15

New Industrial Innovation Policies in a World of Global Value Chains

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Globalization and fragmentation of production have been a defining feature of the international economy during the last two decades. Global Value Chains (GVCs) have spread to cover many countries and sectors, structurally changing the way business is organized, and production is traded internationally. Different shares of value are generated in different segments of the chain, and companies struggle to position themselves and retain competitiveness in the most profitable activities along the chain (Gereffi et al. 2019; Kaplinsky 2000).

This process has deepened over the years, in spite of recent setbacks and the rising protectionist tendencies. The foreign value-added content of exports ("backward participation," i.e. the value that is imported by a country and contributes to its exports) in most major economies represents substantial shares of gross exports (Figure 15.1). Although we record substantial differences across countries, data on foreign value-added of manufactured exports confirm that most countries participate in this mode of organized international production. The share of intermediate imports in gross imports—a way to look at GVCs from another perspective—is also steadily high, with most countries exceeding the 50 percent mark (Figure 15.2).

Interestingly, developing countries appear to record higher foreign value-added shares than Japan, the US, and Europe. Whilst this share has been falling from 2005 to 2015 in China, as a consequence of growing industrial maturity and of a rising domestic consumption of what the country produces, it is still increasing in a country like South Africa. South Korea seems to be following the steps of China, but with a lag. Lee et al. (2017) come to similar conclusions with different sources of macro and firm-level evidence: GVC integration occurs in different ways in different countries, and accompanies different development strategies.

Some changes in GVCs have been observed in a recent report (McKinsey 2019). These include the lower trade-intensity in value chains, with exports declining as a share of gross output in goods-producing value chains. Moreover, the role of services is growing (Figure 15.3), and GVCs are becoming more knowledge-intensive and reliant on high-skill labor. The latter occurs together with a remarkable increase in the investments in intangible assets such as R&D, brands, and intellectual property.

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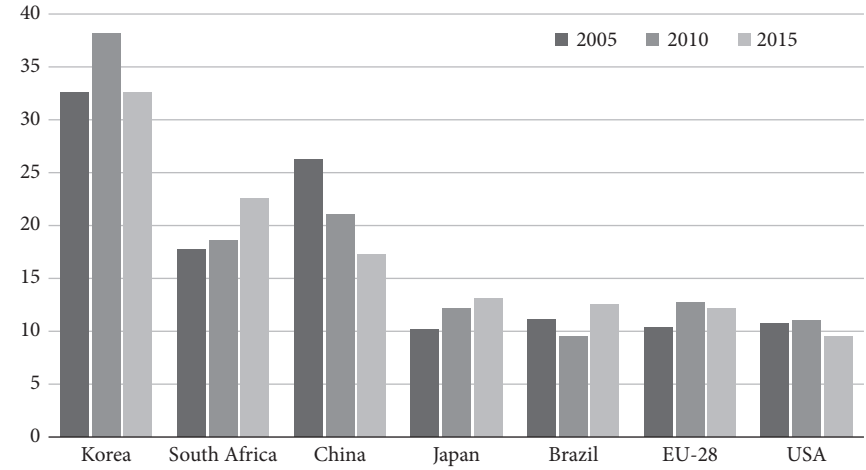

Figure 15.1 Backward participation in GVCs: Foreign value-added share of gross exports. selected countries, 2005, 2010, and 2015
Source: Pietrobelli and Vezzani mimeo, from OECD data.

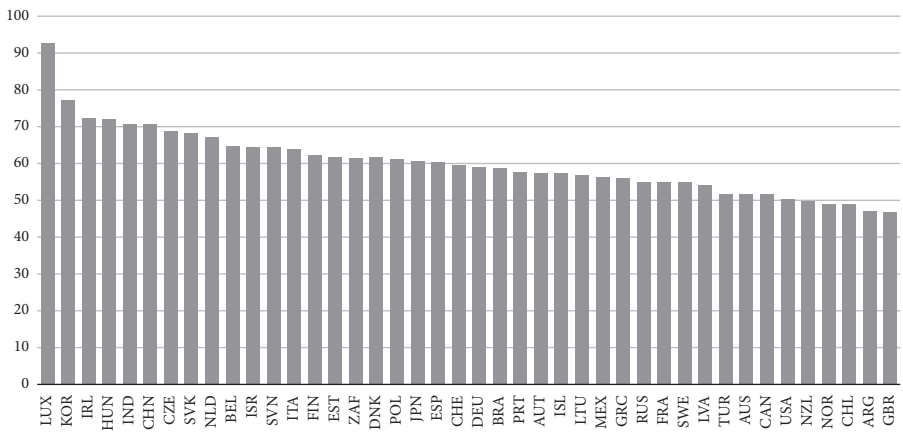

Figure 15.2 Share of intermediate products in gross imports, 2015
Source: Pietrobelli and Vezzani mimeo, from OECD data.

Finally, the regionalization of GVCs, that to some extent has always been a typical feature, is rising, with companies establishing production in proximity to demand, especially in Asia and Europe. According to the report, three forces would explain these changes: (i) emerging countries are consuming more of what they produce and exporting a smaller share; (ii) they are building more comprehensive domestic value chains, less reliant on imported intermediaries; (iii) new technologies such as automation and the Internet of Things, as well as cross-border data flows, are beginning to reshape the organization of GVCs.

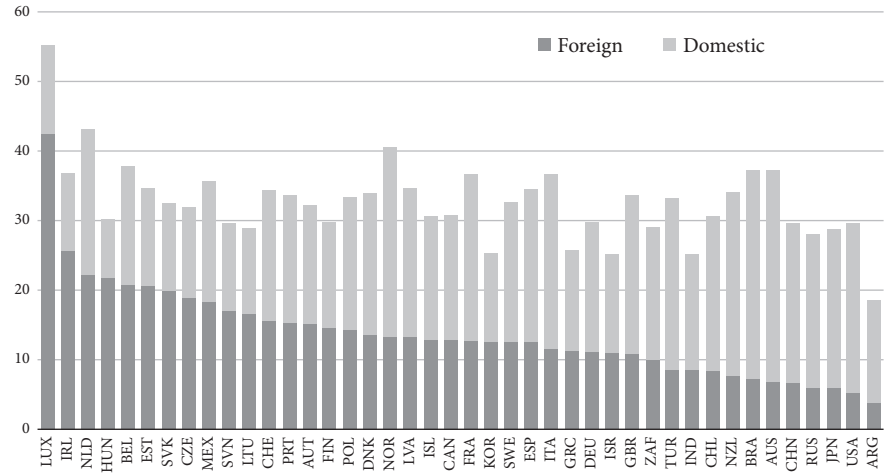

Figure 15.3 Services value-added embodied in manufactured exports, 2015
Source: Pietrobelli and Vezzani mimeo, from OECD data.

An additional fact that has been noted is the large presence of services in international trade. Services value added accounts for between 25 percent and 40 percent of the content of manufacturing exports in most advanced countries, suggesting that services play an important integrating role in GVCs (Figure 15.3). The domestic share of services value added is greater than the foreign share, especially for larger countries, further indicating that many countries are strengthening their domestic participation in GVCs (OECD 2018).

In sum, we are undoubtedly in what has been defined a value chain world (Ponte et al. 2019). The spread of GVCs has offered emerging countries opportunities for innovation and upgrading, but the process has been far from automatic and widespread (World Bank 2019). Reaping such opportunities requires active policies to promote the development of absorptive capacities and local firms' technological capabilities (OECD 2013). In this perspective, it has also become crucial for emerging countries to strengthen innovation systems to absorb the knowledge drawn from GVC integration, and nurture the coevolution between GVCs and innovation systems (Pietrobelli and Rabellotti 2011; Lema et al. 2019).

However, the implication that such a world has for public policies, and in particular for policies oriented to foster innovation and productive development has attracted less systematic attention, and a consistent framework for analysis is still lacking. Governments and international organizations have increasingly used the GVC terminology and insights in their policies and programs (Gereffi 2019). However, a systematic theorizing has lagged behind.

This chapter represents a first cut into this issue, and starts defining a theoretical structure to analyze public policies in a "GVC-world." I will first discuss what are the essential traits of new industrial innovation policy as outlined in the literature (Section 15.1). Then I will elaborate on a possible typology of these policies (Section

15.2) and extend it to a concept of "GVC-oriented policies," that is those policies that target the fostering of production and technology upgrading through GVCs (Section 15.3). In the following sections I will illustrate examples of how GVCs change the nature and meaning of policies in three areas: policies to promote international trade, investment attraction, and innovation. All these examples confirm that a radical rethinking and theorizing of policies is necessary and urgent.

15.1 Key Traits of a New Industrial Innovation Policy Approach

On the basis of the literature, and of all the many interventions tried and implemented in many countries, what are the main desirable traits that industrial policies should have? After several decades of implementation, the model adopted by some East Asian economies may be identified today as a "traditional" approach to industrial policy (Rodrik 2019; Cherif R. and Hasanov F. 2019). In the paradigmatic East Asian cases of South Korea and Taiwan, notwithstanding the differences between the two (Guerrieri et al. 2001), the hypothesis was that policy solutions were known, and that they could be pursued by honest and competent administrations. The policy packages included a prioritization of sectors and a series of sectoral (vertical) incentives conditional upon demonstrated success in international markets.

However, this approach required the fulfilment of several demanding conditions, and many countries decided not to apply it, sometimes advised by foreign organizations. Thus, in many instances a minimalist approach prevailed, equating industrial policy simply to a better "business climate," like for example the enforcement of property rights, and the administrative norms and practices required to carry out business (World Bank 2018). However, these policies often fell short of providing the necessary and comprehensive support needed for industrial development, and gradually a more modern approach developed, both in the literature and in policy practices (Santiago 2015). We may call it a new industrial innovation policy approach, which gives uncertainty and incomplete information a central role, does not presume that policy solutions are known, but instead that need to be discovered, and that a process of institutionalized collaboration and dialogue is essential to achieve this target (Hausmann and Rodrik 2003, 2006; Hausmann et al. 2008; Kuznetsov 2019; Rodrik 1996, 2004, 2019; Bruno et al. 2020; Lall and Pietrobelli 2002). These policies should include both selective and vertical interventions, a dedicated institutional design and the effort to strengthen the institutions required (Crespi et al. 2014). In accordance with a burgeoning literature (Pietrobelli 2016), this approach should explicitly share at least the following traits:

1. The neoclassical justifications for industrial policies were based on a very strict definition of market failures, and the premise that well-functioning markets would produce the desirable result. However, it is always hard to determine the

existence and location and magnitude of market failures and constraints, and the required knowledge is diffused widely within society; it is "embedded" in it (Rodrik 2019). Policymakers live in a world characterized by vast uncertainties and imperfect information. They cannot know beforehand what the right policy interventions are, and need to set up a process to *discover* them. Therefore, they can benefit enormously by understanding the apparently failed behavior of market agents, and need to ask what prevailing market and coordination failures are inhibiting market functioning.

2. Such a discovery process involves substantial *learning* based on tentative, even experimental, policy design and implementation with a built-in capacity to iterate and adjust as a matter of refining policy (Sabel and Zeitlin 2012). Solutions are local, contextual, and unknown ex ante. Experimentation must be encouraged and rewarded, and also consider a calibrated risk of failure. Policies need to be designed to be evaluable, and are discontinued unless validated by a pertinent evaluation, in order to allow the necessary learning (Crespi et al. 2014).
3. The process of discovery of the appropriate industrial innovation policies requires smart, "high-bandwidth" and iterative collaborations between the government and the business sector, with the aim of uncovering where the most significant bottlenecks are. Modern industrial innovation policies need the complementary pieces of knowledge available to the business and to the public sectors, and have to enhance the collaboration to harness them (Fernandez-Arias et al. 2017). The business sector has privileged knowledge of some aspects of business and a profit motivation. The public sector has different direct knowledge concerning policy design, implementation, and evaluation. However, the business sector also has strong incentives to manipulate the government, and appropriate systems of incentives need to be designed and put in place (Rodrik 2019; Crespi et al. 2014). Carrots to reward conducive behavior, and sticks, to punish rent-seeking and opportunism, are both essential components of modern industrial innovation policies.
4. The institutions behind the policies play an essential role, and condition success and failure. Institutional capabilities are needed to explore, design, implement, monitor, and evaluate policies. Without them, the policy treatment may be worse than the disease (Crespi et al. 2014; Lall 2004). Most importantly, institutions may be built and may be strengthened with appropriate investments. With the right incentive schemes, they may be induced to learn and improve. Policy interventions need to be chosen in light of the existing institutional capabilities, and of the efforts to build such capabilities. The institutional capabilities required include—among others—the capability to coordinate actions across public-sector agencies, to protect agencies from undue political pressure, and to ensure public–private collaboration Devlin and Moguillansky (2013) and Pietrobelli (2020). If institutions are weak, the preferred policies should be simple and consistent. However, the process of strengthening appropriate institutions is an essential part of modern industrial innovation policies.

5. This approach needs to be pragmatic and empirically based. Lessons from past successes and failures need to orient the design of future policies and institutional arrangements, and solid evaluations are required to this purpose. As a result, conclusions are dependent on the context, and there is no best practice to emulate. Rather than recommendations based on best practices defined in the vacuum and supposed to work in different circumstances, clever solutions need to be worked out each time.
6. The debate on what industrial policy and what innovation policy are is not useful and often misleading. Innovation is an essential component of industrial policy. Long-term development is intrinsically tied to technological innovation, and the development of industry requires nurturing and supporting innovation.
7. Industrial policies aim at inducing structural transformation in open competitive international markets. The outward orientation is central in this approach, as it provides a key benchmark for comparisons, as well as the opportunities of knowledge flows from abroad. Structural change is also a fundamental objective of these policies.

15.2 Classification of Industrial Policy and Why it Matters

The search for standardized solutions to repeated problems of development in many countries has generated a very varied and nearly endless list of industrial and innovation policies. For example, whilst some governments give matching grants for business innovation projects, or finance incubation services for start-ups, others focus on reducing the number of days to start a business, open offices abroad for export promotion, or offer tax exemptions for tourism activities. Some governments put in place cluster development policies and try to attract foreign direct investments, others subsidize training to close the skills gap for the mining or the electronics sector. The focus on GVCs and the development of local providers is shared by most, whilst the instruments may differ: some provide cold storage facilities for fresh flowers, whereas others create public research organizations for the electronics or the biotechnology sectors. Are all these industrial and innovation policies?[1] Why such a variety? How can we make sense of such a wide assortment?

The large variety of policies is not a problem in itself, and sensitivity to different contexts is needed. Each government should rightly look for policy responses that are specific to the context it wants to influence, and that take into account the peculiarities of the actors involved, their systems of incentives and objectives. However, such a large variety often makes it difficult to understand the rationale and

[1] For an extended discussion on definitions, see Aiginger and Rodrik 2020.

the logic of design and implementation of each policy, may induce errors and limit cross-learning and exchanges of experiences. Indeed, interventions may be classified, and a typology can help analyze their logic as well as their qualities and their risks. Following a highly influential policy report (Crespi et al. 2014), we focus on two dimensions that are useful and practical to generate a simple analytical framework to analyze industrial innovation policies. Later, we shall also use this framework to argue that the logic of these policies needs to be revisited in light of the emergence of GVCs (Table 15.1).

The first dimension is the *scope* of policies, depending on whether they focus on specific sectors, or instead do not target any specific industry in particular. In this regard, the terminology often distinguishes between vertical and horizontal policies. A public center for phytosanitary controls or a tax break for software are examples of vertical policies; a one-stop window for business registration and simplification of business-related procedures is an example of a horizontal policy.[2]

The second dimension of policy refers to the *type of intervention*. In fact, public support cannot only be offered by providing public inputs or public goods, but also by intervening in markets and altering market prices. A market-based intervention would intentionally influence relative prices through taxes or subsidies, and therefore induce agents' behavior in a desired fashion. A tax rebate on R&D expenditure is a classic case of a market-based innovation policy. On the other hand, the government may also intervene thorough the provision of a public good to enhance the competitiveness of a sector (or of the whole economy), such as the setting of norms for certification of quality control or building a new research center on palm oil.

In Table 15.2 we build a simple 2x2 matrix to present some of the many possible industrial innovation policy interventions. A form of horizontal policy through public inputs provision is clearly the promotion of public (and publicly-sponsored) research. The creation of public technology research centers, such as for example the CITE-Vid in Peru, the center devoted to the technological development of the pisco industry in Peru (OECD 2011), is a case of vertical public provision of public inputs. Examples of horizontal market interventions include the typical matching grant schemes for R&D implemented in many countries that co-finance the innovation efforts of firms regardless of the sector considered. If the tax rebates or exemptions are geared towards a specific sector—and the innovative efforts therein—like for example in tourism or biotechnology, this would represent a vertical form of market intervention.

Why does a typology like this matter? First of all, the variety of forms of industrial and innovation policies is already huge, and such a diversity does not help the clear

[2] To some extent, it has been argued that all policies are always vertical, and a fully horizontal policy does not exist in practice (Chang 2002). Building a road with public resources implies favoring the sectors that would benefit from that road, and not all sectors. Subsidizing research and innovation favors innovation-intensive sectors more than traditional sectors that use less innovation. Training is also necessarily specific to specific tasks and skills, and so on. However, we retain here this distinction as it serves as a useful didactic metaphor.

Table 15.1 A typology of innovation policy interventions (examples)

	Horizontal	Vertical
Public Inputs	Funding of basic Research	Sectoral Public Technology centers
Market interventions	Matching grant for innovation	Tax rebates for innovation in biotechnology sector

Source: Adapted from Crespi et al. 2014.

Table 15.2 A typology of GVC-oriented policy interventions (examples)

	Horizontal	Vertical
Public Inputs	• Monitor opportunities for attraction • Streamline procedures for FDI and lead-firm (e.g. One-stop shops)	• FDI and selective lead-firm attraction • FDI in S&T to increase location attractiveness for international research centers (via IP laws and enforcement, or tax concessions, a market intervention). • Skills training center • Quality, Standards, Certification Organizations • Policies to reinforce linkages and potential spillovers between GVC participants and the local knowledge base (e.g., cluster policies, policies for technology transfer, etc.)—may also operate through market interventions;
Market interventions	• Generic R&D&I subsidies for local providers' capabilities • Matching grants for collaborative R&D (regardless of sectors but conditional on collaboration) ✓ *Force* externalities via training commitments and suppliers' development • Policies to encourage international mobility of talent (may also be vertical and through public inputs)	• Selective temporary tax exemptions to new local providers • Local content policies (forcing lead firms to buy locally) • Selective R&D&I subsidies/grants • Promotion of innovative entrepreneurship, e.g., ease access to capital

Source: Author's elaboration.

analysis and decision of which policy would be more appropriate in one context and circumstance than in another. Classifying instruments according to a logic definitely helps policymakers and the private sector choose the appropriate mix of instruments to achieve a selected target, and facilitates cross-learning from policy experiences.

Secondly, public policy considerations to guide the assessment of merits and drawbacks of each instrument change in each quadrant of the matrix. This is especially useful when the risks of rent-seeking by particular groups and lobbyists

need to be assessed and checked, as well as when the difficulty of putting in place a specific instrument, and the institutional requirements related to it, need to be considered. Let us briefly see some examples that may help to understand this remark.

Horizontal public goods are often the easiest interventions to put in place: strengthening respect for (intellectual) property rights or reducing the costs of "doing business" (as argued by the World Bank's "Doing Business" Reports) may be relatively straightforward, with a negligible chance that small groups can appropriate all the benefits of the policy. However, these interventions are often so general that they almost represent a pre-condition for productive development, preliminary to any form of active policy. Horizontal market interventions do not aim at favoring specific sectors, but rather specific activities across many different sectors, like for example training, foreign investment, or R&D expenditure. These interventions tend to be automatic and recurring, and therefore difficult to discontinue once the market failure they intended to address has been solved, and the policy would not be needed anymore. Moreover, they may inevitably remain very general and lack focus.

Vertical public inputs are arranged by the state to offer benefits for specific sectors. Because of the difficulty of selecting the beneficiary sectors, and because they are directed to few sectors, and therefore intrinsically more prone to being captured by isolated rentiers, they have often been more controversial in several countries. However, it is also true that most public inputs, due to their very nature, tend to benefit specific sectors. The technological needs of a non-traditional agri-business sector are likely to be very different from the needs of the software industry. The former often requires norms and institutions (e.g., laboratories and metrology) to comply with and certify phytosanitary and biological standards, whilst the other requires universities graduating highly specialized engineers, and standards and certification of a different nature. Confining state action only to horizontal public inputs, without addressing the specific needs of specific sectors, would imply giving up most options to enhance productivity and markets' functioning. This would amount to remaining oblivious of the "need to choose" that Governments face in any country all the time (Hausmann and Rodrik 2006). Moreover, in this latter category the collaboration and co-financing of the private sector is often natural, with public policies supporting the productive efforts of the private sector.

Vertical market interventions often take the form of subsidies or tax rebates and exemptions granted to specific sectors. For their very nature, they may lend themselves to favoritism and arbitrariness.[3] However, if properly designed and managed, they offer substantial benefits. This may be the case of policies oriented to solve problems of coordination in sectors with latent comparative advantage, whose exploitation is hindered by the difficulty of coordinating the investments of many different actors. The policies adopted by the Costa Rican Government to develop the tourism

[3] See, for example, the case of policies for the rice sector implemented in Argentina and Costa Rica, and how the latter was remarkably affected by the shortcomings of vertical market interventions (Crespi et al. 2014, pp. 48–9).

sector in the mid-eighties included a series of sector-specific incentives such as tax breaks for hotel investments, transport, travel agencies, and others, to provide powerful signals to the economy that tourism was a sector with a clear dynamic comparative advantage. Later, as the industry started to take off, most interventions moved to the quadrant of vertical public inputs to foster the emergence of sustainable tourism, through among others the creation of a national brand, the conservation of natural areas, and a program of sustainable tourism certification (Monge-González et al. 2010). This experience may even hint that in many instances there is likely to be a preferable sequence between horizontal—in the initial phases—and vertical—in later developments—interventions. Of course, specific circumstances may suggest different conclusions, and isomorphic solutions do not offer the same results in different contexts.

This typology of industrial innovation policies may lend itself to useful categorizations of policies in a variety of other domains. In the next section we will discuss in detail how the emergence of GVCs forces a rethink of the logic of public policies, and the adoption of a renewed approach. This typology will prove useful in structuring the ensuing policy discussion.

15.3 GVC-oriented Policies: A Change in the Policy Vision

The need for policies oriented to GVCs is becoming evident in the choices of many advanced countries' governments Gereffi, (2014). For example, the European Union has recently approved a "Communication" and a Strategy paper that openly stress the need of strategic policies for GVCs: "…a successful industrial strategy should build on Europe's strengths and assets in strategic value chains in new technologies, which often requires joint, well-coordinated efforts and investments by public authorities and industries from several Member States;…(to this aim it) is necessary to foster new Important Projects of Common European Interest (IPCEI)" (EC 2017). The need to *fill missing links in relevant value chains* is often called for in these documents, and is expected to be followed by active interventions soon.

The acknowledgment that the existence of GVCs imposes a multidimensional and systemic approach is widespread. Whilst trade, border and investment policies are needed to improve GVC participation, encouraging industrial and technology upgrading requires policies in the area of industrial, innovation, entrepreneurship, and skill development (Kergroach 2019). A recent study has been perhaps the first effort to systematically classify national policies operating through and explicitly taking into account the existence of GVCs. On the basis of the European Commission/OECD Science, Technology and Innovation (STIP) database, and of a clever keyword-based search, Kergroach (2019) selected the major national policy initiatives of fifteen OECD and emerging countries dedicated to attracting Foreign Direct Investment (FDI) and supporting the internationalization of Small and

Medium-sized Enterprises (SMEs) and those promoting industry and technology upgrading. The results reveal that all countries have many policy interventions for upgrading and productive development through GVCs. Interestingly, the policy density for such policies is not related to the development stage of a country. Moreover, the public policy interventions to improve a country's technological and productive capacities through GVCs take different forms and mobilize different instruments. They are not limited to FDI-related policies and programs to support the internationalization of firms, adopt a cross-cutting approach, and spread across various policy areas. Of these, industrial and cluster policies remain the most popular channel for promoting GVC participation.

In an earlier piece on industrial policy with vertically specialized industrialization, that is, reflecting GVCs organization, Milberg et al. (2014) had convincingly argued that governments must look at lead firms and their strategies (as well as states and non-state actors) in creating policies, strategies, and campaigns. They also reminded us that an effective policy focus needs to consider also the regulation of the links with the global economy, in a period of intense changes in the institutions in charge of global governance.

Both the last two chapters agree with us that new industrial innovation policy needs to explicitly consider the implications of the presence of global value chains. Public policies neglecting this dimension risk missing the point and producing undesired and often counterintuitive results. In what follows I will briefly discuss the theoretical implications, propose a taxonomy of GVC-oriented policies consistent with the previous 2×2 approach, and present three concrete examples of areas where public policies are intrinsically related to a "GVC world."

The academic debate has rightly acknowledged that country strategies to further integration in GVCs may target "building" or rather "joining" a value chain (Baldwin 2011). Therefore, some countries may wish to build the entire value chain and maintain the leadership over the sequence of chain layers and across the variety of inter-firm linkages. For example, decades ago South Korea started with subcontracting, limiting FDI, and favoring joint ventures, in order to achieve its long-term target of entering international markets in radically new sectors and nurturing its own lead firms and value chains. However, in the newly prevailing context regulated by the WTO and with a very large number of countries and companies that firmly established their leadership in a variety of sectors, a strategy to build the entire value chain appears hardly feasible. When countries like South Korea, Taiwan, and Singapore started their process of accelerated industrial development, the international context was very different, and the "policy space" much larger (Chang 2002).

What the new context offers, rather, is the possibility for firms and countries to target specific niches in a value chain by developing strong competences, skills, and assets in specific tasks and value chain layers. For example, instead of developing a comparative advantage in the whole garment sector, countries may prefer to target a specific intermediate product (e.g., buttons, or zips, dyed cloth, or packaging for

final retailers) and sell it at a large scale through large buyers or traders operating at a global scale (Gereffi and Sturgeon 2013).

Following a GVC perspective to understand international trade has often attracted the interest on designing and implementing policies to "join" and get access to value chains in order to penetrate international markets. However, as countries also pursue a development objective, policies should also target the complementary and equally important objective of "capturing the gains" and maximize the (potential) benefits offered by GVC integration. The evidence has shown that the benefits from GVCs are far from being granted and automatic, and require much more than "joining" a GVC.

Therefore, in order to capture the gains, the policies to target and attract foreign investors, as well as large GVC lead firms and traders, with their first and second tier of suppliers, need to target the sectors and firms that are likely to interact more and better with domestic firms. Such attraction policies also have an important infrastructural component, with the related necessary logistics that include airports, harbors, and roads, as well as efficient telecommunications and broadband facilities. However, the public policy interventions for capturing the gains from GVCs are not limited to FDI-related policies and programs to support the internationalization of firms and SMEs (Kergroach 2019). Initiatives can span several policy areas, and special attention needs to be paid to the activities attracting intangible assets such as knowledge and technology flows. Moreover, simpler, certain and streamlined regulations affecting business may also help. In general, what really makes the difference is the set of programs and initiatives required to increase the value added captured by local firms, and exploit the opportunities for learning and innovation offered by GVCs (Pietrobelli and Rabellotti 2007). Local suppliers need to develop their technological capabilities to usefully interact with chain leaders and learn from the interaction (Morrison et al. 2008, Pietrobelli 2016).

In turn, this process of interaction also depends on the Innovation System (IS) in which firms are embedded, and that provides them with the necessary public goods (Pietrobelli and Rabellotti 2011). Capturing the gains is in effect related to the development of a local supply base, that in turn needs the public goods related to research and technology development. Research organizations may offer the results of their research, and training and technical education should produce the necessary advanced technical skills, and laboratories, testing, and quality centers should help firms comply with the sophisticated standards that lead firms' and international markets' demand. Standards compliance is a tremendously important area that extends to technical as well as phytosanitary and environmental requirements and certifications. Sometimes specific supplier development programs can also be designed effectively to match the demands of lead firms with the supply of domestic producers (Pietrobelli and Staritz 2017). Countries often use industrial cluster policies to promote enterprise upgrading through GVCs (Kergroach 2019).

Indeed, the relationship between the IS and the GVC and its governance often works two ways and coevolve (Lema et al. 2019): an advanced and smoothly functioning innovation system may attract GVCs prone to local interactions and

help local firms learn and innovate and benefit from the GVC, but at the same time GVCs may contribute important pieces of knowledge and organization to the IS. The more advanced technological capabilities are in local firms, the more GVCs are forced to engage in fruitful productive interactions. This indeed reflects the different forms of learning possible along a GVC, that may go from simply an increased pressure exerted by lead firms and their first-tier of suppliers ("competition effect"), to lead firms deliberately transferring knowledge and being directly involved in the learning and innovation process, to the unintended knowledge spillovers generated from GVC interactions (Pietrobelli and Rabellotti 2011).

Summarizing, the emergence of GVCs requires a deep rethinking of policies for productive development, and the acknowledgment of the role played by coordination and intense interactions among many different entities and actors operating in globalized open markets (Pietrobelli and Staritz 2018). In this regard, we may define GVC-oriented policies as those policies that target the fostering of production and technology upgrading through GVCs. Two important features of these policies stand out and are worth emphasizing:

i. GVC-oriented policies are inevitably multidimensional, cross-cutting policies, affect many different dimensions, and require a systemic vision and the coordinated action of many different entities. Thus, for example, trade policy in the form of import protection without the awareness of the complexity of GVC organization may hinder a country's export capacity. Investment attraction needs to reward investments with a stronger potential for local linkages. Innovation systems have to be coherent with GVCs and leverage their mutual interdependence. Education, training, and migration policies also need to consider GVCs, and attract and develop talents consistently.
ii. GVC-oriented policies go far beyond the domestic economy focus of import substitution industrialization (ISI) policy regimes (Gereffi and Sturgeon 2013). Their focus on developing local firms and their capabilities through direct interventions as well as improving the innovation system may lead to a misleading interpretation of their apparent resemblance with old-style ISI. GVC-oriented policies' immediate link to the international market and their reliance on international production networks and on imported intermediate products and services make them radically different from the past.

Also, GVC-oriented policies may be classified according to the 2×2 framework proposed: they may have a horizontal or vertical nature, depending on whether they target specific sectors (Table 15.2). Horizontal policies may involve setting up the rules and streamlining the procedures to approve and facilitate FDI and lead firms willing to invest and establish their activities in the country. Prior to this, investment attraction agencies may also be strengthened and equipped with the capabilities to attract and interact with GVC leaders. Such attraction can—and often needs—to be selective, targeting specific firms or sectors, like in the Costa Rican example below.

Horizontal GVC-oriented policies could also use market-based interventions, for example strengthening the technological and innovation capabilities of actual and potential local suppliers through instruments like subsidies for Research and Development and innovation (R&D&I) investments, or matching grants for collaborative research between lead firms, local providers, and universities. In order to achieve the objective of maximizing the gains to the local (national) economy, the positive externalities from GVC integration should be fostered and sometimes "forced." Some countries (e.g., Singapore, Costa Rica), in their attraction effort and later interaction with foreign investors and lead firms, induced the latter to invest in supplier development and in training to an extent greater than what would be necessary to the foreign investor only, thereby creating capabilities in excess to the benefit of the host country.

Vertical GVC-oriented interventions can sometimes use the same instruments, but with a vertical, sector-specific, concentration. For example, the policy of firm-level skills training may be strengthened through sectoral technology and training centers (e.g., the palm research center in Colombia in Crespi et al. 2014). Similarly, local firms and potential suppliers, in order to get access to a GVC and comply with the technical and quality requirements, often need to be supported by a solid Quality System, including accreditation and standard bodies, metrology organizations, inspection bodies, and testing and calibration laboratories (Guasch et al. 2007).

Such a broad policy rethink is called for in many areas of activity. Countries need coherent policy packages of the various instruments, all inspired by the same logic acknowledging the new nature of industrial organization in international markets. In the remaining part of the chapter I will briefly discuss some examples of how GVC-oriented policies require revisiting trade policies, investment attraction policies, and innovation policies.

15.4 GVCs and Trade Policies

In a world where more than half of trade is represented by intermediate exchanges, the empirical assessment of trade policy must acknowledge which country is the source of the value that is embedded in trade (Antimiani et al. 2018). Thus, the emergence of GVCs imposes a radical rethinking of the logic and the application of trade policy to understand who is effectively paying the cost of protection. As goods now cross borders many times, first as inputs and then as final products, barriers at the border become costlier and have a cumulative impact along the value chain (OECD 2018). Figure 15.4 reveals how average ad valorem tariffs are higher if one considers direct and indirect tariffs on inputs, in addition to tariffs on final exports. Therefore, protection would be higher for an economy requiring a large share of intermediate imports to produce its exports (Cusolito et al. 2016). In addition, the production activities which are linked to the GVC, are also affected by tariffs faced in the destination market and across different countries (Balié et al. 2019).

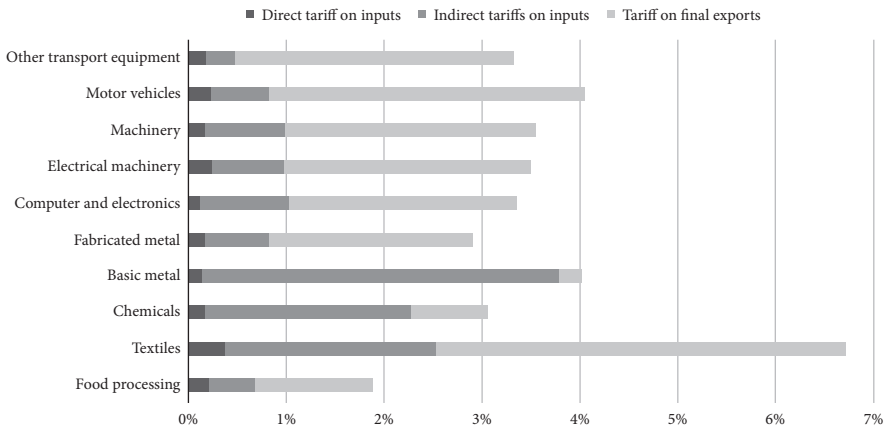

Figure 15.4 Average ad valorem tariffs along the GVC, selected industries, 2015
Source: OECD 2018.

In this line of analysis, Antimiani et al. (2018) present an interesting measurement of trade restrictiveness taking into account the existence of GVCs. They show that the total impact of tariffs can have a significant cumulative impact because of trade in intermediates. According to their analysis:

> Bilateral nominal tariffs and trade flows are not sufficient to provide an accurate picture of the impact of protectionist measures through backward and forward linkages. On the one hand, the value of the index for the domestic value-added (reflected) component relative to the foreign direct value added is indicative of the harm inflicted to domestic producers providing inputs to the exporting sectors of the foreign country. This shows the "beggar thyself" content of protectionism. (Antimiani et al. 2018, p. 28)

At the same time, the importer's tariffs towards third countries also play a very significant role in assessing the overall protection faced, because the value added is exported both directly and indirectly.

In a related paper, Blanchard et al. (2017) develop a value-added approach to modeling tariff setting with GVCs, in which optimal policy depends on the nationality of value-added content embedded in home and foreign final goods. They estimate the influence of GVC linkages on trade policy with newly assembled data on bilateral applied tariffs, temporary trade barriers, and value-added contents for fourteen major economies over the 1995–2009 period. Their findings indicate that GVCs already play an important role in shaping trade policy. Governments set lower tariffs and curb their use of temporary trade protection where GVC linkages are strongest. In sum, the actual structure of protection from imports changes in light of the possible integration of some segments of the economy into GVCs. This may imply the need for lowering tariffs in GVC-intensive sectors.

15.5 GVCs and Investment Attraction Policies

Investment attraction has been traditionally a major focus of policies in developing countries, trusting to benefit from foreign direct investments (FDI) by multinational corporations (MNCs) in the form of increased employment, investments, access to markets and technology, and so forth. With the fragmentation of production and the organization of transactions following the logic of GVCs, this area of policy activity also needs to be reconsidered. To this aim, Costa Rica offers an insightful example of selective attraction of FDI in the GVC spirit, with various interventions through both market instruments and public goods provision, mainly of a vertical nature. This will help us make the more general case.

In their analyses of Costa Rica, Bamber and Gereffi (2013) and Gereffi et al. (2019) studied the electronics and the medical devices sectors and their experience of upgrading. As far as the latter sector is considered, they argue that a key dynamic that facilitated firm upgrading was "…the identification by lead firms themselves of critical 'GVC gaps' in Costa Rica's technical capabilities, which was followed by targeted FDI recruitment efforts by national development institutions (CINDE and COMEX)" (Gereffi et al. 2019).[4] A close look at the selective attraction policy implemented by the Costa Rican agencies suggests that a new consideration of the role and organization of GVCs needs to encompassed in the activities of investment attraction agencies.

The medical devices sector was one of a few sectors targeted by Costa Rica, through CINDE, to attract FDI.[5] The sector had been expanding at healthy rates since Baxter first came to Costa Rica in 1987, and reached nearly $1.5 billion in exports in 2014. However, medical devices range across various levels of complexity, from simple disposable devices (such as catheters) to surgical and medical instruments (such as biopsy forceps), to therapeutic devices (such as heart valves), which go into the body to stay, to complex medical equipment (such as MRI machines).

As of 2007, Costa Rica had been highly successful in attracting multinationals to the sector. But they were mainly producing low-complexity disposables, and not, for example, heart valves or other cardiovascular devices. A careful analysis to "discover" the likely solution revealed that in order to sell them, they needed to go through the process of sterilization, not available locally at the time. Producing them in Costa Rica would have required shipping them to the US to have them sterilized, and then shipping them back for packaging—complicating the logistics and adding greatly to the costs.

Why did not any activity of sterilization develop in the country? With no heart valves and other similar products in production, there was no demand for sterilization

[4] CINDE (*Coalicion Costarricense de Iniciativas de Desarrollo*) is the Investment attraction agency of Costa Rica, and COMEX is Costa Rica's Foreign Trade Ministry.

[5] This case draws from and adapts the evidence analyzed in Box 9.4. in Crespi et al. 2014, and Bamber and Gereffi 2013.

services, and with no demand, there would be no supply: a typical "chicken-and-egg" problem. CINDE quickly realized that the market would not solve the problem by itself. Yet, having a sterilization process in the country would have helped the more complex links of the value chain to develop. CINDE's efforts paid off in early 2009, with the arrival of BeamOne, a contract sterilization processor headquartered in the US, followed by Sterigenics in 2011. Within three years of inauguration of the BeamOne facility, Costa Rica had successfully attracted several companies in the cardiovascular sector, including Boston Scientific in 2009, Abbot Vascular in 2010, and St. Jude Medical in 2010. In 2013, Costa Rica exported nearly $300 million in the therapeutics category of medical devices, and an additional $500 million in surgical and medical instruments. The share of disposables fell from 90 percent in the early 2000s to less than half.

Why did CINDE target sterilization? Because it adopted the logic of GVCs and of a "discovery" process, and realized that a segment of the value chain was missing, and that the market alone would have not solved the problem. Moving Costa Rica into the more profitable sections of the value chain, and capturing more value, required selectively attracting foreign investors in that specific segment. This made it possible for other local firms to discover and develop into new and higher-value stages of the GVC.

15.6 GVCs and Innovation Systems

GVCs are not only, or mainly, a trade-related phenomenon, because this form of industrial organization hinges on dense flows of knowledge exchanges, and as such change firms' behavior in a fundamental way. Capturing the gains from GVCs crucially implies an active attitude of local firms investing in learning, in technology adoption and absorption, and in developing the capabilities necessary to interact with lead firms and upgrade in GVCs Grazzi and Pietrobelli (2016).

This process of capturing the gains reflects a number of underlying conditions: first of all, access to GVCs is unequal across countries and regions (OECD 2018); secondly, local suppliers differ in their capacity to absorb, master, and adapt knowledge and capabilities that leading firms can transfer to them (Pietrobelli and Rabellotti 2007); thirdly, governance patterns have heterogeneous impacts on learning mechanisms in value chains: for example, in modular chains, learning can be the result of a pressure to match international standards and comply with them, or sometimes lead firms can facilitate learning through direct involvement if suppliers' competence is low and if the risk of non-compliance is high, and even enjoy mutual-learning with two-way knowledge flows (Pietrobelli and Rabellotti 2011).

However, local suppliers' upgrading efforts, and their interactions with buyers, are also contingent on the prevailing local innovation system, its level of depth and maturity. In turn, the development of the IS also hinges on firms' capabilities, and their GVC integration. A true "co-evolution" of GVC and IS occurs, that can lead to

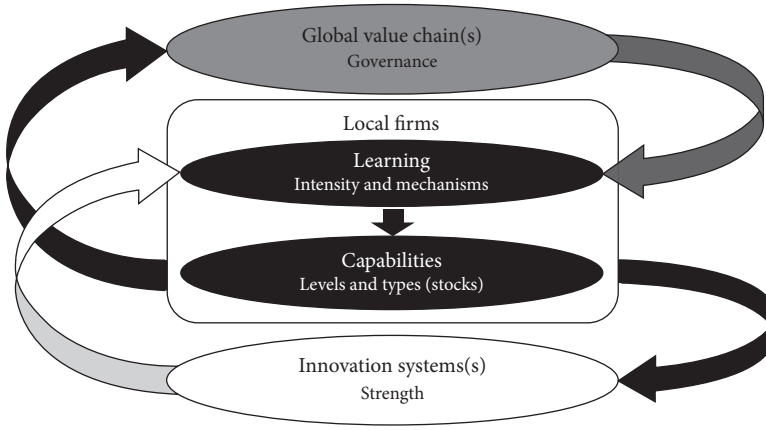

Figure 15.5 The co-evolution of GVC and IS with regard to firms' innovation capabilities
Source: Lema et al. 2019.

widely different results in terms of firms' upgrading performance (Lema et al. 2019), and also to widely different policy implications. As we explain in a different article, such co-evolution follows two-way flows that affect both the mechanisms through which ISs and GVCs contribute to the process of accumulating and shaping firm-level capabilities and learning, and also those mechanisms through which innovative firms, via their evolving capabilities, influence local IS characteristics and GVC governance (Figure 15.5 and Lema et al. 2019).

This coevolutionary approach has powerful implications for public policies. Thus, firm-level upgrading along GVCs can benefit—and in turn needs—a well-developed IS, and IS will not develop without firms and other actors requesting its improvement. We illustrated some possible co-evolution trajectories, ranging from *gradually increasing, to leap-wise increasing*, *stagnating* and *reverting*. For example, Lee and Shapiro (2018) highlight how China's and South Korea's strategies of GVC integration consisted of processes of moving "*in a GVC and out and in again*," in parallel developing and deepening a national IS to foster local suppliers' upgrading processes up to becoming true leaders of newly created GVCs.

Consistently with this approach, a policy geared towards capturing the gains of GVC integration needs to encompass new industrial innovation policy. Strengthening the IS by fostering firm-level innovation (e.g., through matching-grant programs), technology adoption and absorption, collaborations with universities, in a way that is coherent with the characteristics and requirements of (present and future) GVCs in the country are examples of GVC-oriented policy.

Similarly, targeted training programs, that is, to create the skills local firms need for their integration into and upgrading within GVCs, and investments in public organizations to provide technology services in the areas of standards, metrology, testing, and certification (upper right-hand side quadrant in Figure 15.2) pertain to this group of policies.

15.7 Conclusions

Global value chains are changing not only the way firms organize production but also the policies that influence social and economic development. This is occurring in several areas and require a framework apt to encompass these developments. In this chapter we made a first effort to develop and illustrate this framework. After outlining the essential traits of new industrial innovation policy, I presented a typology of industrial innovation policies and extended it to "GVC-oriented policies," that are those policies that target the fostering of production and technology upgrading through GVCs. The examples from trade and foreign investment policies, and from innovation policies, confirm that a radical rethinking and theorizing of policies is necessary and urgent. Future research will need to move further and deeper in this direction.

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