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Competitiveness and industrial policy: from rationalities of failure towards the ability to evolve

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January 12, 2016

Abstract

This article elaborates a dynamic rationale of industrial policy, focusing on how to strengthen the socio-economic system's ability to evolve, i.e. how to achieve high real income together with qualitative change. It highlights that the ubiquitous rationalities of failure, be it of markets, governments, or systems, are rooted in a peculiar habit of accepting hypothetical perfect states as normative benchmarks. In contrast, a dynamic logic of intervention should start from the question, what the system aims to accomplish. Combining the structuralist ontology of micro-, meso- and macro with the functional principles of evolutionary change, the paper proposes a general typology of economic policies based on their respective contributions to the system's ability to evolve.

JEL Codes: O25, L52, L53

Key Words: Industrial policy, competitiveness, evolutionary economics, structural change

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1 Introducing the puzzle

Together with lasting concerns about growing global competition, the financial and economic crisis has prompted a remarkable renaissance of industrial policy.[1] It is, however, a puzzle of many parts with numerous related policies already in place and firmly embedded in proper institutional structures and organisations, which are responsible for their configuration and conduct. Consider, for example, innovation policy, education policy, trade policy, competition policy, state aid regulations, sector regulations, SME policy, cluster policy, and so forth. Do we really need another industrial policy? And if so, what should be distinctive about it? Consequently, this article elaborates on the concept of *competitiveness* and dynamic *industrial policy* not as another separate policy field, but a comprehensive heuristic which substitutes the orthodox emphasis on allocative efficiency by the evolutionary focus on the drivers of industrial development. We thereby interpret development as the growth of real income in combination with qualitative transformations of the socio-economic system (Schumpeter, 1911).

In the orthodox welfare approach, the above policies pursue their objectives independently of each other. This is the case, even though some kind of presumed market failure is the common denominator, and referred to, as soon as there is a need to legitimize an intervention. If taken literally, these policies all aim to maximize allocative efficiency, i.e. economic welfare in terms of a society's producer and consumer rents for given technologies and preferences. While economists are trained to accept welfare maximization as the ultimate rationale of public intervention, policy makers typically feel less confident about it, sensing that something more essential is missing. But economists will then explain that, for given time preferences, static efficiency also translates into welfare-maximizing steady state growth. And growth is something policy makers care about, since it provides for high income, employment, and tax revenues. But what if static efficiency is not sufficient to provide for an 'optimal' growth path of real incomes? What if other objectives of a society, such as social inclusion, or acceptable working conditions, interfere with the functioning of factor markets? And what if individual time preferences do not support sufficient sacrifice and effort to conserve our natural environment? Or let us ask, finally, what the optimal welfare path for the development and introduction of a new product would be, for instance a life-saving drug?

Even if canonical economics displays its analytic strengths and produces sophisticated formal solutions to such questions, a closer look at the underlying assumptions soon reveals them to be rather artificial and disconnected from the real world. The static rationale of market failure and allocative efficiency is a poor guidepost in a dynamic world, where the continuous transformation of consumer preferences, technologies, and production structures enables multiple trajectories of development. Without denying the elegance, and analytic adaptability of welfare economics, a fundamental inconsistency remains between its neat and closed formal solutions on the one hand, and the nasty variety of multiple equilibria and trajectories in evolving complex systems on the other.

To better understand the drivers of real income growth and qualitative change, we turn to the paradigm of evolutionary change and identify the basic functions a system must perform in order to foster development. For all these functions one typically finds existing policies that already address them more or less directly. Hence, we won't invent new policies. Instead, this paper offers an alternative and integrated perspective, which helps to prioritize and coordinate different policy areas under a common and more realistic logic of public intervention.

The remainder of this article is organized as follows. In Section 2, we discuss the multiple faces of industrial policy. In Section 3 we identify competitiveness as its distinctive and enduring target. Section 4 addresses the conventional rationalities of 'failure'. Sections 5 explains the functions a system must perform to foster industrial development and Section 6 relates them to structural change at various target levels. Section 7 discusses the benefits of the dynamic rationale, whereas Section 8 fits the various analytic pieces into a coherent typology. Section 9 summarizes and concludes.

2 The multiple faces of industrial policy

Historically, industrial policy originates from sectoral targets. At the early stages of development, most governments, especially those controlling a sufficiently large home market, promoted their domestic industries through privileges (monopoly rights), tariffs, subsidies, etc.. The classic early writing with a comprehensive strategic focus is Alexander Hamilton's *Report on Manufactures* of 1791, which introduced the infant industry argument and was praised by Schumpeter (1954, p.199) as "applied economics at its best".[2] Of his ambitious programme, the direct subsidies Hamilton had preferred were extremely unpopular and never implemented, but protective import tariffs were introduced (Irwin, 2004). Later governments raised them far above the initially modest rates, promoting domestic manufacturing production at the expense of export oriented agricultural interests. Thereby they turned the US into one of the most protective countries in the world (Chang, 2002).

Sectoral targets had a heyday in the period of industrial reconstruction after WWII, when the war had established firm government control in different areas of the economy and capital stocks were depleted.[3] Public ownership, direct support, the regulation of credit and bond markets, and business-friendly sector regulations were the main instruments used to facilitate investment and to rebuild and expand the production capacities in many countries. Arguably, the European Union grew out of the joint effort for industrial reconstruction between the former opponents of war, focusing first on the coal and steel industries, and later on atomic energy. Sectoral priorities also characterised industrial policy in Japan.[4] But especial attention was also given to the regulation of banking relationships, where households were left little options among saving vehicles, effectively channeling their funds towards the banking sector. The banks in turn focused on corporate lending and gained a central position in the new *keiretsu* system, which had replaced the older family

based *zaibatsu* groups of enterprises (Hoshi and Kashyiap, 2006, p. 92).[5]

The situation changed with the end of the reconstruction boom, which was also due to the overcapacity in targeted industries, such as steel or shipbuilding. Instead of *picking the winners*, industrial policy became increasingly engaged in *defending the losers*, and was held responsible for delaying the necessary structural adjustments. More than through mere 'government failure', industrial policy was also caught in a strategic *prisoner's dilemma*. Nations would in principle have been better off with a coordinated readjustment of oversized industries, thus shortening the crisis and its cost. But without transnational coordination, the dominant strategy for the individual countries was to support their industry. If the other countries did as well, it was necessary to protect industries from unfair competition and the resulting danger of a disproportionate decline. And if the others did not, maintaining one's support through public interventions was an opportunity to gain a stronger market position with higher payoffs after the crisis. Since many countries more or less faced the same strategic dilemma, the outcome was one of broad and costly support to oversized industries and the subsequent slow overall adjustment.

The growing cost of targeted sector interventions made industrial policy increasingly unpopular during the crises of the 1970s, and in the 1980s nourished intense debates about the proper role and relative merits of government versus market coordination. Given the inability of governments to manage the necessary restructuring of industry, free competition on liberalized markets was the obvious method to effect needed reforms. While traditional sector policies never ceased to exist, the momentum shifted towards pro-market reforms, focusing on the deregulation and privatization of target sectors. With a clear intention to render them more productive, we can also count them among sectoral policies. But among developed economies such as Japan and the EU, the policy orientation increasingly converged towards the US model with its emphasis on 'horizontal' reforms and competitiveness more generally (Porter, 1990; Nezu, 2007).

From there on, a closer look at the development of industrial policy in the European Union is helpful to understand the changing attitudes. The heterogeneous policy traditions, institutions, and national interest of its member states induced a more deliberate discussion of the meaning and purpose of industrial policy. And since inconsistent arguments are easily exploited by opposite factions, more effort was directed towards clearing conceptual ambiguities. Part of this struggle can be traced in the official documents. These show how in the EU the general understanding of the term 'industrial policy' has considerably changed and moved beyond the traditional narrow definition.[6]

The pro-market agenda in the EU found its most important realization in the Single European Act of 1986, which aimed to liberalize trade by creating a Single European Market. In contrast, "old" industrial policy disappeared from the agenda. For example, the European Commission (1990) emphasized structural adjustment and optimal resource allocation through market competition, considering the completion of the Internal Market an industrial policy *par excellence*. Viewed from the perspective of the "old" industrial policy, such *framework* policies were its exact antithesis. Despite this inherent contradiction,

in 1992 the European Union explicitly established industrial policy as one of its responsibilities in the Treaty of Maastricht. Since then, industrial policy has been considered "horizontal in nature" and aiming "to secure framework conditions favorable to industrial competitiveness" (Nenova and Sarup, 2012, p.1).

However, the sector level came back into the picture. First, in the acknowledgement that even horizontal policies affect industries differently. Horizontal policies are thus not neutral, but strategic instruments for fostering structural change towards desired activities. Second, policy practice showed that many horizontal measures must be adjusted to the particular context of an industry, when reaching the stage of implementation. Together, these arguments blurred the strict boundaries between vertical and horizontal policies, which previously had been heavily charged by ideological pre-conceptions. In the European Union, this resulted in the formulation of a new *integrated industrial policy*, which still emphasized horizontal measures, however in combination with the fine-tuning of sector specific regulations and framework conditions (European Commission, 2005; Allen et al., 2006). In the meantime, the sectoral perspective has returned more strongly in the controversial objective of *re*-industrialisation (Peneder and Streicher, 2016). When industrial policy was further elevated to one of the Horizon 2020 flagship initiatives, the EU basically continued its integrated approach, but added some bolder sectoral accentuation.

To conclude, industrial policy has always meant different things to many people, who adjusted its interpretation to their pre-conceptions and particular needs of the time. Up to the present day, supporters and opponents tend to pick their examples from different historical periods, without accounting for the changing context. Table 1 summarizes different concepts of industrial policy, distinguishing between purely sectoral and functional targets, or hybrids of the two. The *sectoral* policies are often called 'vertical' in the sense that they directly address particular industries, which are considered to be of particular importance or need of public intervention. In contrast, *functional* approaches, better known as 'horizontal' policies, should not directly discriminate between sectors, but target certain functions of the economic system.

At the bottom of the table we find the most narrow definitions, resting on the distinction between the 'old' industrial policy of *sectoral targeting*, as opposed to pure *framework conditions*, aimed, for example, at an efficient, frictionless allocation of resources on labour and capital markets. A broader integrated perspective acknowledges the differential sectoral impact of horizontal instruments, where the functional and sectoral policies can become complements rather than antagonisms. The target of industrial policy shifts accordingly from individual sectors to *structural change* towards activities with a higher potential for the creation and capture of value added (Pitelis, 2006). Education and innovation policies become the primary instruments to foster that change. While generally considered horizontal policies, which foster specific functions of the system, such policies also need to start from and be fine-tuned to the context and needs of the specific industry. This is why the broadest approaches identify industrial policy with competitiveness more generally – a notion which requires some further discussion in the following section.

3 Competitiveness

3.1 Krugman's critique

Industrial policy typically does not confine itself to the objective of structural change, but aims for the more comprehensive goal of 'competitiveness'. Yet competitiveness is another tricky concept, which can bear many different meanings. The lack of a commonly accepted definition gave room to a major controversy (Krugman, 1994a,b, 1996; Cohen, 1994; Prestowitz 1994; Thurow, 1994; and Fagerberg, 1996). When in the 1990s competitiveness emerged as the new 'paradigm' of industrial policy, the economics profession generally turned a blind eye on it. Because competitiveness did not match any variable known from the existing theoretical canon, it was generally considered non-scientific, a political folly. Occasionally, it met with outright hostility, such as in Paul Krugman's (1994, p. 44) notoriously vivid sermon: "*So let's start telling the truth: competitiveness is a meaningless word when applied to national economies. And the obsession with competitiveness is both wrong and dangerous.*" The verdict by the future Nobel laureate could not have been more crushing.

In his critique, Krugman raises a number of important arguments. His main points are three: First, international trade is not a zero-sum game, but creates value by deepening the division of labor and leading to more efficient international specialization. In contrast, popular country-rankings create a false impression of conflict between nations. Second, especially in larger economic areas such as the U.S. or the EU, growth and employment predominantly depend on domestic demand, with the contribution of trade being relatively minor. Third, in the long run, wages and productivity always move together. Consequently, low wages are a sign of low competitiveness and vice versa. Conversely, productivity, or in other words the ability to earn high real incomes, should be the prime target of economic policy. To Krugman, this is fundamentally different from the notion of competitiveness, since productivity does not invoke any idea of competition at the level of aggregate entities such as countries or regions.

All three points are valid and important. However, Krugman's main conclusion does not necessarily follow from them. According to him, competitiveness is a valid concept only for individual firms, whereas nations or regions would not compete in any meaningful sense. Here his argument is obviously constrained by the static view of a given distribution of comparative advantages. Though he correctly states that competition between countries and regions is not a zero-sum game, neither is competition between individual firms. Only in a static world with given technologies and preferences does the additional value earned by one firm inevitably come at the expense of another. In a dynamic world with continuously changing technology and tastes, there is more truth in the popular saying that competition stimulates business.

More generally, Krugman's argument ignores the relatedness between the micro-, meso- and macro-levels of economic activity. Without denying their fundamental differences,

they are nonetheless part of the same economic reality, part of the same interdependent system. Turning to the question of whether there can be competition between countries or regions, we should recall that competition arises from scarcity.[7] The crucial point is: do such scarcities only affect the micro-level, and must any contribution to alter them also arise there? Of course, individual enterprises, households, and workers are the immediate drivers of the economic process. But going beyond them, a region's relative abundance of natural resources, capital, labor, and intangible assets determines which firms locate there, are successful and grow, decline, or even exit. It is thus the relative scarcity at the aggregate level, which also affects industrial location and specialization at the meso-level. If we further account for the empirical fact that different industries exhibit different levels and growth of productivity, differences in industrial specialization have an impact on a region's overall level of per capita income. However, the meso- and macro-levels are not mere passive aggregates of choices by the micro-units, they are also the level at which many policies actively shape the creation of competitive advantages and thus exert an influence on the outcome of the competitive process among the individual market participants.

In short, the micro-, meso and macro-levels of economic activity are inextricably interwoven. Locations compete for activities with high value added as the source of high per capita incomes and hence (material) well-being. Sometimes they compete directly, as is the case with the promotion of inward foreign direct investments. For the most part, the competition is indirect – that is, for providing favorable business conditions to particular sectors or the general location. In either case, the micro-, meso- and macro-levels evolve jointly and affect each other. Individual firms' choices depend on the overall attractiveness of a location, which is simultaneously shaped by macro-policies and the meso-dynamics of particular firm populations (agglomeration and bandwagon effects, competition for specific labour skills, etc.). In that process, nothing is static and little exogenous (even the relative abundance of natural resources is not independent from the scope, efficiency and care taken during past extractions and explorations, both at home and in foreign locations). Public policies regularly interfere, either in a cognisant manner or unknowingly, but should generally be more successful, the better one understands their varied impact and interdependencies.

Is competitiveness then really a 'dangerous obsession'? Of course, there is the risk of escalating trade and subsidy wars between countries. But the solution requires international coordination (as with the WTO), or even economic integration (as with the European Single Market programme). This implies deliberate industrial policies specifying detailed rules, common product standards etc. for particular products and sectors, which invoke many competing interests and bargaining contests between nations. Moreover, out of the hypothetical and perfect equilibria with full-employment the displacement of activities and according job loss are real problems for any community. Still, the competition for capturing value within the global system of production is not a zero-sum game, but itself an important driver of development. Be it within particular industries, clusters of related activities, or entire business locations, competition raises the incentives to innovate and

speeds-up the diffusion of new ideas at the system level (Fagerberg, 1996, p. 49). This dynamic perspective is fundamentally different from Krugman's reference to the traditional gains from trade through comparative advantages, since the competition between locations and the policy responses induced by it become essential elements of the process. Given such considerations, economists ought to better understand competitiveness as a valid and natural policy concern.

While the competition for better business conditions carries a huge potential to raise per capita real incomes and living standards through successful quality upgrading (the 'high road'; Aiginger, 2015), such an outcome is not autonomously assured. On the negative side, the process may instead turn into a downward spiral of declining social and environmental standards in order to compete primarily on low costs (the 'low road'). The outcome will much depend on the strategic orientation, and thus on the particular objectives and targets of the policy interventions, which we will address in the next section.

3.2 The 'iceberg' model

Once we accept competitiveness as a meaningful policy objective, we must care about its specific targets and drivers. In a first step, we align with Krugman and put on-top productivity as its primary target. Better than any other indicator, it is able to aggregate the impact of many relevant variables. Under strict neoclassical assumption, there is a body of theory which helps to relate productivity growth to the expansion or contraction of certain factors. But otherwise it is a pure measurement, which in itself does not reveal much about its underlying determinants. To gain a more comprehensive understanding of competitiveness and its main drivers, we need to uncover different layers of causative factors.

The 'iceberg' model of competitiveness in Figure 1 illustrates the point. On top, we have *productivity* appearing in different forms. GDP per capita is a comprehensive measure of the overall level of real income, and hence indicates the level of development in terms of material well-being. It rises if *ceteris paribus* labour productivity, more narrowly defined as GDP per hour worked, or technical efficiency in terms of multi factor productivity increases. But it also grows with rising employment, and hence all kinds of labour participation, be it from women, youth, the elderly, or specific disadvantaged groups. [8]

Rather close to the surface of per capita income, growth accounting is the established method to decompose it into contributions from various productive *resources*, or inputs, interpreted in terms of an aggregate production function. The latter is a fictional construct with questionable theoretical foundations[9] and linking input output data by means of an accounting identity (Felipe and McCombie, 2013). On the positive side, aggregate production functions allow for a first empirical approximation that is based on a unified analytical framework, where all input factors are simultaneously related. Further, the development of multi-sector models with heterogenous types of capital goods helped to mitigate the restrictive assumption of identical functional relationship.

But growth accounting cannot tell us, what has caused the increased use of a particular factor, or what has driven the growth of multi-factor productivity. For this purpose, one must turn to the underlying *structural* determinants and is typically confined to partial analyses, e.g. of international differences in demand, technology, the nature of competition, or global value chains, etc.. Analyses at this level investigate differences and changes in the composition of characteristic attributes, which serve to uncover a system's relative strengths and weaknesses. Thus empirical structural analysis helps to identify the prime suspects for eventual policy interventions and reform, supporting the strategic orientation and prioritization of the policy agenda.

Again we must not think to have hit the bottom of ultimate causes, but acknowledge that the structural characteristics are themselves affected by differences at the level of *institutions*. These can relate to specific sector regulations, the effectiveness of educational and innovation systems, the function of labour and capital markets, the provision of public infrastructure, the tax system, or social capabilities (Fagerberg et al, 2014), such as an egalitarian income distribution, participatory democracy, or public safety. Addressing particular institutions, this is the level at which the analysis can support the design and reform of specific policies.

Even more fundamental determinants of competitive performance reside at the deepest level, i.e. the prevalent *cultural values and norms* which shape human behavior. Among these we find the general understanding of what constitutes basic natural liberties and accepted restrictions subject to the needs of social organisation (Newcomb, 1870). Other examples are the people's predisposition for entrepreneurial initiative or a sense of achievement, but also, more generally, a society's willingness to support the provision of collective goods, solidarity, and ethics. The latter factors lie outside the reach of immediate policy action, but may be affected by enduring institutional reforms in the very long run.[10]

To indicate a true improvement in competitiveness, the growth of real income must be sustainable. If income growth is the objective, macroeconomic stability from sound fiscal and monetary conditions, social inclusion, and the conservation of the natural environment are necessary constraints. More generally, competitiveness cannot be pursued in isolation, but must be aligned with the other objectives of society. More than treating them as mere constraints, industrial policies can actively seek to contribute to societal goals, like social and regional cohesion, conservation of the environment, and others.[11] This brings into focus the importance of qualitative transformations of the socio-economic system, not only in response to economic opportunities and needs, but also to societal goals at large. Qualitative change necessarily requires a dynamic perspective. The characterization of a system is conditional on a specific period, and 'change' in terms of qualitative differences can only arise and be observed through the passage of time.

Finally, from the above considerations we can derive some straightforward definitions that are helpful for the later policy analysis: To begin with, we conclude that *competitiveness* is the ability of an economic system to develop, i.e. to achieve high real incomes together with qualitative change, be it within firms, at the level of firm populations, sec-

tors, or the aggregate economy, in a sustainable manner and in support of the overall goals of society. In short, competitiveness is the ability to evolve in accordance with a long-term rise of living standards. As a consequence, we understand *competitiveness policy* to be the set of public interventions that aim to foster *economic* development in the above sense. In contrast, industrial policy aims more specifically to enhance the competitiveness of industry (however broadly defined). Consequently, *dynamic industrial policy* is the set of public interventions to foster industrial development, i.e. industry's ability to evolve in accordance with a society's long-term rise of living standards. With these definitions in mind, we can next turn to different rationalities of public intervention and thus come to the core of the argument put forward in this paper.

4 Rationalities of 'failure'

Examining the prevalent logic of intervention, we find on one side of the debate the opponents of industrial policy, who stress the arguments of *government failure*, generally discarding industrial policy by reference to agency problems and the according tendency of dominant business interests to capture public resources and regulations in their favor (Tullock, 1967; Krueger, 1974). On the other side of the debate, the supporters of industrial policy either mould the common rationale of *market failure* (Bator, 1958) to any policy considered useful, invoke the alternative arguments of *system failure* to emphasize the lack of coherence in the institutional set-up (Smith, 2000), or point at more specific *strategic failures* in policy making (Cowling and Tomlinson, 2000, 2011).

Of course, each argument has its true points. Government *failure* is omnipresent. Warnings of policy capture or unintended consequences of public interference in complex, self-organizing systems are highly warranted. To this one must add the cost of competitive rent seeking in order to influence the public intervention. If taken literally, market *failure* is equally ubiquitous. Since the idea of perfect competition represents a hypothetical ideal state generally untenable in real business, one can almost always find a reason why a benevolent government could in principle improve social welfare. Also the notion of system *failure* correctly addresses blind spots in the previous arguments, paying additional attention to barriers of cooperation and knowledge flows between relevant actors. Finally, important and valid points are made when e.g. lacking governance structures in support of the public interest are denoted a strategic *failure*.

It is, however, revealing that all the rationales refer to *failures* in order to legitimize, motivate, or discard activities. Can we think of any other area in which we accept such a *logic of failure* to motivate human actions? For instance, consider education. Can anyone who motivates only by reference to failures be a good parent or teacher? Certainly not. Or consider sports coaches, or managers in business. Those who are successful typically find ways to motivate in a positive way towards the desired goals. It is simply not natural to argue in the negative, but a very peculiar attitude of our profession.

Such peculiarities seek an explanation. And in this case, the apparent reason seems to be that only economists learn to accept the ideal of hypothetical perfect states as a normative benchmark. This directly relates to our preoccupation with *welfare economics*. What has been developed there for good analytical purposes, has by means of routinized exposure in the textbooks and habit in the scientific discourse become so deeply engrained in our canon, that it is mostly taken for granted without initiating much further reflection. Or who, in the realm of policy debate, has taken seriously the implication of Arrow's (1950, 1963) *impossibility theorem*, which demonstrated that neither political voting nor the market mechanism can create optimal social choices in the sense of a rational and consistent aggregation of the preferences of sovereign individuals: "The failure of purely individualistic assumptions to lead to a well-defined social welfare function means, in effect, that there must be a divergence between social and private benefits if we are to be able to discuss a social optimum. Part of each indvidual's value system must be a scheme of socio-ethical norms, the realization of which cannot, by their nature, be achieved through atomistic market behavior" (Arrow, 1950: 343).

In the meantime, further paradoxes and inconsistencies in the aggregation of individual preferences have surfaced (Blackorby and Donaldson, 1990). For collective dynamic choices, Jackson and Yariv (2014, 2015) point at the systematic bias towards the present, and showed that with heterogeneous time preferences any Pareto and non-dictatorial method of aggregation must either be time-inconsistent (to obtain a cardinal ranking) or intransitive (for an ordinal ranking). The popular assumption of an all-powerful, omniscient, and benevolent dictator to amend the situation is therefore not that innocuous as generally perceived. It does not, as many belief, merely abstract from the obvious difficulties of policy implementation, but avoids to admit the theoretical impossibility to determine the public intervention by the benchmark of a reasonably defined and unique social welfare optimum.

Due to the canonization of welfare economics in our textbooks (Blaug, 2007) most economists have difficulties to understand the peculiar nature of the approach, just as the non-economists find it difficult to understand our preoccupation with ideal states in terms of perfect equilibria. One exception is, when economists engage in debate about the unrealistic assumptions applied in the other's approach. The witty verbal exchanges between Buchanan and Musgrave (1999) or Stigler and Samuelson (1963) are good cases in point. While Stigler calls the assumption of an omnipotent state an "article of almost desperate faith" (ibid., p. 4), Samuelson points at the knife-edge conditions for perfect equilibrium: "the elementary consideration that a line is infinitely thinner than a plane would make it a miracle for these conditions to be met" (ibid., p. 26).[12]

To conclude, in a dynamic and open system, normative benchmarks of hypothetical perfect states are ill-defined, and therefore the heuristic of 'failure' is a poor foundation for intervention. Competitiveness and industrial policy require a dynamic rationale instead of the traditional static argument of allocative efficiency. The foremost question to start with, is not what 'failure' a policy must rectify, but what it aims to achieve.

5 Ability to evolve

Dynamic industrial policy aims to foster economic development, which is tantamount to the objective of enabling and molding evolutionary change. To define a dynamic rationale of industrial policy, we must consequently turn to evolutionary economics, the aim of which "is to explain the growth of productive knowledge ... understood as the human ability to create (material) welfare" (Stoehlhorst, 2014, p. 677). "In contrast to explaining the allocation of *given* scarce resources," the emphasis is on explaining "how cumulative change *alters* the resource constraints" (ibid., p. 670). In contrast to the orthodox approaches, evolutionary economics thus naturally connects with our interest in competitiveness – even more so if we acknowledge its distinctive ontology of multi-level interactions, where processes simultaneously unfold in the individual, structural and collective levels of analysis.

Multi-level processes are essential for evolutionary change. Dopfer (2015) postulates an ontology, where all existences are physical actualisations of information with a bimodality of physical (matter and energy) and non-physical (information) categories of existence. These existences have a propensity to associate and emerge into structure, which itself unfolds as a process. From this follows an indispensable interdependence between the micro-, meso- and macro levels of existence (Dopfer et al, 2004). In short, we have a systemic connect: populations (as aggregates) always evolve through the changing composition (hence meso-structure) of its individual entities (at the micro-level). As regards our concern for industrial policy, the multi-level ontology of evolutionary economics thus naturally breaks the traditional and ideologically afflicted dichotomy between sectoral interventions and mere conditioning framework policies.

Complementing the ontological perspective of the *structuralist - evolutionary* programme (Lipsey et al., 2005), Witt (2014) brings into focus its modalities of causal explanations. He distinguishes three types of particular interest: (i) *Proximate* explanations aim for an intelligently reduced representation of real phenomena. In addition, (ii) why something has evolved requires an ultimate explanation of its distinctive *function* within a system. Finally, (iii) how something has evolved calls for a *historical* explanation. As Witt argues, evolutionary research distinctively addresses all of them.

The three types of explanations are also of specific relevance to competitiveness and industrial policy. Obviously, policy practice (and advice) is often confined to the first type of proximate explanations about how particular mechanism or interventions may work, following general ideas about the expected average behavior in a system. Less frequently but of equal importance, the third type of knowledge about specific institutions and their history can be a decisive factor in the success or failure of concrete interventions. Through its emphasis on the historical specificity of development, the evolutionary lens can provide public agencies with a much-needed realism.[13] Finally, the second type of ultimate explanations may seem to be the farthest removed from policy practice. It refers to the highest level of abstraction, but in return also invokes a fundamental change of perspective. It leads us to ask: What are the ultimate functions, which the system must accomplish in

order to evolve? And what drives the processes that cause qualitative change through the emergence of novel structures?

At the most general level, and consistent with a wide array of authors,[14] evolutionary change is characterized by the simultaneous interplay of the three elementary principles of *variation*, *cumulation*, and *selection*.[15] They are not meant as an analogy from the natural sciences, but represent a higher level of abstraction (a meta-theory), which can characterize the time behavior of many different systems and forms. It therefore goes without saying that the evolution of a socio-economic system is not a process of natural selection, but one of *cultural evolution* (Dopfer, 2015).

Irrespective of the manifold differences among their specific realisations, no system can evolve if either of the three functions is missing. First, novelty and *variety* are requisite to any change. Second, *accumulation* introduces the dimension of time and renders the system dynamic.[16] Finally, *selection* channels the process towards altering constraints that are caused by given scarcities in the system. Without it, any arbitrary variation would be infinitely preserved and may be amplified through cumulative effects. The selection environment is where scarcities, and with them economics, come into the picture.

Table 2 further illustrates the requisite nature of these functions for evolutionary change. None of them raises much analytic interest, if considered alone. A common example for pure variation is *white noise*, where any observation $y_t = \epsilon_t$, and ϵ_t is an independently distributed random variable of zero mean. Without selection, there is no scarcity and hence no economic interpretation. The same applies to mere accumulation, for instance the deterministic but *blind growth* by a constant factor a, where $y(t) = y_0 e^{at}$. Finally, pure selection without variety has nothing to operate upon. We may call this state *stasis*. For illustration, consider the general selection dynamics

$$\frac{dx_i}{dt} = x_i(f_i - \phi), \tag{1}$$

where x_i is the frequency of type i, which increases (decreases), if its fitness f_i is higher (lower) than the average fitness of a population ϕ. Without variety, f_i must be equal to ϕ. Hence, there won't be any change in the frequencies, or other dynamic behavior. Still this description can be of practical importance, since systems may get locked into such a situation, if selection has previously consumed all of its initial variety and no (endogenous) source of novelty can refuel the process.

When two of the elementary principles apply, complexity increases and some familiar characterizations emerge. First, we consider variation in combination with accumulation, while no principle of selection applies. Again, the lack of selective constraints implies that this system is not subject to any economic interpretation. The typical example would be a *random walk*. In the simplest case, the time series is determined by the expression $y_t = y_{t-1} + \epsilon_t$ with ϵ_t being a random source of variation and y_{t-1} representing the cumulative and time-dependent nature of the system. If we add a constant trend component d, the process $y_t = y_{t-1} + d + \epsilon_t$ is called *random drift*.

We can similarly imagine a system in which only the two elements of variation and selection interact, but no accumulation takes place. This would correspond to a *stationary state* such as in the familiar static equilibrium models. The lack of accumulation means that the system is invariant with respect to time. Variations only cause fluctuations around a certain equilibrium configuration determined by the selective constraints. The crucial assumption is that at any point in time the probability distribution p of the variable y_t remains the same: $p(y_t) = p(y_{t+m})$. Perfect competition achieves exactly that by assuming the strongest possible mechanism of selection, which instantaneously eliminates any deviations from the optimal equilibrium solution.

Steady state growth is a convenient example for the interaction of cumulation with selection. It is the foremost starting point for breaking through from a stationary state to a dynamic system and implies that in equilibrium the various quantities grow at constant rates. Stochastic variations may exist (as with the aforementioned stationary state), but consistent with their macroeconomic focus, the models do not depict variation with a continuing effect in the sense of structural changes.[17] Theories of endogenous growth also rely on the framework of steady state equilibrium analysis, thereby eschewing the even more complex dynamics of evolutionary change.[18]

This brings us to our final characterization of *evolutionary change* as the simultaneous interplay of all three functions. At its most general, consider a constant population of $\vec{x} = (x_1, \dots x_n)$ units of selection, let's say individual firms. These are carriers of either of $i = 1, ..., N$ distinct information sets, let's say different production systems. Firms may change from system j to system i with probability q_{ji}. The transition matrix $Q = [q_{ij}]$ is stochastic and quadratic (n x n). Innovation, i.e. the introduction of a novel production system, corresponds to a change of frequency x_i from 0 to 1. Other changes in the frequencies represent the further diffusion, decline or extinction of a production system.

Selection occurs over the simplex S_n, i.e. $\sum_{i=1}^{n} x_i = 1$, and production systems have different fitness values f_i. Changes in the frequency of particular production systems depend on their advantage or disadvantage relative to the average fitness of the population $\phi = \sum_{i=1}^{n} x_i f_i$. If fitness values depend on the frequency distribution of production systems $\vec{x}$, a fundamental equation of evolutionary change (Nowak, 2006) can be expressed as follows:

$$\frac{dx_i}{dt} = \sum_{j=0}^{n} x_j f_j(\vec{x}) q_{ji} - \phi x_i. \tag{2}$$

Such models typically offer no closed solution, but require the use of analytic simulations (e.g., Caiani et al, 2014; Dosi et al., 2014). Note that the neoclassical equilibrium with perfect competition characterizes a special case, where all firms simultaneously know about a new technology, can adopt them (or enter and exit the market) without cost, and must immediately do so. Otherwise consumers can instantaneously and without cost shift to the most competitive rival. Since these assumptions don't allow for any meaningful differences

in the relative fitness of the firms, the entire dynamic of this equation, i.e. the structural changes in the frequency distribution of the population won't occur.

In contrast, with evolutionary change firms must continuously search their fitness landscape, which is a time-consuming process of trial and error. In their pursuit of favorable resource niches, populations tend to 'move uphill', i.e. find or adopt information sets with higher fitness values. Since the variety of behavior is not instantaneously selected away by any rule of perfection, novel ideas enjoy a certain margin of error. This permits experimentation and the accumulation of more complex information sets through learning. Selection still operates in favor of production systems that are more effective in altering given scarcities. In the sphere of cultural evolution, this means foremost the deliberate search and adoption of better rules and practices through learning (Nelson and Winter, 1982). Where such capabilities are constrained, differential growth, or the dynamics of entry and exit will take its place (Metcalfe, 1998).

6 Structural change

The principles of evolutionary change directly relate to the structuralist agenda. They connect and permeate the micro-, meso- and macro levels of an economy, thereby propelling their continuous transformation. Starting from the bottom upwards, the individual processes of creating, maintaining and capturing value from competitive advantage are highly situational and idiosyncratic. While novelty originates in the opportunity seeking creativity of individual and corporate entrepreneurship, organization and management define the structural context of incentives and decision making, determining which ideas get authorized and funded.

The *dynamic capabilities* approach embraces the evolutionary perspective at the level of strategic management. Merging the idea of Schumpeterian competition with *resource based theories* of the firm in the tradition of Penrose (1959), the focus is not on efficient allocation or contracts, but on how firms create and capture value within fast moving environments. Teece et al (1997, p. 516) consequently define "dynamic capabilities as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments." With regard to the theory of the firm, the capability approach explicitly rejects the market failure rationale, arguing that "causality goes mainly from firms to market creation rather than from market failure to firms" (Pitelis and Teece, 2009, p. 12). One core finding is that distinctive competences cannot, in general, be acquired through market transactions, but the firm itself must build, integrate and continuously reconfigure them. This process involves substantial sunk costs from long-term commitments to particular competence domains. The consequence is organizational inertia and path dependence, which is the source of much firm heterogeneity even within narrowly defined industries. It is thus prerequisite to the study of corporate demography at the level of entire firm populations.

In this domain, *organizational ecology* pursues a deliberate evolutionary approach (Hannan and Freeman, 1989; Carroll and Hannan, 2000). One of its most successful hypotheses concerns *resource partitioning* among large and small firms, which is more effective in discovering and exploiting varied niches from segmented markets and heterogenous consumer tastes. It is a compelling instance of how the industry-level composition of heterogenous firms impacts on the aggregate creation of value. While the micro-level explains the sources of variation, consumer tastes and preferences define the selection environment. Of course, these are not independent, but also conditioned by their perception of what variety and quality of goods the firms can offer. In short, the micro- and meso-level co-evolve with qualitative transformations always relating to changes in the composition of lower-level structural characteristics.

Another related strand of literature, the large body of empirical work on productivity growth, does not easily mix with an evolutionary interpretation. The reason is the important role of neoclassical production functions needed for a sufficiently robust measurement, in particular the assumption of constant returns to scale and factors earning exactly their marginal product because of perfect competition. Traditional growth accounting progressed top down by decomposing the aggregate production into ever more heterogenous industries and input categories, in this sense becoming more structuralist. It refined the residual measure of technological change by attributing a growing part of growth to shifts from less to more productive sectors and inputs (such as ICT-capital or high-skilled labour). In recent years, however, the growing availability of large scale microdata has spurred a new approach, which studies the impact of structural characteristics in the corporate demography on aggregate performance bottom-up (Syverson, 2011; Haltiwanger et al, 2013; or Decker et al, 2014). The empirical findings strongly support the evolutionary-structuralist emphasis on variety, selection and compositional effects driving aggregate outcomes.[19]

If we finally move towards linking the meso- and macro-levels of economic activity, Pasinetti (1981, 1993) provided the canonical model of *Structural Economic Dynamics* (SED).[20] Structural variations enter via sectoral differences in technological change and demand elasticities. Both sources are exogenous, but the model elaborates their interaction within a closed economy characterised by macro-economic resource constraints. The main mechanism shows that productivity growth in a particular sector leads to a decline of its relative prices, whereas consumers spend the according gains of real per capita income also on other sectors, depending on their respective income elasticities of demand. While technological change drives the growth of real income, different demand elasticities determine the sectoral composition of production, which in turn affects the weight of further productivity gains of a sector in aggregate growth.

In recent years, manyfold extensions of Pasinetti's multi-sector model have flourished. One common theme is the benefits of promoting export-oriented industries with a high income elasticity of demand, which presumably correlates with a high degree of technological sophistication. For example, Araujo and Lima (2007) developed a multi-sector model

of Thirlwall's (1979) balance-of-payments (BoP) constrained growth. They highlight how sectoral specialization and aggregate income together affect the elasticity ratio of export *vs* import demand and thus an economy's overall growth path. Regarding industrial policy, the standard BoP model offers in principle a symmetric rationale for either export promotion and/or import substitution strategies. But apart from strictly temporary protection of infant industries, the modern literature clearly favors export-led development. On the one hand, only exports provide for an exogenous increase of effective demand. On the other hand, larger international markets facilitate economies of scale and positive spillovers from Kaldor-Verdoorn effects (Araujo and Trigg, 2015). In contrast, import substitution is not only plagued by the danger of retaliation in international trade, but may also cause negative learning effects from prolonged protection (Cimoli and Porcile, 2011).

The upshot is that aggregate populations must seek to evolve through structural changes in favor of more productive activities, and thereby raise the average ability to alter the given material constraints. This directly relates to an economy's capacity to earn high and sustainable per capita incomes and thus to our concern about competitiveness. But as illustrated in the 'iceberg' model, there can be no comprehensive understanding of its drivers, if we stay within the narrow focus of welfare 'optimising' allocation choices. In contrast, the modern systems perspective, be it at the sectoral, regional-, national- or global level, owes much of its growing popularity to the explicit acknowledgement of complexity and fundamental uncertainty at the heart of real-life decisions (Freeman, 1987; Lundvall, 1992; or Nelson, 1993). Unfortunately, it is also true that its broader perspective comes at the expense of many contextual findings, which are difficult to generalise and test against hard facts or counterfactual observations. To promote effective policy interventions, the evolutionary-structuralist agenda must therefore aim to explain the basic mechanisms within a general and flexible framework, but won't release us from the systematic study of the empirical, historical, and institutional particulars.

7 What difference does it make?

The neoclassical paradigm has been extremely successful in rationalizing public interventions that we generally consider good and necessary, e.g. with regard to public goods, external effects, asymmetric information, or indivisibilities that constrain competition. Its success originates in the intelligent choice of assumptions and rules that enabled a winning balance between flexibility in response to actual policy needs and comprehensible principles for general guidance. But as Nelson (2009, p. 9) highlights, "these concepts and maxims are not logically tied to a structure of modern neoclassical economic theory. They are perfectly at home within an economic analysis structured by evolutionary theory". In other words, we don't have to throw out the baby with the bath water.

But what difference does it then make, whether we apply one or the other logic of intervention? Nelson sees the main advantage of evolutionary theorizing in a more real-

istic approach to institutional complexity. It specifically helps to overcome the privileged standing of pure market organization as the presumed default structure, which is misleading since markets (i) are never perfect, and (ii) never exist in a pure form. Instead, they are always conditioned by non-market institutions, which can be either more obstructive or supportive of particular activities and outcomes. Acknowledging the high degree of uncertainty together with a strong dependency of the effectiveness of public interventions on the situational context renders the idea of optimized policy prescriptions untenable. Instead, the evolutionary approach emphasises the importance of policy experiments and the need to provide institutional space for processes of discovery (Metcalfe, 1994; Cantner and Pyka, 2001; Mazzucato, 2011).

For the purpose of the current analysis, we can add the following aspects that ought to have a deeper import on our understanding and consequent practice of economic policy. First and foremost comes the transition from the negative logic of failure, where policy is only admissible if it corrects inefficiencies in the static allocation of resources, towards the active pursuit of a *dynamic objective*, i.e. to enhance the system's ability to evolve. The evolutionary-structural perspective opens our field of vision to the problem of competitiveness at the level of industries, regions or countries, which is otherwise alien to the concepts and terminology of the neoclassical tradition. The competitiveness of aggregate entities thus becomes a natural, meaningful and necessary concern of policy, generally characterized by the statistical moments of variables on economic performance in heterogenous populations.

Second, the multi-level ontology of evolutionary thinking breaks the ideologically afflicted dichotomy between 'vertical' and 'horizontal' policies. Sectors hardly exist in economic textbooks and it is therefore no coincidence that economists tend to regard sectoral policies with suspicion. In contrast, in the evolutionary-structuralist approach populations evolve through the changing frequencies of certain traits among the individual carriers. It regularly pays attention to the meso-level, no matter whether this refers to entire industries, technologies, special activities or other finer grained units of analysis. Hence, unlike the orthodox canon, industrial policy is not alien to the analytical apparatus of evolutionary economics. Instead, competitiveness and industrial policy are tightly embedded in a multi-layer system of enterprise, structural, and general framework policies.

Third, the dynamic perspective adds substance and scope to our arguments about the relative merits of market coordination versus government control. In general, *markets* excel in terms of allocative efficiency by coupling selection directly with the given preferences, utility and welfare of consumers. But market competition also associates with higher productive efficiency, because its stronger principle of selection tends to detect and punish incompetence, slack, or corruption more rapidly (Leibenstein, 1966). Hayek (1945) characterized market competition as a discovery process, which effectively co-ordinates the largely decentralized knowledge about supply and demand. Thinking of the above selection equation, market competition also fosters the learning about one's own competitive advantages, helping to specialize on activities that congrue with one's relative strengths. Among

the weaknesses, the aforementioned arguments of market failure are well known. Dynamic considerations lead us to add that self-organization is myopic and can lead to a lock-in to inferior local equilibria. Furthermore, the market itself is blind to any social objectives that are not effectuated by differences in the consumer's willingness to pay. Both instances may call for public interventions, either to lift the system out of inferior equilibria, or to channel its development in accordance to other goals of society.

If we analogously account for the specific strengths of *governments*, we must emphasize its potential for purposeful, planned and directed intervention, with a capacity to set priorities that also account for the non-economic goals of a society. Governments typically command and can mobilize large amounts of resources (e.g. for big infrastructure projects). And of course, they may correct market failures, e.g. through subsidies, taxes, or specific regulations. Conversely, government control suffers foremost from agency problems due to the diffuse power of the electorate as its principal. This brings forward rent-seeking behavior and capture by interest groups, but also notoriously renders governments susceptible to allocative and productive inefficiencies. The reason is a weaker principle of selection, where the link between effort, performance and reward is less immediate than with market interactions. To this we may add the threat of a Leviathan state, commonly associated with growing authoritarian control and administrative burden, but also with the crowding-out of private initiatives (Buchanan and Tullock, 1962). Clearly, substituting the argument of market failure by a dynamic rationale does not *a priori* imply a call for more government intervention.

But where does that leave us with regard to the question of when governments should or should not intervene? Aren't we losing the clear guidelines offered by the simpler rationale of market failure? The dynamic perspective is necessarily more comprehensive. It offers more complex answers, but in reply to deeper questions. In contrast, the core of the market failure argument is easily taken on board by the straightforward and even simpler rule of *opportunity costs*: If private markets are more efficient than governments in accomplishing a certain task, then don't waste public resources on it. They can certainly create more value in other uses.[21] Furthermore, given the scarcity of public resources, a positive net gain in welfare need not be sufficient to justify a particular initiative. Instead, governments must set priorities according to their relative benefits and costs. One practical implication is that regular and systematic evaluations of public interventions should be commissioned and supervised by independent agencies that are not promoting or affiliated to particular programs, since only they may properly account for the opportunity costs from a wider array of initiatives.

Fourth, once we leave aside the calculus of optimization and its hypothetical idealizations of markets and the state, the new framework necessarily invokes the political economy dimension of government action, such as the rules which determine the returns to productive *vs* merely rent-seeking activities, group conflicts, regulatory capture or corruption. For instance, these are important to avoid a naive attitude towards stakeholder participation. What the institutionalized 'dialogue' with them can achieve, is to localize potential Pareto

improvements, and if necessary, offer a platform to negotiate feasible compensations. But it generally won't eliminate the underlying conflicts of interest or the need for deliberate political choices. Their quality crucially depends on the strength and integrity of the public institutions.

To this we must add the degree of development, which affects the kind of policies needed and the capacity to conduct them. As a consequence, less developed and emerging economies will generally need different kinds of public interventions than developed economies with a high self-organizing capacity of markets and private institutions. The distinction between the 'developmental state' approach (, stressing processes of catching-up through fostering investment and industrial upgrading, and the more recent notion of the 'entrepreneurial state',[22] which seeks to push the frontiers of new technologies, business models, or social innovations, reflects that difference.

Finally, the dynamic perspective directly relates to strategic concerns, such as the threat of escalating trade and subsidy wars that arise from prisoner's dilemma situations. The notion of market failure cannot tell us much here. Instead, we must turn to game theory. Its most important practical implications are the need for international cooperation, for example through economic integration, or enforceable multilateral agreements, together with some leverage of potential retaliation, if cooperation does not work.

8 Fitting the pieces

The introduction characterized competitiveness and industrial policy as a 'puzzle of many parts'. In this final section we briefly sketch, how the new approach can help to fit the varied pieces. While this is not the place to discuss individual policies, their instruments or interdependencies in detail, the aim is to realize three objectives. First, to organize a variety of relevant policies along the theoretic dimensions of evolutionary system functions and the ontological distinctions of micro-, meso- and macro. Second, to demonstrate that the dynamic rationale can motivate them without necessarily referring to the notion of market failure. It is thus shown to be at least a viable alternative to the traditional approach, while actually offering a more general and comprehensive heuristic. The third aim is to highlight their contributions to the common general objective of enhancing the system's overall ability to evolve.

The typology in Table 3 organizes the variety of different policies according to their particular system functions and target levels of intervention. In short, at the micro-level *enterprise policies* address individual firms, whereas at the meso-level *structural policies* may target specific industries, technologies, clusters, or focus on other intermediate levels of aggregation (e.g. certain tasks, occupations or labour skills). Finally, at the macro-level *framework policies* comprise economy-wide regulations and institutions, infrastructure, as well as public interventions for macroeconomic stabilisation. If we turn to the different system functions, innovation resurrects the requisite variety in the economic realm. The

accumulation of productive resources represents the second pillar of evolutionary change, whereas markets and regulations shape the selection environment. From an evolutionary perspective, all these elements are strongly interdependent and develop jointly within complex, path-dependent and non-deterministic processes (Arthur, 2014). In policy practice, the different functions and target levels must consequently overlap with regard to specific organizational bodies and institutional arrangements. However, this shall not distract from their characteristically distinct logic.

A few examples may illustrate the point. If we first focus on the function of introducing novelty to the system, Table 3 follows the common convention of distinguishing between 'research-', 'technology-' and 'innovation policies' in relation to our micro-, meso- and macro-structure. *Research* policies generally target the macro-level framework conditions of R&D without directly discriminating between particular firms, sectors or technologies. Examples are the regulation of intellectual property rights, institutional reforms in the general organisation of universities, or general budgetary provisions for universities and research labs. Because of the greater distance to the market they are less tied to particular sectors and firms, and the emphasis is typically more on basic research and scientific excellence rather than business applications and immediate economic returns. Political savvy in terms of the ability to promote an agenda and to assert one's claim for public resources, legal expertise together with a thorough understanding of how rules and regulations affect the incentives within the research community are distinctive competences needed at this level of policy making.

In contrast, *technology* policies target particular fields of activity, such as specific 'key-', 'enabling-', or general purpose technologies, and directly intervene in their favour. Typically, they address basic and applied research. Pursuing the same overall function of introducing novelty to the system, the target communities, instruments, tools and required expertise are nevertheless fundamentally different from the former activities at the macro-level. Strategic planning and the ability to set priorities among different technology fields are distinctive competences. To help with the selection of proper targets, policy puts much emphasis on science-industry relationships and the involvement of stakeholders.

Finally, at the micro-level, *innovation* policy addresses individual enterprises, which may, for example, apply for grants, preferred loans, or guarantees provided by specialised promotion agencies. The focus accordingly shifts from basic to applied research and the introduction of novelty to the market. Similar tools are available for *start-up* policies, which introduce novelty through the entry of new firms, though coaching services (e.g. business incubators) and equity related instruments (e.g. seed finance or support to business angels) gain in importance. In both instances, a key competence is in handling individual projects, i.e. offering a fair, efficient and accurate selection among submissions. This requires specific process knowledge and a reasonable ability to understand and evaluate heterogenous projects. Some programmes may be of general nature, selecting projects only according to their novelty and economic potential, other may focus on particular technologies. In the latter case, they apparently overlap with technology policy and require deliberate choices

about the design of different decision levels and repositories of expert knowledge.

If we turn our attention towards the accumulation of productive resources, investment is the central concern and framework policies at the macro-level dominate the picture. But only if we go beyond the idea of perfect equilibrium, where undistorted markets anyhow guarantee the full employment of resources, the field of vision opens to deliberate policies that foster their accumulation. Monetary policy may be most affected. Out of equilibrium, it is no longer confined to regulate only the price level (as envisioned in the European Central Bank's official mandate that was so thoroughly debased during the recent financial crisis). Instead, interest and exchange rates are understood to have an impact on real production. Similarly, many fiscal policies affect the process of accumulation. On the side of revenues, the tax system has a crucial import on the incentives to invest own effort, time and wealth to economic activities. But considering it merely a source of market failure misses its relevance for the corresponding expenditure side. For example, stabilisation policies can reduce uncertainty and thereby improve the investment climate, whereas the public provision of infrastructure addresses the accumulation of productive common goods.

At the meso-level, strategic considerations may initiate public expenditures that are targeted towards particular locations and activities, such as providing enhanced transportation facilities to certain logistic hubs, advanced information and communication networks to central research organizations, or specialized educational facilities adapted to the specific need of local industries. Policies directed at cluster formation and smart specialization aim to enhance accumulation through localized dynamic spillovers. Another example are targeted diffusion promotion schemes, which offer subsidies or preferential tariffs to strategic inputs such as advanced manufacturing technologies with a presumed high impact on industrial productivity. Historically, these have regularly been of great importance to countries in the process of technologically catching-up (Chang, 2002).

At the micro-level, most policies that directly target individual enterprises within this pillar relate to 'growth capital', typically provided via a some kind of development bank that offers loans, guarantees or certain equity instruments. Their role depends on how well the private capital markets are developed. Many initiatives target small and medium sized enterprises, exports, or certain underprivileged groups (e.g. minorities, women, people in distressed areas). Public initiatives for micro-finance and venture capital tend to attract most attention. Both aim to compensate for weak capital markets. But these are not static givens and approaching them purely via the rationale of market failure is misleading for two reasons. First, the most advanced capital markets have developed private solutions to the presumed market failure, some of them in deliberate opposition to public intervention (Kenney, 2015). Second, these markets must themselves evolve – typically not by design and simple institutional reforms, but through dynamic learning effects. These imply thick markets with a diversified ecology of experienced investors and portfolio managers as well as specialised legal, technical and other services. In a dynamic perspective, the tricky challenge for policy is to help kick-start the process, but to get out of the way when private initiatives start to develop. [23]

Finally, public policy shapes the selection environment in many ways. At the macro-level, far reaching choices regard economic integration. These may range from pegging one's currency to that of a major trading partner, various multi- and bilateral agreements on trade, FDI, or intellectual property rights, up to the EU's Single Market Programme. Neither is easily explained in terms of the traditional rationales of failure. But any such agreement certainly affects our three system functions. Arguably, levelling the selection environment among otherwise segmented markets is its most distinctive task, which strongly interacts with the other functions as well. In addition to the productivity enhancing effects of increased competition, the larger markets offer bigger opportunities for economies of scale and specialisation, hence raising the incentives for investment, including innovation, and structural change.

To this we must add all kinds of social-, labour-, environmental- and other regulations, certainly too numerous to discuss here. What they have in common is to shape the selection environment in defining by what means firms are allowed to compete or not. Once child labor, hazardous work practices, or the emission of toxic waste are abolished, no firm is allowed to use such practices to reduce cost. Even if we all agree on the need for such regulations, it evidently makes a big difference in our attitude towards public policy, whether we consider it in principle a cause of distortion and 'failure', which has to justify itself relative to the hypothetical ideal of a perfect market, or whether we acknowledge that policy has to define the rules in a way that aligns the competitive process with the needs and goals of society. Within those rules the competitive process shall then unfold with all its vigor and creativity. Directed towards the benchmark of perfect equilibrium, the rationalities of failure provide little help to understand that process. In contrast, the evolutionary paradigm is exactly about creative adaptation to varied and changing environments and therefore better connects to actual policy practices in the real world.

Many policies affect the selection environment at the meso-level – certainly more than we can discuss at this place. Suffice to mention that trade agreements generally specify very detailed rules for different industries, requiring much expertise and attracting considerably lobbying effort from business. The same applies to the many detailed product regulations. Most relevant to our purpose, however, is competition policy, since it deliberately aims to enhance the selection function of the economic system and seeks to protect consumers and potential new entrants in the market from the abuse of monopoly power and collusive behavior. It naturally associates with individual markets, and hence a focus on the meso-level. One of its biggest challenges is to balance the trade-off with the innovation function, where temporary monopoly rents from being first and ahead of the market are the primary incentive to invest resources in R&D and related activities. Within fast moving environments, when firms mainly compete for and not in the market (Geroski, 2003), boundaries are difficult to draw. In recent years, the hypothesis of an inverted-U relationship between competition and innovation has attracted much attention (Aghion et al, 2005) and its estimation in a simultaneous system emphasized the interdependency between the two functions (Peneder and Woerter, 2014).[24]

Policies that interfere with the selection process by addressing individual enterprises are a particularly discriminating form of intervention, and public procurement is its most notable instance. It draws least attention, where it is most common, i.e. with regard to favouring local content in the regular procurement of goods and services by (local) governments and public organisations. In many instances, proximity is a natural advantage and local sourcing fully consistent with economic efficiency. Often procurement from more distant suppliers is equally viable, but when technological complexity and economies of scale are small, so are the associated benefits of specialisation, price differences, and potential efficiency gains from a larger pool of competitors. From a dynamic perspective, maintaining a varied and differentiated ecology of firms is a valid goal of regional development, and especially in distressed regions may well dominate pure efficiency considerations.

The economic cost of restricting one's supply base by way of privileges to firms with a local representation increases with economies of scale and technological complexity. But the very same factors also generate first mover advantages and can render the industry an attractive target of industrial policy. In its most ambitious form, public procurement as an industrial policy aims to anticipate future demand and to shape the selection environment by opening new resource niches. These shall attract firms to innovate at an early stage in the life-cycle of a new product or industry, assuming that the benefits of first mover advantages will later compensate for the initial cost.

For example, the French 'Grand Projets' had their strongest leverage where public investments in large-scale infrastructure nourished a privileged market for domestic suppliers, thereby promoting economies of scale and dynamic learning effects (Cohen, 2007). However, without a complementary outward orientation towards export markets one may end up "leading without followers", as Kushida (2011) has described the case of the "Japanese 'Galapagos' telecommunications sector". The examples which attract most attention, however, are the US defense and space programmes. They have established a voluminous demand for privileged domestic suppliers in high-technology sectors with large economies of scale and dynamic learning effects. Subordinate to other political objectives, Ketels (2007) doubts their efficiency as a tool of industrial policy. However, the sheer size of the market together with a strong governance keeping up rivalry among potential suppliers is a powerful source of spillovers to civilian applications as well.

To summarize, as an effective tool of industrial policy (and not merely distributing rents to local constituencies) public procurement must meet at least four critical requirements: (i) the identification of a viable source of strategic advantage (i.e. public leverage together with dynamic learning effects); (ii) the capability to act as an advanced customer with anticipative demand; (iii) strong governance, and (iv) a deliberate responsibility for and management of the system's selection function.

9 Summary

The article elaborates a dynamic concept of competitiveness and industrial policy as drivers of Schumpeterian development, i.e. high real incomes together with qualitative changes of the socio-economic system. Proposing a distinct dynamic logic of public intervention, it aims to reconcile policy rationales with the actual concern of public agencies. It first shows that Krugman's famous critique on the notion of competitiveness for aggregate economies ignores the fundamental relatedness between the micro-, meso- and macro-levels of activity. While individual enterprises, workers and households are the immediate actors, a location's relative abundance of productive resources influences its specialization at the meso-level, which in turn affects the aggregate per capita income. Instead of passively adapting to given scarcities (comparative advantage), dynamic industrial policy aims to alter them by the creation of competitive advantages. Locations compete for favorable business conditions in order to generate higher income and living standards from creating and capturing more value within the system of global production.

We highlight the economists' peculiar dependence on rationalities of failure, be it either of markets, governments, or systems. It originates in our habit to accept hypothetical perfect states as normative benchmarks, inherited from the canon of static welfare optimization. This stands in contrast to a dynamic logic of intervention, which targets the functions that an open system must accomplish in order to evolve. Combining the ontological distinction between the micro-, meso- and macro levels of activity with the functional principles of evolutionary change, a new typology substitutes for each policy field the rationale of allocative efficiency by its particular dynamic function, which should help to better coordinate and refocus economic research and policy towards the common objective of enhancing the system's overall ability to evolve.

Policy thus shapes and channels the further evolution of the system in manyfold ways. Those entrepreneurs who creatively cope with the given constraints, will sustain, grow faster, become more, and ultimately advance the process of development. For many of these policies one can also invoke the traditional rationale of market failure. But the situation resembles a tilted image: once one acknowledges the dynamic function of these policies and their orientation towards development, the efficiency-based logic of failure seems forced. Anyway, it cannot provide an integrated perspective. Allocative efficiency is simply not their constitutive purpose, but more an intellectual bracket to align common policy sense with the theoretical canon. The uneasiness of this match greatly contributes to the widening gap between politics and economic research. In contrast, the contribution of the various policies to a well-functioning socio-economic system, reasonably efficient in the short-run, but above all able to develop in the long-run, can be a truly unifying goal. It is also more consistent with how people in the policy agencies perceive themselves and their contribution to society. The switch of perspective from the canonical rationalities of failure towards the system's ability to evolve, thus creates the opportunity for a novel, more realistic and better integrated understanding of competitiveness and industrial policy.

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Notes

[1] To give a few examples of the growing stream of literature in recent years, see Hausmann and Rodrik (2003), Bianchi and Lavory (2006, 2014), Rodrik (2008, 2013), Cimoli et al (2009), Aghion et al (2011), Pisano and Shih (2012), O'Sullivan et al (2013), Stiglitz and Lin (2013), Warwick (2013), Van Reenen (2013), Pianta (2014), Bailey et al (2015), Farla (2015), or Mazzucato et al. (2015).

[2] As Schumpeter (1954, p.199) explains, Hamilton "knew Smithian economics well – not only A. Smith himself – so well in fact as to be able to mold it to his own visions of practical possibilities or necessities and to perceive its limitations". In contrast, with regard to the second classic writer on industrial policy, Friedrich List, Schumpeter was very critical of his deterministic historical 'evolutionism'.

[3] Civic and business elites were acquainted with government direction, and the shortage of capital called for coordinated efforts and prioritization. In addition, the Soviet Union's experiment with central planning seemed to perform better than its critics anticipated (Grabas and Nuetzenadel, 2014).

[4] "Thus, government support, especially through Japan Development Bank loans, was concentrated on steel, shipbuilding, machinery, petrochemicals, and synthetic fibers, all of which were expected to be able to reduce costs quickly by importing new technology" (Hoshi and Kashyiap, 2006, p. 208).

[5] The situation was different in the US, with a particular challenge being the transformation of war-time production facilities towards the supply of goods for civilian purposes. Some of them became profitable targets of the newly emerging venture capital business (Peneder and Resch, 2015), and private enterprise generally was in a favorable position to take the initiative in producing for the post war surplus demand.

[6] Lacking a similar process, the USA rather continued its "long history of strong denials that industrial policy is part of its overall economic policy tool kit", even though it "clearly engages in policies that are targeted at specific industries or sectors, and it does use horizontal policies that have differential effects across industries" (Ketels, 2007, p. 150).

[7] For instance, scarcity can affect natural resources, capital, labour, or intangible assets, such as human skills and technological knowledge. Also the access to certain markets can be scarce, giving a natural advantage to firms in a location that is better integrated than others.

[8] Note the difference to the popular measures of relative unit labour costs or real effective exchange rates. Being jointly determined by productivity and labour costs, their increase may, for example, associate with rising international market shares – the so called Kaldor paradoxon (Fagerberg, 1988). Rather than measuring competitiveness *per se*, their task is to indicate imbalances, if wages rise ahead or fall behind the growth of labour productivity relative to a country's trade partners. In the end, it is still productivity growth which determines what wages an economy can afford to pay in a sustainable manner.

[9] Capital goods are heterogenous and therefore have no comparable physical unit of aggregation. In the neoclassical world of perfect equilibria all markets clear at paying the different factors their marginal product. Hence, one can aggregate heterogenous capital services by their deflated money value, i.e. simply by the sum of the real factor incomes. As a corollary, the whole method and existence of aggregate production functions with capital as a separate input rests on restrictive assumptions such as perfect competition and constant returns to scale (Kaldor, 1955-56).

[10] Note that one can dig ever deeper in the search for ultimate causes. For instance, the human capacity for cultural evolution is itself conditioned by our natural history, i.e. for example our genetic predispo-

sition to learn language, empathy, altruistic behavior, trust and coordination, as studied in the field of *neuroeconomics*. See e.g. Witt and Binder (2013).

[11] GDP is well understood to be a measure of material well-being. In recent years, other dimensions of social development have attracted attention under the banner of 'Beyond GDP' (e.g. Stiglitz et al, 2010; Aiginger et al, 2013). At a conceptual level, there is no contradiction with the approach presented here, just a considerably broader target. If a society manages to provide better quality of life, for example, by means of a better healthcare system, social inclusion or environmental protection, this corresponds to a rise in productivity and hence real income. For a given endowment with material, social and intellectual resources the society can provide more value to its citizens. The problem is rather operational, one of providing a general concept and adequate empirical measures. In that regard, Kapeller and Scholz-Waeckerle (2015) develop a general evolutionary heuristic for the systematic appraisal of manifold dimensions of social development and relate it to established systems of Beyond GDP indicators.

[12] Note also the remarkable change of mind among the founders of 'new welfare economics'. Kaldor (1972, p. 1240) argued that "equilibrium theory has reached the stage where the pure theorist has successfully (though perhaps inadvertantly) demonstrated that the main implications of this theory cannot possibly hold in reality, but has not yet managed to pass his message down the line to the textbook writer and to the classroom." Hicks distanced himself from his influential *Value and Capital* as "a perfect competition book, running that particular assumption, a very convenient assumption, to the death. I don't believe in it. Even in the work that I did soon after that, I began to drop it – such as the work that I did on welfare economics" (as quoted in Klamer, 1989, p.172).

[13] "The reconstruction of how presently observable mechanisms have evolved often uncovers significant, contingent features of these mechanisms by which their functioning (or reasons for their mismatch) can better be understood" (Witt 2014, p. 655).

[14] See Veblen (1898), Nelson and Winter (1982), Hodgson (1993, 2002), Metcalfe (1994, 1998), Aldrich et al (2008), or Winter (2014). For a critical view, see Witt (2008), Buenstorf (2006) and Cordes (2006).

[15] Darwin (1859) was the first to comprehensively understand their complex interdependency, which he called the 'correlation of growth': "I mean by this expression that the whole organization is so tied together during its growth and development, that when slight variations in any one part occur, and are accumulated through natural selection, other parts become modified" (Darwin, 1859, p. 182).

[16] Our emphasis on 'accumulation' is owed to the interest in economic development and growth of real income. Other disciplines use different terms, such as 'reproduction' in biology, 'integration' in sociology (Luhman, 1997), or 'retention' in institutional economics (Hodgson, 1993).

[17] Note that Hicks refused to consider them dynamic: "I do want to say that perfect foresight models, such as steady state models, really are static. Although there are differences between one moment of time and another, they have so much in common that the thing really remains static" (quoted in Klamer, 1989, p. 173).

[18] See Aghion and Howitt (2009) for models of innovation as an endogenous driver of Schumpeterian *growth*. This is nevertheless different from Schumpeterian *development*, with its distinctive additional emphasis on structural change among heterogenous populations.

[19] For example, Decker et al (2014, p.12) report that in US manufacturing "about 60 percent of industry-level productivity growth happens within existing establishments and the rest comes from reallocation of productive resources resulting from entry, exit, and the expansion and contraction of existing establish-

ments". With regard to employment, they conclude that "most startups fail, and most that do survive do not grow. But among the surviving startups are high-growth firms that contribute disproportionally to job growth. These high-growth young firms yield the long-lasting contribution of startups to net job creation" (ibid, p. 10).

[20] "The evolution of modern economic systems, ... the permanent changes in the absolute levels of basic macro-economic magnitudes (such as gross national product, total consumption, total investment, overall employment, etc.) are invariably associated with changes in their composition, that is, with the dynamics of their structure" (Pasinetti, 1993, p. 1).

[21] Take for instance Keynes (1926, p. 12): "We must aim at separating those services which are *technically social* from those which are *technically individual*. ... The important thing for government is not to do things which individuals are doing already, and to do them a little better or a little worse; but to do those things which at present are not done at all."

[22] On the former, see e.g. Amsden (1987, 1989), Wade (1990, 2012), or Chang (1994, 2006). On the latter see Ebner (2006, 2009) and Mazzucato (2011).

[23] As a practical implication, the dynamic perspective leads one to prefer the fund-of-funds approach over direct capital infusions. In the former, public funds offer capital to private funds, which then manage the investments in their portfolio firms. In the static logic of market failure, the two instruments would be largely equivalent. From the dynamic perspective, fund-of-funds as exercised e.g. by the European Investment Fund (EIF) have the advantage of nurturing the development of a private venture industry in addition to the provision of risk capital.

[24] In short, at high levels of initial rivalry, further competition tends to reduce the incentives to invest in innovation, whereas at low levels of initial rivalry an increase in competition raises the innovation effort. Since only the latter situation is likely to be brought to trial in front of a competition authority, the conclusion is generally affirmative of a strict ruling in antitrust cases, arguing that it can in principle enhance innovation and competition simultaneously.

Figures & Tables

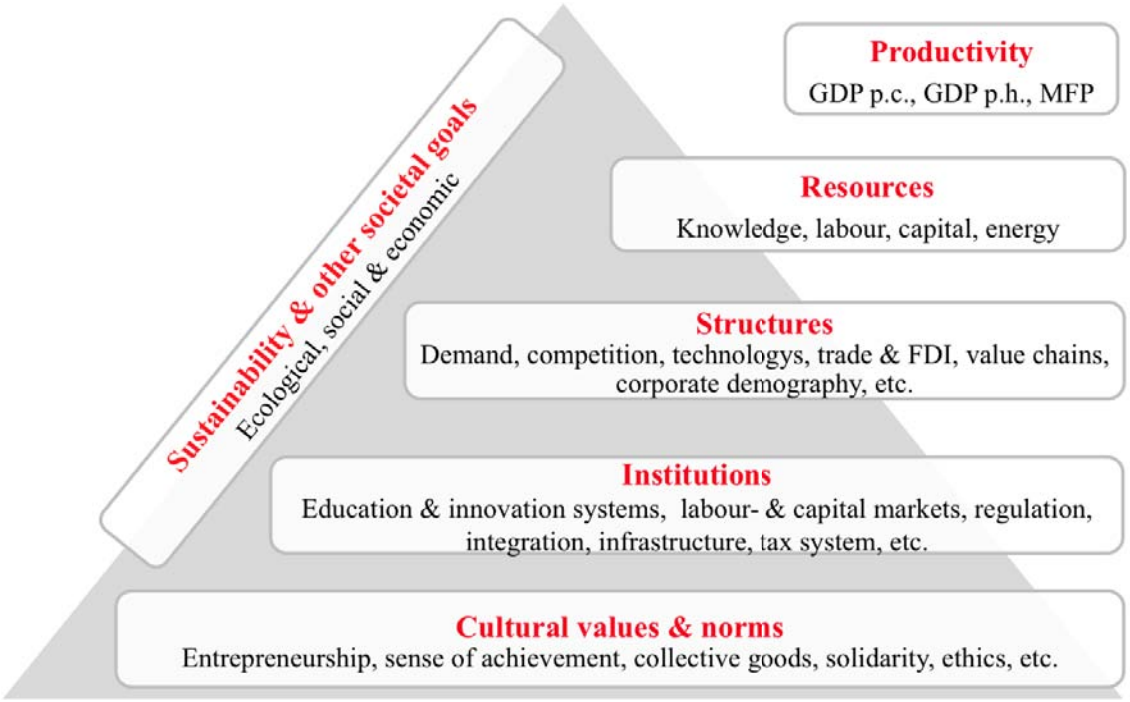

Figure 1: The 'iceberg' model of competitiveness

Table 1: The multiple faces of industrial policy

Sectoral	Hybrid	Functional
	Competitiveness	
	Ability to evolve: Real income growth & qualitative change **Societal objectives**: Civil liberties, distribution, environment, etc. → Fine-tune policies to *meso-environment* of particular industries (stakeholder dialogue)	
	Structural Change	
Activities (sectors & tasks) → *High growth* of value added & employment	Progressive **factors**: Innovation, higher education, labour skills, etc. → *Differential impact* on industries	
Sector targets		Framework conditions
Manufacturing Tradable services etc. (Agriculture) →*Income & jobs*		Correction of **market failure:** Frictions, public goods, externalities, monopoly, asym. information, etc. → *Efficient allocation*

Table 2: A general characterization of system dynamics

	Variety → *Change*	**Cumulation** → *Time*	**Selection** → *Direction*
	Purely stochastic		
Stasis	–	–	+
Blind growth	–	+	–
White noise	+	–	–
Static equilibrium	+	–	+
	Structural		
Random walk/drift	+	+	–
Steady state growth	–	+	+
Evolutionary change	+	+	+

Table 3: Integrated competitiveness and industrial policy

	Dynamic System Functions		
Target level	**Innovation** → *Variety*	**Resources** → *Cumulation*	**Markets & regulation** → *Selection*
Micro	Innovation & start-up policy	Enterprise Policies, e.g. Growth capital: micro-credit, venture capital; export promotion	Public procurement
Meso	Technology policy	Structural Policies, e.g. Targeted investment & diffusion programmes	Competition policy; trade policy; sector regulations
Macro	Research policy	Framework Policies, e.g. Monetary- & fiscal policy; infrastructure; education	Economic integration; environmental-, social- & labour regulations