of knowledge-based capital largely defines the value of upgrading

The competitive advantage of firms and their upgrading potential are eroded if knowledge-based capital is easily replicated. Replication is likely to be more difficult when intangible assets have the following characteristics:

Firm-specificity and non-separability: Some types of knowledge-based capital are inseparable from certain firm characteristics. This indicates that these assets are firm-specific and difficult to trade. Firms need to build them in house through investments over a period of time.

Latecomer disadvantage: It is difficult to replicate knowledge-based capital that has been built up through investments over a long period. To build a comparable level of knowledge-based capital in a short period will incur disproportionately high costs. Also, if knowledge-based capital results in increasing returns to scale, latecomers will have difficulty accumulating new knowledge, compared to firms with a larger initial stock of knowledge-based capital (Dierickx and Cool, 1989).

Causal ambiguity: The link between different types of knowledge-based capital and competitive advantage can be ambiguous, making it hard for rivals to identify which types they need to replicate in order to catch up. The ambiguity is especially marked if knowledge-based capital is tacit, integrates different types of knowledge-based capital or is firm- or relationship-specific (Reed and Defilippi, 1990).

Path dependency: Certain types of knowledge-based capital, such as advanced technology or competitive organisational structures, reflect a firm's individual history of technology investments, entrepreneurial activities and successes and failures, which are practically impossible for rivals to replicate (Barney, 1991).

Computerised information (software and databases) that is available in markets is unlikely to be the source of upgrading. Crowd computing[3] has significantly reduced the investments required to exploit the latest software and datasets, and web communities provide abundant information on their effective use. However, firms' datasets on customers and product sales, which they exploit for marketing and new product development, are protected as a very valuable corporate asset. Exploiting these data also requires investments in new capabilities and organisational change. Such assets are therefore largely non-replicable, at least until the technology and the ability to capture and analyse such data become widespread. Computerised information is also often integrated in a firm's organisational structure and thus largely firm-specific. Moreover, the combination of information and communication technology (ICT) and organisational capital contributes more to a firm's productivity growth than investment in only one of these (Brynjolfsson et al., 2002).

While innovative property, and in particular technological knowledge, can be replicated to some extent, sophisticated technology and design are considered important sources of competitive advantage. In general, innovative property is more replicable if it is codified as standards or well-defined routines. For instance, management know-how on the cost and quality of production is often transferred to suppliers (Javorcik, 2004). Innovative property is harder to replicate if it contains complex and abstract knowledge or is embodied as tacit knowledge in specific employees or corporate systems. Advanced technology embodied in workers as tacit skills is not easily transferrable. Firms that risk imitation by a rival have strong incentives to increase the share of tacit knowledge and non-codified know-how in their production process (Thoenig and Verdier, 2003). Innovative property can also be strongly path-dependent. For example, a long tradition of sophisticated design allows firms in Italy's Lombardy region to be global leaders in their market segments (Czarnitzki and Thorwarth, 2009).

Many economic competencies possess the characteristics described above. A firm's brand equity – reputation or image – is built through strategic expenditure and accumulated expertise. Because of its cumulative and path-dependent nature, it is hard to replicate. Furthermore, creating a brand is a rather unclear process (e.g. the contribution of marketing to a firm's brand image is not immediately clear). Similarly, firm-specific skills and organisational structure are not separable from a firm's other organisational features and are therefore non-tradable. They are also tacit and are developed through the firm's history of entrepreneurial activities and a process of trial and error. Although their superficial components are often documented and can be learned, it is often impossible to define their contribution to the firm's competitive advantage.

In Table 7.2 the different types of knowledge-based capital are related to their upgrading potential and ease of replication. For example, economic competencies, such as superior management, brand equity and organisational structure, are generally more difficult to replicate than innovative property or computerised information. This suggests that chain upgrading based on such assets can ensure more value than upgrading supported by novel technology or datasets. In practice, however, it is often the combination of several types of knowledge-based capital that is the source of firms' competitive advantage.

Table 7.2. Upgrading of GVC activity and relevant intangibles

Type of upgrading	Essential knowledge-based capital	Replicability	Value created from upgrading
Chain upgrading	Firm-specific management skill (acquired from entrepreneurial trial and error), Flexible organisational structure	Low	High
Functional upgrading	Sophisticated technology and design, Recognised brand, marketing ability, Retail and collaboration networks		
Product upgrading	Advanced production technology and quality management skill, good design, "Big data" on consumer preference		
Process upgrading	Rich know-how in process management, Efficient procurement network, software and other ICT processing complex tasks	High	Low

Source: Based on Kaplinski and Morris (2002).

Competitive dynamics in GVCs

Knowledge-based capital increasingly constitutes an integral part of companies' business models. Sustained competitive advantage is increasingly based on innovation, which in turn is driven by investments in R&D, design, organisational capital, employee skills, marketing/sales experience, etc. (OECD, 2010). The higher value added that firms generate in GVCs largely hinges on the (continuous) development of superior capabilities and firm-specific "resources" which are often intangible, non-tradable and difficult to replicate (Wernerfelt, 1984; Dierickx and Cool, 1989). Korkeamaki and Takalo (2010) calculated the commercial value of Apple's iPhone and estimated that patentable technologies (i.e. innovative property) explained about 25% of the total value. A large part of the remainder is explained by "soft technologies" (Bloom and Van Reenen, 2010), i.e. capabilities such as design, engineering, management, marketing, etc., which are partially built on previous innovations and products that reflect the cumulative nature of innovation (e.g. the Apple name and corporate image based on earlier products such as the iPod and the Mac notebook).

Knowledge-based capital is increasingly important in the governance of GVCs since firms can use their specific capabilities to shape the industry architecture and to capture a larger share of value. Superior capabilities allow firms to innovate and compete in their own market segment, but also to change the competitive conditions of the whole value chain. Firms are often able to manage linkages with other firms within a GVC so as to make themselves less replaceable while making other firms more dependent on them. Because the latter have to co-operate with them to create value, such firms can leverage their position in GVCs and capture more value.

As industries and products become more fragmented and decentralised, economic competencies in terms of system integration skills can leverage companies' innovation activities in GVCs. The lead firm integrates the different stages of the value chain and makes the different elements work together. The example of Apple shows that its strong design capabilities enabled it to take the lead in integrating the different components and

services into its different products. Lead firms in electronic GVCs have used standards not only to transfer knowledge to their suppliers but also to lower barriers to entry in the corresponding segment of the GVC and thus increase competition among suppliers (Shapiro and Varian, 1999).

In some GVCs, individual firms have succeeded in providing inputs that are indispensable and non-substitutable (Teece, 1986; Jacobides et al., 2006; Simon, 2009). Such firms enjoy the fruits of innovations by other participants in the GVC through increased demand for their products or services. For example, McKinsey (2010b) described how Japanese companies achieve high value added in a number of GVCs: "In 30 different technology sectors with revenues of more than USD 1 billion, Japanese companies control 70% or more of global market share. They have done so by creating an array of "choke point" technologies on which much larger industries depend. Mabuchi Motor, for instance, makes 90% of the micro motors used to adjust car mirrors worldwide. Nidec makes 75% of the world's hard-disk drives. Japanese companies own nearly 100% of the global market for the substrates and bonding chemicals used in microprocessors and other integrated circuits."

Activities in network industries have increasingly achieved the same dominance. Providers such as Microsoft, Nintendo or Apple supply the infrastructure on which the value created by many other GVC participants, such as programme developers, is based. When Nintendo attracted many users in the US market in the late 1980s, many game developers wrote games for the Nintendo Entertainment System (NES) and made the system even more popular. Because those developers obtained more demand for their games on NES than on rival systems, they not only paid royalties to Nintendo but even promised not to make their game available on other systems for two years following its release (Lev, 2001). Branding is a more general case of such dominance: only a few firms have successfully built recognised brands. Firms that attribute their brand to a final product act as the guarantor of quality (Jacobides et al., 2006) and capture a lion's share of the value-added generated by the GVC (Gereffi, 1999).

The importance of knowledge-based assets in GVCs

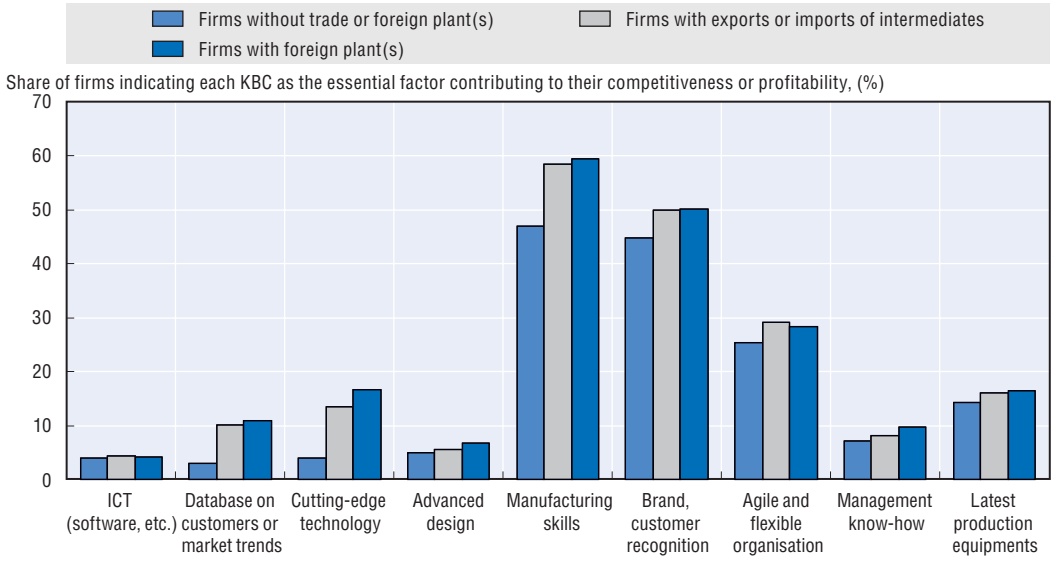
Knowledge-based capital and upgrading at the firm level: Survey results for Japan

There has been little analysis of the importance of knowledge-based capital for GVC upgrading by companies and countries. A survey recently conducted by Japan's Ministry of Economy, Trade and Industry (METI)[4] provides some initial findings. The results show, first, that manufacturing firms in Japan consider economic competencies such as manufacturing skills, brand equity and agile organisations a more important source of competitive advantage than cutting-edge technology or computerised information (Figure 7.3). The Japanese firms that are most engaged in GVCs, i.e. those that export or import intermediate goods or own offshore plants, view such competencies as more important than firms that have no foreign trade or foreign plants. They also place greater emphasis on cutting-edge technology and "big data" as sources of competitive advantage than firms oriented towards the domestic market.

Second, the survey results reveal that many firms engage simultaneously in different types of upgrading, with process and product upgrading the most frequent combination. Efforts to move to higher value-added activities (i.e. functional upgrading) and to enter new industries or value chains (i.e. chain upgrading) mostly involve product or process upgrading. However, the share of firms engaging in functional or in chain upgrading (6% and 13%, respectively) is markedly smaller than that of those engaging in process or in product upgrading (63% and 70%, respectively). This indicates that functional and chain upgrading are more challenging, most likely because they require large investments in knowledge-based capital.

Third, firms in Japan consider agile and flexible organisations as the essential knowledge-based assets for functional and chain upgrading. In general, the survey results suggest that the categories of knowledge-based capital that are more difficult to replicate (e.g. organisational structure, firm-specific manufacturing skills) are at the heart of upgrading (Figure 7.4). Many firms also consider the development of databases as an essential resource, a sign that the systematic use of "big data" to strengthen competitiveness is gaining importance in Japan.

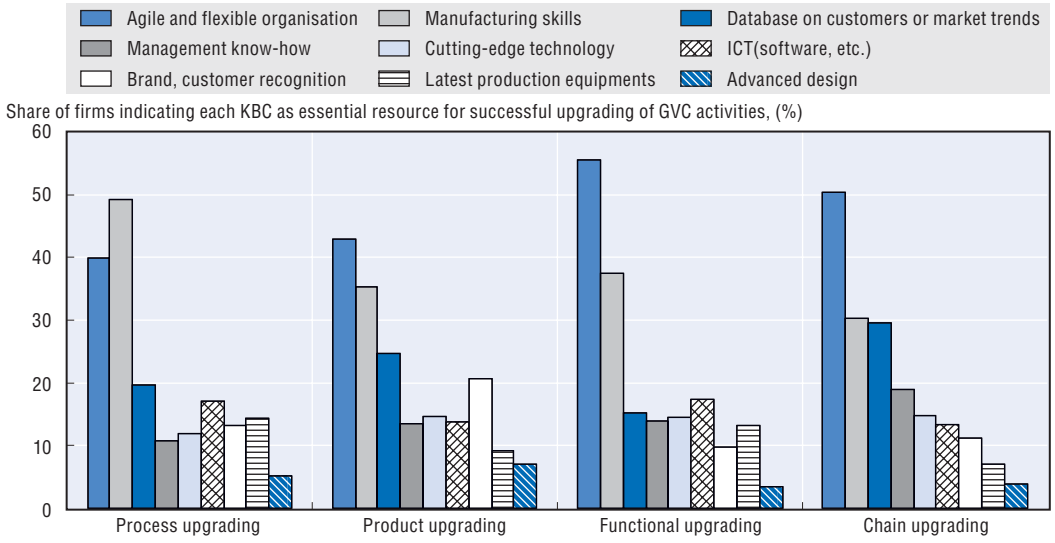
Figure 7.3. Knowledge-based capital and the competitiveness of manufacturing firms in Japan



Note: The shares do not add up to 100% because firms are allowed to select multiple forms of knowledge-based capital they consider essential. The figure shows the share of firms that indicate the form of knowledge-based capital concerned to be essential to competitiveness.

Source: Japanese Ministry of Economy, Trade and Industry survey on global value chains, November 2012.

Figure 7.4. Knowledge-based capital and GVC upgrading in firms in Japan



Note: The shares do not add up to 100% because firms are allowed to select multiple forms of knowledge-based capital as essential resources. The figure shows for each group of firms engaging in specific types of upgrading, the share of firms that indicate each form of knowledge-based capital to be essential for upgrading.

Source: Japanese Ministry of Economy, Trade and Industry survey on global value chains, November 2012.

Knowledge-based capital and the export competitiveness of countries

While data on physical capital have long been available, data on knowledge-based capital at the economy level have only recently become available.[5] These data are largely limited to developed economies, and this should be kept in mind when interpreting the results of the econometric work described below. The analysis tests knowledge-based capital as a factor of production against more traditional determinants of export specialisation such as physical and human capital. It also explores its interaction with GVC activities such as offshoring on the hypothesis that knowledge-based capital allows countries to create and capture more value in GVCs. It finds that the export competitiveness of countries in a world of GVCs is to a large extent determined by these assets.

The analysis extends the model used in Chapter 6, which demonstrates the importance of outsourcing and offshoring for countries' export competitiveness, proxied by measures of revealed comparative advantage (RCA). In the extended model, knowledge-based assets are included as a factor of production that may contribute to the specialisation patterns of countries. Like the other factors of production, knowledge-based capital (measured at the country level) is included dependent on the intensity with which knowledge-based capital is used at the industry level in order to capture differential effects across industries.[6] Export competitiveness is again measured on the basis of RCA both in gross and value added terms to capture the unequal distribution of value along GVCs (Table 7.3).

Table 7.3. The effect of knowledge-based capital on the export competitiveness of countries

	RCA in gross exports (symmetric)			RCA in value added (symmetric)		
Variables	**I**	**II**	**III**	**I**	**II**	**III**
Domestic demand index	0.024*** (0.009)	0.020** (0.009)	0.019** (0.009)	0.023** (0.009)	0.019** (0.009)	0.018* (0.009)
Physical capital endowment × physical capital intensity	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.004*** (0.000)	0.003*** (0.000)	0.003*** (0.000)
High-skill endowment × High-skill intensity	3.077*** (0.475)			3.064*** (0.483)		
Outsourcing Index (broad definition - intermediate use intensity)	0.111*** (0.010)	0.127*** (0.010)	0.125*** (0.010)	0.081*** (0.010)	0.097*** (0.010)	0.095*** (0.010)
Offshoring Index (Broad definition - Intermediates import intensity)	0.159*** (0.036)	0.172*** (0.035)	0.161*** (0.035)	0.094*** (0.035)	0.107*** (0.035)	0.096*** (0.035)
Knowledge-based capital endowment × High-skill intensity		0.040*** (0.005)	-0.01 (0.009)		0.041*** (0.005)	-0.007 (0.010)
Knowledge-based capital endowment × High-skill intensity × Intermediates import intensity			0.685*** (0.097)			0.665*** (0.097)
Knowledge-based capital endowment × Intermediates import intensity			-0.286*** (0.042)			-0.278*** (0.042)
Observations R-square	6585 0.316	6585 0.317	6585 0.323	6585 0.308	6585 0.31	6585 0.315

Note: Robust standard errors are reported in parentheses. Significance levels are indicated by: *** at 1%, ** at 5%, and * at 10% level.

Source: OECD calculations.

The econometric results show first that knowledge-based capital enhances the export competitiveness of skill-intensive industries. The more a country invests in knowledge-based capital, the more likely it is to develop a comparative advantage in international trade in such industries (Table 7.3, column II).[7] This finding is in line with the positive effects of factors of production such as physical and especially human capital (Table 7.3, column I) and underlines the importance of knowledge-based capital as a productive resource.

Second, the positive effect of knowledge-based capital is larger in industries that are high-skill- and offshoring-intensive (Table 7.3, column III) and indicates a strong complementarity between knowledge-based capital and integration in GVCs. The results show that offshoring magnifies the positive effects of knowledge-based capital in terms of export specialisation. Countries with knowledge-based assets are likely to benefit more from their integration in GVCs through offshoring of higher-skill and higher-technology industries. As discussed above, these assets allow companies to innovate faster and better, to position themselves in higher value-added activities in GVCs and to govern the architecture of their GVCs. These advantages at the firm level determine the export specialisation and competitiveness of countries.

An extension of this exercise measures separately the impact of each of the three components of knowledge-based capital (computerised information, innovative property, and economic competencies) on export specialisation (Table 7.4 shows the results in terms of RCA in value added).[8] Economic competencies stand out as the category of knowledge-based capital with the largest impact on export specialisation in skill-intensive industries, followed closely by computerised information and innovative capabilities.

This clearly shows that superior corporate strategies and competitive organisational structures matter a lot for export specialisation at the industry level, perhaps more than the often-mentioned technological leadership and R&D. Results again seem to be largely driven by industries that are both high-skill- and offshore-intensive in all three components. All three forms of knowledge-based assets allow for a higher level of specialisation, especially in industries with more open input markets.

Table 7.4. The effect of different categories of knowledge-based capital on the export competitiveness of countries

Variables	RCA in value added (symmetric)					
	Computerised information			Innovative property		Economic competencies
	I	II	III	I	II	III
Domestic demand index	0.023** (0.009)	0.022** (0.009)	0.021** (0.009)	0.020** (0.009)	0.017* (0.009)	0.016* (0.009)
Physical capital endowment × Physical capital intensity	0.004*** (0.000)	0.003*** (0.000)	0.004*** (0.000)	0.003*** (0.000)	0.003*** (0.000)	0.003*** (0.000)
Outsourcing index (broad definition - intermediate use intensity)	0.092*** (0.010)	0.090*** (0.010)	0.092*** (0.010)	0.091*** (0.010)	0.100*** (0.010)	0.099*** (0.010)
Offshoring index (Broad definition - Intermediates import intensity)	0.104*** (0.035)	0.098*** (0.035)	0.108*** (0.035)	0.101*** (0.035)	0.111*** (0.035)	0.092*** (0.035)
Knowledge-based capital endowment × High-skill intensity	0.150*** (0.027)	-0.062 (0.049)	0.058*** (0.010)	-0.022 (0.018)	0.162*** (0.015)	0.005 (0.029)
Knowledge-based Capital endowment × High-skill intensity × Intermediates import intensity		2.913*** (0.488)		1.104*** (0.179)		2.154*** (0.303)
Knowledge-based capital endowment × Intermediates import intensity		-1.193*** (0.211)		-0.447*** (0.077)		-0.944*** (0.128)
Observations	6585	6585	6585	6585	6585	6585
R-square	0.306	0.309	0.307	0.31	0.316	0.322

Note: Robust standard errors are reported in parentheses. Significance levels are indicated by: *** at 1%, ** at 5%, and * at 10% level.

Knowledge-based capital and upgrading of countries in GVCs

The results of countries' process, product, functional and chain upgrading can be captured in the domestic value-added content of countries' exports.[9] The idea is that knowledge-based capital allows companies and countries to create and capture more value through their exports. The model is similar to the one used above, but the estimation procedure is somewhat different.[10] The effect of knowledge-based capital (on the country level) is dependent on the industry's skill intensity in order to capture differences across industries (Table 7.5). The estimation is carried out for total knowledge-based capital as well as for the three categories: computerised information, innovative property and economic competencies.

The results underscore the importance of knowledge-based capital for upgrading in GVCs. Countries with a larger endowment of knowledge-based capital are more likely to create and capture more value from their exports. Each category of knowledge-based capital has a positive effect on upgrading. As in the case of export competitiveness the results suggest that economic competencies have the largest impact, followed here by innovative property and computerised information. As such, the results are largely in line with conjectures regarding the non-replicable nature of knowledge-based capital and its link to the value of upgrading. Another interesting result is that the effect of R&D is smaller than that of innovative property as a whole, which confirms the important role of non-R&D-based innovation, such as design, for value creation.

Table 7.5. The effect of knowledge-based capital on GVC upgrading

	Ratio of value-added to gross exports (VAX)						
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
h × All KBC	0.9158*** (0.1937)					1.3840** (0.6963)	1.3865** (0.6873)
h × Computerised information		0.5746*** (0.2081)					
h × Innovative property			0.7913*** (0.2078)				
h × R&D				0.5135** (0.2058)			
h × Economic competencies					1.0086*** (0.2427)		
f × Financial development							0.229 (0.9469)
Physical capital stock per hour worked	0.3634*** (0.0437)	0.4472*** (0.0463)	0.3953*** (0.0436)	0.4262*** (0.0438)	0.3811*** (0.0492)	0.3478*** (0.0743)	0.3390*** (0.0789)
Country-Industry fixed effects	yes	yes	yes	yes	yes	yes	Yes
Year fixed effects	yes	yes	yes	yes	yes	yes	Yes
Country-year fixed effects	No	No	No	No	No	yes	Yes
Industry-year fixed effects	No	No	No	No	No	yes	Yes
Number of observations	682	682	682	682	682	682	682
R-squared	0.995	0.994	0.995	0.994	0.995	0.997	0.997

Note: Robust standard errors are reported in parentheses. Significance levels are indicated by: *** at 1%, ** at 5%, and * at 10% level.

Policy considerations

Although the main actors for upgrading in GVCs are firms, governments can support upgrading in GVCs in various ways. Policies to support the upgrading process are largely similar to policies to enhance productivity. Therefore, governments should strengthen product market competition to strengthen the incentives for firms to: enhance productivity; foster a dynamic business sector that allows new, innovative firms to emerge, experiment and grow; invest in productivity-enhancing public goods such as education, research and infrastructure; and provide the framework conditions that support business investments in such areas. Well-designed demand-side policies, such as innovation-oriented competitive public procurement, can also help strengthen the innovation system and ensure that innovation meets public needs.

A particularly important driver for upgrading in GVCs is investment in knowledge-based capital. Investments in knowledge-based capital not only drive productivity growth, they also determine the extent to which the final product of a value chain can be differentiated in consumer markets, which in turn determines the total value the GVC can create. Business investment in knowledge-based capital underpins much of the knowledge economy. Accordingly, many policy areas affect these investments. Framework conditions are crucial, as they provide the overall context for investment in knowledge-based capital and for the efficient reallocation of resources to new sources of growth, including those that rely on knowledge-based assets.

In addition, policies to increase business investment in knowledge-based capital must be founded on evidence that businesses would otherwise underinvest in knowledge-based capital. For firms, the ability to internalise fully the returns to investments in knowledge-based capital varies among the different types of assets. The strongest evidence for private underinvestment concerns R&D-related spending. But positive externalities, which can lead to socially suboptimal investment, also exist for design and other forms of knowledge-based capital (many businesses' designs are copied, an indication of spillover of value).

Knowledge-based capital as a source of value creation in GVCs has several implications for policies to increase the gains from global engagement. The recognition that assets such as data, design, brands, management and organisational arrangements play an important role in capturing value in GVCs opens the way to policy thinking that goes beyond policies oriented towards technology and tangible capital. The breadth of knowledge-based capital points to the need for a broader concept of innovation than the conventional view dominated by R&D. A wider perspective on innovation's drivers could require the redesign of some long-standing innovation programmes.

For example, most OECD governments operate programmes that facilitate firms' access to research or technology-related advice and information, often from universities and public research organisations. These schemes – such as innovation vouchers, know-how funds and technical extension services – tend to focus on technological information, typically by creating links to academics in science, technology, engineering and mathematics (STEM) disciplines. The work on knowledge-based capital suggests that an exclusive focus on STEM disciplines is too narrow. Businesses also interact with academics for reasons other than technological development.

Policy frameworks might also facilitate collaboration on non-R&D-based innovation. Collaboration on R&D by private firms and public research entities is increasingly common in OECD countries, owing to the growing complexity of innovation and need for complementary knowledge. Collaboration can help government laboratories or universities to obtain funding for research activities and help ensure that their research is commercially relevant, while firms gain access to these institutions' accumulated knowledge. New OECD evidence shows that such collaboration is associated with stronger productivity growth in firms in R&D-intensive sectors. While maintaining the critical role of universities in fundamental research, policy might enlarge the focus of collaboration-enabling programmes beyond R&D. Policies that facilitate links between GVC participants and the local knowledge base (research and training institutions) can lead to positive feedback loops between knowledge-based capital and the upgrading of GVC activities. Such linkages enhance firms' ability to absorb knowledge from counterparts in a GVC.

Evidence suggests that countries that are more successful at channelling resources to the most productive firms also invest more in knowledge-based capital. Entrepreneurial activity is essential to the process of reallocating labour and all forms of capital to their most productive uses. Having efficient mechanisms to reallocate tangible resources takes on heightened importance – to implement and commercialise new ideas, firms require a range of complementary tangible resources to test ideas (e.g. to develop prototypes), develop marketing strategies and eventually produce at a commercially viable scale. Innovative firms can play a key role in diversifying countries' participation in GVCs and in supporting the upgrading process. The use of knowledge-based capital in the upgrading of value chains will also require experimentation by firms of all sizes with new business models and organisational forms. Countries with more stringent regulations in product, labour and (to a lesser extent) credit markets, tend to invest less in knowledge-based capital while investment in knowledge-based capital is also positively correlated with debtor-friendly bankruptcy codes.

Financing is also a key area because it supports innovation and diversification. In traditional debt markets, tangibles (assets such as equipment and structures) have well-defined market prices and readily serve as collateral. The increasing importance of knowledge-based capital underscores the need for market-enhancing policy instruments to address shortfalls of early-stage risk capital that affect young knowledge-based capital intensive firms and the need for better ways for firms to communicate the value of knowledge-based capital in their business models.

Lowering barriers to international trade and investment also encourages more efficient resource allocation by increasing knowledge diffusion and technology transfer across borders. As knowledge is partly embodied in – and can spill over from - imported intermediate goods, reductions in tariffs on intermediate inputs are associated with significant productivity growth in downstream manufacturing sectors. Reductions in tariffs on foreign high-technology intermediate inputs boosts the productivity of sectors closest to the technology frontier, but has no impact on sectors more distant from the frontier. And across service sectors in OECD countries, higher restrictions on foreign direct investment (FDI) are associated with lower allocative efficiency.

Because of the specific economic features of knowledge-based assets, especially its intangible nature, certain key policy settings will also need to be updated in the fields of taxation, competition, corporate reporting, intellectual property and in policies that enable the exploitation of data as an economic asset. In the highly interconnected, knowledge-driven economy of GVCs, high-quality intellectual property rights (IPR) are an increasingly important framework condition. These help protect the critical knowledge-based capital that enables firms to create value and compete in global markets and help to avoid easy replication by rivals of new design and technologies. A sound and high-quality IPR regime, combined with good enforcement, is therefore important. However, there are concerns that certain features of IPR regimes may be hindering innovation and competition and have not kept pace with technological change. In a world increasingly based on knowledge assets, IPR regimes must be coupled with pro-competition policies and efficient judicial systems to help erode the rents arising from monopoly protection. There is also a need for greater mutual recognition and compatibility across IPR systems internationally, for instance to permit cross-border copyright licensing.

The rise of knowledge-based capital also amplifies the importance of some framework policies already understood to be essential, such as in education. Attention must likewise be given to complex regulatory issues, for instance in connection with data privacy and security. Indeed, as new technologies develop, based on knowledge-based capital new regulatory challenges are likely to emerge.

Notes

1. The innovation literature traditionally distinguishes between four types of innovation: process innovation, product innovation, marketing innovation and organisational innovation (OECD, 2010).
2. Hulten (2010) adapted this framework to Microsoft and reported that KBC explained more than 40% of its productivity growth.
3. Using the power of people out in the web to undertake tasks that are hard for individual users of computers to do alone (Miller, 2012).
4. In November 2012 Japan's Ministry of Economy, Trade and Industry (METI) surveyed Japanese enterprises on their engagement in GVCs. Information was obtained from 2 269 firms, of which 54% were manufacturing firms, 51% were exporters and 37% possessed offshore plants, on their various activities related to GVCs, their efforts to achieve higher profit margins and the forms of KBC they consider essential for successful upgrading.
5. On-going work should also provide finer measurements of these assets (OECD, forthcoming). The data for knowledge-based capital come from Corrado et al. (2012) who calculated detailed measures of its three components (computerised information, innovative property and economic competencies) for 14 European countries and the United States. The sample used to test the hypothesis is therefore much smaller than the one used in Chapter 6.
6. In the absence of data on knowledge intensity at the sectoral level, they are proxied by high-skill intensity. More detail is provided in Annex 7.A1.
7. Column I of the OLS results reproduces results in Chapter 6 for the subsample of 14 countries used in this experiment. Column II replaces high-skilled labour endowment with intangible capital endowment, dependent on high skill intensity at the industry level. As in the model used in Chapter 6, other controls include external economies of scale, and the country's capital endowment, dependent on capital-intensity at the industry level. Column III introduces two interaction variables to measure separately the impact of KBC endowment on specialisation in industries that are both high-skill- and offshoring-intensive.
8. Under the same specification, each component enters the equation when the other two are excluded.
9. There is no widely agreed measure of GVC upgrading. The measures used so far have largely depended on data availability. The new results on trade in value added allow for more complete measurements.
10. Comparing differences at two points in time (or, in other words, at two different levels of KBC endowment) yields the estimator in question, much as in the previous model. More detail is provided Annex 7.A2.

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Annex 7.A1
Econometric model on the effect of knowledge-based capital and export competitiveness

The data

The purpose of this exercise is to extend the empirical framework used in Chapter 6 to include measures of knowledge-based capital and its interaction with offshoring activities. The data for knowledge-based capital come from Corrado et al., (2012) who calculated detailed measures of its three components for 14 European countries and the United States. [1] The size of the sample that is used to test the hypothesis is therefore much smaller than the one used in Chapter 6.

Gross export data are sourced directly from the WIOD International Supply and Use Tables. Export value-added is extracted from the same tables using the OECD inter-country input-output (ICIO) system comprising all three components of domestic value-added (direct, indirect and re-imported), and calculated as gross exports minus foreign value-added according to:

$$\mathbf{x_{it}}^{VA} = \Sigma_j \, \mathbf{x_{ijt}}^{VA} = \Sigma_j \, (\mathbf{x_{ijt}} - \mathbf{V_{jt}} \, \mathbf{B_{jit}} \, \mathbf{x_{ijt}})$$

where $\mathbf{x_{it}}^{VA}$ is the sum across partner countries j of bilateral vectors of domestic value-added $\mathbf{x_{ijt}}^{VA}$ embodied in gross exports $\mathbf{x_{ijt}}$ from country i to j at year t. Each element of the vector corresponds to one sector of the economy. $\mathbf{V_{jt}}$ is a diagonal matrix representing value-added shares of the partner country j at year t. And $\mathbf{B_{jit}}$ is a block matrix representing total requirements in gross output from country j for a one unit increase in country i's demand. $\mathbf{B_{jit}}$ is part of the global Leontief inverse matrix $\mathbf{B_t}$ sourced from WIOD. For more details on the OECD inter-country input-output system see (OECD, 2013).

The model

The relationship between revealed comparative advantages (RCAs), country endowments, and sectoral sourcing activities, is modelled using the benchmark linear OLS model of Chapter 6, augmented to include measures of intangible capital endowment and its interaction with offshoring activities. The preferred specification is:

$$\begin{aligned} SRCA_{ist} = {} & \beta_0 + \beta_1 D_{ist} + \beta_2 (K_{it} \times k_s) + \beta_3 (IK_{it} \times h_s) + \beta_4 Int_{ist} + \beta_5 Imp_{ist} + \\ & + \beta_6 (IK_{it} \times Imp_s) + \beta_7 (IK_{it} \times h_s \times Imp_s) + c_{it} + c_s + u_{ist} \end{aligned}$$

[1] **Years**: 1995-2009; **Countries:** Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Slovenia, Spain, Sweden, United Kingdom, United States; **Industries:** ISIC Rev.3 sectors AtB, C, 15t16, 17t18, 19, 20, 21t22, 23, 24, 25, 26, 27t28, 29, 30t33, 34t35, 36t37, E, F, 50, 51, 52, H, 60, 61, 62, 63, 64, J, 70, 71t74, L, M, N, O, P.

where the dependent variable $SRCA_{ist}$ stands for the Symmetric Revealed Comparative Advantage index in country *i*, sector *s* and year *t*, calculated as $(RCA_{ist} - 1)/(RCA_{ist} + 1)$. The adjustment was introduced by Laursen (1998) to render Balassa's RCA index comparable on both sides of unity.[2]

Regressors

D_{ist} *Domestic demand index:* The index corresponds to the domestic share of sector *s* in country *i* total consumption, relative to the share of the sector in total world consumption in year *t*:

$$D_{ist} = (D_{ist}/D_{it}) / (D_{st}/D_t)$$

The index is designed to measure the weight of this sector in domestic consumption relative to the world average. It is introduced as a control for external economies of scale, capturing factors such as better infrastructure for the needs of the industry, the availability of cheaper inputs, or a history of growth. Domestic demand D_{ist} is calculated as the sum of final demand by households, non-governmental organisations (NGOs) and the government. *Source:* WIOD Socio-Economic Accounts.

$K_{it} \times k_s$ *Capital endowment × industry intensity:* Capital endowment at the country level (K_{it}) is captured conditionally in an interaction term with the industry's capital intensity (k_s). Capital endowment is measured relative to the size of the labour input (capital stock divided by the number of hours worked in the country to take into account part-time employment). Capital intensity is calculated at the industry level as expenditure shares in value added from a single reference country, averaged over 15 years. The reference country used is the United States, subsequently excluded from the sample. *Source:* WIOD Socio-Economic Accounts.

$H_{it} \times h_s$ *Skilled labour endowment × industry intensity:* The impact is captured by an interaction between skill-intensity at the industry level (h_s) and abundance of high skills at the country level (H_{it}). Endowment is measured at the country level as hours worked by high-skilled workers relative to total hours worked in the economy. High skill intensity at the industry level is calculated as expenditure shares in total labour compensation from a single reference country averaged over 15 years. The reference country used is the United States, subsequently excluded from the sample. *Source:* WIOD Socio-Economic Accounts.

Int_{ist} *Outsourcing index:* Intermediate use intensity (intermediates expenditure I_{ist} excluding expenditure for energy as a share of gross output GO_{ist}) relative to the sectoral average of the same ratio across all countries in the same year: $Int_{ist} = (I_{ist}/GO_{ist}) / (I_{st}/GO_{st})$. *Source:* WIOD International Supply and Use Tables.

Imp_{ist} *Offshoring index:* Import intensity in intermediate use (share of imported intermediates I^{imp}_{ist} in total intermediates I_{ist}) relative to the sectoral average of the same ratio across all countries in the same year: $Imp_{ist} = (I^{imp}_{ist}/ I_{ist}) / (I^{imp}_{st}/ I_{st})$. *Source:* WIOD International Supply and Use Tables.

2 The asymmetry it addresses is that standard RCAs range from zero to one if a country is not specialised in a given sector, while the index ranges from one to infinity otherwise.

$IK_{it} \times h_s$ *Intangible capital endowment × skill intensity:* Intangible capital endowment at the country level (IK_{it}) is captured conditionally in an interaction term with the industry's skill intensity (h_s). The index therefore varies over countries and years in a single dimension (knowledge-based capital) disentangling its impact over an invariable set of industries that are both high-skill- and offshore-intensive. Intangible capital is calculated as the sum of three categories of assets: investment in computerised information; innovative property; and economic competencies for which recent data exist only at the country level (Corrado et al., 2012), relative to the size of the labour input (number of hours worked in the country). Intangible capital intensity is proxied by high skill intensity at the industry level, corresponding to expenditure shares in total labour compensation from a single reference country, averaged over 15 years. The reference country used is the United States, and it is subsequently excluded from the sample. *Source:* WIOD Socio-Economic Accounts.

$IK_{it} \times h_s \times Imp_s$ *Intangible capital endowment × skill intensity × offshoring intensity:* Intangible capital endowment at the country level (IK_{it}) is captured conditionally in an interaction term with the industry's skill intensity (h_s, see above) and with the industry's offshoring intensity (Imp_s). Offshoring intensity at the industry level is calculated as import intensity of intermediate use (share of imported intermediates in total intermediates; *Source:* WIOD Supply and Use Tables) from a single reference country averaged over 15 years. The reference country used is the United States, which is subsequently excluded from the sample. Notice that, to facilitate the interpretability of this three-way interaction, variation of high-skill and offshoring intensity over countries and time is suppressed, with values by sector taken from a single reference country (the United States, subsequently excluded from the sample), and averaged over time. The equation is complemented with a two-way interaction of knowledge-based capital endowment with offshoring intensity (see below), to ensure that the main effects are marginal to their interaction effect (the so-called *principle of marginality*).[3]

$IK_{it} \times Imp_s$ *Intangible capital endowment × offshoring intensity:* Intangible capital endowment at the country level (IK_{it}) is captured conditionally in an interaction term with the industry's offshoring intensity (Imp_s).

$c_{it} + c_s$ *Country × year fixed effects and sector fixed effects*: These are included to capture systematic deviations of SRCAs across sectors in certain countries, as well as across countries in certain sectors. A sector might systematically have low SRCAs across countries because a single country dominates world production and exports; that asymmetry will be absorbed by the sectoral fixed effect. Similarly, a country's exports might be very little diversified and dominated by few sectors; the average RCAs across sectors will therefore be low, an outcome that will be absorbed by the country fixed effect interacted with year to ensure that variations across time of this structure is suppressed.

Notice that because both the independent and dependent variables are index numbers, normalised for various types of asymmetries, the level of the coefficients in the results is not directly interpretable. Coefficients for the same regressor can nevertheless be compared in an ordinal way between two sets of regressions, adding some insights to the discussion.

3 See Nelder, J. A. (1977), A Reformulation of Linear Models, *Journal of the Royal Statistical Society*, Vol. 140 (1), pp. 48–77.

Annex 7.A2
Econometric model on the effect of knowledge-based capital and GVC upgrading

1. The data

Data on the domestic value added content of exports are obtained from OECD-WTO TiVA Database and are partly estimated based on the inter-country input-output (ICIO) system. The data are on an annual basis from 1995 to 2009 for 18 industries.

The measures of knowledge-based capital come from Corrado et al. (2012) as in the previous econometric model. The study produced "harmonised" estimates of knowledge-based capital investment for the EU27 and included estimates for the United States. It also estimated the stock value of knowledge-based capital for 14 EU economies and the United States.

2. The model

While the estimates of knowledge-based capital are only available at the economy level, a recent approach that explores within-economy variation across industries is employed following Rajan and Zingales (1998). A country industry "Difference-in-Difference (DID)" approach enables a stronger inference of causality than the usual cross-country regressions because it involves comparisons within an economy and is therefore free from the problems caused by omitted country factors.

This framework is applied to the relation between industry-level VAX and economy-level stock of knowledge-based capital. The following equation is estimated:

$$\mathrm{VAX}_{ijt} = \beta\left(h_{ij} \times \mathrm{KBC}_{jt}\right) + \gamma X_{ijt} + \alpha_{ij} + \alpha_t + \epsilon_{ijt}$$

The left-hand side is the domestic value added content of exports (VAX) for industry i in economy j at time t, transformed as continuous variable. The first term on the right-hand-side is the interaction of industry i's knowledge-intensity (proxied by the labour compensation share of engaged personnel with tertiary education, obtained from the EU-KLEMS database) and the stock of knowledge-based capital of an economy j at the time t. The knowledge-based capital stock per hour worked by engaged personnel is expressed in log values. The second term is a vector of control variables which may influence both VAX and KBC. In the standard regression, only the economy-industry level physical capital per hour worked by engaged personnel is included. The third and fourth terms represent economy-industry fixed effects and time fixed effects. The former fixed effects control for unobserved heterogeneity specific to each industry in each economy—such as the unique history or initial integration into GVCs by an industry in an economy. The latter fixed effects control for change in world's economic condition at each point of time. The last term is an error assumed to be independent and identically distributed across economies and industries but potentially correlated across times. Heteroscedasticity-consistent standard errors are used to correct for the potential effect of serial correlation.

Chapter 8

Global value chains: Managing the risks

Globalisation has made it easier for local risks to become global risks. Global value chains (GVCs) have recently acted as important channels of contagion, because of their global network character. Local demand and supply shocks that start in one part of the global economy can spread rapidly to the entire world. Global disruptions such as the 2008 financial crisis and the 2011 Japanese earthquake have brought the potential global systemic risks to the attention of policy makers. While firms are the first in line to manage the risks of GVCs, governments also have an important role, since disruptions in GVCs can have major political, economic and security implications for national economies. A multi-stakeholder approach on an international scale will increase the speed and effectiveness of pre-disruption planning and of post-disruption responses.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Globalisation and systemic risk

Globalisation has integrated societies, countries and economies through various channels: international trade (of both goods and services), foreign direct investment (FDI), the international migration of people (including the highly skilled), cross-border knowledge and technology flows, etc. The emergence of global value chains (GVCs) has increased the connectivity and the interdependencies of countries. Global links and geographically concentrated production due to increasing specialisation allow a local event to become a global disruption. National economies have therefore become more vulnerable to so-called systemic risk, i.e. the risk of the breakdown of an entire system.

In a system characterised by strong links[1] the failure of a single entity or cluster of entities may result in cascading disruptions that can bring down the entire system or large parts of it (Schwarcz, 2008). Growing cross-border interconnectivity also increases the risk of shocks spreading quickly worldwide. The OECD (2011a) defines global shocks as "rapid onset events with severely disruptive consequences covering at least two continents" (OECD, 2011a). The financial and economic crisis in 2008 was a full-blown global economic shock and clearly demonstrated that increased interconnectivity and interdependency implies greater vulnerability. While globalisation itself is not the cause of the adverse shock, it may act as a very effective transmission mechanism.

It is not obvious if and when a shock originating in one part of the network will have system-wide effects. Greater connectivity initially decreases individual risk – through risk dispersion and diversification – and increases the overall robustness of the system.[2] However, beyond a certain threshold, it increases the system's fragility and thus systemic risk (Battiston et al., 2009; Gai et al., 2007; Watts, 2002). This threshold differs from system to system and is directly affected by a second system characteristic: the degree of redundancy (or back-up) in the system (Elmqvist et al., 2003; Korhonen and Seager, 2008). When diversity decreases and/or system redundancies are eliminated, substitutability (the extent to which other components of the system can provide the same services in the event of a failure) also decreases. The greater the redundancy in the system, the easier it is for other elements to take over in the event of a failure in one part of the system.

Several major disruptions in recent years have increased (policy) attention to global systemic risks, both economic and societal (Goldin, 2010; OECD, 2011a). Some key areas of potential risk are briefly discussed below.

Pandemic risks

Because living creatures have become more mobile, globalisation may increase the likelihood of diseases becoming epidemics or even pandemics. While an epidemic is generally expected to remain restricted to a certain area, a pandemic implies a highly infectious disease that spreads worldwide and may endanger human populations (e.g. a new form of influenza). The rapid diffusion of a virus is facilitated by the rapid rise in the flows of products, people, livestock, etc., often through a relatively small number of infrastructure hubs. Recent data show for example that the world's top 30 airports process almost half of all international passengers and handle over two-thirds of all international freight (Airports Council International, 2009). In addition the world's top ten ports handle more than 50% of the global economy's container traffic (American Association of Port Authorities, 2009).

Pandemics can result in major losses and costs. The economic costs of pandemics are typically due not only to fatalities, hospitalisation and medical treatment (the so-called direct costs), but also to indirect costs such as absenteeism and productivity losses (OECD, 2011a). During a pandemic, supply shocks would also be likely in transport, trade, payment systems and major utilities (IMF, 2006).

Resource risks: The example of food security

Food security[3] is increasingly compromised by volatile world prices and reduced domestic food production. The two food commodity price spikes since 2007 have pushed the costs of food above incomes for many poor people, although there were nearly as many malnourished people in 2005 when food commodity prices were at historical lows (OECD, 2011b).[4] Globalisation is believed by some to contribute to food price volatility and thus endanger food security in certain parts of the world. Others argue that it is not globalisation but barriers to food trade (hence, the *lack* of globalisation) that cause much of the trade-induced volatility (Ghemawat, 2011).

Pressures on food prices are exacerbated by the continuing rise in population and consumption, which fuels global demand. Food security is also affected by the global trend towards standardisation and increasing monoculture, which is reducing biodiversity and increasing systemic risk. Increased productivity and a more sustainable food system will be necessary to improve global food security (OECD/FAO, 2012). There is considerable discussion about whether current levels of investment in agriculture and technology will be able to increase global food production to the levels needed to feed a growing world population (World Bank, 2008; Ridley, 2010; Ghemawat, 2011).

Geopolitical risks

Globalisation has also changed the character of geopolitical risks, as it has given individuals greater power. The communication and transport networks that underpin globalisation can be used for many purposes, such as societal and political protests, but also for terrorism, organised crime and corruption. Civil unrest in one country can trigger a chain of events that quickly affects neighbouring countries as happened in Tunisia and Egypt in 2011.

Global business is directly affected by the increase in geopolitical risks because of the geographical spread of their activities. A survey of board-level directors showed that political violence (including terrorism) led 37% of directors to avoid investment in certain regions, 22% to change their travel policy and 23% to increase their insurance spending (Economist Intelligence Unit, 2007).

Infrastructure risks

In today's global economy, the efficiency and effectiveness of infrastructure is crucial to business and national competitiveness. Infrastructure systems are increasingly concentrated and structured as networks around a limited number of hubs or nodes. Such complex systems can collapse if a disruption occurs in a sufficient number of the system's nodes. For example, the four leading air freight carriers, which account for the majority of global air cargo, have implemented so-called hub-and-spoke networks around hubs in North America, Europe and Asia. When the volcanic eruption in Iceland in 2010 produced an ash cloud over the air space of Europe's major air hubs, many companies were unable to deliver products or key components to markets and production systems both in Europe and across the world (OECD, 2011a).

Because of the increasing global interdependence of critical infrastructure networks (transport, telecommunications, electricity, etc.), a failure in one system may affect other interdependent systems (through cascading failures) and may have far-reaching repercussions. Communication networks increasingly serve as a backbone for critical infrastructure systems as well global business operations. For example, the international co-ordination of activities in GVCs relies heavily on ICT networks. A 2007 survey of 465 businesses showed that 54% were entirely dependent on uninterrupted Internet connectivity (Secure 64, 2007). The increasing reliance on public communication networks makes companies vulnerable to system failures (caused by power failures, technical faults, or even natural disasters) as well as to cyber attacks, which have become increasingly sophisticated.[5]

Financial/economic risks

In the financial/economic crisis of 2008 global linkages, and thus globalisation, facilitated the spread of the crisis (OECD, 2010a). What started as a financial crisis in the United States rapidly became a global economic crisis and led to a dramatic collapse in international trade and FDI, in which GVCs played an important role (see below). Owing to the extent of the contagion across assets, institutions and countries, the financial crisis rapidly acquired a global character (Blanchard, 2009).

Securitisation, the aim of which is to pool assets and distribute risk across a variety of actors, resulted in closer links among financial institutions. In addition, an expanded credit supply and under-assessment of risk, combined with the use of intermediate and often unregulated and non-transparent lenders, further undermined the stability of the financial system. When payment difficulties appeared in the subprime mortgage segment of the US property market, resulting from high mortgages and falling housing prices, financial institutions became unwilling to lend to each other. Households cut back their consumption and started to save. At the same time, access to credit became more difficult and more expensive, thereby lessening corporate investment, especially in small businesses. As a result, the financial crisis reached the real economy, resulting in a drop in stock markets and a deterioration of business and consumer confidence that affected all economic operators.

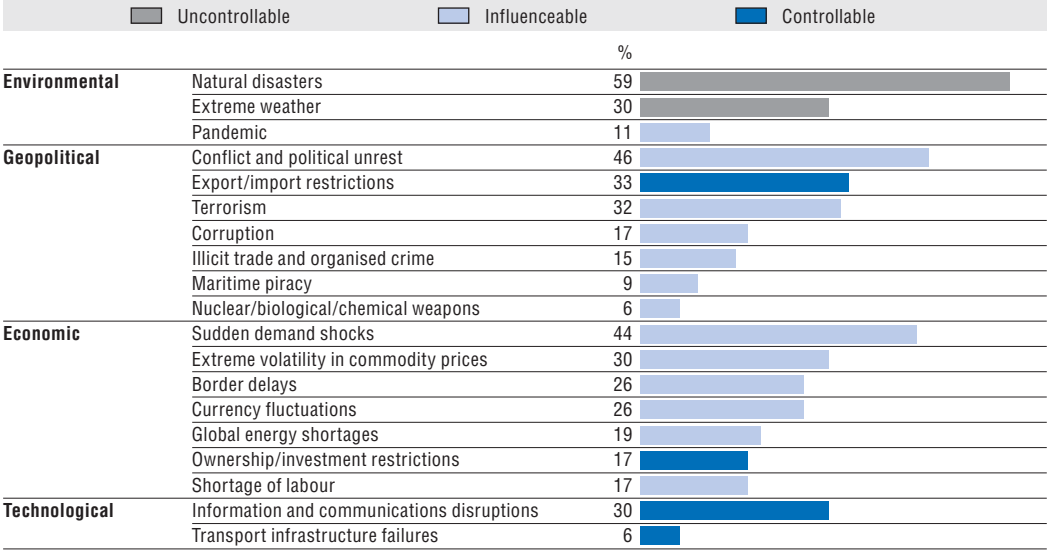
Global value and supply chain risks

GVCs involve interdependent and interconnected networks of firms, industries and economies, and can be considered potential carriers of global contagion. The small margin of error that firms typically build into value chains in order to reduce costs considerably increases the risks. Just-in-time models, lean supply structures and a lack of redundancy mean that a breakdown in one part of the chain may quickly have detrimental effects throughout the value chain. Furthermore, as GVCs have become more complex and extended,[6] this has generated further risks, but these are not always visible and are therefore less easily controlled by firms. Indeed, management does not always have a clear view of how their value chains are structured on a day-to-day basis.

There are many causes or drivers of supply chain risks and they have become more varied over time, as a result of the increased importance, length and complexity of GVCs. Supply chain risks are often categorised as "internal to the firm", "external to the firm but internal to the supply chain network" or "external to the network" (Christopher and Peck, 2004). Based on this, several classifications of GVC risk have been proposed (see Annex 8.A1). A recent World Economic Forum survey of company executives ranks

external events as most likely to have significant global effects on GVCs (Figure 8.1). By distinguishing environmental, geopolitical, economic and technological factors, the close relationship between GVC risks and other categories of global systemic risk becomes clear.

Figure 8.1. Drivers of global supply chain risks



Source: World Economic Forum (2012).

The link between GVCs and global systemic risk: The 2008/09 financial crisis and the 2011 Japanese earthquake

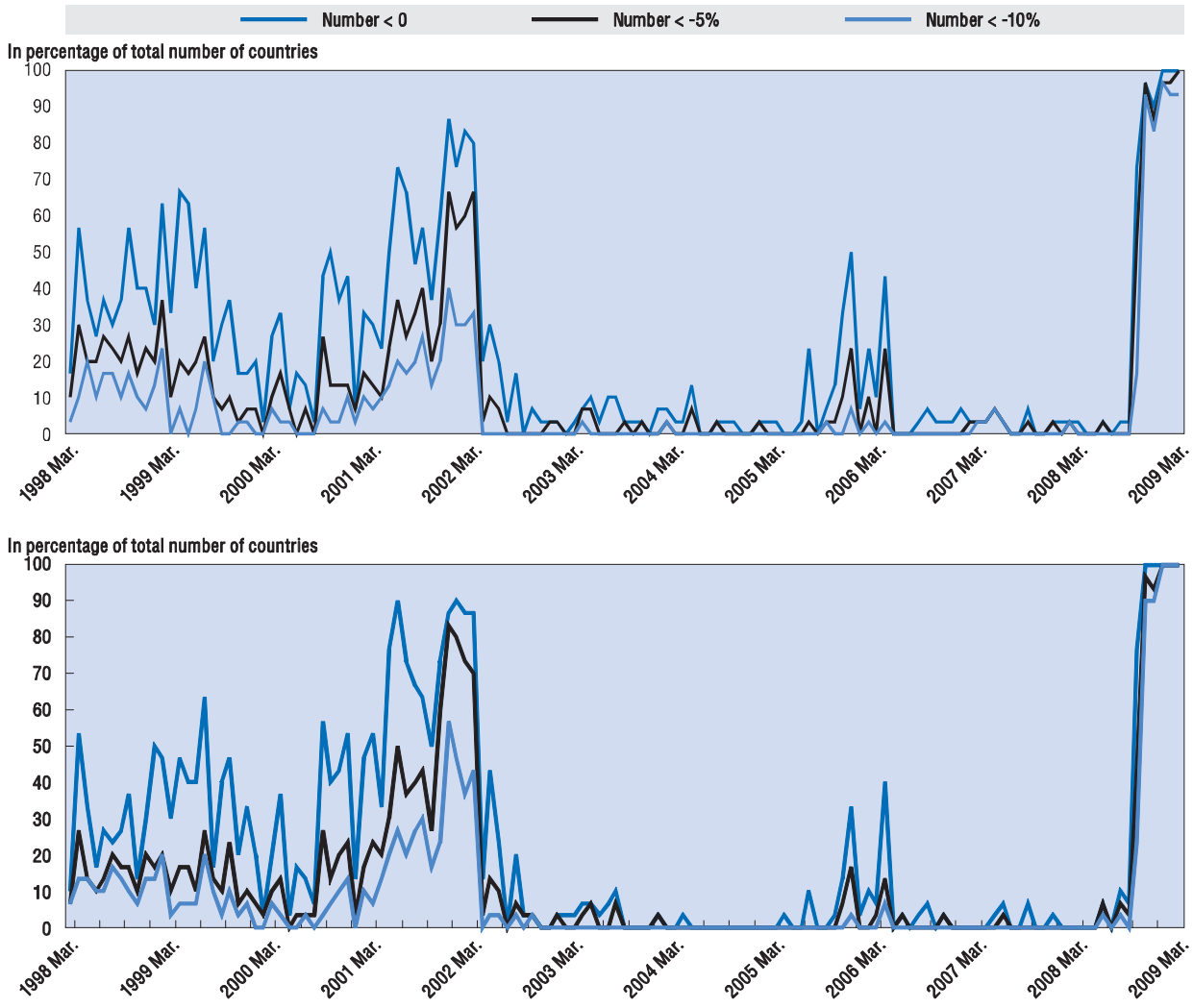
The trade collapse during the financial/economic crisis of 2008

The financial crisis rapidly spilled over to the real economy and triggered a drastic decline in trade across the world between the third quarter of 2008 and the second quarter of 2009. It was the steepest and deepest fall in world trade since the Great Depression (OECD, 2010b) and was described by Baldwin (2009) as "severe, sudden and synchronised". While the drop at the start of the crisis was similar to past downturns for individual countries, the 2008/09 collapse in trade was the direct result of strongly synchronised, dramatic declines in a large number of countries: by the end of 2008, 90% of OECD countries reported declines in exports and imports of more than 10% (Araujo and Oliveira Martins, 2009). At the end of the first quarter of 2009, this was the case of all OECD countries. The same situation existed on the import side: all OECD countries registered negative growth of imports of more than 10% from January through March 2009 (Figure 8.2).

Figure 8.2. Synchronisation of trade, OECD countries, 1998-2009

Magnitudes of decline in monthly growth rates (year-on-year)

Exports (above), Imports (below)



Source: Araujo and Oliveira Martins (2009).

International trade has been both a casualty of the crisis and one of its main channels of transmission (Escaith et al., 2010). In fact, trade links between countries may have amplified demand shocks (OECD, 2010a; IMF, 2011). Previous work has demonstrated the importance of international trade in propagating business cycles (Burstein et al., 2008). Countries typically "catch" demand-led recessions from countries to which they export disproportionately and transmit recessions to countries from which they import disproportionately (Ferrantino and Larsen, 2009). These crisis propagation mechanisms were strengthened in the 2008 crisis by the interdependency of trade between countries: the synchronous drop in countries' trade flows enhanced the decline in trade in individual countries and contributed significantly to the dramatic collapse of trade at the aggregate level (OECD, 2010b).

There is increasing evidence of higher business cycle correlations in countries with stronger GVC linkages (Burstein et al., 2008; Bergin et al., 2009; Ng, 2010; Gangnes et al., 2011). GVCs feature prominently among the reasons put forward to explain the large size and synchronous timing of the collapse of trade in 2008.[7] However, while GVCs may indeed act as a channel for the international propagation of adverse external shocks, they are not the cause of the shocks themselves.[8] A number of factors explain the link between GVCs and the 2008/09 collapse in trade.

First, GVCs have intensified trade linkages among countries as the international fragmentation (or division) of production has increased trade in intermediates (in addition to capital and consumption goods/services). Intermediates are exchanged across borders several times and are therefore registered more than once as "international trade" before they are integrated in final products (see Chapter 1). Since GDP is a value added concept whereas trade is expressed in output terms, the drop in trade in 2008/09 rapidly became a multiple of the drop in GDP[9] (Bems et al., 2009; Levchencko et al., 2009). Moreover, the elasticity of trade to GDP has increased over the last decades, from below 2 in the 1960s to over 3.5 during the recent crisis (Freund, 2009). Instead of reflecting a long-term structural change, Escaith et al. (2010) argue that the high trade elasticities measured during the course of the crisis merely reflect a short-term (up to four years) and transitory overshooting of the responsiveness of trade to GDP.

Second, the large size of the trade/GDP multiplier during the 2008/09 crisis was largely due to a compositional effect, i.e. the fact that the original demand shock was concentrated in so-called postponable goods (Baldwin, 2009; O'Rourke, 2009; OECD, 2010b). The production of postponable goods, such as consumer durables and investment goods, is typically organised in GVCs that cover several countries. As a result, the industries most affected by the crisis were those characterised by international production networks (OECD, 2010a). As these industries represent a larger share in world trade than in world value added (because of the GVCs and trade in intermediates), the drop in demand affected trade much more than it did GDP.[10] The increasing importance of GVCs, in combination with this composition effect, amplified the impact of the business cycle on trade when firms adopted production plans that reflected lower anticipated demand.

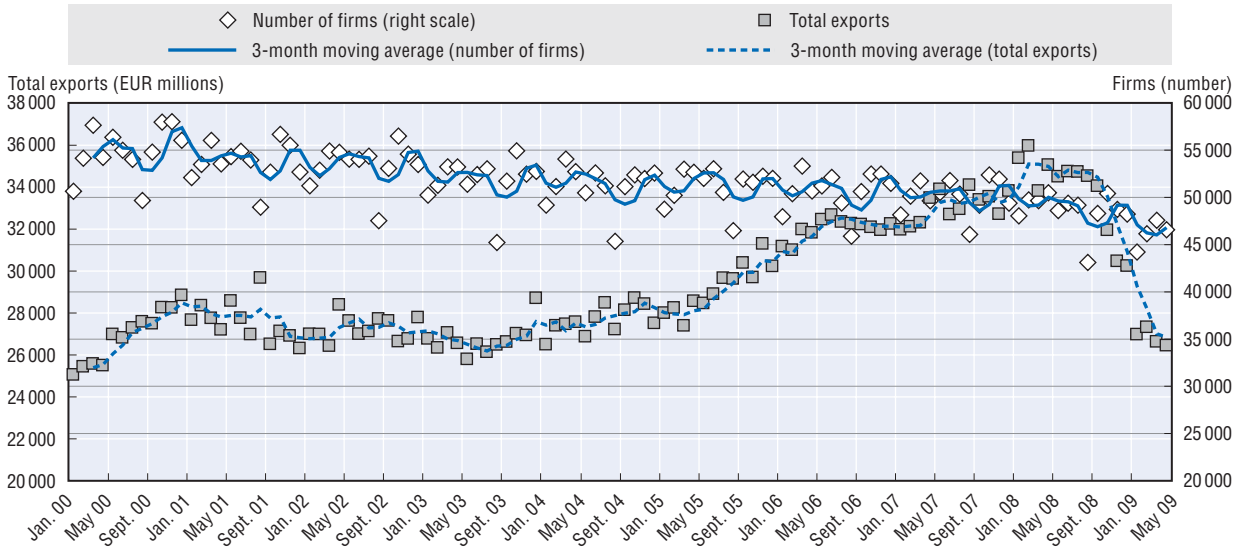
Third, recent research for the United States has shown that inventory dynamics in GVCs also contributed to the strong drop in trade in 2008/09 (Alessandria et al., 2011). Supply chains are characterised by a so-called "bullwhip" effect, whereby even small changes in final demand cause large changes in demand for parts and components higher up the value chain. As information on demand becomes distorted along the chain, the variability in orders is amplified as it moves up the supply chain.[11] When a downstream firm encounters a drop in demand for its final products, its first reaction is to run down inventories; therefore, a slowdown in downstream activities leads to an amplified reduction in demand for inputs located upstream. This effect is stronger in an international setting as participants in international trade have more severe inventory management problems (Escaith et al., 2010). In addition, importing firms have inventory ratios that are roughly twice those of firms that only purchase materials domestically, and the typical international order tends to be about 50% larger and half as frequent as the typical domestic order (Alessandria et al., 2011).

Altomonte et al. (2011) report similar results for French imports and exports, and explain how inventory adjustments within GVCs magnified demand shocks when trade collapsed. They found that MNEs were able to adjust faster to the negative demand shock than small and domestic firms. Because of more limited information asymmetries, intra-group trade in intermediates dropped faster at the start of the crisis but also recovered faster.

Fourth, not only the size but also the synchronisation of trade declines is related to the structural characteristics of GVCs. The just-in-time nature of many GVCs causes a demand shock in final goods in one country to pass almost instantly to suppliers of intermediates in other countries; these cascade effects ensure that the demand shock is felt throughout the entire supply chain. GVCs also lead to simultaneous declines in imports and exports. The dependence of exports on imported intermediate goods implies that a country's exports and imports tend to move in the same direction in response to changes in either domestic or foreign demand (Bems et al., 2009).

Fifth, GVCs also acted as a channel to transmit supply-side shocks across countries during the collapse (Escaith and Gonguet, 2009). The credit crunch that followed the financial crisis lessened the availability of finance and this, in combination with lower demand, forced companies (e.g. suppliers of parts and components) in GVCs to halt their activities. Given that the goods/services produced in GVCs are largely transaction-specific, i.e. specific to clients' needs, this will result in higher production costs or even the total disruption of the value chain if client firms are unable to find substitute suppliers.

Figure 8.3. Total value of French exports and total number of French exporters, January 2000 to April 2009



Source: Bricongne et al. (2012).

Evidence for France (Figure 8.3), Japan and the United States indicates, however, that GVCs were not entirely disrupted by the trade shock (Bricongne et al., 2012; Schott, 2008; Wakasugi, 2009). Most of the collapse involved adjustments along the intensive margin (i.e. a reduction in volume) instead of along the extensive margin (i.e. a reduction in the number of suppliers). This suggests that relationships and trade flows in supply

chains may be relatively resilient to adverse shocks such as the economic crisis, and this may be related to the large sunk costs involved in developing global production networks. Companies also consider alternatives very carefully before taking irrevocable steps to reduce their global value chain (Altomonte and Ottaviano, 2009).

The Japanese earthquake and tsunami of March 2011

The earthquake and tsunami that struck the northeast coast of Japan on 11 March 2011 created enormous human, ecological and economic damage. The direct economic consequences of this natural disaster included injuries and loss of life (which also reduced companies' human resources) and physical damage to factories, buildings and equipment as well as to public infrastructure (transport, telecommunications, electricity, etc.). In addition, for quite some time after the disaster, scheduled blackouts (e.g. in electricity) resulted in significant interruptions of activity.

The economic impact of the earthquake and tsunami rapidly spread to the rest of Japan and the rest of the world. Relatively soon after the disaster, several Japanese firms reported production slowdowns in their affiliates abroad; slowdowns also occurred in foreign industries, such as automotive and electronics, which relied on Japanese inputs. Since direct as well as indirect suppliers were affected by the disaster, the flow of inputs to production in the rest of Japan and in other countries started to dry up and in some cases led to the complete disruption of international supply chains. The impacts were particularly significant because Japan plays a central role in GVCs, notably as a producer of higher value intermediates (e.g. parts and components) that are used in industries across the globe.

Japanese car factories had to shut down production and close (some) plants. These plants produced not only for Japan; some also provided engines and other parts needed by assembly plants around the world. Honda and Nissan plants in the United Kingdom, for example, were forced to cut back production; for models such as Toyota's Prius Hybrid, production shut down completely since Japan was the only source. European and US carmakers that sourced intermediates from suppliers in Japan were also affected. One example is Robert Bosch, a major supplier to almost every car manufacturer in the world; it supplies a broad range of parts (fuel injectors, pumps, hydraulics, electronic control systems, etc.) from its affiliates or independent subcontractors in Japan (What Car?, 2010; Bloomberg Businessweek, 2010).

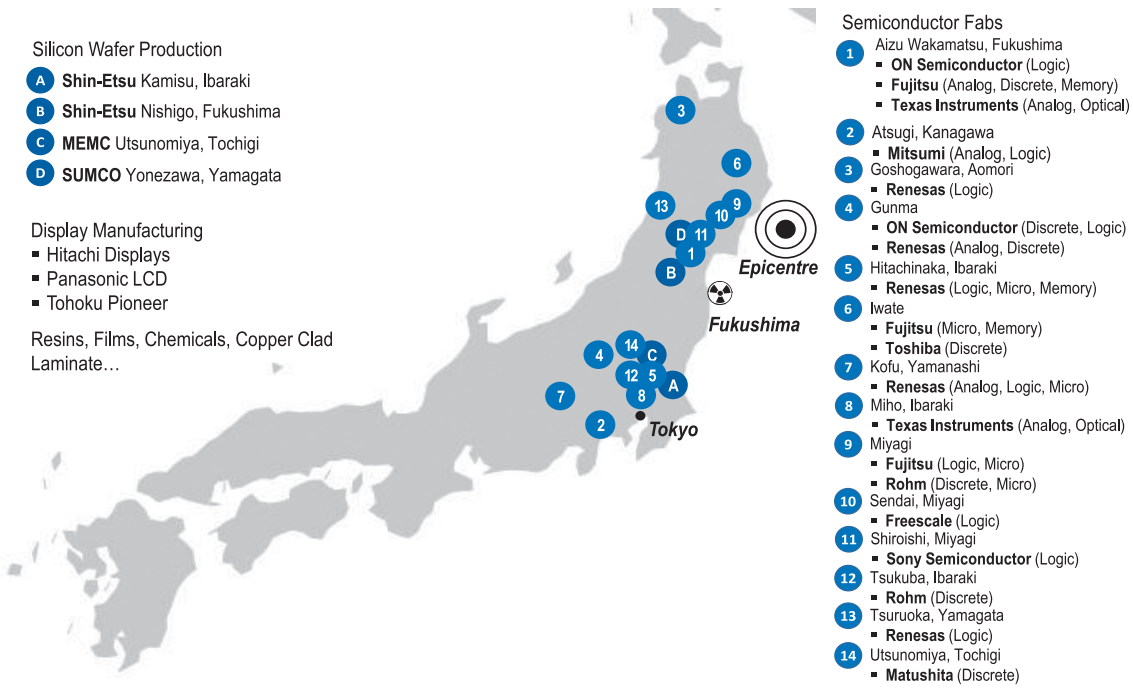
Sourcing from a single source seems to have been an important cause of the disruption in some automotive industry GVCs. Because of the complexity of their GVCs, many car assemblers were surprised to discover that their standard two-supplier rule for critical parts had been circumvented further along the supply chain. Merck KGaA produced 100% of the global supply of the Xirallac pigment used in car paint at a factory in northeast Japan. As a result of the earthquake and tsunami, operations in this plant were suspended until May 2011 and resulted in a major disruption of the supply chains of various car manufacturers (*The Wall Street Journal*, 2011).

Japan is an important producer in the upstream segment of electronics manufacturing, especially of high-technology parts and components: estimates of Japan's share in the supply of world electronics component range from 16% to 30%. IHS iSuppli estimated that Japan accounted for 21% of semiconductors, 49% of optical components, 57% of image sensors, 40% of microcontrollers, 33% of display drivers and 60% of silicon wafers. And, while a large part of the electronics industry in Japan is concentrated in the southeast, several electronics manufactures were seriously affected by the earthquake/

tsunami (Figure 8.4). Given the geographic distribution of these suppliers, automotive electronics were hit particularly hard, while wireless communication and data processing were only mildly affected (IHS iSuppli, 2011).

The impact on the automotive and electronics industries[12] following the Tohoku earthquake and tsunami illustrate how supply shocks can propagate rapidly through GVCs.[13] As production is sequentially organised, with goods produced in a series of stages in different countries by specialised suppliers that ship them further down the chain, adverse shocks are quickly transmitted along the value chain. Because of lean inventories and just-in-time deliveries there is little slack in the system and the disruption of a critical and non-redundant element can cause a system-wide shutdown. Eliminating stocks and reserves in such a system typically increases efficiency when the system works smoothly, but makes it easier for problems to spread (Jervis, 1997).

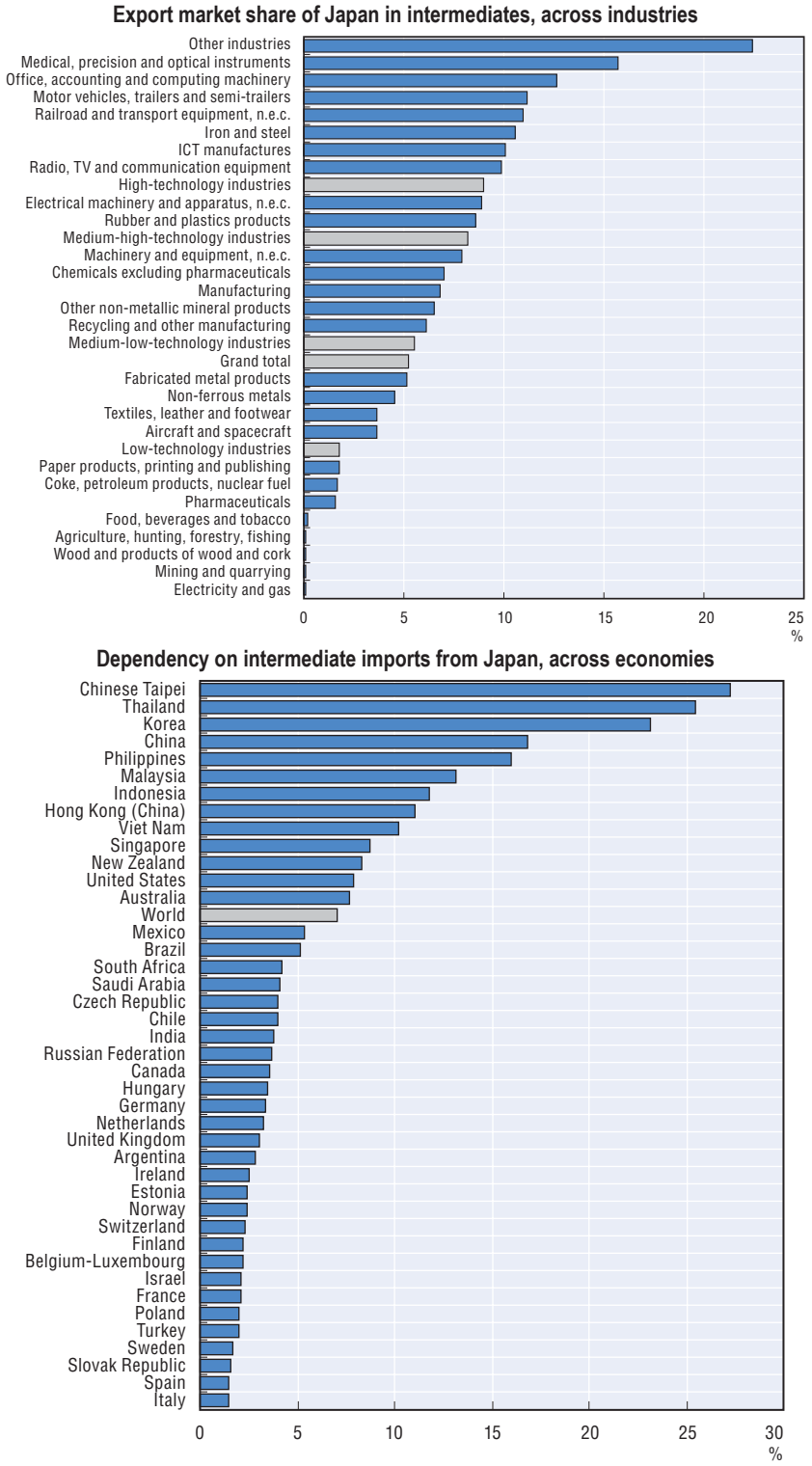
Figure 8.4. Location of key electronic components/materials manufacturers in northeast Japan



Source: IHS (2011).

Japan's position in the production of electronic and automotive intermediates is illustrated by its exports before the earthquake/tsunami. In 2009,[14] Japan's total market share of manufacturing exports in intermediates was 6.8%, with higher figures in electronics, motor vehicles, and iron and steel industries (Figure 8.5). Owing to the strong regional integration of South-East Asia, the economies of Chinese Taipei, Thailand, Korea, the Philippines and China were particularly dependent on intermediate imports from Japan. (Japan accounted for 15% or more of intermediate imports in these economies.) Other economies depended less on imports from Japan, yet Japan was responsible for close to 8% of all intermediate imports in the United States (Figure 8.5). European countries depend less on imports of intermediates from Japan, and are likely to have been less seriously affected.

Figure 8.5. Importance of Japan in intermediates production, 2009



Note: Export market share of Japan calculated as exports of Japan over world exports; import dependency calculated as imports from Japan over world imports.

Source: OECD calculations based on OECD (2011c), "STAN Bilateral trade database by industry and end-use category", *STAN: OECD Structural Analysis Statistics* (database), doi: 10.1787/data-00599-en.

StatLink *http://dx.doi.org/10.1787/888932835157*

Table 8.1. Sectoral transmission of a supply-driven shock emanating from Japanese industrial sectors, 2008

Percentage increase in sectoral domestic production costs resulting from a 30% rise in the price of intermediate inputs imported from Japan

From Japan to:[1]	China	Indonesia	Korea	Malaysia	Philippines	Chinese Taipei	Thailand	United States	Average[1] (exported shock)
Chemical products	0.7	0.3	2.2	2.1	1.0	3.2	1.0	0.3	1.4
Petroleum and petroleum products	0.1	0.0	0.0	0.7	0.3	0.1	0.0	0.1	0.3
Rubber products	0.6	0.6	1.7	1.1	1.2	2.6	1.3	0.4	1.3
Non-metallic mineral products	0.5	0.4	0.8	1.3	0.7	1.2	1.2	0.2	0.9
Metals and metal products	1.0	1.4	2.8	4.5	2.2	3.6	2.7	0.4	2.4
Industrial machinery	1.4	4.9	2.9	3.1	2.3	5.0	7.5	0.6	3.5
Computers and electronic equipment	3.6	1.5	3.0	4.3	7.4	5.6	5.7	0.8	3.9
Other electrical equipment	2.3	1.4	3.0	4.3	1.9	5.2	6.3	0.6	3.2
Transport equipment	1.4	1.6	2.9	3.8	2.1	3.4	5.8	1.0	2.8
Other manufacturing products	0.9	1.0	2.7	2.4	1.2	4.2	1.7	0.4	1.8
Average (imported shock)	1.2	1.3	2.2	2.8	2.0	3.4	3.3	0.5	2.2

1. Unweighted average.

Source: Escaith et al. (2011).

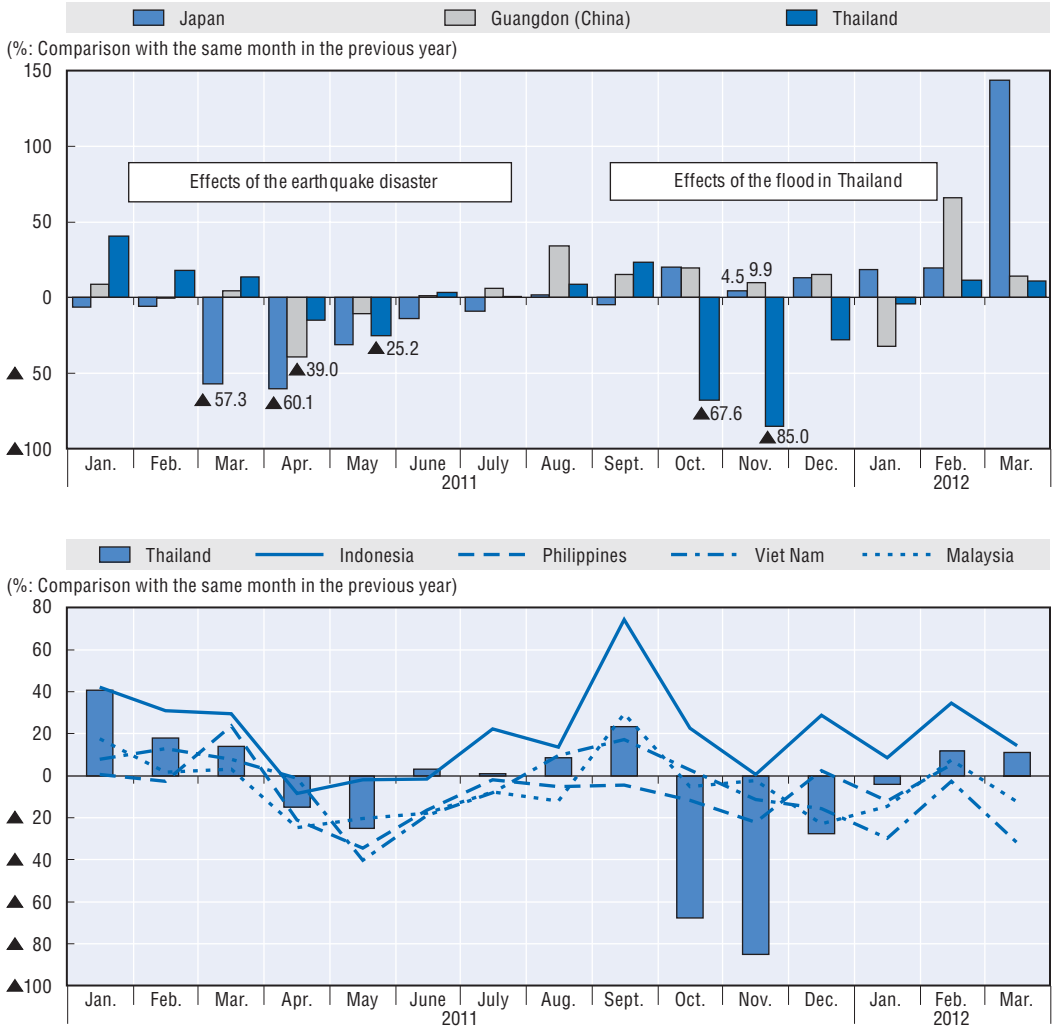
The dependency of South-East Asian economies on Japanese intermediates is especially high in electronics (medical/precision and optical instruments, electrical machinery, radio/TV/communication equipment), and transport equipment (motor vehicles), but also in chemicals, rubber and plastics, and iron and steel. Chinese Taipei has import dependency ratios of over 60% in a number of industries; other Asian economies have ratios of 20% to 30% in these industries (see Annex 8.A2). The central position of Japan in the electronics and automotive industries is visualised in more detail when mapping vertical trade between countries (Asian Development Bank, 2011).

Clearly, these average dependencies do not give a complete picture of economies' vulnerability to adverse shocks, since a disruption in the supply of one specific product (especially a critical and non-redundant input) could result in the complete breakdown of a GVC. Bilateral trade flows of intermediates on the product level can give a more detailed appreciation. Thailand, for example, has import dependency ratios of above 70% with Japan in several product categories (HS 6-digit classification) in the electronics industry; at a more detailed product level, the dependency is likely to be even greater (in terms both of the number and size of the import dependencies).

The risk of breakdowns in GVCs forces companies to look for alternative suppliers. Disruptions to supply chains are not always easy to address, however, and may take some time to rectify. Intermediates are often transaction-specific so that shifting to other suppliers implies higher costs (search, adaptation, switch, etc.). The supplier may be on

the other side of the world and a just-in-time business model does not factor in quick substitution of alternative suppliers. Escaith and Gonguet (2011) estimated the costs of the disruptive supply shock due to the natural disaster in Japan on GVCs in Asia;[15] the results show that it led to higher production costs, particularly in Chinese Taipei and Thailand. This is in line with the above results on import dependency. Small open Asian economies strongly integrated in GVCs seem to have suffered most; China and Indonesia seem to have been less affected (Table 8.1).

Figure 8.6. Effect of Thai floods and the Japanese earthquake/tsunami on automotive production in Asia, 2011



Note: The trend for Guangdong in January-February 2012 is influenced by a seasonal factor; the Vernal Equinox Day was in February in 2011, but in January in 2012. Figures for Thailand, Indonesia and Malaysia are based on the volume of production. Figures for the Philippines and Viet Nam are from the automotive production index. The figures for the Philippines in March 2011 have not been disclosed.

Source: White Paper on International Economy and Trade 2012, Japanese Ministry of Economy, Trade and Industry

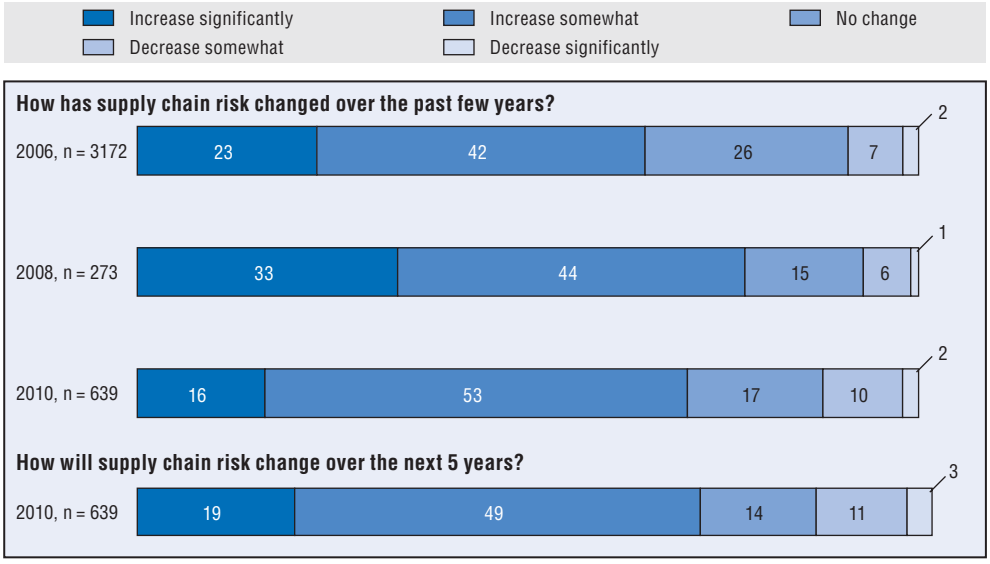
Other natural disasters have also affected GVCs over the past decade and have made consumers, companies and governments realise the fragilities inherent in today's international production and supply networks. The most visible examples are probably Hurricane Katrina, which affected the United States in August 2005, the Christchurch earthquake in New Zealand in February 2011, and the flooding in Thailand in November 2011. Depending on the position of the affected area in GVCs, the resulting production disruptions may affect the regional, national or global level. Floods in Thailand, for example, inundated areas that accounted for 45% of the world's manufacturing capacity of computer hard disk drives and led to global disruptions not only in the computer but also in the automotive industry. Figure 8.6 compares the impact of the Thai floods to the Japanese earthquake/tsunami on automotive production in neighbouring Asian countries and again shows Asia's strong regional integration.

Policy implications for the management of GVC risks

Companies' management of supply chain risks

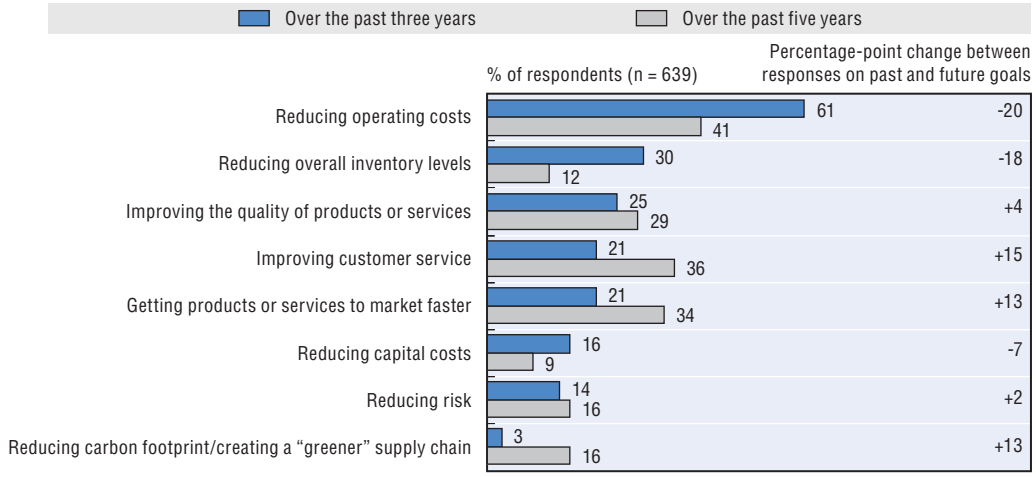
Because breakdowns in GVCs can have detrimental effects on companies, efforts are made to be prepared for risks to their supply chains. Surveys of company executives indicate that the size and frequency of supply chain shocks have increased in recent years and are expected to continue to do so (Figure 8.7; McKinsey & Company, 2010). A 2011 survey found that 85% of company respondents had suffered at least one significant supply chain disruption in the previous 12 months (Business Continuity Institute, 2011). While not all, or even most, of GVC disruptions are likely to result in global and cascading failures, company executives consider that their companies' ability to mitigate and manage supply chain risks is sometimes limited (The McKinsey Quarterly, 2006). This is most likely due to the variety of potential supply chain risks. While a supply chain risk that is internal to the company or its GVC can often be largely addressed through effective organisation, external supply chain risks are typically less easily controlled or influenced by individual companies (see also Figure 8.1).

Figure 8.7. GVC risk on the rise



Source: Exhibit from "The Challenges ahead for Supply Chains", McKinsey & Company (2010).

Figure 8.8. Companies' top two goals in supply chain management



Source: Exhibit from "The Challenges ahead for Supply Chains", McKinsey & Company, 2010.

The focus in GVC management has traditionally been on enhancing efficiency and cost reduction. For example, a 2010 survey, taken before the earthquake/tsunami in Japan, found that risk management had relatively low priority (Figure 8.8). Just-in time-business models, minimum inventories and lean manufacturing have significantly reduced the overall robustness of GVC networks, and traditional buffers in the supply chain have been removed. In addition, GVCs are increasingly complex and sometimes quite rigid, since companies rely on several suppliers in different locations.

The global disruptions in the aftermath of the Japanese earthquake/tsunami (and other natural disasters) are expected to reinforce the search for less vulnerable GVCs.[16] Firms are also likely to reorient their sourcing strategies towards more risk diversification. While this may not lead to the least-cost option, it would help safeguard organisations' profitability and viability (McKinsey & Company, 2010). In a global world characterised by uncertainty, companies increasingly try to complement "just-in-time" with "just-in-case" strategies by adjusting supply chains to enable them to withstand a variety of shocks. For example, companies increasingly look at how concentrated their supply chains are in terms of numbers of suppliers but also their geographical concentration in order to evaluate their capacity to handle unforeseeable events such as natural disasters, geopolitical risks (e.g. terrorists attacks), etc. They seek a trade-off between efficiency and cost reduction on the one hand and risk diversification and redundancy on the other by holding larger (critical) inventories, stimulating suppliers to spread their production facilities geographically, switching parts of orders to (smaller) second-source suppliers, or "splintering" GVCs into shorter and less complex chains (Malik et al., 2011). A 2009 survey of logistics providers revealed that nearly one-quarter of their North American and European clients had taken steps to shorten their supply chains during the previous year (Lieb and Lieb, 2009; Ghemawat, 2011).

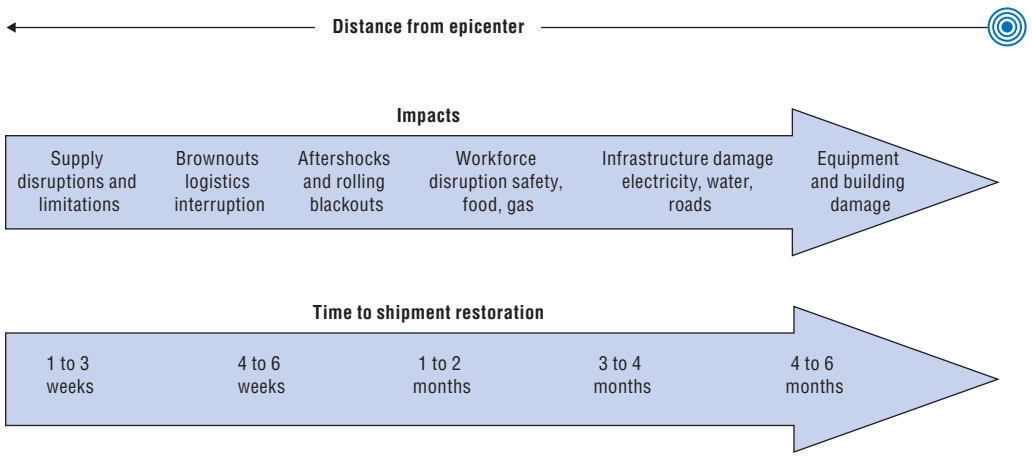
The recent trend towards "back-shoring" or "near-shoring" is also motivated by company strategies to balance cost savings and risk dispersion in GVCs. A number of companies (especially in the United States) have been reported to consider bringing activities they had offshored back to the United States (see Chapter 6). In order to diversify the risks inherent in their supply chains, companies sometimes consider shorter and alternative GVCs for the same product, often close to their major markets. Other

important motivations for back-shoring activities are the sometimes rapidly rising costs of production in emerging economies and the greater operational flexibility it offers companies for adjusting to changing demand.

Companies have been aware of the need for risk management and contingency planning in their activities for a long time.[17] However, the complex web of interdependent GVC relationships with suppliers requires a focus on risk management that extends beyond the individual company. Because of the many potential sources of risk in different parts of the GVC, the first steps in risk management are risk identification and risk assessment/evaluation (i.e. assessing the likelihood and consequences of specific risks) throughout the chain. It is necessary to understand the sources and impacts of risks in order to establish responsibility for risk management, as the sources and the casualties may not be the same (Manuj and Mentzer, 2008). Once a company has identified and prioritised the risks it may face, it can develop and implement risk strategies. In general, companies may undertake actions both to mitigate the exposure to supply chain risk and/or to mitigate the consequences of the risk in question (Lessard, 2012).

The overall objective of supply chain management is shifting to increase GVCs' robustness (i.e. the ability to quickly regain stability after a shock), flexibility (i.e. the ability to change according to a set of predefined contingency scenarios), agility (i.e. the ability to change when/if scenarios fail), and resilience (i.e. the ability to reinvent the chain when the necessary conditions no longer hold). In spite of the clear need for better risk management in GVCs from end to end, the evidence presented above demonstrates that GVCs have shown a certain level of resilience to shocks. In the financial/economic crisis, overall breakdowns in GVCs were limited as a major part of the adjustments took place along the intensive margin (i.e. firms reduced volumes). Following the 2011 earthquake/tsunami in Japan, several GVCs actually broke down, but companies were able to shift to other suppliers after some time, albeit at higher cost. IHS iSuppli estimated that the entire electronics industry had recovered by the end of the third quarter of 2011; the duration of production disruptions varied depending on the distance from the earthquake epicentre (Figure 8.9). The affected companies farthest from the epicentre took only one to two weeks to restore production, while the companies closest to the disaster took as long as four to six months to return to normal (IHS iSuppli, 2011).

Figure 8.9. Supply chain impact and recovery – earthquake/tsunami in Japan, 2011



Source: IHS (2011).

A multi-stakeholders approach to managing GVC risks

The role of government in managing supply chain risks appears rather limited, as decisions regarding the length of the chain and the number of alternative suppliers are entirely company matters. It is for example hard to envisage governments prescribing minimum levels of critical inventories or minimum numbers of suppliers across different geographical entities for the day-to-day management of companies. However, governments increasingly need to understand, and in some cases to manage, risk to GVCs, as these now constitute the backbone of the global economy. Disruptions in GVCs can have major political, economic and security implications for national economies. From a national security point of view, security of supply plays a role if a country risks becoming entirely dependent on one (or a limited number of) foreign supplier(s) in an area considered of strategic importance. In such cases, governments may consider developing a minimum stock or inventory, as is currently the case with oil supplies.

Because disruptions in GVCs may seriously damage national economies, governments will benefit from better insight into their countries' position in GVCs. Countries downstream in a GVC (i.e. closer to final consumers) are relatively more vulnerable to adverse supply shocks higher up the value chain that may endanger the secure supply of imports (of final as well as intermediate goods). In addition to the above-mentioned indicators on (direct) import dependency, network analysis[18] based on bilateral trade data can be used to analyse a country's "supply vulnerability" in order to take account of possible disruptions throughout the value chain. Countries' direct and indirect dependencies can thus be assessed, given that their production and exports of goods and services depend heavily on the imports of intermediates produced in previous stages of the GVC (see Chapter 1).

Countries higher up in the value chain (i.e. farther away from final consumers) typically import negative demand shocks through their exports to countries further down the chain. Depending on where countries are positioned in GVCs (see above), companies' inventory adjustments in GVCs may amplify these adverse shocks. Some early insight into "demand vulnerability" can be gained from the new OECD-WTO Trade in Value Added (TiVA) Database; Figure 8.10 shows where countries' domestic value added is found in the final demand of other countries and how concentrated it is. The idea is that, other things being equal, a higher concentration means greater vulnerability to demand shocks from abroad. Mexico and Canada display relatively high demand vulnerability, as 70% of their value added exports go to five countries and are strongly oriented towards the United States. Demand shocks in the United States will not only affect these two countries but also risk having important effects through GVCs in countries such as, Israel, China, the United Kingdom, Ireland and Japan.[19] The top five (final) destination countries typically represent around 40% of domestic value added for most exporting countries.

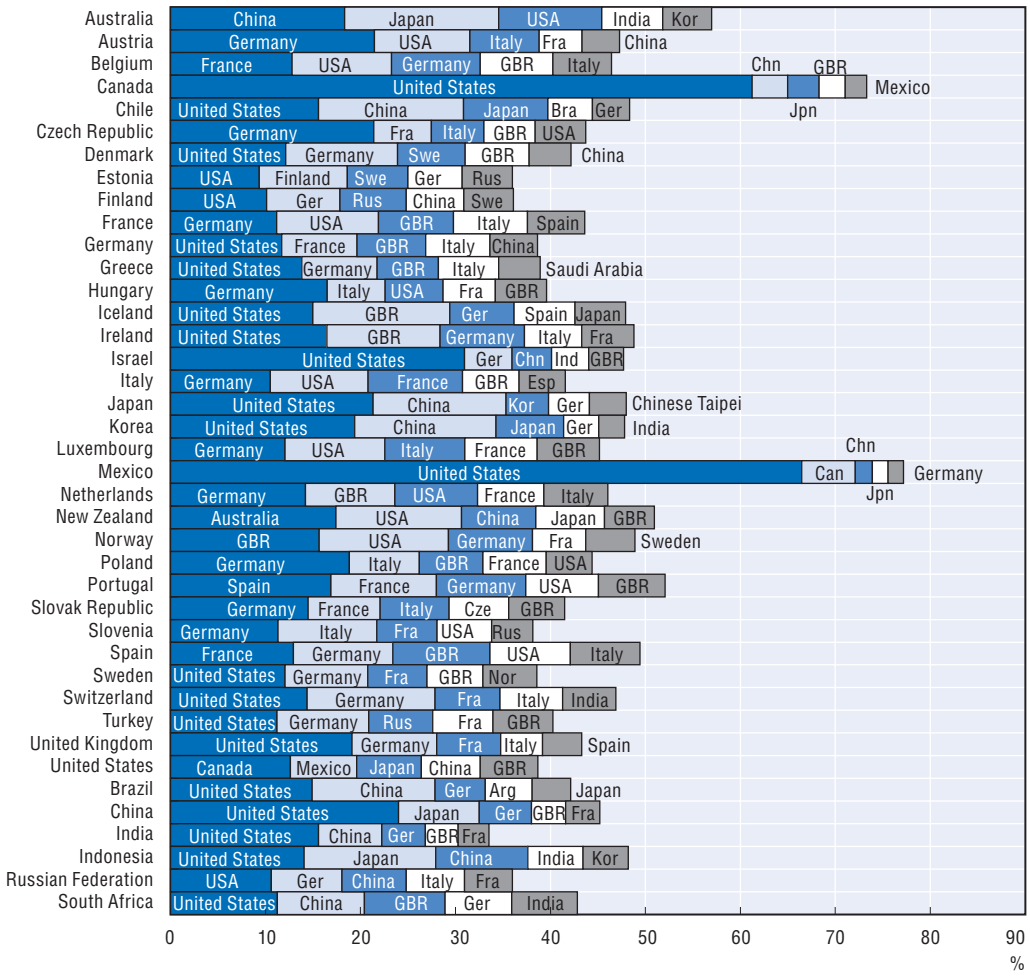
Individual companies on their own cannot manage the global and cascading consequences of GVC disruptions. Systemic risk calls for a high level of collaboration between the private sector (businesses, professional bodies, suppliers, customers, etc.) and the public sector (World Economic Forum, 2012). Sharing of information and experience can help to identify the vulnerabilities in GVCs and to increase the resiliency of these transnational networks; private-public collaboration will increase the speed and effectiveness of pre-disruption planning as well as post-disruption responses. In addition, co-operation and information exchange can help raise awareness of GVC risks (e.g. for Small and Medium-sized Enterprises (SMEs), help explore different scenarios, develop

appropriate solutions and assign different responsibilities, ensure that the regulatory and planning environment reflects the key risks, etc.

One outcome of public-private co-operation could be codes of conduct that articulate mechanisms and rules for preventing and mitigating GVC risk. They could be inspired by global initiatives such as the OECD Guidelines for Multinational Enterprises, which contains a set of voluntary principles and standards for responsible international business conduct.[20] While not legally binding, all multinational enterprises headquartered in adhering countries are bound to comply with these guidelines and adhering governments are required to deal with allegations of violations.[21]

Figure 8.10. Vulnerability to demand shocks in GVCs, by economy, 2009

Domestic value added in foreign final demand, dependence on top five economies



Source: OECD/WTO (2013), OECD-WTO: Statistics on Trade in Value Added, (database), doi: 10.1787/data-00648-en (accessed April 2013).

StatLink *http://dx.doi.org/10.1787/888932835176*

The United States launched in January 2012 a National Strategy for Global Supply Chain Security to promote the efficient and secure movement of goods and to foster a resilient supply chain. The strategy plans to update threat and risk assessments, align programmes and resources, build resilient infrastructures and engage government, the private sector and international stakeholders (United States White House, 2012).

Global systemic risk related to GVCs, as well as the other risks discussed above, increasingly requires a multi-stakeholder approach in which governments, the business sector, international organisations, academia, etc., work together across national borders. Based on expert views from various fields and sectors, foresight (instead of pure forecasting) exercises could provide various scenarios about the future that take into account the complexity and uncertainty of emerging risks and shocks. For some categories of systemic risks, the objective will be to reduce vulnerability to such risk. For others, particularly those that are least probable and unforeseeable, the question will be less about mitigation than about flexible and resilient systems that can respond effectively and manage the consequences. The development of institutions, infrastructures and resources for the "during" and "after" phases of such crises needs to be carefully planned (Casti et al., 2011). Domestic actions and policies can help to enhance the flexibility and thus resilience of economies to future shocks linked to GVCs.

Work is currently under way, at the OECD and elsewhere, to examine what governments should/could do about new forms of systemic risk and the global consequences. The G20/OECD framework for disaster risk assessment and financing provides risk assessment tools that help governments to adopt cost-effective policies to prevent and manage risk in partnership with the private sector and civil society. In addition, the OECD Principles on Country Risk Management, to be delivered in 2014, aims to frame the international policy dialogue and support countries' efforts to prepare for and respond to global risks. This indicates that crisis responses will increasingly need to be co-ordinated across governments, particularly for cases of catastrophic risk (the so-called "Black Swan" events).

Action should be taken to build up global capacity to understand and assess systemic risks before they occur. Databases on global interconnections and models that identify vulnerable hubs in systems (including critical infrastructure) are first steps in determining the likelihood of events that could disrupt entire systems. Given that these shocks happen very infrequently, a broad range of data will be needed to estimate the probability of such events. In addition, estimates of the costs of these global shocks, including their direct and indirect effects, are needed to guide government action (OECD, 2011a).

Capacity building in governments and in the private sector may also require training and greater awareness of the risks of GVCs. The growing complexity and interconnectedness of the global economy make it increasingly difficult for policy makers and analysts to understand fully the operation of their economies and the critical features of the connections involved.

The benefits and costs of (re-)regulation have been much debated in (global) policy circles in the aftermath of the financial crisis of 2008. It is very difficult to develop effective regulation for preventing systemic risk resulting in global crises. Such crises are non-linear events (they occur without much warning), are not easy to detect, and even more difficult to prove (Spence, 2010). Opponents of regulation argue that lack of information will make regulation prone to error and largely counter-productive. However, doing nothing can be very costly. More positive views of regulation point to the potential benefits of prudential measures such as "alarms, breakers and cushions" (Ghemawat, 2011). The monitoring of risks includes the implementation of alarms, i.e. surveillance and early warning systems to detect the exposure of countries to global systemic risk at an early stage. Breakers curb contagion and prevent different parts of the system from falling like dominos when the shock occurs. If alarms and breakers are insufficient, cushions can

soften the blow to the system by holding strategic reserves. Adequate contingency planning and proportionate precautionary measures can help countries mitigate contagion.

Finally, an option discussed in some quarters is to (try to) push back globalisation in order to curtail potential global channels of contagion. This proposal ignores, however, the many benefits of globalisation for millions of people across the world in terms of economic growth, rising incomes, employment, etc. Furthermore, globalisation helps to reduce risk as it allows countries and firms to diversify away from individual unsystematic risks. Economic integration has led to an increase in the number of customers/suppliers in different countries, thereby spreading countries' and firms' exposure. The downside to reduced vulnerability to domestic shocks may be increased external vulnerability. Globalisation does have certain negative side effects, including potential global systemic risks. It is clear that further work is needed on ways to reduce these negative consequences while safeguarding the benefits of globalisation.

Notes

1. Globalisation is of course one important source of these increased linkages and interdependencies. Panic behaviour can be a source of contagion, in particular in financial systems. For example, bank runs may occur if people believe there will be a crisis.
2. The larger a system, the more space for individual actors to diversify and reduce (unsystematic) risk; in contrast, diversification does not alleviate systemic risk.
3. Food security refers to "a situation that exists when all people, at all time, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2003).
4. The policy challenge for improving food security in the medium to longer term is to find an effective, coherent mix of policies that: i) promote food production, in particular through productivity growth; ii) foster trade and the functioning of markets; and iii) address the wider development and social dimensions of food insecurity (OECD, 2011b).
5. See OECD (2011a) on cyber attacks, including their incidence, impacts and economic effects. The OECD's Committee for Information, Computer and Communications Policy is working on issues including critical information infrastructure and cyber security.
6. Manufacturing and sourcing strategies increasingly involve more complexity, in terms of technological requirements (e.g. growing numbers of intermediate inputs produced by multiple suppliers in different locations) and customer requirements (e.g. different varieties of a specific product).
7. Other reasons are composition effects, the credit crunch, "murky" (hidden) protectionism and fiscal stimulus programmes that provided relatively strong support to non-tradable sectors (e.g. construction, infrastructure).
8. In 2008, the origin of the shock was uncertainty in financial markets, which led to a sharp drop in demand as consumers, firms and investors increasingly postponed purchases and investments.
9. For a given reduction in income, trade declined "not only by the value of the finished product, but also by the value of all the intermediate trade flows than went into creating it" (Yi, 2009).
10. In addition, services count for a large share of GDP and a smaller share in trade.
11. The bullwhip effect is the result of rational behaviour on the part of economic agents confronted with distorted information. The causes are related to lack of co-ordination and communication in the chain, differences in delays for information and material flows, the size of order batching, etc.

12. Electronics and the automotive industry were not the only industries directly affected by the disaster. Industries such as chemicals also suffered because of the lack of intermediates but the effects seem to have been smaller.

13. Similar consequences were reported in the aftermath of the 9/11 terrorist attacks.

14. Data for 2009 were used as detailed 2010 bilateral trade data are not yet available for a number of economies.

15. The analysis is based on international supply-use tables that measure the intensity of forward linkages across economies using so-called Gosh matrices to estimate the effect on production costs. The 30% impact on the cost of resourcing inputs imported from Japan after the supply was disrupted is based on the low possibility of substitution (Armington elasticity) among suppliers of intermediate products, at least in the short-term.

16. Similarly, companies in the electronics industry learned important lessons about GVC management from the collapse of the semiconductor industry in 2001.

17. Proactive risk management can become a competitive advantage as greater resilience may allow companies to stay in the market while competitors are out, or alternatively may help companies to enter the market more rapidly and at a lower (recovery) cost (Zurich, 2012).

18. Network analysis is used to evaluate the position of actors in a system, taking into account the direct and indirect links between them.

19. This indicator does not quantify the actual effect of a negative demand shock abroad on the domestic economy, it only signals the dependence of the domestic economy on final demand abroad.

20. In areas such as employment and industrial relations, human rights, environment, information disclosure, combating bribery, consumer interests, science and technology, competition, and taxation.

21. These guidelines increasingly have a GVC perspective. The 2011 guidelines apply not only to the enterprise's own operations, but also to those of its suppliers. MNEs are bound to conduct "due diligence" to ensure the firms they deal with abide by the OECD guidelines.

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Annex 8.A1
Classification of GVC risk

POTENTIAL RISKS TO AN ORGANISATION AND ITS SUPPLY CHAIN

External, end to end risks

- Natural disasters
- Sabotage, terrorism, crime, war
- Labour unavailability
- Lawsuits
- Accidents
- Political uncertainty
- Market challenges
- Technological trends

Supplier risks

- Physical and regulatory risks
- Financial losses and premiums
- Upstream supply risks
- Production problems
- Management risks

Distribution risks

- Infrastructure unavailability
- Labour unavailability
- Warehouse inadequancies
- Lack of capacity
- Cargo damage or theft
- IT system inadequacies or failure

Internal enterprise risks

- Operational
- Demand variability
- Design uncertainty
- Financial uncertainty
- Testing unavailability
- Supplier relationship management
- Enterprise underperformance
- Political uncertainty
- Personnel availability
- Planning failures
- Facility unavailability

Source: Supply Chain Risk Leadership Council (2011).

Categories of GVC risks

Turbulence	Environment characterised by frequent changes in external factors beyond your control	Natural disasters Geopolitical disruptions Unpredictability of demand Fluctuations in currencies and prices Technology failures Pandemic
Deliberate threats	Intentional attacks aimed at disrupting operations or causing human or financial harm	Theft/piracy Terrorism/sabotage Labour disputes Industrial espionage Special interest groups Product liability
External pressures	Influences not specifically targeting the firm, that create business constraints or barriers	Competitive innovation Social/cultural change Political/regulatory change Competitive price pressures Corporate responsibility Environmental change
Resource limits	Constraints on output based on availability of the factors of production	Supplier capacity Production capacity Distribution capacity Raw material availability Utilities availability Human resources
Sensitivity	Importance of carefully controlled conditions for product and process integrity	Complexity Product purity Restricted materials Fragility Reliability of equipment Safety hazards Visibility of disruption to stakeholders Symbolic profile of brand Concentration of capacity
Connectivity	Degree of interdependence and reliance on outside entities	Scale/extent of network Reliance upon information flow Degree of outsourcing Import/export channels Reliance upon specialty sources
Supplier/customer disruptions	Susceptibility of suppliers and customers to external forces or disruptions	Supplier reliability/trust/loyalty/relations Customer disruptions

Source: Pettit et al. (2010)

Annex 8.A2. Import dependency from Japanese intermediates, 2009
(Imports of intermediate goods from Japan as share of total intermediate imports)

Industry	ISIC Rev.3	Chinese Taipei	Thailand	Korea	China	Philippines	Malaysia	Indonesia	Hongkong (China)	Viet Nam	Singapore	New Zealand	United States	Australia	World	Mexico	Brazil	South Africa	Saudi Arabia	Czech Republic	Chile	India	Russia	Canada	Hungary	Germany	Netherlands	United Kingdom	Argentina	Ireland	Estonia	Norway	Switzerland	Finland	Belgium-Luxembourg	Israel	France	Poland	Rest of the World	Turkey	Sweden	Slovak Republic
Manufacturing	15 to 37	27.3	25.4	23.2	16.8	15.9	13.1	11.7	11.1	10.2	8.7	8.3	7.9	7.6	6.9	5.4	5.1	4.2	4.0	4.0	4.0	3.8	3.6	3.5	3.5	3.3	3.2	3.0	2.8	2.4	2.3	2.3	2.2	2.1	2.1	2.0	2.0	2.0	2.0	2.0	1.6	1.5
Food products, Beverages and Tobacco	15 to 16	1.8	1.5	1.7	0.4	0.1	0.6	0.4	4.3	0.6	2.7	0.2	0.7	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.3	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Textiles, Textile Products, Leather and Footwear	17 to 19	15.1	7.4	6.9	15.8	3.5	5.9	2.0	3.9	7.6	5.2	1.2	4.7	1.7	3.7	0.7	0.5	0.4	0.0	0.3	0.2	2.4	0.4	1.6	0.3	1.1	0.7	1.0	0.2	0.7	0.2	0.6	0.9	1.1	0.7	0.3	1.3	0.4	0.5	0.3	0.6	0.1
Wood and Products of Wood and Cork	20	0.6	1.3	0.4	0.8	8.1	0.9	1.6	0.3	0.7	0.4	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Pulp, Paper, Paper Products, Printing and Publishi	21 to 22	13.0	14.7	8.6	6.5	4.6	8.5	4.6	10.3	6.9	5.6	9.2	2.5	4.1	1.8	0.7	1.3	1.4	0.0	0.2	0.9	1.7	0.4	0.6	1.4	0.4	1.1	0.3	0.2	0.1	0.1	0.3	0.1	0.2	0.2	0.3	0.4	0.4	0.4	0.3	0.1	0.1
Chemical, Rubber, Plastics and Fuel Products	23 to 25	28.3	19.8	25.9	16.4	12.2	9.2	6.3	12.1	5.0	7.6	10.5	5.1	9.3	5.2	1.6	2.4	3.2	11.4	1.5	5.7	3.1	3.5	2.0	1.0	2.1	1.6	1.7	2.0	3.4	3.3	1.1	1.7	1.1	1.8	2.3	1.7	1.0	1.3	1.5	2.6	0.8
Coke, Petroleum Products, Nuclear Fuel	23	1.3	7.8	3.1	8.8	7.5	0.8	0.3	4.1	0.4	6.1	15.7	0.5	12.1	1.8	0.6	0.9	0.8	..	0.1	7.7	2.3	1.2	0.4	0.0	0.4	0.4	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.4	0.0	0.1	0.1	0.8	0.0
Chemicals and Chemical Products	24	32.3	18.8	33.1	16.6	15.6	11.9	9.6	15.8	6.3	11.2	6.4	7.2	4.5	6.1	1.6	2.2	2.9	0.0	1.5	2.2	3.0	1.5	1.4	0.8	2.4	2.1	2.1	2.3	5.6	0.6	1.5	2.3	1.7	1.9	2.8	2.4	1.2	1.4	1.9	4.0	1.2
Chemicals excluding Pharmaceuticals	24-2423	33.0	19.6	34.9	16.8	17.0	12.3	9.8	16.6	6.6	12.0	7.2	8.4	5.0	7.1	1.6	2.3	3.2	0.0	1.5	2.3	3.1	1.7	1.7	1.0	3.3	3.1	2.4	1.9	5.5	0.6	1.6	1.8	1.7	2.1	3.2	2.8	1.2	1.5	2.0	4.5	1.3
Pharmaceuticals	2423	8.0	4.8	11.2	9.0	2.1	2.9	6.1	3.1	1.3	3.9	1.4	3.2	3.1	1.7	1.4	1.2	0.9	0.0	0.9	0.9	1.5	0.4	0.3	0.1	0.7	0.2	0.6	4.5	5.7	0.6	1.0	3.0	1.4	1.3	0.4	1.2	0.8	0.8	1.4	0.2	0.8
Rubber and plastics products	25	63.6	35.5	65.1	27.5	23.0	18.8	28.4	21.3	22.3	15.5	7.7	9.0	13.8	8.7	3.2	7.3	10.0	46.2	2.4	9.3	9.0	9.7	4.7	1.9	2.5	3.0	2.3	3.1	1.3	21.4	1.6	1.1	1.2	4.1	4.4	1.5	1.2	4.9	4.7	1.4	0.6
Other Non-Metallic Mineral Products	26	56.3	29.9	40.1	27.2	13.3	23.5	12.7	12.6	12.2	18.5	1.8	4.4	4.9	6.6	2.2	2.2	7.7	0.0	0.3	2.2	4.5	1.8	1.2	1.1	3.4	1.2	1.1	0.6	0.4	0.3	1.0	0.5	0.6	1.4	0.4	1.0	0.9	1.6	1.0	0.6	0.2
Basic Metals and Fabricated Metal Products	27+28	30.1	26.8	28.6	18.8	26.7	22.5	21.1	11.2	13.8	14.0	7.0	4.8	5.4	7.0	6.9	5.7	2.3	4.1	1.3	1.8	2.6	1.9	2.4	2.5	1.0	1.5	4.6	1.0	0.5	0.4	4.4	6.0	1.1	1.0	0.5	0.7	1.1	2.5	0.7	0.8	0.3
Basic metals	27	29.8	24.8	31.8	17.7	30.7	23.4	21.7	11.1	13.2	15.0	8.6	4.0	6.1	7.5	8.5	4.4	1.9	5.2	0.9	2.5	2.4	2.0	2.4	0.7	0.8	1.5	5.7	0.6	0.8	0.2	6.4	8.3	0.5	0.9	0.4	0.3	0.8	2.8	0.4	0.9	0.3
Iron and Steel	271+2731	40.2	39.1	42.2	28.5	37.2	28.5	22.8	29.1	15.2	20.6	15.6	8.2	23.7	10.6	13.7	7.1	3.3	10.9	0.9	3.0	10.2	2.8	5.1	0.4	0.9	2.4	4.2	0.9	1.4	0.3	16.7	0.6	0.7	1.0	0.3	0.1	1.2	3.3	0.6	0.5	0.3
Non-Ferrous Metals	272+2732	23.4	11.7	14.4	10.7	21.3	19.4	18.6	7.4	7.6	11.5	1.8	1.3	0.4	4.6	1.3	0.8	0.4	0.0	0.8	0.4	0.3	0.3	0.1	1.0	0.6	0.2	6.5	0.2	0.1	0.1	0.0	11.6	0.0	0.7	0.6	0.6	0.1	0.7	0.2	1.5	0.2
Fabricated metal products	28	33.6	34.5	11.8	26.0	12.4	17.9	19.1	11.9	17.3	10.7	4.5	6.6	2.9	5.2	4.4	9.1	3.1	0.0	2.2	0.8	5.9	1.7	2.4	5.4	1.5	1.7	2.1	1.6	0.2	0.6	0.6	0.4	2.8	1.6	0.7	1.5	1.7	1.7	2.7	0.7	0.4
Machinery and equipment	29 to 33	24.7	25.2	19.8	15.8	17.8	12.9	16.9	11.8	24.7	8.7	9.1	11.5	8.3	10.0	8.9	7.0	7.6	0.0	9.5	3.1	6.3	5.4	5.2	4.9	8.1	8.2	3.9	4.7	2.4	2.7	2.9	1.7	4.8	3.9	3.4	4.0	4.4	3.5	5.7	1.8	2.7
Machinery and Equipment, n.e.c	29	34.4	30.8	24.8	22.5	25.3	16.2	19.3	17.2	15.7	10.4	10.3	11.5	6.8	8.0	5.4	9.0	5.0	0.0	2.9	2.8	7.6	3.1	3.4	2.3	4.5	6.9	3.2	6.0	2.3	1.5	1.0	0.5	2.4	3.7	2.5	2.6	3.1	2.9	7.1	1.3	1.8
Electrical and Optical Equipment	30 to 33	23.5	24.2	18.7	15.1	17.3	12.5	15.4	11.6	27.8	8.4	8.4	11.5	9.6	10.6	9.6	6.2	9.6	0.0	11.1	3.4	5.5	7.0	6.4	5.4	9.6	8.6	4.3	3.8	2.4	3.0	4.7	2.5	6.1	4.1	3.7	4.8	5.0	4.0	4.7	2.1	2.9
Office, Accounting and Computing Machine	30	4.0	9.7	11.6	14.7	36.1	4.2	13.6	14.9	39.1	10.8	13.4	15.1	19.7	12.7	12.9	9.4	19.8	0.0	15.6	12.6	0.9	29.4	15.9	5.6	23.8	11.6	2.2	12.9	1.3	29.0	11.4	5.2	12.2	3.0	1.5	11.3	8.4	8.2	16.7	1.7	13.8
Electrical Machinery and Apparatus n.e.c	31	33.7	27.7	27.3	25.6	27.7	12.7	19.5	17.4	26.1	12.0	7.3	8.9	5.7	9.0	7.6	8.7	7.1	0.0	3.3	1.5	6.0	3.5	3.6	4.0	4.5	6.2	3.3	2.3	2.9	1.0	2.0	1.3	1.7	4.5	1.5	3.0	3.5	2.2	3.9	1.7	1.7
Radio, Television, Communication Equipme	32	21.8	27.6	13.8	12.0	10.0	13.6	12.6	9.2	23.5	7.1	5.7	10.5	7.6	10.0	8.2	3.8	3.8	0.0	12.3	1.7	5.9	2.7	5.6	6.1	8.0	5.4	7.9	1.0	4.3	1.5	2.6	2.5	8.4	4.8	3.8	4.3	3.6	6.0	1.9	1.4	2.7
Medical, Precision and Optical Instruments	33	39.2	31.5	45.5	27.8	22.8	28.4	19.0	26.1	35.9	13.9	10.3	14.2	10.9	15.8	29.4	8.6	7.6	0.0	23.7	5.1	7.2	6.8	10.3	1.3	10.9	7.6	4.5	6.1	1.3	6.9	7.6	3.0	9.1	2.6	9.5	5.1	13.0	5.9	7.4	7.3	3.8
Transport equipment	34 to 35	44.2	59.6	24.4	38.6	34.8	14.8	33.7	4.5	18.8	5.8	7.0	16.3	12.8	9.2	6.2	13.4	5.5	3.2	1.8	5.7	14.5	9.8	6.6	6.5	2.7	4.4	5.8	6.8	3.0	6.8	2.7	1.3	3.2	5.4	2.3	2.8	3.7	8.8	4.4	1.5	1.9
Motor Vehicles, Trailers and Semi-Trailers	34	61.9	67.9	30.3	46.9	50.4	23.2	41.8	29.9	20.3	20.8	16.6	17.2	17.5	11.2	6.5	18.9	8.4	15.7	1.7	6.1	20.3	10.7	7.3	6.9	2.3	4.3	7.5	6.9	6.6	7.1	4.5	1.4	4.0	5.7	5.7	5.3	3.6	11.7	4.7	1.4	1.9
Other transport equipment	35	24.4	12.4	2.9	7.7	14.0	4.3	13.3	0.4	9.9	1.6	1.3	14.7	2.5	4.9	0.6	5.4	0.9	0.0	3.0	2.2	5.0	0.4	4.9	0.1	3.5	4.6	3.2	2.9	1.3	3.0	0.9	1.2	1.0	2.8	0.3	0.8	4.1	1.5	0.6	1.8	1.3
Aircraft and Spacecraft	353	2.9	0.0	0.4	0.8	1.4	4.5	0.2	0.2	21.4	1.2	0.6	14.2	1.4	3.7	0.2	2.2	0.1	0.0	0.0	0.1	1.9	0.0	4.9	0.0	2.8	0.6	2.8	0.0	0.9	0.0	0.4	0.3	0.1	0.1	0.1	0.5	5.2	0.4	0.0	1.5	0.0
Railroad and Transport Equipment, n.e.c	352+359	32.9	35.2	17.5	21.6	21.2	3.4	20.1	4.6	4.5	7.8	8.4	20.2	6.1	11.1	0.9	30.4	4.0	0.0	4.5	2.6	11.3	1.2	5.5	0.1	7.8	18.8	7.3	3.4	8.0	4.3	3.1	2.8	4.7	8.8	4.1	6.4	2.5	4.3	2.3	2.2	1.6
Recycling and Other manufacturing	36+37	30.1	32.9	16.9	37.2	19.3	31.8	21.1	12.5	13.1	8.7	4.1	4.0	5.9	6.2	8.0	8.8	3.1	0.0	0.6	5.2	4.5	7.3	3.3	0.8	1.5	14.7	3.7	2.4	1.2	2.3	1.1	0.9	2.1	1.3	1.1	3.2	0.8	2.1	8.6	1.0	0.4
Electricity and gas	40	..	0.0	0.0	0.0	..	23.0	1.8	0.0	0.0	79.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	..	0.0	0.0	..	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	..	0.0	0.0	0.0	0.0	0.0	0.0
Other industries		74.2	10.3	58.3	11.8	7.8	20.5	2.0	21.7	4.1	55.9	11.8	6.6	1.5	22.6	1.4	9.8	6.0	..	0.7	0.4	1.1	0.0	3.5	2.2	28.1	8.3	1.4	7.6	0.4	1.9	0.0	0.1	2.5	7.9	3.7	0.4	0.9	3.3	3.4	1.9	12.7

Source: OECD (2010c), "STAN Bilateral Trade Database 2010", STAN: OECD Structural Analysis Statistics (database), doi: 10.1787/data-00028-en (accessed May 2013).

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Interconnected Economies

BENEFITING FROM GLOBAL VALUE CHAINS

Global Value Chains (GVCs) have exploded in the past decade and refer to the international dispersion of design, production, assembly, marketing and distribution of services, activities and products. Different stages in the production process are increasingly located across different economies, and intermediate inputs like parts and components are produced in one country and then exported to other countries for further production and/or assembly in final products. The functional and spatial fragmentation that has occurred within GVCs has significantly reshaped the global economic landscape, thereby raising some new major policy challenges for OECD countries and emerging countries alike: trade policy, competitiveness, upgrading and innovation and the management of global systemic risk.

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