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Directing Structural Change: from Tools to Policy

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Abstract

Structural change towards diversification and competitiveness is important to make our economies productive, wealthy and sustainable. In market economies, structural change is essentially driven by private entrepreneurs who challenge incumbents with new business ideas and take risks to implement them. While public policy cannot fully anticipate the outcomes of such market-driven search processes, it does have important roles in directing structural change: it can facilitate stakeholder processes meant to overcome coordination and information failure and thereby smooth the transformation; it can make pre-competitive investments in infrastructure and skills for the future; and it can help align structural change with broader societal objectives, such as environmental sustainability or job creation. To fulfil these roles, policymakers need to have an idea about future competitive patterns of specialisation. The challenge is to anticipate trends and facilitate action towards promising futures in ways that are as evidence-based as possible and effectively synchronised with market forces.

Our paper makes three essential contributions to addressing this challenge: (1) We identify five influential methodologies for anticipating future competitive advantages, analyse their strengths and weaknesses, and suggest ways to consolidate their most valuable features in one synthetic approach. (2) In doing so, we emphasise the importance of disruptive change, stemming in particular from decarbonisation as well as the digitalisation of economic processes and products. Such game changers are likely to affect virtually all economic sectors, thereby reducing the predictive power of methodologies that essentially extrapolate from the past. (3) We highlight the need to contextualise the various analytical tools, and caution against using them as technocratic blueprints. To be of practical use, evidence-based assessments of future competitive advantages need to be embedded into a political economy framework that takes account of both societal objectives (normative level) and implementation capabilities (institutional level).

Contents

1 Why structural change matters[1]

In the debate about growth and development, the concept of structural change has always been at centre-stage. How the composition of economic sectors changes and diversifies over time is crucial for productivity growth, technological upgrading and hence long-term economic dynamism. Thus, in general, structural change is uniquely considered

> as a central feature of the process of development and an essential element in accounting for the rate and pattern of growth. It can retard growth if its pace is too slow or its direction inefficient, but it can contribute to growth if it improves the allocation of resources. (Syrquin, 2007, p. 4)

There is consensus on the need to *analyse* evolving patterns of structural change and to assess their implications in terms of a country's growth prospects and competitiveness, and the feasibility of doing so. At the same time, there is already a controversial debate on the validity of attempts to *predict* its future course and, one step further, on appropriate policies to *steer* it in a certain direction. This is because, evidently, entrepreneurs are the main drivers of structural change. When investing financial, technological and managerial resources into new business ideas, they take risks, expand existing, or create new, demand, challenge incumbents and, in the process, change the structure of an economy. In such an essentially market-driven process, policymakers cannot fully anticipate the direction of change, but they nevertheless have two important roles. Firstly, they can facilitate stakeholder processes meant to overcome coordination and information failure and thereby accelerate the transformation; secondly, they can help to harmonise structural change with broader societal objectives, such as environmental sustainability as well as employment creation and other elements of social inclusion.

Any endeavour aimed at directing or promoting structural change so as to achieve predefined economic and social goals will seek to base itself on expected competitive advantages grounded in some kind of economic reasoning. The level of ambition will differ from country to country, as will the readiness to take risks, e.g. in terms of assumptions on technological capabilities and learning curves. Yet, rational policy making must rely on evidence-based scenarios of future economic opportunities in order to bring the relevant stakeholders to the table, facilitate coordination and make the necessary pre-competitive investments. This leads us straight into the central issue addressed in this paper: *What are relevant theory-based predictors of future competitive advantages and how can they be effectively applied in guiding real-world policy choices?*

In answering this question, our paper makes three essential contributions to the advancement of the debate:

- We assess the strengths and weaknesses of various contemporary methodologies and suggest a practical approach to identifying competitive advantages – based on a participatory and iterative process of public–private policy learning that can incorporate the strengths of various methodologies. Hence, the paper is aimed at laying the foundation for a consolidation – and ultimately a synthesis – of different methodologies.

1 The authors are grateful for very helpful comments and suggestions from Dominique Bruhn, Michele Clara, Amirah el-Haddad, Sarwar Hobohm, Elvis Melia and Philipp Neuerburg.

- In doing so, we factor in the growing role of disruptive structural change. If, indeed, we are faced with radical structural change that arrives fast, impacts virtually all economic sectors across the board and disrupts the prevailing techno-economic trajectory, what then are the implications for a sound process of predicting future competitive advantages? In light of current development trends, two dimensions of disruptive structural change, in particular, are widely acknowledged: the *decarbonisation* (see e.g. DDPP, 2015) and the *digitalisation* (see e.g. Brynjolfsson & McAfee, 2014) of economic processes and products, and the pressing requirements both generate for redesigning our established production and consumption patterns.
- We will highlight the necessity of embedding evidence-based approaches to measuring competitiveness into a political economy framework that connects such tools to societal objectives (normative level) and to implementation capabilities (institutional level). We thus argue for going beyond technocratic toolbox approaches and incorporating context-dependent information on specific actors and conditions.

On a terminological note, throughout this paper both the terms "comparative advantage" and "competitive advantage" will be used. While this is unavoidable simply for practical reasons (as both terms feature in the various methodologies under consideration), our own preference is clearly in favour of the latter. Without going into an in-depth discussion, it would seem that the Ricardian notion of endowment-based comparative advantages has given way to the more dynamic concept of competitive advantages that are amenable to policy interventions – in other words, are at least partially "man-made". In both the business development literature (Porter, 1990) and the literature on global competition, trade and investment (Dunning, 1992; Enright, 1998), much emphasis is placed on policy-induced competitive edges, on structural features of markets (entry and exit conditions), on patterns of demand and intra-industry trade, and generally on ways to combine market-based entrepreneurial search processes with pro-active policy support. Such a perspective seeks to integrate elements of a country's given resource endowment with elements rooted in capabilities created by history and policy, thus emphasising the importance of context-specificity (on reconciling both aspects see Lin, 2012a, p. 89). This is clearly in line with the findings of evolutionary theory of economic change (Nelson & Winter, 1982), specifically its emphasis on cumulative causation leading to self-reinforcing techno-institutional trajectories. Initial investments, which are often historically contingent, constitute sunk costs and create network effects and increasing returns, all of which favour path-dependent investments over other options that might have been just as lucrative before the current techno-institutional trajectories were established. Resulting patterns of specialisation are thus not explicable on the basis of factor endowments alone. Likewise, the "new trade theory" (Krugman, 1980; Krugman, 1991) essentially invokes economies of scale and network effects in explaining increasing intra-industry specialisation among nations with similar factor endowments.

Against this backdrop, divergent productivity potentials between industries, coupled with significant empirical evidence for technology spillovers, make a strong argument for the stimulation of technological learning and specialised institutions. Empirical evidence shows that creating competitive advantages is feasible. A proactively intervening industrial policy can, under the right circumstances, and if judiciously applied, influence in which industries a country will develop strong growth potentials and future competitive edges. (For a review of both the opportunities and risks of selective industrial policy interventions, see Altenburg & Lütkenhorst, 2015).

Yet, as emphasised above, even preceding the thorny issues of policy design and practice, the question emerges of exactly how promising economic sectors can be identified. This issue is at the heart of this paper. In recent years, several methodologies have been suggested that exhibit complementary features and would seem to offer potential for consolidation. If this can be achieved, the analytical foundation for targeted industrial policies could be made both more evidence-based and more effective. While this, in and by itself, would not guarantee policy success, it would represent a great step forward in this direction – taking into account that the very tools allowing an identification of future growth potentials may also be able to contribute to strengthening the monitoring and evaluation of policy impact. This paper presents various approaches (some of a more recent nature, others already well established) providing valuable insights into the determinants of competitive advantages. Furthermore, it argues that none of them provides a full picture, but combining them we can produce a synthesis that is able to consolidate their strengths and rectify potential weaknesses.

While, at its core, this paper thus addresses methodological choices in *identifying* potential competitive advantages, there is only a small space between analysis and policy, between "growth *identification* and *facilitation*" – which is why Lin and Monga (2010) have rightly combined both aspects from the very start, even in labelling their own approach. While our aim is distinctly *not* to design a blueprint or guiding principles for industrial policy, we will also discuss aspects relevant to the implementation of the methodologies reviewed under real-world conditions. This includes the recognition that policy decisions tend to reflect a range of broader societal goals that go beyond issues of competitiveness; hence, the methodologies need to be linked to societal objectives so as to gain legitimacy and political support. Moreover, governance capacities need to be taken into account to assess how well institutions are prepared to make good use of the proposed methodologies.

The paper is organised along the following lines. At the outset, Section 2 reviews the most relevant individual methodologies considered as building blocks for a synthesis. First, we discuss three recent approaches that suggest which industries to promote, drawing on historical patterns: the experience of other countries, and on the potential for knowledge spillovers between related industries. Section 2.1 covers Lin and Monga's concept of latent comparative advantages as the basis for growth identification and facilitation, while sections 2.2 and 2.3 are concerned with the product space methodology developed by Hausmann and his collaborators, and the technological life-cycle approach proposed by Lee. Subsequently, we draw on two well-established older concepts. Section 2.4 covers key insights from value chain analysis, thus taking into account aspects of governance structures and power asymmetries in international trading relations. Section 2.5 addresses technology foresight as a methodology, emphasising the advantages of a participatory dynamic process aimed at exploring "possible futures" in an uncertain policy-making environment. Finally, Section 3 develops our own consolidation and synthesis, again building on the argument from Lin and Monga's growth identification and facilitation framework as a starting point and adding further dimensions and insights from the other approaches. Moreover, we argue that the methodologies under consideration can only deliver their full potential if they are able to respond to new phenomena of disruptive structural change and if they are embedded in a strategic and broad-based process of policy learning. Finally, we will provide some pointers as to how such processes can be successfully designed and managed.

2 Methodologies and tools to identify competitive advantages

The following subsections present the rationale and theoretical underpinning of five relevant methodologies in order to identify competitive economic sectors/industries for active policy promotion, and briefly describe how these approaches can be implemented. The selection is based on three criteria. All five approaches

- emphasise specific determinants of competitive advantage,
- provide practical methodologies and tools based on well-established bodies of research, and
- have exerted significant impact on the policy discourse related to economic development.

As we will show, they are complementary in nature, thus allowing a combination of tools in designing and implementing evidence-based industrial policy.[2] Section 2 is largely descriptive in nature. For each approach, we first summarise the conceptual foundations and then explain how these are translated into concrete analytical tools. This section sets the stage for a comparative assessment of the relative strengths and weaknesses – and ultimately a consolidation – of these approaches, which will follow in Section 3.

2.1 Growth identification and facilitation framework

We start our review with one of the most recent contributions: the growth identification and facilitation framework developed by Lin and Monga, which has rekindled the debate on suitable methodologies for pinpointing economic sectors/industries with promising development potential. The approach was developed in various publications, starting with initial thoughts in Lin and Chang (2009), which were subsequently formalised in Lin and Monga (2010) and Lin (2012, 2012a). We will draw on these sources, as appropriate.[3]

Lin and Monga essentially build on Ricardo's concept of comparative advantage, which they advance by introducing the notion of *latent* comparative advantages, proposing that governments should promote those industries in which a country is likely to develop a comparative advantage in the future, as suggested by the historical experience of successful similar countries. Lin and Monga argue strongly in favour of putting factor endowments at the centre, while also recognising the need to sharpen and promote existing endowments with light-handed government interventions. On the one hand, they emphasise that profit-maximising firms will only then choose their industry and technology in accordance with comparative advantages, if the relative abundance of factors is reflected in their relative prices – hence an efficient market mechanism is critically important. On the other hand, firms assuming a pioneering role in a new industry

2 While they are based on the above specific criteria, the ultimate selection of the methodologies leaves room for debate and judgement. Additional methodologies have been proposed and could also be considered, as was done, for example, by Radosevic (2017, forthcoming) in the more specific context of assessing the European Union's "smart specialisation' concept.

3 Lin and Chang (2009) was published in a debate format. When referring to this source, we will ensure attribution of individual views to each of the authors, respectively.

of a developing country are usually quite far away from also being global pioneers. In other words, they cannot apply patents in order to gain a temporary monopoly position and retain parts of their rent. Lin and Monga thus argue that further incentive-creating government interventions can be justified. Specifically, these should be in the nature of lowering entrepreneurial search costs through the provision of risk-reducing information, the creation of hard and soft infrastructure in line with new capital and skill requirements, and direct support to risk-taking entrepreneurs, rewarding their first-mover role (Lin & Monga, 2010, p. 5-7).

Discussing historical experiences, Lin and Monga claim that overambitious goals were the key reason why governments in developing countries often failed when trying to proactively support desired industries. Too often, perceived "winners" were picked despite the fact that they did not comply with a country's latent comparative advantage. Political aspirations to promote capital- or knowledge-intensive industries in poor countries were doomed to fail, because their required endowment with capital and skilled labour was "comparative-advantage-defying" (Lin, in Lin & Chang, 2009, p. 487).

Lin and Monga argue that developing countries were generally more successful when their governments targeted mature industries in countries with similar endowment structures and only slightly higher levels of development. This comparative historical perspective helped governments to identify the *latent* comparative advantages that were *inherent* in their own industries (based on national factor endowment structures) so that only a small amount of support by industrial policy was sufficient for these industries to quickly gain competitiveness. What then would be the lessons from this approach for governments in developing countries? Since the relative endowment structure is crucial for relative factor prices, comparative advantages and the optimal industrial structure (Ju, Lin, &Wang, 2015), Lin and Monga argue that poor countries seeking to reach income levels comparable to developed countries need to close their relative endowment gaps first. Future industrial potentials are seen as being "*endogenous* to the country's endowment structure" (Lin, in Lin & Chang, 2009, p. 485-486; emphasis in original), with the consequence that the role of government policy is confined to the provision of gradual upgrading support.

In essence, the methodology assumes that focusing on comparative advantages enables the accumulation of capital so that, in turn, comparative advantages change towards higher capital intensity, and previously hidden opportunities can be revealed over time. Specifically, Lin and Monga suggest promoting industries that have been proven drivers of growth in similarly endowed countries.

At the level of practical implementation, the authors propose six concrete steps to be taken by policy-makers in developing countries (Lin & Monga, 2010; for a more detailed elaboration, see Lin, 2012a, on which our summary is based):

- *Step 1: Choosing the right target*

  Prepare a list of tradable goods and services that have been produced for the last 20 years by countries that have experienced dynamic growth, exhibit similar endowment structures and a per-capita income level not more than twice as high as your own.

- *Step 2: Removing binding constraints*

  Focus on those industries from the list in which private firms are already operating (as an indicator that the required specific input factors at least partly exist) and examine their upgrading constraints as well as entry barriers for other firms.

- *Step 3: Attracting global investors*

  Create incentives for foreign firms from the countries identified in step 1 to relocate their production processes.

- *Step 4: Scaling up self-discoveries*

  Support successful existing industries that are unable to upgrade and scale up due to a lack of know-how and inadequate technological capabilities.

- *Step 5: Creating dedicated support infrastructure*

  Reduce transaction costs by establishing industrial parks and export-processing zones.

- *Step 6: Providing limited incentives*

  Provide limited, time-bound compensation for the positive externalities generated by existing pioneer firms.

2.2 Product space analysis

A different approach for identifying competitive advantages has been put forward by Hausmann, Hwan and Rodrik (2005), Hausmann and Klinger (2006) and Hidalgo, Klinger, Barabási and Hausmann (2007). Building on evolutionary economic theory, they highlight how new technological capabilities gradually evolve, based on spillovers from previously existing capabilities. A country's current export structure would thus reveal potential candidates for future competitive advantages that build on technologically related assets.

Hausmann and Klinger's (2006) model of the product space builds on the hypothesis that if a pair of products requires similar infrastructure, technology, capital, institutions or skills, they are likely to be co-produced. Diversifying the industrial structure of a country is seen as easier the more already existing assets and capabilities from "nearby" products can be capitalised on. It is thus considered more difficult for poorer countries to diversify their exports and enhance their level of product sophistication than for countries already exporting a greater variety of products. This implies the risk that existing activities may stay isolated in the product space without creating relevant spillovers.

Proximity and the structure of the product space are therefore of great importance. More specifically, a country's position within the product space has significant implications for its patterns and speed of structural transformation. The fact that the product space turns

out to have a very densely connected core region, and a periphery region with less-connected products, helps explain why some countries face barriers in upgrading their productive structure. It becomes important to balance proximity and the upscaling potential of a product, and to steer the economy into denser parts of the product space.

Moreover, industrial policy measures aimed at promoting industries identified as being relatively easy to reach should acknowledge two types of externalities accompanying structural change (Hausmann and Klinger (2006). First, new market entrants can profit from successful pioneer firms that have proved the economic viability and competitiveness of an activity and created dedicated capacities in terms of infrastructure, technology, knowledge, information etc. (*intra-industry spillover*). Second, as firms in other industries can learn from the experience gained in a specific sector, and adopt, adjust and enhance technologies, every new industry "shortens the distance" to other products that may be produced in different industries (*inter-industry spillover*). Compensating pioneer firms that accept the challenge and "try their luck" in a chosen sector for these externalities thus constitutes an important part of a successful intervention strategy.

In applying the product space methodology and measuring "proximity" as the conditional probability of successfully exporting any pair of goods, Hausmann and Klinger (2006) develop a measure that is independent of any *a priori* belief about what specific factor makes the two goods similar, as it is based on observed export outcomes alone.[4] Additionally, mapping the calculated proximities in a "tree network" gives a visual impression of the heterogeneous core-periphery structure of the product space (Hidalgo, Klinger, Barabási & Hausmann, 2007).

For the examination of a country's current position in the product space and the derivation of potential support-worthy upgrading candidates, Hausmann and Klinger (2006) plot the average proximity of a potential new good to all goods that the country already has a comparative advantage in, a measure they call "density", against the upscale potential of the new good. The upscale potential is measured as the difference between the income level associated with a potential new product, based on the income per capita of countries with comparative advantage in that product, and the income level induced by a country's export basket.

2.3 Technological life-cycle approach

The concept of entrenched, historically shaped technological trajectories also informs the methodology developed by Keun Lee. Departing from the recognition that technologies have distinct life-cycles – go through phases of rise, maturity and decline – Lee (2013) adopts a dynamic approach to identifying potential competitive advantages. Based on empirical evidence largely drawn from Asia, he suggests specialising in technologies that have short life-cycles – arguing that by strategically picking such technologies, exposure to competition from more advanced incumbents can be reduced.

4 In order to avoid considering marginal exports that have not already passed a strict market test, Hausmann and Klinger (2006) only consider "substantial" exports, defined as products with a "revealed comparative advantage" (Balassa, 1965).

Lee's methodology is essentially to target middle-income countries within a catch-up scenario. Specifically, it seeks to address the risk of countries entering a "middle-income trap", in which previous growth spurts cannot be sustained. In such a scenario, middle-income countries are not yet capable of competing with more sophisticated producers in mature economies, while being no longer able to meet low-cost competition from poorer countries. The latter aspect is reinforced by the "fallacy of composition" syndrome "that occurs when all developing countries flood the market with similar goods […] thus reducing the relative price of these goods and making the sector less profitable" (Lee, 2013, p. 6). As a result, the "low road" to competitiveness (competing on low-cost, low-skill manufacturing) is effectively being closed, and the challenge is to gradually move into a pathway based on exploring new technological domains.

Lee's central argument evolves around the concept of technological life-cycles and posits that in times of paradigm shifts, in particular in short-cycle technologies, emerging economies are faced with a unique window of opportunity: "Short-cycle technology-based sectors matter because these sectors are where new opportunities tend to emerge more frequently and are also where more profitable business is available with lower entry barriers" (Lee, 2013, p. 172). Also, there are fewer encounters with the technologies of advanced countries, fewer royalties to pay, and the possibility of first-mover advantages associated with product differentiation. Thus, gradually entering into sectors where technologies become obsolete more frequently leads to technological inter-sector diversification, increases leapfrogging possibilities, and promotes the localisation of knowledge creation and diffusion. Due to the subsequent improvement of their technological capabilities, local firms can then upgrade and move towards technologies with longer cycles or greater originality, so that the investments into short-cycle technologies can be considered a strategic "detour" (Lee, 2013, p. 22). Summing up, "qualified latecomers can advantageously target such sectors and specialize in them. This venture is risky but sensible […] because the short cycle of such technologies implies that the dominance of the incumbent tends more often to be disrupted" (Lee, 2013, p. 19). Furthermore, dominant incumbents frequently adopt the conservative strategies of ignoring or neglecting new technological threats and seeking to further exploit their existing innovation rents. The result is a "competence-destroying discontinuity" that new entrants can turn into a competitive advantage.[5] Three possible catch-up avenues are being distinguished: path following (imitating technological leaders), path skipping (following technological leaders yet accelerating the process by skipping some of the stages taken by earlier leaders) and path creating (leapfrogging, i.e. exploring entirely new technological fields).

Importantly, Lee is careful to confine his argument to the catch-up challenge facing middle-income countries, for which he recommends technology-focused specialisation trajectories, whereas for low-income countries he keeps advocating trade-based specialisation patterns (Lee, 2013, p. 225).

In operationalising his theoretical approach at the country, sector and firm levels, Lee relies on patent data and applies four innovation system variables that are supposed to

5 Without developing an elaborate methodology, Ha-Joon Chang advocates a similar approach, arguing that "it is simply not possible for a backward economy to accumulate capabilities in new industries without defying comparative advantage and actually entering the industry before it has the "right" factor endowments" (Chang, in Lin & Chang 2009, p. 491).

reflect the key dimensions of the relevant literature: "short- versus long-cycle specialisation, the localisation of knowledge creation (vs. foreign reliance), high- versus low-originality technologies, and balanced or unbalanced growth strategies (concentration over actors or sectors)" (Lee, 2013, p. 36). The most important variable, namely the cycle time of technologies, which serves as an indicator for the reliance on existing technologies, is measured by the mean backward citation method: the faster new patents are being cited by others, the lower is the importance of already existing technologies and the smaller may be the disadvantage for latecomers. As exemplified by the rapid catch-up period of South Korea and Taiwan (1980-95), gradually decreasing the average cycle time of patents held by the respective country leads to a patent portfolio that is very different from that of already advanced economies, which tend to be specialised in sectors with relatively long cycles.

2.4 Value chain analysis

The approaches reviewed so far take different perspectives on how to identify future competitive advantages based on an economy's current capabilities. They all implicitly share two assumptions. First, that the relevant unit of specialisation that defines competitive advantages are *products* made in one country and then traded for other products manufactured in another country. Second, that if a country has the right endowments, including technological and entrepreneurial capabilities, it can diversify into hitherto new products and start trading them.

Value chain research casts doubts on both assumptions. With respect to the first assumption, it shows that global production processes are increasingly being sliced up into stages of production, and that investors seek locations to optimise the cost of production of each and every stage. This results in the functional and geographic unbundling of production into business functions or even tasks (Baldwin, 2012). More than half of today's trade in goods, and close to three-quarters of trade in services, are accounted for by intermediate goods and components serving as inputs for further processing (Miroudot, Lanz, & Ragoussis, 2009). Hence, the units of specialisation are business functions and tasks (Grossman & Rossi-Hansberg, 2006) rather than products: if a country is good at assembling garments, it may also have advantages in assembling other products (a similar task), but it may have no competencies related to other aspects of garment production, such as spinning, weaving and designing.

Regarding the second assumption, trade is increasingly organised by orders from large international corporations that specify exactly what is to be produced how, when, and in which amount (Gereffi & Korzeniewicz, 1994). These "lead firms" typically concentrate on a few core competencies that generate the highest value added and rely on suppliers to take care of the non-core competencies. To guarantee that their suppliers produce according to the quality standards and consumer preferences prevailing in more sophisticated markets, and ensure a friction-free flow of materals along the various stages of the value chain, lead firms predefine many aspects of production, including quantities and delivery times as well as technical, environmental or social product and process standards. Put differently, they "set and/or enforce the parameters under which others in the chain operate" (Humphrey & Schmitz, 2004, p. 96). Lead firms thereby become gatekeepers to markets. Whether newcomer firms can embark on a new export activity and

how easily they can accumulate new capabilities to upgrade towards activities of higher returns and added value thus largely depends on the lead firms' purchasing strategies and the power relations between the parties.

Value chains may therefore be "governed" in diverse ways and entail different benefits and risks for local producers (Gereffi & Luo, 2014). There may be constellations where global contractors connect local firms to hitherto inaccessible international markets, make new technologies available and even actively support their suppliers in upgrading their capabilities and increasing their profits; but there may also be constellations in which local firms find themselves locked into low-revenue tasks, where lead firms systematically try to squeeze their margins and shift market risks onto their suppliers. Countries aiming to diversify and upgrade their exports need to make use of global value chains such that they maximise the benefits in terms of access to markets and technologies while avoiding constellations that are exploitative or very risky. Policymakers must therefore understand the respective market constellations as well as the strategic interests and actions of international lead firms.

This is where value chain analysis kicks in. It helps to understand in what conditions integration in global value chains can become a driver of competitive specialisation, technological learning and productive upgrading, and when suppliers have a chance to capture a decent share of the overall rent. Value chain analysis breaks down the determinants, such as the complementarity of lead firm vs. supplier assets; the complexity of transaction and codifiability of information; the suppliers' capabilities; the predictability of market trends; the relative importance of specific investments; and the quality of institutions in the host economy (for a detailed overview see Altenburg, 2006). For example, the suppliers' bargaining power and upgrading opportunities increase when they possess scarce capabilities, when the number of local competitors is small, or when trust-based, long-term relationships are needed because transactions cannot be entirely codified in contracts. Conversely, their situation weakens when they are easily substitutable, when they need to make customer-specific investments that increase the cost of switching to other customers, or when output markets are subject to strong fluctuations and lead firms use subcontractors to pass on market risks. Moreover, suppliers may see their upgrading option restricted when lead firms prevent them from adopting higher-value functions that the latter regard as their own core competency (Schmitz & Knorringa, 1999).

Various methodologies have been developed to capture specific aspects of value chain governance, and a number of handbooks for practitioners exist (e.g. Kaplinsky & Morris, 2000; Springer-Heinze, 2007), but there is no well-defined and generally accepted methodology for value chain analysis. Policymakers need to draw on these sources in eclectic ways that fit their specific purpose. A customary procedure is "value chain mapping" – a visual representation of "all activities, actors and relationships among segments of the chain, and the interactions between producers and intermediaries" (Subramanian, 2007, p. 13). As proposed by McCormick and Schmitz (2001), it is helpful to split the mapping process into a first, conceptual, phase, identifying the qualitative contours of the value chain, before moving into quantifying the key variables and relationships between various actors. In terms of quantitative analysis, De Backer & Miroudot (2013) use methodologies to assess, on the basis of statistics on trade and value added: (a) the extent to which a country is involved in a vertically fragmented production process, differentiating between foreign and domestic value addition; (b) the length of GVC and how many

production stages a country is involved in; and (c) its "upstreamness" (i.e. how many stages of production are located between a given industry and the final stage of delivery to the customer). This can be complemented with firm-level data. Subramanian (2007), for example, suggests a relatively simple procedure to measure the costs and immediate benefits at various stages of the value chain and benchmark them against competitors.

Analysing the power relations between contractors and suppliers, the risk-sharing arrangements, the lead firms' willingness to support technological learning and other key determinants of the profitability and upgrading opportunities, however, can only be done on the basis of a case-by-case assessment. Kaplinsky and Morris (2000) and Altenburg (2006) discuss the relevant analytical categories that policymakers need to take into account to understand contractual relationships in value chains and improve the conditions for the insertion and upgrading of domestic firms. Gereffi, Humphrey and Sturgeon (2005) offer a useful typology of value chain governance. They distinguish between modular, relational and captive value chains and discuss in which circumstances these are likely to develop. In the case of captivity, in particular, suppliers with low capabilities make highly dedicated investments, thus facing significant switching costs and being at the mercy of larger buyers trying to lock them in. The typology thus helps to distinguish constellations with more or less desirable characteristics and thereby informs policy makers of where competitive specialisation leads to the most desirable outcomes.

2.5 Technology foresight

The technology foresight approach takes an important additional step by starting from a clean slate and adopting a mainly open perspective on the whole menu of available technology choices. Essentially, it provides a set of tools "for collectively exploring, anticipating and shaping the future" (Cassingena Harper, 2013, p. 6) within an overall scenario of high uncertainty and limited predictability of future economic and technological trends.

Indeed, identifying potential competitive advantages invariably involves a high degree of uncertainty, above all in an environment characterised by widespread policy interventions and by waves of disruptive change that tend to invalidate both historical patterns of development and trend extrapolations. Different foresight methodologies, instruments and implementation practices have been developed over time, all of which, though in various configurations, combine data analysis and expert knowledge. Considering the high degree of uncertainty inherent in the anticipation of emerging trends in technologies and markets, expert opinion plays a particularly important role in foresight exercises. Hence, we can generally observe a "wide participation of a large number of stakeholders and experts, namely, the government, science, industry and civil society" (UNIDO, 2005, p.vi).

While not rigorously codified and more in the nature of a soft, qualitative approach, technology foresight has evolved over time and is often positioned today as an integral element of an innovation system designed to respond to uncertainty. In this perspective, technology foresight can be considered as an instrument aimed at overcoming coordination deficits between fragmented actors: "Foresight could be seen as reducing uncertainty by enabling creation and pooling of knowledge. Without an intervention firms might dissipate their technological efforts over too wide a range of activities and fail to achieve critical mass" (Cassingena Harper, 2013, p. 9). The two central contributions of

foresight exercises to societal search processes would thus lie in the coordination of a multitude of actors and in the provision of a shared assessment and vision going forward, especially in times of disruptive change, when linear extrapolations from the past provide little guidance – or, put differently, in creating a "national project" to direct structural change and transformation that can be regarded as a key element of an effective industrial policy (see also Section 3.2 below).

At the level of implementation, foresight exercises thus bring together stakeholders from various disciplines and backgrounds. Technology foresight is not a single theory or tool, but rather consists of a range of methods originating from different fields, some of which can be classified as being more technical, others as more participatory in nature. At the rather technical end of the spectrum, statistical methods are applied, borrowed from the general field of forecasting and typically including computer-based simulation modelling as well as trend extrapolation. In contrast, more interdisciplinary exercises are organised to address the long-term challenges of anticipating possible and likely "futures".[6]

3 From tools to policy

In the preceding section, we have reviewed five different methodologies that have been developed to identify an economy's potential competitive advantages. To varying degrees, these methodologies are rooted in economic theory, ranging from new structuralist to more evolutionary concepts, and from macro perspectives to technology and business orientations. All five approaches clearly seek policy relevance. Beyond mere theorising, they seek to provide a practical apparatus meant to equip policy makers with effective tools for promoting structural change towards enhanced competitiveness.

In Section 3, we will now take a step towards a possible consolidation of the approaches presented so far. We will argue that the various methodologies can be of a complementary nature and, by building on each other in an eclectic approach, significant synergies can be gained. Furthermore, we will emphasise that various, essentially technocratic, tools must be embedded in a policy implementation process that needs to meet a number of critical preconditions in order to be effective.

In this context, and above all for the approach to be policy-relevant, it is essential to broaden the perspective beyond just targeting growth, productivity and competitiveness. Any meaningful methodology, any analytical tool that seeks relevance for real-world policy choices, must be capable of responding to multiple societal goals that also encompass, for example, social inclusion and environmental sustainability. As we have argued elsewhere, industrial policy, like any other policy domain, is normative in nature

6 The specific practices applied within technology foresight exercises are manifold. Inter alia, they range from mundane tools such as issue surveys, SWOT analysis, expert panels and brainstorming to more sophisticated instruments such as Delphi, critical technology paths, horizon scanning and simulation modelling and horizon scanning. (For a comprehensive review see UNIDO, 2005.) In emphasising scientific interdisciplinarity as a response to real-world complexity, the latter type of technology foresight is akin to integrated assessment modelling, which has gained particular importance in dealing with global or regional climate change and energy scenarios. Here, in addition to forecasting, backcasting methodologies – in other words, ones that explore the technological implications and preconditions of meeting long-term targets – are increasingly applied and translated into technology roadmaps (DDPP, 2015; IEA, 2014).

and cannot afford to ignore the complexity of goal systems with both their synergies and trade-offs (Altenburg & Lütkenhorst, 2015, p. 7ff.).

3.1 Consolidating various methodologies

Obviously, the sequence in which the various approaches were presented in Section 2 was chosen deliberately. Combining conceptual novelty with a highly pragmatic implementation roadmap, the growth identification and facilitation framework developed by Lin and Monga has made a pivotal contribution to the debate on establishing and promoting future growth opportunities in the context of developing countries. We will thus use it as our reference point for the consolidation sought in this section and build upon the foundation it has laid.

At its very core, the approach advocated by Lin and Monga suggests pinpointing *latent* comparative advantages in industries that correspond both to a country's own endowment structure and, in an historical perspective, to upgrading potentials that have proved realistic in countries with higher levels of income per capita. During the ensuing debate, a number of problematic aspects have been raised, which are briefly recapitulated below:

- At the empirical level, several authors have pointed to the strong evidence of sustained dynamic growth in countries (such as South Korea and China) that have aggressively promoted industrial sectors far removed from their existing or even latent comparative advantages (Chang, in Lin & Chang, 2009, p. 497; Rodrik, 2011, p. 228). It is thus argued that the importance of new technological and policy capabilities and spillovers *originating from* a process of strategic, non-incremental risk-taking (Lim, 2011, p. 303) is underestimated – that enhanced capabilities may well be created *as a result* of setting ambitious targets for economic diversification.
- The reference to slightly more advanced countries as comparators has been challenged, as their industrial structure and successfully growing sectors may themselves have been, at least to some extent, the result of policy distortions (Pack, 2011, p. 298). Furthermore, the use of *per capita* income levels as a yardstick has been questioned in view of its limited value as a predictor of available "entrepreneurial and technical skills or the government's capability to create the institutional foundations for the necessary transformation" (Altenburg & Lütkenhorst, 2015, p. 62).
- It is emphasised that venturing into new technologies poses difficult issues of absorption and adaptation, so that it cannot be assumed "that technologies are equally accessible and can be efficiently operated by all producers" (Amoaka, 2011, p. 296). This aspect implicitly points to the challenges of entering existing value chains in which power asymmetries between lead firms and new entrants may stifle opportunities to upgrade. When newly emerging market opportunities are seized by pioneer firms that are able to build first-mover advantages, entering the market at a later stage becomes increasingly difficult.
- At the most fundamental level, the Lin and Monga approach is considered as too static and incremental, thus limiting its responsiveness to entirely new framework conditions: "What happens if the current circumstances have changed so fundamentally that a comparison with the past is less informative (for example, […] new communications technology […] new global rules and institutions, climate change)?" (te Velde, 2011, p. 260).

In what follows, we will review how the other approaches exposed in Section 2 may address some of the arguments raised above. In contrast to the growth identification and facilitation framework, the product space methodology developed by Hidalgo, Klinger, Barabási and Hausmann (2007) does not suggest adapting success stories from other countries as much as searching for possibilities inherent in the domestic economy itself. Building on evolutionary economic theory, it highlights how new technological capabilities can be gradually derived as a result of spillovers from already existing ones. The approach starts from a stocktaking exercise during which countries first examine their current position in the product space and then identify specific opportunities of "jumping" to "proximate" goods. The emphasis is thus more on earlier skills and capability investments in related industries than on endowment-based factor cost constellations.

In terms of upgrading and diversification strategies, both Lin and Monga (2010) and Hidalgo, Klinger, Barabási and Hausmann advocate a gradual evolution rather than disruptive shifts in production patterns. However, the latter's network analysis makes a distinction between more- and less-desirable product categories and suggests that developing countries at the periphery of the product space need to make rather large, challenging jumps in order to reach high-productivity products that may put them on a path towards income convergence with the richer economies at the core. To encourage the necessary entrepreneurial risk-taking associated with new activities, both approaches put equal stress on the importance of compensating pioneer firms.

While widely acknowledged as an innovative approach to determining competitive advantages, the product-space methodology has been criticised on technical grounds, specifically with regard to the availability and interpretation of trade data. It is pointed out that the reference to trade data as a proxy for a country's production structure may be tenuous, that trade classification systems are often not skill-specific, and that other important factors like trade policies and market size are insufficiently reflected (Radosevic 2017, forthcoming). Similarly, further context-dependent dimensions such as, for example, geographic conditions, the quality of institutions and entrepreneurial capabilities are not adequately considered. Most importantly, "the logic […] is that only domestic factors are embodied in a country's export […] Given the nature and scale of processing trade, this assumption does not hold necessarily true […] in global supply chains" (Fortunato, Razo, & Vrolijk, 2015, p. 13). Whether an exported computer incorporates the latest or an outdated technology, and whether it has been developed or just assembled in a country makes a big difference in terms of spillover potential. This is where the next two approaches come into the picture – implicitly in the case of the technology life-cycle approach and explicitly in the case of value chain analysis.

Lee's technology life-cycle approach, just like Hausmann's, is evolutionary in nature. However, the characteristics of products (and their underlying technologies) as a source of competitive advantage are specifically linked to dynamic life-cycle considerations. Based on the lead question of how catch-up processes can be sustained over time, Lee proposes *trade-based* specialisation strategies for low-income countries, as opposed to *technology-based* specialisation strategies for middle-income countries, and suggests a growth trajectory that explores "new opportunities in emerging technologies that rely less on existing technologies that are most likely already dominated by incumbent advanced countries" (Lee, 2013, p. 30), particularly as mature technologies may only offer low-wage niches with limited growth prospects. Based on this argument, Lee recommends that catch-up countries specialise in shorter-cycle technologies, which are characterised by a

fast turnover, rely less on existing technologies and capabilities, and thus "may lead to the faster localization of a knowledge-creation mechanism" (Lee, 2013, p. 19). However, this begs the question of whether a sequence of shorter-cycle technologies (as they are likely to be subject to frequent changes) will actually translate into a coherent and sustainable long-term development pathway.

Interestingly, Lee himself considers his approach to be directly complementary to that of Lin and Monga by adding short-cycle technology as a specific criterion for specialisation. Similarly to both Lin and Monga (2010) and Hidalgo, Klinger, Barabási and Hausmann (2007), he also calls for targeted public support. Since entering into areas of emerging technologies is associated with risks, such as the possible lack of an initial market for the new technologies, government assistance is suggested regarding investment in R&D capabilities and encouragement of risk-taking. Lee concedes that a gradual and cautiously phased transition into new sectors should serve as a starting point before "it becomes prudent to take the risk of leapfrogging […] and thus reducing catch-up time" (Lee, 2013, p. 227). At the same time, there are also complementarities to certain elements of value chain analysis, such as the recognition that developing countries are forced to compete harder than advanced economies for a place in global value chains.

While not offering a list of specific technologies, Lee provides a dynamic tool to predict regularities in technological change to be exploited by latecomers. However, countries that follow Lee's strategy will only react to technological changes on short notice. They could take on a more active role if they had an additional tool to determine which technologies might be on the rise in the future.

The three approaches compared so far share some common characteristics that point to limitations regarding their application in real-world policy settings and to the risk of arriving at unrealistic conclusions:

- All three methodologies are "mechanistic" in the sense that they advocate the reliance on formalised analytical tools (latent comparative advantage, product space, technological life cycles), regardless of the specific country context. Accordingly, they do not adequately capture institutional and policy capabilities as well as specificities such as being land-locked or an island state.[7]
- More specifically, there is a general disregard of the important role being played by neighbouring countries. As underlined by Collier in the context of Africa, the development prospects of a land-locked country depend fundamentally on infrastructural transport investments undertaken by its coastal neighbour, which is why being "landlocked with bad neighbours" (Collier, 2007, p. 53) is one of the greatest constraints to building up competitive industries.[8]
- In applying competitiveness analyses across countries mostly by looking at factor endowments, there is a danger of arriving at similar conclusions on the key sectors to

7 As explicitly stated by Hidalgo with reference to the product space approach, "certain products, e.g. Rwandan prawns or Kenyan ivory, are listed as "export opportunities" […] despite obvious geographical or political impediments to their production and export. The tables are meant to indicate relationships between capabilities, in order to be used as one tool among many in guiding production decisions" (Hidalgo, 2011, p. 20).

8 As has recently been shown (Bahar, Hausmann, & Hidalgo, 2014), the chances of a product being successfully exported by a country rise dramatically (by 65 per cent) if it is already exported by one of its neighbours.

be prioritised, with the resultant risk of falling into the "fallacy of composition" trap (Streeten, 1982) – recommending a sectoral strategy that may turn out to be self-defeating in terms of overly optimistic assumptions on global demand elasticities.

Against this backdrop, the value chain approach can deliver some of the required context-specificity. One of its key advantages is the emphasis on real-world conditions for successful integration into global inter-firm transactions. Not being spatially blind, it can well capture factors related to geographical proximity. In addition, unlike the three approaches compared so far, value chain analysis explicitly addresses the challenge of exactly how to overcome power asymmetries in new technological and product spaces in which existing firms have already built up expertise, capabilities, market presence and supplier networks. Clearly, the value chain approach has to rely on other methodologies (like the ones reviewed above) to identify industries with potential for upgrading in the first place. However, once such industries have been ascertained, value-chain analysis can add a pragmatic perspective and extend the discussion to taking a closer look at the governance of international trade. Neither detecting latent comparative advantages nor identifying proximate industries and promising short-cycle technologies are sufficient conditions for competitiveness or commercial success. In fact, it is crucial for policy makers to understand patterns of value chain governance. Appreciating the "rules of the game" is a precondition for developing countries to realistically assess entry barriers, anticipate where rents can be captured and what upgrading risks and opportunities exist. This aspect is key to forging deals with powerful lead firms that allow national firms to benefit from the former's technology and market access without subduing the domestic partners to captive relationships.

In terms of identifying upgrading potentials, value chain analysis calls for a more granular approach than looking at entire industries. The emphasis is placed on specific processing stages as well as business functions (such as R&D, design, assembly, packaging, marketing) within globally dispersed production systems. Trade flows are thus essentially broken down into a multitude of smaller "tasks" that can be unbundled and linked to corresponding infrastructural and skill requirements (UNIDO, 2009, pp. 18-20). While the product space model highlights the importance of technological proximity between product groups as a determinant of successful diversification, value chain analysis suggests that the proximity of *tasks* may be more relevant. For example, the garment and the electronics industries per se may not be proximate, but the labour-intensive *assembly* of garments and electronics may require very similar inputs and therefore allow for promising leaps between these industries.

However, value chain analysis also remains subject to an important "single loop" caveat[9] insofar as it is essentially based on an analysis of prevailing constellations, thus limiting the relevance of its conclusions for future scenarios. This becomes particularly important when technological and/or institutional change is disruptive and fast.

This is where technology foresight enters the picture. In its various methodologies and tools, neither past experiences, proximities or spillovers, nor issues of power and

9 According to Argyris and Schön (1978), "single loop" learning means that actions are adjusted when they do not lead to the desired result, whereas frame conditions are considered as given. In contrast, "double loop" learning takes place in cases where adjusting actions are insufficient and frame conditions must be revised as well.

governance are placed at the centre of attention. Within a dynamic, future-oriented perspective, technology foresight adopts a "double loop" approach – it is not confined to a given context, but can fundamentally question whether currently prevailing conditions will remain as they are. Foresight activities are used to passively predict, reactively manage and proactively create a still uncertain future with a focus on ways to steer development towards a desired direction. This future-oriented approach is able to identify drivers, anticipate what might happen under certain circumstances, and examine variations and interactions. It helps to predict and anticipate emerging opportunities and problems, and thus can identify priorities and design commensurate strategies. At the same time, without being embedded in a broad stakeholder dialogue, technology foresight exercises have been shown to be in danger of focusing on fancy hi-tech developments that cater more to engineering ambitions than to commercial entrepreneurial realities.

In Table 1, we provide a comparative synopsis of the approaches discussed in this paper in which their defining features are recapitulated. Clearly, as argued above, they can be conceived as building on each other, adding complementary layers of analysis and reflection and thus lending themselves to a *sequential application*. Starting with an identification of latent comparative advantages as assessed against the historical experience of comparator countries, and considering both the broader capabilities created so far and the potentials for technological spillovers, an initial list can be generated of industries providing seemingly reasonable candidates for upgrading. This can be considered as an evidence-based menu of options that needs to be narrowed down further by subjecting it to a "reality check": considering given power relations in global value chains, which of the industries stand a reasonable chance of insertion and upgrading? At the same time, only industries that exhibit a long-term potential for sustained growth deserve to be supported. Drawing on tacit stakeholder knowledge, with a view to anticipating future technological trends, a roadmap could be designed for a realistic development path.

Table 1: Synoptic presentation of methodologies to identify competitive advantages

Highlighted determinants of diversification and upgrading	Growth identification and facilitation framework (Lin & Monga)	Product space analysis (Hidalgo, Hausmann and others)	Techno-logical life-cycle approach (Lee)	Value chain analysis (various authors)	Technology foresight (various authors)
Basic factor endowments and historical experiences of slightly more advanced countries	x				
Technological proximity to previous-ly created (export) capabilities		x			
Length of technological life-cycles and intensity of competition with incumbents			x		
Power constellations within value chains affecting conditions for entry, upgrading and rent capture				x	
Data analysis, modelling and pooling of expert knowledge on "likely futures"					x

Source: Authors

Overall, the merits of applying a particular approach depend essentially on the specificity of a given development context. In this context, two criteria deserve particular attention.

First and foremost, there are good reasons for linking different approaches to different levels of economic development. Arguably, at early stages of economic development, when the relative weight of factor endowments is relatively high, trade-based specialisation should be the focus, whereas the risks taken in "jumping ahead" are lower at later stages, when significant technological, institutional and policy capabilities have already been acquired and mastered. This argument is acknowledged by both Lin and Monga (2010) and Lee (2013).

Second, it would seem that methodologies placing less emphasis on technological continuity and past experience are a logical response to *disruptive structural change*. While key dynamics of competitive integration into world markets have remained largely unchanged, there are strong indications of more radical, path-disrupting changes going forward. In emerging scenarios of fast and radical transformation in framework conditions, a premium is placed on embracing the future and a penalty on sticking to the past. As Lee puts it when discussing "competence-destroying discontinuity": "The strategy of leapfrogging makes more sense during a paradigm shift when every country or firm finds itself faced with the challenge of dealing with a newly emerging techno-economic paradigm" (Lee, 2013, p. 18).

At present, arguably the most fundamental paradigm shift stems from *global climate change imperatives* and related international agreements that require all countries – albeit to varying degrees – to commit to decarbonisation of their economies and future technology corridors (DDPP, 2015). The defining features of this transformation towards sustainable production and consumption patterns are the high uncertainty and long-term horizons involved, as well as the need to create new, and to disrupt old, pathways (Lütkenhorst, Altenburg, Pegels, & Vidican, 2014). Such characteristics cannot be adequately captured by methodologies based on the historic development experience of comparator countries (Lin & Monga, 2010) or the infrastructure, technology, capital, institutions or skills created in existing sectors (Hidalgo, Klinger, Barabási, & Hausmann, 2007). Any radical economic paradigm change, such as the shift from fossil to renewable sources of energy, is likely to turn previously valuable assets and capabilities from "nearby" products into "stranded assets" (Carbon Tracker Initiative, 2013) that encumber the necessary transition.

At the same time, there may be significant benefits to be reaped for developing countries positioning themselves strategically as early adopters of a low-carbon transformation (Porter & van der Linde, 1995; Ambec, Cohen, Elgie, & Lanoie, 2011). Such benefits include the early acquisition of the technological and managerial capabilities required for innovative low-carbon technologies, the generation of future export potentials in increasingly regulated markets (along the lines of measuring carbon footprints), and avoiding the risk of a "carbon lock-in" (Unruh, 2000) into technologies that are bound to decline and will possibly soon be subject to international de jure or de facto bans (Altenburg & Lütkenhorst, 2015, p. 89).

In addition to climate change imperatives, there are likely to be fundamental implications arising from the *digital revolution* in its various manifestations. While the speed and

magnitude of incipient changes are still subject to debate, it is beyond doubt that the patterns of international specialisation are to some extent being redrawn: "If you take most of the costs of labour out of the equation by installing robots and other types of automation, then the competitive advantage of low wages largely disappears" (Brynjolfsson & McAfee, 2014, p. 184). The result would be a growing trend towards "reshoring" of previously outsourced labour-intensive manufacturing operations and thus significantly reduced scope for one of the most powerful avenues of creating competitive advantage for latecomer economies in recent decades.

If the current emphasis on disruptive structural change is more than a hyped-up fad – and there is indeed mounting evidence that we are faced with long-term fundamental transformation forces at work – then we will have to revisit how future competitive advantages are identified. This would essentially call for an integration of different strands of research (economic, technological, environmental) that to date are largely proceeding in parallel without much cross-fertilisation. In combination with technology foresight tools, value chain analysis could provide an effective conduit for assessing the implications of disruptive change. Specifically, this applies to understanding the emerging trade implications of new carbon footprint compliance standards as well as to the digital technology-driven regionalisation and shortening of previously global value chains.

3.2 Adopting a political economy perspective

As mentioned above, a crucial aspect in assessing the methodologies and tools reviewed in this paper is related to their practical implementation under realistic policy conditions. Invariably, these are *normative* in nature and are fundamentally shaped by a multitude of broader societal goals that go beyond issues of competitiveness. These may reflect both additional economic objectives (e.g. those related to employment, income and asset distribution, or the developmental impact of particular economic sectors[10]) and further non-economic objectives (e.g. those related to social inclusion or environmental protection). Political boundaries thus stem from the fact that economic policy making is inevitably guided by multiple societal goals and targets, which more often than not involve harsh trade-offs and are difficult to reconcile. This is easily overlooked when considering industrial policy only in the narrow economic space of productivity growth, competitiveness and patterns of specialisation. Any specific industrial policy involves a delicate normative balancing act (Altenburg & Lütkenhorst, 2015, ch. 2), which is further exacerbated in developing countries, where the borderline between market and non-market governance structures is typically rather fuzzy (Cimoli, Dosi, Nelson, & Stiglitz, 2009, p. 21; Altenburg, 2013).

The analytical tools themselves deliver a *technical basis* for analysing current and prospective competitive advantages. While they do have some explanatory value, they provide only partial solutions and limited specificity when it comes to identifying

10 Indeed, when Rodrik diagnoses a "premature deindustrialization" of many developing economies, this clearly carries the *normative notion* of a desirable sector-specific pathway, or in his own words: "These developing countries are turning into service economies without having gone through a **proper** experience of industrialization" (Rodrik, 2015, p. 3; emphasis added). However, what exactly is considered "proper" has remained subject to debate.

commercially viable business opportunities and taking concrete investment decisions. What they help to establish are broad directions and "corridors" for future competitive advantages that can guide entrepreneurial search – hence the importance attached by both Lin and Monga and Hausmann to incentivising and rewarding pioneering firms. In this perspective, both profit-seeking business decisions and industrial policy decisions aimed at overcoming coordination failures are mutually connected in the same "discovery process" (Rodrik, 2007).

For this reason, the application of the various analytical tools is embedded in complex political negotiation and decision-making processes that are shaped by vested and emerging interests, power asymmetries between different stakeholders, and often conflicting objectives. Moreover, societal values influence what kind of industries merit public support, such as in the case of risk-prone (e.g. nuclear) or cultural (e.g. film) industries. Hence, decisions about support-worthy industries are never purely technical or rational. Even well-intentioned, evidence-based policy making takes place within political boundaries that subject competitive search processes to the value judgements and self-interests of different actors. Rent seeking behaviour by enterprises is a reality as much as political capture, which sometimes turns economically justified temporary subsidy schemes into long-lived bureaucratic monsters that counteract the intended purpose of such incentives (Laffont & Tirole, 1991). Rational and effective policy making towards identifying and promoting competitive advantages thus presupposes both the willingness and the capability of governments to act in support of the common good. Seen against the prevailing reality, particularly in developing economies, both assumptions are often heroic (Chang, 1996).

The methodologies discussed in this paper need to account for this reality and be responsive to a tangled web of interests, goals and actors – for which they seek to provide a strengthened evidence base. In reality, the creation of new competitive advantages originates from both antagonistic and cooperative relationships between governments, local and foreign firms, a variety of business and financial institutions, and civil society. This is the heart of the concept of embedded autonomy, which portrays governments as having to walk a tightrope between independence and engagement: "Embeddedness provides sources of intelligence and channels of implementation that enhance the competence of the state. Autonomy complements embeddedness, protecting the state from piecemeal capture" (Evans, 1995, p. 248).

We argue that this concept can serve as an overarching framework when it comes to applying the various methodologies presented in Section 2 above. In this perspective, determining potential competitive advantages becomes less an abstract question of *selecting* a specific methodology than a challenge of *applying* complementary features of various approaches within a structured implementation process that reflects the shortcomings of real-world politics.

Developmental states (which Evans juxtaposes with predator states) are characterised by the existence of a meritocratic bureaucracy and the presence of transformative alliances based on shared norms and trust between the public and private sectors. Where these basic preconditions are met, the identification of areas of competitive advantage and the design of conducive industrial policies can be interpreted as a joint endeavour "designed to elicit information about objectives, distribute responsibilities for solutions, and evaluate outcomes as they appear" (Rodrik, 2007, p. 112).

What is needed is to put in place a *robust and structured process* of societal dialogue and stakeholder consultation in policy design, implementation and learning – a challenge that is as crucial as it is difficult to meet.[11] This paper is not the place to comprehensively address the broader issue of industrial policy making in developing countries. In a nutshell, they are faced with the formidable task of "inventing" a competitive, inclusive and sustainable future under conditions of pervasive market failures and weak state capabilities. For this to succeed, numerous preconditions and principles of good practice have been advanced. We will just highlight three main pillars (for specifics see Altenburg & Lütkenhorst, 2015, Section 5.4).

Agreement on a national "transformation project"

With a view to achieving unity of purpose and coherence of action, the various societal stakeholders need to agree on a long-term, broadly defined transformation project that establishes signposts for a desirable pathway towards future patterns of competitiveness and growth. This would establish a sense of directionality without stifling market-based decisions. Rather, private investors and their entrepreneurial search processes would benefit from well-defined development trajectories (sometimes also referred to as broad "technology corridors"), within which competitive processes can and should unfold – and in which governments can be important facilitators of consensus-building among stakeholders and can enable distributed knowledge to feed into the chosen development path.[12]

This is turn calls not just for the identification of potentially competitive industries but also for designing a long-term "policy path" that remains consistent over time. For instance, a government can create markets for green investments (as has been done in many countries through feed-in tariffs for renewable energy) which trigger technological learning effects, economies of scale and decreasing unit costs – and in turn increase the pressure on future governments to continue on the same path.[13] The various methodologies discussed in this paper can be instrumental in helping stakeholders make realistic and evidence-based choices.

Combining policy support with competitive elements

There is ample evidence of how effective industrial policy approaches can be designed by building upon competitive mechanisms. A few illustrative examples will suffice to make the point. In various countries, new product and process standards are derived from proposals and best practices from private industry; R&D subsidies are granted only after receiving and assessing competitive submissions from industrial clusters or, in some cases, entire regions; feed-in tariffs (i.e. prioritised and subsidised grid access for renewable energy sources) are applied on the basis of competitive bidding procedures; innovative technologies are piloted in cost-shared private–public collaboration schemes; and,

11 Vidican et al. (2013) provides a factually rich country study of what this entails in the specific case of the emerging solar energy industry in Morocco.

12 Specifically with regard to the transition towards sustainability, Mazzucato argues that "the history of technological change teaches us that choosing particular sectors in this process is absolutely critical […] the green revolution will not take off until it is firmly picked and backed by the state" (Mazzucato, 2013, p. 27).

13 In technical terms, this is referred to as enhancing the "endogeneity" (Karp & Stevenson, 2012) of future policies.

importantly, business development agencies provide their services within competitive approaches (e.g. with strict eligibility criteria for enterprises, compulsory co-financing or voucher schemes). This differs fundamentally from earlier, rigid, top-down approaches imposed by government fiat.

Stimulating policy learning

There is a potential conflict between identifying future competitive advantages, designing a transformative "national project" and "locking in" a specific policy path (or "corridor of options") on the one hand, and on the other hand being open to necessary policy adjustments based on results derived from regular monitoring and evaluation. This makes openness to policy learning critically important and calls for the creation of strong and independent evaluation capacities, which are institutionally unbundled from policy implementation and regulatory functions. Enforcing continuous learning can help to move policy-making from a linear to an adaptive frame and eventually trigger a self-enforcing learning spiral. Again, this can be combined with various technical methodologies. At different points in a learning spiral, new competitive spaces, priority sectors and technological roadmaps are likely to emerge that need to be assessed and substantiated. At times, this may call for a look at factor endowments and latent comparative advantages; in other instances, the specific skills and capabilities needed for insertion into an existing value chain may need to be established; or, in contexts of high uncertainty, technology foresight exercises may be required to validate possible scenarios.

In conclusion, we would argue that there is a clear premium to be gained from organising a rational and effective policy process, which can accommodate and integrate the different approaches of identifying competitive advantages. Along this process, decisions need to be made and risks to be taken, which also implies that, inevitably, failures will occur. The latter, however, can be minimised by insisting on participatory approaches drawing on various sources of distributed stakeholder knowledge and by designing robust mechanisms for policy learning. This has the added advantage of keeping political capture in check. The various methodologies discussed in this paper offer considerable discretionary scope for interpretation, and private agents will seek to influence policy decisions in their own favour. Allowing all stakeholders from industry, civil society, research and academia to take part in the process can contribute to confining and balancing the various vested interests. This assumes particular importance, as transforming an economic structure inevitably has two dimensions: the creation of new competitive industries (where innovative investors lobby for access to incentives) and the downside of phasing out uncompetitive industries and undesirable technologies (where incumbents lobby for compensation for their stranded assets).

References

Altenburg, T. (2006). Governance patterns in value chains and their development impact. *The European Journal of Development Research, 18*(4), 498-521.

Altenburg, T. (2013). Can industrial policy work under neopatrimonial rule? In A. Szirmai, W. Naudé, & L. Alcorta (Eds.), *Pathways to industrialization in the twenty-first century: New challenges and emerging paradigms* (pp. 345-372). Oxford: Oxford University Press.

Altenburg, T., & Lütkenhorst, W. (2015). *Industrial policy in developing countries: Failing markets, weak states*. Cheltenham and Northampton: Edward Elgar.

Ambec, S., Cohen, M. A., Elgie, S., & Lanoie, P. (2011). *The Porter Hypothesis at 20: Can environmental regulation enhance innovation and competitiveness?* (Discussion Paper 11-01). Washington, DC: Resources for the Future.

Amoaka, K. Y. (2011). Comment, DPR debate: Growth identification and facilitation: The role of the state in the dynamics of structural change. *Development Policy Review 29*(3), 295-297.

Argyris, C., & Schön, D. A. (1978). *Organizational learning: A theory of action perspective,* Reading, MA: Addison-Wesley.

Bahar, D., Hausmann, R., & Hidalgo, C. (2014). Neighbors and the evolution of the comparative advantage of nations: Evidence of international knowledge diffusion? *Journal of International Economics, 92*(1), 111-123.

Balassa, B. (1965). Trade liberalisation and "revealed" comparative advantage. *The Manchester School of Economic & Social Studies 33*(2), 99-123.

Baldwin, R. (2012). *Global supply chains: Why they emerged, why they matter, and where they are going.* (Discussion Paper 9103). Centre for Economic Policy Research.

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. New York and London: W.W. Norton.

Carbon Tracker Initiative (2013). Unburnable carbon 2013: Wasted capital and stranded assets. Retrieved from http://carbontracker.live.kiln.it/Unburnable-Carbon-2-Web-Version.pdf

Cassingena Harper, J. (2013). *Impact of technology foresight* (Nesta Working Paper 13/16). Manchester: Manchester Institute of Innovation Research. Retrieved from http://www.innovation-policy.org.uk/

Chang, H.-J. (1996). *The political economy of industrial policy*. Houndmills: Macmillan, 2nd edition.

Cimoli, M., Dosi, G., Nelson, R., & Stiglitz, J. (2009). Institutions and policies shaping industrial development: An introductory note. In M. Cimoli, G. Dosi, R. Nelson, & J. Stiglitz (Eds.), *Industrial policy and development: The political economy of capabilities accumulation* (pp. 19-38). Oxford: Oxford University Press.

Collier, P. (2007). *The bottom billion: Why the poorest countries are failing and what can be done about it*. Oxford and New York: Oxford University Press.

De Backer, K., & Miroudot, S. (2013). *Mapping global value chains* (OECD Trade Policy Paper 159). Paris: OECD Publishing.

Dunning, J. (1992). The competitive advantage of countries and the activities of transnational corporations. Transnational Corporations, No.1 (February), 135-168.

DDPP (Deep Decarbonization Pathways Project). (2015). *Pathways to deep decarbonization 2015 report – executive summary.* SDSN-IDDRI.

Enright, M. (1998). The globalization of competition and the localization of competitive advantage: Policies towards regional clustering. In N. Hood & S. Young, S. (Eds.), *The globalization of multinational enterprise activity and economic development.* Basingstoke/London: Macmillan Press, pp. 303-331.

Evans, P. (1995). *Embedded autonomy: States and industrial transformation*. Princeton: Princeton University Press.

Fortunato, P., Razo, C., & Vrolijk, K. (2015). *Operationalizing the product space: A road map to export diversification*. UNCTAD/OSG/DP/2015/1, March 2015.

Gereffi, G., & Korzeniewicz, M. (Eds.) (1994). *Commodity chains and global capitalism*. Westport: Praeger.

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of gobal value chains. *Review of International Political Economy, 12*(1), 78-104.

Gereffi, G., & Luo, X. (2014). *Risks and opportunities of participation in global value chains* (Policy Research Working Paper 6847). Washington DC: World Bank.

Grossman, G., & Rossi-Hansberg, E. (2006). The rise of offshoring: It is not wine for cloth any more. In *The new economic geography: Effects and policy implications* (pp. 59-102). Jackson Hole ConferenceVolume, Federal Reserve Bank of Kansas City.

Hausmann, R., & Klinger, B. (2006). *Structural transformation and patterns of comparative advantage in the product space* (CID Working Paper 128). Cambridge, MA: Center for International Development at Harvard University.

Hausmann, R., Hwang, J., & Rodrik, D. (2005). What you export matters. *Journal of Economic Growth, 12*, 1-25.

Hidalgo, C. (2011). *Discovering Southern and East Africa's industrial opportunities* (Economic Policy Papers series 2011). Washington, DC: The German Marshall Fund of the United States.

Hidalgo, C. A., Klinger, B., Barabási, A. L., & Hausmann, R. (2007). The product space conditions the development of nations. *Science, 317*(5837), 482-487.

Humphrey, J., & Schmitz, H. (2004). Governance in global value chains. In H. Schmitz, *Local enterprises in the global economy, issues of governance and upgrading* (pp. 95-109). Cheltenham and Northampton: Edward Elgar.

International Energy Agency (2014). *Energy technology roadmaps. A guide to development and implementation*. Paris: Author.

Ju, J., Lin, J. Y ., & Wang, Y. (2015). Endowment structures, industrial dynamics, and economic growth. *Journal of Monetary Economics*, *76*, 244–263.

Karp, L., & Stevenson, M. (2012). *Green industrial policy: Trade and theory* (Policy Research Working Paper 6238). Washington, DC: World Bank.

Kaplinsky, R., & Morris, M. (2000). *A handbook for value chain research* (prepared for the IDRC). Brighton: IDS. Retrieved from http://www.ids.ac.uk/ids/global/pdfs/VchNov01.pdf

Krugman, P. (1980). Scale economies, product differentiation, and the patterns of trade. *The American Economic Review, 7*(5), 950-959.

Krugman, P. (1991). Increasing returns and economic geography. *The Journal of Political Economy, 99*(3), 483-499.

Laffont, J., & Tirole, J. (1991). The politics of government decision-making: A theory of regulatory capture. *Quarterly Journal of Economics, 106*(4), 1089–1127.

Lee, K. (2013). *Schumpeterian analysis of economic catch-up. Knowledge, path-creation, and the middle-income trap*. Cambridge: Cambridge University Press.

Lim, W. (2011). Comment, DPR Debate: Growth identification and facilitation: The role of the state in the dynamics of structural change. *Development Policy Review, 29*(3), 301-303.

Lin, J. Y. (2012). *New structural economics: A framework for rethinking development policy.* Washington, DC: World Bank.

Lin, J. Y. (2012a). *The quest for prosperity: How developing economies can take off*. Princeton: Princeton University Press.

Lin, J. Y., & Chang, H.-J. (2009). DPR debate: Should industrial policy in developing countries conform to comparative advantage or defy it? A debate between Justin Lin and Ha-Joon Chang. *Development Policy Review, 27*(5), 483-502.

Lin, J. Y., & Monga, C. (2010). *Growth identification and facilitation: The role of the state in the dynamics of structural change* (Policy Research Working Paper 5313). Washington, DC: World Bank.

Lütkenhorst, W., Altenburg, T., Pegels, A., & Vidican, G. (2014). *Green industrial policy. Managing transformation under uncertainty* (Discussion Paper 28/2014). Bonn: German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).

Mazzucato, M. (2013). *The entrepreneurial state: Debunking public vs. private sector myths*. London: Anthem Press.

McCormick, D., & Schmitz, H. (2001). *Manual for value chain research on homeworkers in the garment industry.* Retrieved from http://www.eldis.org/vfile/upload/1/document/0803/id12631.pdf

Miroudot, S., Lanz, R., & Ragoussis, A. (2009). *Trade in intermediate goods and services* (OECD Trade Policy Working Paper 93, TAD/TC/WP(2009)1/FINAL). Paris: OECD.

Nelson. R., & Winter, S. (1982). *An evolutionary theory of economic change*. Cambridge, MA and London: The Belknap Press of Harvard University Press.

Pack, H. (2011). Comment, DPR Debate: Growth identification and facilitation: The role of the state in the dynamics of structural change. *Development Policy Review*, *29*(3), 298-301.

Porter, M. E. (1990). *The competitive advantage of nations.* New York: Free Press.

Porter, M. E., & van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *The Journal of Economic Perspectives*, *9*(4), 97-118.

Radosevic, S. (2017, forthcoming). EU smart specialization policy in a comparative perspective: The emerging issues. In S. Radosevic et al. (Eds.), *Advances in theory and practice of smart specialization*. Elsevier Science Publishers.

Rodrik, D. (2015). *Premature deindustrialization* (Economics Working Paper 107). Princeton: Princeton: School of Social Science, Institute for Advanced Study.

Rodrik, D. (2011). Comments on "new structural economics" by Justin Yifu Lin. *The World Bank Research Observer*, *26*(2), 227-229.

Rodrik, D. (2007). Industrial policy for the twenty-first century. In D. Rodrik, *One economics – many recipes: Globalization, institutions and economic growth.* Princeton, Oxford: Princeton University Press.

Schmitz, H., & Knorringa, P. (1999). *Learning from global buyers.* Brighton: Institute of Development Studies.

Springer-Heinze, A. (2007). *ValueLinks manual: The methodology of value chain promotion*. Eschborn, Germany: GTZ.

Streeten, P. (1982). A cool look at "outward-looking" strategies for development. *The World Economy*, *5*(2), 159-170.

Subramanian, U. (2007). *Moving toward competitiveness: A value chain approach.* Washington, DC: World Bank.

Syrquin, M. (2007). *Kuznets and Pasinetti on the study of structural transformation: Never the twain shall meet?* (Working Paper 46). International Centre for Economic Research.

te Velde, D. (2011). Introduction, DPR Debate: Growth identification and facilitation: The role of the state in the dynamics of structural change. *Development Policy Review*, *29*(3), 259-263.

UNIDO (United Nations Industrial Development Organization) (2009). I*ndustrial development report 2009: Breaking in and moving up: New industrial challenges for the bottom billion and the middle-income countries*. Vienna: Author.

UNIDO (2005). *UNIDO technology foresight manual. Volume 1: Organization and methods.* Vienna: Author.

Unruh, G. (2000). Understanding carbon lock-in. *Energy Policy*, *28*, 817–830.

Vidican, G., Böhning, M., Burger, G., de Siqueira Regueira, E., Müller, S., & Wendt, S. (2013). *Achieving inclusive competitiveness in the emerging solar energy sector in Morocco* (Studies 79). Bonn: German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE).

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