PRODUCTION DEVELOPMENT

Micro-macro interactions, growth and income distribution revisited

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Contents

Abstract

The international economy is marked by major asymmetries in technological capabilities and power, both at the domestic and international levels —a point emphasized by the structuralist tradition. These asymmetries strongly affect economic outcomes and place major constraints on economic policy. This working paper discusses how the microeconomics of learning interacts with structural change and the evolution of aggregate demand to generate either virtuous paths of economic development or vicious circles of underdevelopment and lagging behind. Some implications of these growth paths for the international and domestic political economy are discussed.

Introduction

The international economy is marked by major asymmetries in technological capabilities and power, both at the domestic and international levels—a point emphasized by the structuralist tradition. These asymmetries strongly affect economic outcomes and place major constraints on economic policy. This working paper discusses how the microeconomics of learning interacts with structural change and the evolution of aggregate demand to generate either virtuous paths of economic development or vicious circles of underdevelopment and lagging behind. This working paper updates and extends a previous paper on the microfoundations of heterogeneity (Cimoli and Porcile, 2015).

Chapter I focuses on the trinity formed by Keynes-Knight uncertainty, bounded rationality and decision-making based on rules or heuristics. Chapter II focuses on learning and its interaction with the technological intensity of the production structure. Chapter III discusses the forces that may lead a country to fall into a low-growth trap and the crucial role that institutions (and in particular the industrial and technological policies) can play in allowing it to escape from such a trap. Chapter IV acknowledges that institutions are shaped by power, and discusses how a less diversified, less technologically intensive production structure reinforces institutions that hinder productivity growth. This section also discusses the international political economy trilemma set forth by Rodrik in his analysis of globalization. Chapter V focuses on the interplay between micro x macro variables shaping the country's growth path. Technological change and demand-driven growth are combined to give rise to either virtuous processes of productivity and employment growth or to "truncated" patterns that end up in a slow-growth trap.

I.   Rationality and institutions in an uncertain world

The microfoundations of economic models continue to be a highly debated topic in the economic literature. This topic focuses on the behavior of individual agents —firms, consumers or households— and their interactions in order to derive from them macroeconomic outcomes. Microfoundations (implicitly or explicitly) are concerned with at least four crucial questions: i) the nature of agents' rationality, ii) how they form expectations and learn, iii) how capabilities are built, used and transformed over time (allowing for both adaptative and creative responses to a changing environment); and iv) role of the institutional setting in shaping decisions, technological change and market outcomes. The questions are interrelated. The way we respond to question (a) determines to a large extent the answer to the others.

Rationality

Rational agents use all the information they have to the best of their abilities to attain a certain objective. Hence, to understand how rational agents behave we have to understand how they collect and process information, and how their abilities develop. Abilities and information are used to form expectations and decide what to do. In economics we are interested in expectations about present and future prices, market shares, consumption patterns, the policy environment and technical change, including the emergence of new goods and sectors in the economic landscape —just to mention a small subset of relevant economic variables.

One avenue to model micro decisions is to assume that a) firms have perfect knowledge of the parameters and equations of the economic system and b) are able (at least on average) to make optimal decisions on production, consumption and innovation. This is the basis of the rational expectation hypothesis which attributes to economic agents an almost infinite capacity to gather and process information. Even if firms do not consciously optimize, the selection process in the market will ensure that only firms that behave *as if* they were following an optimization program will survive.[1]

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[1]   Under very restrictive conditions, rational expectations place the economy in a path which is Pareto optimal. Transparency in the market place and a complete set of risk markets lead to optimal micro decisions that produce an efficient aggregate (macro)

From this perspective, technology is either a variable fully incorporated ex ante into the process of dynamic optimization or it takes the form of exogenous shocks. However, technical change is about discovering new things, which by definition cannot be part of the agents' information set at time zero. Neither can it be considered mana falling from heaven, totally exogenous to the economic system. Technical change follows patterns that respond to economic incentives and which can be studied and explained. But to do so it is necessary to abandon rational expectations and embrace a theory of rationality consistent with the uncertainty and market incompleteness that are inherent to a world of rapid technological and industrial transformation (see also section 0.2).

This leads us to a second approach to address rational behavior, which acknowledges that agents neither know the true parameters of the economic system nor the paths it might follow in the future. Information is partial and could only be gathered at a cost, which implies that decisions must be taken based on a limited amount of information. There are some events or states of nature that are just outside the horizon of the agents. Therefore, the world is characterized by Keynes-Knight fundamental uncertainty, which is different to the concept of risk. The latter implies a known distribution of probabilities which can be used as the basis for the maximization of expected utility or profits; uncertainty on the other hand implies that the distribution of probabilities is unknown, and hence uncertainty cannot be included in the optimization problem. In the context of Keynes-Knight uncertainty, optimization based on a known (subjective or objective) probability distribution is not possible.

As most frequently happens in economics, there is no consensus on the meaning of Keynes-Knight uncertainty (Gillis, 2003; Gilboa et al, 2008). The definition we will use is that it represents a situation in which not even subjective probabilities could be assigned to all the possible states of nature. Some authors, however, uses uncertainty for the cases in which probabilities are subjective and not objective. Objective probabilities mean that there is enough experience and scientific knowledge to allow agents to form beliefs and expectations over future events based on past records end evidence. Subjective probabilities imply that such a knowledge or scientific base does not exist and hence probabilities are personal guesses. The crucial point is that, even if it were accepted this "soft" connotation of Keynes-Knight uncertainty (subjective probabilities), expectations would be based on guesses not only about the future but also about how other agents perceive the future. Expectations are therefore constructed through an inter-subjective process whose fragile basis makes them volatile. Such a process could not be captured by dynamic optimization as assumed in rational expectations models.

Uncertainty is particularly acute when it comes to investment decisions (whose impact is felt many years after the moment in which the decision is taken) or when rapid technical change redefines competitive advantages. Hence it is at the heart of the *two main dynamic forces* of the economic system: investment that expands aggregate demand and embodies new production capabilities; and technical change that transform these capabilities. Rapid technical change implies that it is difficult for economic agents to know whether the existing technology and the current technological path will still be profitable in 10 years time. It is also difficult to know which technology has the highest potential when there is a race between several competing technologies.

This converges with Keynes' view of the capitalist economy as essentially unstable. Investments strongly depends on expectations whose bases are fragile and which may vary swiftly and unpredictably —responding not only to changes in the markets due to technical change, but also and to waves of optimism, "irrational exuberance", panics, herd behaviour and manias, magnified by the financial markets.[2] Instability is part and parcel of the workings of every market, but is particularly strong in the

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outcomes. The literature on the existence and efficiency of equilibrium under rational expectations is vast. For an early discussion see Newberry and Stiglitz (1982).

[2] In some cases, fluctuations in investment respond to systematic, predictable forces which could be monitored and controlled by policy makers. Markets generate cycles driven by their internal dynamics as the classical works of Minsky show, and governments have instruments to prevent them from occurring or to cushion its worst effects (see Minsky, 1977; see also Kregel, 1998). But there is other kind of fluctuations that are much less predictable. Economic historians like Kindleberger and agents directly involved in the financial markets (regulators like Greespan or investors like Soros) have acknowledged and documented the importance of waves of pessimism and optimism in the behaviour of these markets.

case of the financial markets, where assets are highly liquid, highly interconnected and can be traded at a very high speed. Financial globalization further boosts such instability, giving rise to what Turner has called a major "negative externality" for the whole economic system.

Institutions

Agents have to make decisions; they cannot be immobilized by uncertainty. And there is a way out which is to adhere to conventional patterns of behaviour —social norms and rules of thumb or heuristics. Perfect knowledge and high rationality are beyond the agent's capabilities, but widespread, socially accepted norms provide a basis for decisions in a context of uncertainty and bounded rationality.

The concept of bounded rationality was suggested by Herbert Simon as "a rationality that is consistent with our knowledge of actual human choice behavior, [which] assumes that the decision maker must search for alternatives, has egregiously incomplete and inaccurate knowledge about the consequences of actions, and chooses actions that are expected to be satisfactory (attain targets while satisfying constraints) (Simon, 1997, p. 17). The heuristics that conform to a satisfying behaviour are not rigid but evolve, as discussed below.

A simple metaphor may help to illustrate the difference between the two approaches to decision-making. Imagine a person that arrives to a different country where she has to make decisions within a short time period, which severely limits her ability to collect information. This person is rational: she cannot optimize, but knows that by relying on certain rules of behaviour will do just fine —for instance, she may adopt the norms of the natives, as the old aphorism suggests, "when in Roma do as the Romans do". This is the how the theory of bounded rationality explains behaviour: the future —especially with respect technology and investments— is a foreign country whose structural parameters one ignores. More than that: when it comes to technical change, this foreign country is periodically invaded by high-tech "barbarians" that break the rules and redefine the parameters of the model in ways that not even the barbarians could predict. The high-tech actors themselves only gradually discover where creative destruction is taking them. In the same vein, the routine-driven agents of the Walrasian equilibrium take too much time to perceive in which direction the world is changing —and that they need to do something to avoid extinction.

Skidelski (2010, p. 100) suggests another metaphor:

"The future (...) resembles the past in the way that children resemble their parents and forebears: the genetic ingredients are the same, but the possible combinations are unlimited. Tiny differences in initial arrangements can make for huge differences in outcome. To cope with uncertainty, human beings fall back on conventions."

The rational response when one knows so little about the future is to follow **conventional rules or heuristics** for decision making that are a satisfying guide under uncertainty, even if one knows that such heuristics are not optimal.[3] A classical statement from Keynes (1937, p. 114) is useful to understand the link between uncertainty and heuristic-driven decison:

"Knowing that our own individual judgment is worthless, we endeavour to fall back on the judgement of the rest of the world which is perhaps better informed. That is, we endeavour to conform with the behaviour of the majority or the average. The psychology of a society of individuals each of whom is endeavouring to copy the others leads to what we may strictly term a conventional judgment".

Some rules are followed under ordinary circumstances, while others are devised to respond to exceptional circumstances —for instance, a change in the technological paradigm, in the exchange rate regime or in the industrial policy. There is a hierarchy of heuristics in which meta-heuristics are used to change the current ones, in response to the external or internal context in which the firm operates.

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[3]   Davidson uses the concept of nonergodicity—the future does not reproduce the statistical patterns of the past, which means that past and present values (for instance, of asset prices) are not necessarily a good proxy of future values—to explain fundamental uncertainty. In his words, in a "nonergodic world, it is impossible to actuarially estimate insurance payouts in the future" (Davidson, 2009).

Heuristics and social conventions, considered as devises that help agents to cope with uncertainty, are the basis for the definition of institutions. The latter are the behavioural rules upon which "actors' expectations converge" (Krasner, 1982) and "give a durable structure to social interactions" (Bowles, Microeconomics, p.p. 47-48). North (1990, p.3)[4] defines institutions as "humanly devised constraints that shape human interactions". They may be formal or informal, written or unwritten, explicit or implicit —none of these attributes is crucial for the definition of institutions. What is crucial is their role in *shaping expectations and constraining behaviour* so as to structure or "organize" interactions, i.e. generate identifiable patterns in a context of fundamental uncertainty.

In a world of atomistic competition, strategic interactions are inexistent. The firm reacts to signals of the system, not to decision-making from any identifiable agent. There is just one rational response (optimization) for firms to survive. But in the real world most economic interactions are strategic, entailing big players whose decisions depend on expectations over decisions of the other players. Interactions are not anonymous; on the contrary, each agent tries to guess how others will react to any move she takes. Institutions reducing uncertainty by (implicitly or explicitly) coordinating expectations and offering an anchor to decision making are still more important in a setting populated by big players.

The "representative", hyper rational agent does not interact with its environment or with other agents in any relevant sense. Perfect foresight and complete markets allow her to take decisions at time zero and, from this very moment and until infinity, to incorporate all possible feed backs from the environment (except for random shocks). An agent with bounded rationality, on the other hand, moves over time through trial and error, using heuristics to decide and changing them when consistently receives positive or negative feed backs from the system (procedural rationality). In this sense, heuristics and institutions are context-specific and exhibit path dependence —meaning that decisions taken in the past change both actors and context, in such a way that they irreversible close or open certain paths in the future—, thereby representing a persistent source of heterogeneity in the economic system.[5]

An example: climate change

A paradigmatic example of the problems of decision-making under uncertainty is the case of the constraints placed on growth by climate change. Scientists are able to predict that the current pattern of economic growth (which the literature calls BAU, business as usual) is unsustainable from an environmental point of view: global warming and the depletion of natural resources could lead to a serious environmental crisis in the future, with large-scale (even catastrophic) effects on the ecological systems and the economy. On the other hand —given the nonlinearities inherent to complex ecological systems— they cannot predict the timing and the specific features that a future environmental crisis would take (Stern, 2013).

There are two key relationships subject to nonlinearities and unpredictable behavior in climate change: the impact of CO_2 emissions on the temperature of the earth, and the impact of rising temperatures on GDP and consumption. These two relationships form the so-called "damage function" which is crucial for estimating the negative externalities of climate change (Pindyck, 2015, p.865). As a result, although there are many economic models that aim to measure these externalities, they offer little effective help to improve decision-making. Indeed, they could even be counterproductive for policy analysis. In a recent review of the findings of these models, Pindyck (2013) suggests that they convey a deceiving sense of precision, while grossly downplaying the risks and potential costs of climate change.

And yet, in spite of these uncertainties, decisions have to be made. Pindyck concludes that to "*the extent that we are dealing with unknowable quantities, it may be that the best we can do is rely on the*

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4 For a critical analysis of the different meanings that the word "institutions" has taken in the literature see Hodgson (2006).
5 The rational expectations model sought to provide micro foundations to aggregate models. But at the same time microeconomists increasingly moved towards accepting bounded rationality and violations of the high rationality assumption, which are the subject of a growing research field, that of behavioural economics; see Kanheman (2003). Micro theory became more and more aware of asymmetries and other features of the real world that had been absent in conventional microeconomics and are by large still absent in rational expectations models.

'plausible'". This might be read as a canonical Keynes-Knight response.[6] It entails that we should abandon the idea that it would be possible to find an optimal growth path in which the marginal effects of increasing contamination are matched by the marginal increase in welfare or GDP. Instead, we should adopt conventional or consensual rules stemming from the debates of the scientific community as regards what can be considered reasonable to expect with such a limited amount of information. From this it would emerge a "rule of thumb" for the amount of contamination and the rate of growth that are sustainable. The rule "keep global warming below $2C^{o}$" is precisely this type of rule —rational, satisfying but, most likely, not optimal.

Summing up, the hypothesis of bounded rationality is not only a more realistic approach to how agents behave and policies are formulated. It is also theoretically more consistent both with a world in which there is true uncertainty and where large and persistent differences in productivity, technological capabilities, institutions and and technological intensity of the production structures (along with divergence in real wages) are pervasive.

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[6]   This point has been recently underlined by Foley (2014): "Keynes" GT [General Theory] can be regarded as an early and pioneering contribution to the theory of asymmetric information and the consequences of informational imperfections in multiplicity of equilibria and dependence of equilibria on expectations.

II. Learning and the co-evolution of capabilities and the production structure

Localized learning and tacitness

The previous discussion on rationality and decision-making has important implications for thinking of technical change and structural change. It suggests that learning is an evolutionary process (sensitive to initial conditions and previous trajectories) in which patterned rules of behaviour interact with the economic and technological setting. If this is the case, technological learning should exhibit properties similar to those of learning in general. Technological learning cannot occur detached from the agent's experience and technological domian: technological learning is "localized" and idiosyncratic. An early, insightful hint on this property of technical change —and the importance of experience— was set forth by Samuelson (1948): "Knowledge is *not* an input such as the more you use it, the less is left. Effective knowledge is even more important than knowledge, and unfortunately cannot be acquired by reading a book or by editorial exhortation" (italics in the original).

The way in which economists look at technology changed dramatically in the past twenty years. In the sixties technology was largely seen —as Joan Robinson put it— as given by "God and the engineers". Cost minimization implied that the firm could choose the optimal combination of capital and labour along the isoquant for a given technology. Technical change was deemed to exogenously shift upwards the production function, allowing the firm to produce more or the same quantity with less capital and labour. This view was abandoned in most growth models since the early eighties.[7]

Two early dissenters are Atkinson and Stiglitz (1967), who point out that learning is localized —it takes place around, and in connection with, the technology firms effectively use and in which they have accumulated experience. There are no smooth, continuous isoquants perfectly defined ex ante, but rather "points" clustered around (or moving in the vicinity of) existing production processes and capabilities. A major step forward in the analysis of technical change came about with the work of Nelson and Winter

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[7]   Endogenous growths models made innovation a function of economic variables, part and parcel of deliberate efforts by the firm to create a (transitory) monopolistic position.

(1982) and the evolutionary literature (for an early review see Dosi, 1988), who suggested the concepts of "tacitness" and routines. Such concepts incorporate and extend that of localised technical change.

A central theme in Nelson and Winter's work is that firms´ capabilities are embodied and reproduced in "routines" —which in turn have a tacit content, meaning that they cannot be fully translated into words or learnt from manuals. Routines are based on systematic repetitions, on heuristics that agents perform almost automatically. They are the crystallization of experience: as such, they are context-specific, idiosyncratic and could not be diffused through codified instructions. As experience is central to learning, increasing returns in production are heightened, as productivity increases with the accumulation of experience in production, investment and innovation.

The concept of routines in firms is symmetric to the concept of skills in individuals. The skills of a person are her ability to almost unconsciously execute a task through a set of articulated steps which could not be explained in words —and which are rooted in the person's experience.[8] In the words of Nelson and Winter (1982, p. 124-25):

"Routines are the skills of an organization. The performance of an organizational routine involves the effective integration of a number of component subroutines (themselves further reducible), and is ordinarily accomplished without ´conscious awareness´".[9]

Technology is not information that can be bought, taken from shelves and put into use immediately. It emerges from experimentation, failures, corrections and adaptations. Technical change does not happen at the moment in which a new machine is bought in the market; this is just the starting point of a learning path as this machine is incorporated to the production routines of the firms, and adjusted to specific market, technological, and even cultural conditions. Differences across countries in the availability and cost of natural resources, qualified labor, the size of the market, supplier chains and so on and so forth, demand dedicated investments, research and institutions to build up absorptive capacity of foreign technology (Katz, 1982; Fagerberg et al, 2001).

This form of perceiving learning and capabilities, based on tacit knowledge and routines, has significant implications for macro models, in particular for understanding specialization and structural change in open economies. This is the point addressed below.

Co-evolution: structural transformation, selection and learning

The potential for learning vary across technologies and sectors. Some of them are more conducive to innovation and "jumps" in productivity than others —what it has been labelled the "technological opportunity" associated with a certain technology/sector. Different technologies also differ in the importance of tacit knowledge and increasing returns. Such differences affect the dynamics of competition and market concentration. The higher are tacitness, increasing returns and technological opportunity, the more powerful the forces leading to the concentration of market shares.

In effect, tacit and localized learning imply that the latter does not take place in a vacuum but emerges within the limits and stimuli provided by existing capabilities and production processes. In open economies, what the country produces and learns depend on its current pattern of specialization and the set of capabilities it commands. *The international division of labour has significant learning consequences*: the pioneer contributions of Lall (1992, 2000) and Pavitt (1984) provide strong empirical support to the idea that different sectors play different roles in innovation and diffusion of technology. There are leading sectors which generate learning spillovers to the rest of the system, while others are "supplier dominated". The perception that some sectors comprise the crucial loci of innovation is widely acknowledged in the technological and

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[8]   Imagine, for instance, that Luis Suarez writes down very detailed instructions on how to score in a world cup match, and we learn these instructions by heart. This does not mean that we now have the skills of this player. It is most likely that we will fail if we try to apply his instructions in the field. In the same vein, Dosi and Nelson (2013) "are ready to bet that most eaters randomly extracted from the world population would systematically rank samples of English cooks to be 'worse' than French, Chinese, Italian, Indian ones, even when performing on identical recipes!!".

[9]   It is interesting to note the similarity between the concept of routines in the firm and institutions in the social system. Both concepts refer to "standardized patterns of human transactions and interaction" (Nelson and Nelson, 2002). This makes these authors refer to institutions as "social technologies".

business literature (see for instance Government Office for Science, 2013), but it is not dominant in the economic profession. An economy whose firms mostly compete in sectors with high technological and growth opportunities will dynamically attain a better performance in macroeconomic variables (GDP growth, wages, exports, investment) than an economy whose firms are mostly located in low-tech sectors.

The importance of specialization from a learning point of view is sometimes addressed in the literature through the distinction between static and dynamic comparative advantages. Static comparative advantages depend on the existence of abundant natural resources and / or a large supply of cheap labour which allows for lower production costs. Dynamic comparative advantages, on the other hand, depend on leads and lags in innovation and technological capabilities which give rise to leads and lags in productivity and the quality of goods produced by firms located in different countries (Dosi et al, 1990). In the long run, dynamic comparative advantages play the leading role in shaping growth and market shares in the international economy. Exports based on static comparative advantages are more volatile and dependent on the "commodity lottery". They may experience a decline in demand and prices as technical change reduces the content of natural resources per unit of production, or create substitutes whose dynamics is knowledge-driven (which makes unskilled labour and natural resources a less valuable competitive asset). Conversely, rents based on knowledge and on the ability of moving upwards in the quality and productivity ladders are more persistent. Learning also allows the firm to respond faster to economic shocks. Rents from knowledge do not tend to decline, but are continuously recreated through innovation (Reinert, 1995).

In the real world both kinds of comparative advantages, static and dynamic, coexist in different degrees. A key challenge to development policy is to use initial static comparative advantages to build up dynamic comparative advantages. To move in this direction, firms should be able to learn and approach the best practice faster than the velocity at which the international technological frontier moves. There is a race between innovation by the leaders and catching up by the followers, which redefines specialization and growth. Diagram 1 offers a schematic representation of this interplay between learning, capabilities, the technology gap and international specialization.

Diagram 1
The interplay between technological innovation, diffusion and selection in the global market
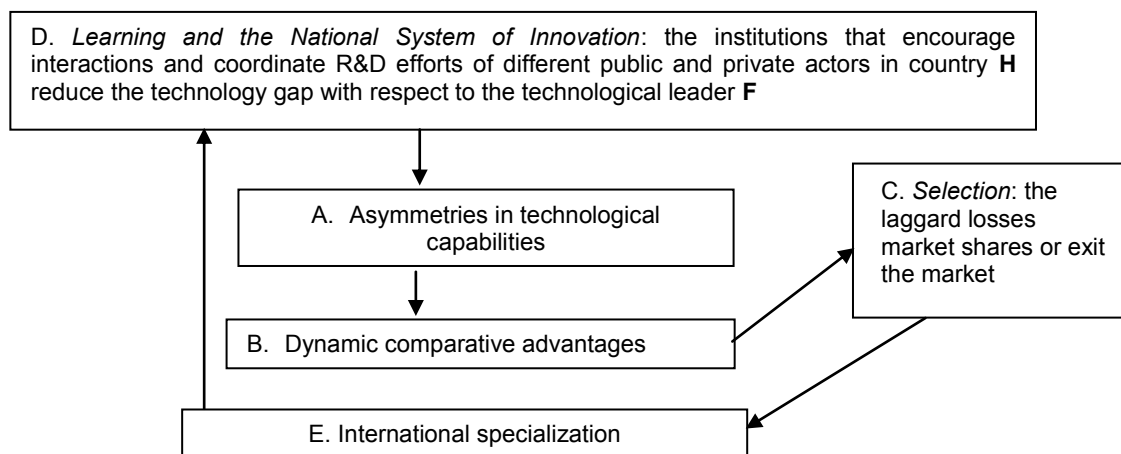
Source: The authors.
Note: Dynamic comparative advantages depend on leads and lags in technology, which in turn depends on the *NSI* (the latter shapes A's ability to absorb foreign technology) and specialization itself (learning is also a product of A's experience in production). The selection process expands the market share for the leading firms; diffusion (learning and catching up in A) allows A to remain competitive and diversify. If selection works faster than diffusion, B gets all the high-tech markets and A will not be able to change its pattern of specialization.

Diagram 1 tells the story of diversification, technology-driven leads and lags in productivity and quality, and global market shares. We begin with box A, which indicates that there are technological asymmetries between firms in the laggard country **H** and firms in the advanced country **F**. These

asymmetries are in part the result of accumulated capabilities within the firms themselves and in part derived from externalities and complementarities in learning activities in the whole system (the National System of Innovation, NSI, more on this later). They entail that firms in country **H** will be competitive mostly in sectors which are less knowledge intensive, which define country **H**'s dynamic comparative advantages (box B). The existing pattern of specialization is efficient (from a Ricardian, static perspective) in the sense that any other arrangement would imply higher production costs. However, the specialization of **H** may be inefficient from a dynamic perspective, as the country's production concentrates in sectors or activities with lower technological opportunities (lower Schumpeterian efficiency) and a lower rate of demand growth (lower Keynesian efficiency). In other words: **H**'s specialization gives this country less opportunities to learn and less demand stimuli for growth.

Assume now that some firms in country **H** aim to enter new, more knowledge-intensive sectors whose growth prospects and potential profits are higher. In addition, assume that the initial move towards diversification is based on some static comparative advantage (such as lower wages, natural resources) or policy-generated "distortions" (tariff protection, public financing or export subsidies). This effort may succeed in the short run. But the survival space for laggards conferred by a combination of static comparative advantages and protection declines in the long run. For wages tend to increase, natural resources to be exhausted, and policy support to be discontinued if the productivity gap is not reduced through time. The only way to sustain a more diversified production structure in country **H** is to reduce the technology gap. And firms in country **H** must do so before competition renders them out of the game.

There are two kinds of forces that define whether firms in country **H** will survive or not in the new sector they entered. First, the *selection process* allows firms which are closer to the technological frontier to expand their market share using their cost/quality competitive advantages (box C). If the initial gap and the intensity of the selection process are high, the new entrants (from country **H**) in the market will not survive. In the opposite direction, the *diffusion process* allows firms in country **H** to learn from the best practices in country **F** and reduce the technology gap. The velocity of diffusion depends on the institutional support for learning and technical change, the NSI (box D). If technological catching up is faster than market selection, firms in country **H** diversify and hence the country changes its pattern of specialization by increasing the share of knowledge-intensive sectors in the production structure (box E). Such an increase will in turn accelerate the learning process, producing a virtuous feedback from structural change capabilities to learning (arrow from E to D).

The efforts of imitators to catch up may be impaired by increasing returns (falling costs of production due to experience accumulated by the first comers) that widen the initial asymmetries. This is why catch up is rarely a spontaneous process. Most frequently, it requires strong industrial and technological policies in the laggard economy to speed up learning and compensate for the initial disadvantage. The higher are "tacitness", increasing returns and the institutional barriers to the international diffusion of technology (for instance, strong property rights on some crucial technologies), the more important is the role of these policies. The role of the industrial and technological policy in the laggard country is still more important when the advanced country accelerates its own rate of innovation.

The failure to diversify production and capabilities compromises growth *and* trade. Trade and diversification are not enemies, quite the contrary. The expansion of capabilities may bring about more and not less opportunities for participating in the international division of labour. A diversified economy becomes more integrated to the world economy mostly through intra-industry trade, while a country which is a low-tech commodity producer will have a supply-side (technological) constraint to integrate into the world economy. Trade for a less diversified country will be tied to the vagaries of the commodity markets.

Taking stock: technological capabilities and the production structure (and with it the pattern of specialization) co-evolve; their mutual interactions are the driving force behind development success or failure. Catching up in income per capita requires convergence both in terms of capabilities and in terms of the production structure. Both goals are difficult to achieve, and few countries have succeeded in this endeavour. What does it make convergence so difficult? There are strong inertial forces in the pattern of specialization which explain why catching up is relatively infrequent, related to tacitness, increasing returns in technological change and the institutional setting. More on this is discussed in the next sub-section.

III. Structural Inertia, Lock-in and Institutions

Path dependency and structural inertia

There are several definitions of path-dependence. A straightforward one is provided by Kenneth Arrow (2004, p.23):

> *"(T)he long-term historical evolution of an economy (or any other system) depends on where it started, or perhaps on some of the disturbances to the system during its history. The critical point is that the effect of these initial conditions or disturbances is essentially permanent; it does not gradually vanish with time".*

Arrow (2004, p. 24) argues that irreversibility is the crucial determinant of path dependence. One cannot revise decisions and change a growth or technological trajectory when investments are irreversible. This is precisely the case of investments in knowledge. Tacit, experience-based learning implies that firms and countries build capabilities that are sector-specific. They cannot use these capabilities in production and innovation in sectors totally unrelated (from a technological point of view) to the one in which they operate. They cannot throw their knowledge away and immediately replace it with a new set of experiences (Robinson's "irrevocable past"). What a firm knows today is a function of the capabilities it created yesterday and of current production patterns (which define the feasible region of learning).[10] Moving to new sectors or activities would be difficult, even if there are signals indicating that they offer much higher returns in the future. This is a powerful force leading to path dependence.

Increasing returns are usually an important part of the story of path dependence (while its presence is not strictly necessary). They are widespread in learning and technical change (a simple "micro" example: once you learn some maths, you would be able to understand parts of the physics book that were indecipherable before). The concepts of learning by doing, learning by investment, and learning from user-producer interactions, are all examples of reduction of costs and quality improvements as a result of accumulated experience. The corollary of increasing returns to learning is that early movers tend to keep their competitive advantage over late comers (and the diffusion of the

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[10]   As set forth by Dosi (1988, p. 1130), "Technological search processes in firms are cumulative processes"(...) "What the firm can hope to do is to technologically in the future is narrowly constrained by what is has been capable of doing in the past".

advanced technology will occur more based on the elimination of the laggards than on catching up). History matters: an initial advantage (or even good luck, *i.e.* a positive random shock at time zero) may lead to large differences in economic performance in the future.

Increasing returns sustain divergence (see diagram 1 above); they also sustain *lock in* processes, where *lock in* describes a situation in which a country or economic agent is trapped in a path whose performance is (in terms of productivity, learning and growth) clearly inferior to alternative paths (Arthur, 1989; David, 1985). Increasing returns makes investments in the existing production pattern more profitable than investments in diversification for the late comers. The latter will have to compete with firms that have already moved down the learning curve. Lock in prevents the economy from moving to sectors where opportunities for innovation and productivity growth are higher (Schumpeterian efficiency) and where demand growth is faster (Keynesian efficiency).

A related concept is that of *hysteresis*, which designs a process in which a transitory shock transforms the economy in a persistent way (there are changes in the production structure that cannot be reverted). The effect of a shock lasts in the presence of hysteresis well beyond the moment the shock ceased. The concept is useful in discussing the links between the short run and the long run. Changes in policies that are frequently seen by policy makers (especially in macroeconomics) as affecting solely the short run, or which are adopted under very special circumstances as emergency remedies, might cast a shadow on the long run (Setterfield, 2009).

In macroeconomics the concept of hysteresis has been used to analyze the endogeneity of the natural rate of unemployment and of the "natural rate of growth". Long periods of unemployment undermine the unemployed ability to find a job when the economy recovers. People are unemployed because they were unemployed in the past, no matter how well the economy is doing now (Blanchard, 2016; Yellen, 2016). As regards economic growth, in a world of fierce technological competition, hysteresis may be a more general phenomenon than usually acknowledged in the literature.[11] In particular, a short run policy that depresses investment at a certain point in time (for instance, to cope with an explosive debt or rising inflation) may result in a rise in the technology gap in one sector which in turn (with a rapidly moving international technological frontier) make key firms exit the market. Neither the ground lost in the technological race, nor the firms and capabilities lost in the crisis, would be recovered when the economic conditions improve.

The New Keynesian School in macroeconomics holds that there are rigidities in prices that prevent the economy from attaining full employment in the short run. Menu costs and rigid contracts, for instance, reduce the flexibility of firms to adjust to shocks in such a way that involuntary unemployment cannot be ruled out in short run equilibrium. In the long run, however, prices are fully flexible and the economy finds its optimum path with full employment. But this conclusion misses a significant part of the story. If rigidities are related not just to the behaviour of prices in the short run, but also to the dynamics of technical change and diversification, then there may be barriers to full employment even in the long run. In effect, even if prices have enough time to adjust, price signals at most reveal profit opportunities for a *given* set of technological capabilities and for a given distribution of leads and lags in productivity in the international economy. But in developing economies it is precisely poor capabilities and technology lags what make unviable the acceleration of growth. If these capabilities offer few technological opportunities and the production structure is made of less dynamic sectors —in technology and demand growth—, high flexibility in prices would just reinforce the existing less dynamic pattern of specialization. Price flexibility accelerates the traverse of the economy towards static comparative advantages.

Lock in and path dependence, however, are not destiny. There is a role for institutions and for the industrial policy in particular in escaping a lock-in situation.

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[11] The idea of hysteresis has been used to discuss the effect of depreciation in the diversification of exports: depreciation gives an initial advantage that allows the firm to pay for the fixed costs of entering in a new external market; once the firm is exporting, it will remain doing so even if the exchange rate returns to its initial level (Baldwin and Krugman, 1989).

Institutions and the National System of Innovation

If learning evolves and is context specific, related to institutions and to the previous experience that firms, markets and technology have gone through, there are several possible equilibrium growth paths and history matters. Which of them the economy will transit is neither given nor can it be predicted with certainty at the initial moment. Institutions are a significant force in selecting which path the economy will eventually take. They are also crucial for overcoming lock in phenomena.

As noted by Bowles (2006, p. 13): "if generalized increasing returns are common, many different outcomes may be equilibria. Of these, the sates most likely to be observed will depend critically on institutions governing the relevant dynamics, including such things as the exercise of power, collective action, and other forms of noncontractual social interactions".

In particular, there is a subset of institutions which are especially important in shaping learning and structural change, which will be called the "National System of Innovation" (NSI, see diagram 1; see Freeman, 1995; Freeman and Lundvall, 1988; OECD, 1997). These institutions coordinate efforts at learning by different actors (universities, R&D centres, firms, policy-makers, offices for standardization and quality control, training, labour unions, among others) so as to foster interactions, complementarities and knowledge spillovers throughout the economic system. The concept stresses the systemic nature of learning —there is more in innovation than learning and R&D within the firm, for a substantial part of the learning process is based on interactions— and recognizes its national specificity —the NSI evolves and varies with the history and policies of each country, and also depends on its pattern of specialization (which as mentioned reflects existing capabilities).

OECD (1997, p. 9) argues that "the innovative performance of a country depends to a large extent on how these actors relate to each other as elements of a collective system of knowledge creation and use as well as the technologies they use.". In turn Lundvall (2004, p. 7) argues that the concept of NSI might be seen as..."'Schumpeter Mark III' (not designed by Schumpeter though). While Mark I referred to individual entrepreneurs, Mark II referred to big corporations as major drivers of innovation and growth. The innovation system perspective brings in a broader set of actors and institutions as shaping the innovation process. It takes collective entrepreneurship one step further by bringing networking among firms and knowledge institutions into the picture."

In other words, the concept of NSI aims to fully take into account the heterogeneity of the agents involved, the importance of interactions, and the specificities (historical and institutional) of the evolution of learning. In the words of Lall (1992, p.169) in a pioneer work: "National capabilities are not simply the sum of thousands of individual firm-level capabilities developed in isolation. Because of externalities and interlinkages, there is likely to be synergy between individual FTCs", where FTCs stands for firm-level technological capabilities.

Innovations in this context include not only the development of new products and process but also the diffusion of knowledge based on minor, incremental innovations and adaptations of technology to the specific (technological, production, institutional) context in which firms operate. This approach sheds new light on the dynamics of the international diffusion of technology (catching up). If laggard firms have to learn how to use the leading technology in their specific conditions, it is not possible to make a clear-cut distinction between innovation and diffusion. Diffusion always requires adaptation, adjustments and (minor) improvements to function in a new environment. Taken in isolation, each of these changes has little impact. But their cumulative effect may set in motion an idiosyncratic technological trajectory with a significant impact on productivity and competitiveness.

Cumulative minor innovations are a driving force for catching up when the international technological frontier moves slowly. Investments in building technological capabilities may take place within formal R&D departments, but in many cases are part of the so-called informal R&D —the resolution of specific problems that come up during the investment and production processes (Katz, 1987). Engineers and workers use part of their time for trouble-shooting, which represents a crucial source of learning, in spite of being frequently unregistered. On the other hand, in periods of emergence of new technological paradigms or swiping transformation in the structure of production —as those brought about by robots, artificial intelligence and the information and communication technology, and

increasingly by biotechnology and nanotechnology—, this informal process of learning could fall short of what is required to catch up. The role of NSI becomes still more important in periods in which there is a transition between technological paradigms. Opportunities and challenges change radically in these periods, and policies are still more important to pick a more dynamic path.

The emergence of new technological paradigms has a loose relationship with market demand and relative prices. They are more closely related to scientific and technological breakthroughs spurred by public support in leading areas (frequently, but not exclusively, associated with objectives of national security) than with market guidance. As sets forth by Mazzucatto (2011, pp. 48-49): "*By being more willing to engage in the world of Knightian uncertainty, investing in early stage developments, for example dreaming up the possibility of the internet or nanotech when the terms did not even exist, it (the state) in fact creates new products and related markets. It leads the growth process rather than just incentivising or stabilising it*".

This point has been reinforced by Stiglitz (2014, p.21) when he discusses the reasons why the United States was (and probably is) the technological leader. He emphasises that this position could hardly be attributed to cut-throat competition. Instead, in his words, it was "*the result of government actions, in response to the Cold War that led to heavy investments in military research, which had large spillovers to the civilian sector (including, arguably, the development of the internet)*."

In sum, the he velocity of diffusion and its impact on productivity depend to a large extent on the domestic efforts (of firms and other actors that belong to the NSI) at learning. Firms are not passive "recipients" that simply select the most profitable technology from the shelves. Once a new capital good is imported, a new process adopted or the production of a new good started (even if this process / good are already used/produced in other countries), a learning process begins which gives rise to an idiosyncratic technological path, based on minor innovations. Again, diffusion/imitation/catching up are not automatic nor spontaneous: the word "imitation" should not carry any negative connotation when refereed to catching up with the technological frontier. Successful imitators took advantage of international spillovers, but success depends on domestic R&D and the NSI. Using foreign technology to build endogenous capabilities is an extremely difficult process that requires major local efforts to succeed.

IV. Institutions and power: Schumpeterian political economy

Rules of the game

Institutions are the rules of the game and are shaped by those who have power. If a certain institutional setting at some time contradicts the distribution of power —for instance, institutions in the labour market favours labour, but labour has negligible effective political power; there are regulations for curbing emissions or the depletion of natural resources, but contaminating firms and large mining companies are the main contributors to political campaigns; there are regulations to improve public education, but a significant share of the parliament is made of people who own private schools, and so on and so forth—, institutions will be changed. It is not infrequent that a country endorses formal rules (for instance, laws or regulations) which are simply ignored or by-passed (which means that actual institutions do not necessarily coincide with the rules laid by the law). Economic power can be translated into political power which in turn is used to strengthening economic power.[12] In the long run there should be a correspondence between power and institutions (both political and economic). The distribution of economic power depends on the production structure and the initial distribution of assets (including human capital). An archetypical case is that of an enclave economy, as described below.

- There are a few owners of natural resources and a large group of unskilled workers in informality or subsistence activities.

- The economy is highly specialized in exporting natural resources. The rents derived from these resources are extremely concentrated in the hands of the owners of the small exporting sector (that could also be controlled by foreign firms). The concentration of income and wealth reflects the lack of diversification of the economy, which demands few skills and capabilities.

- Workers have no expectation of improving their lot through learning and productivity growth within this simple production structure.

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[12] See Acemoglu and Robinson (2006). The classical book on the interactions between the production structure, political power and institutions is Barrington Moore (1966).

- The owners of natural resources have no incentives for investing in more knowledge-intensive activities for which the country do not have (static) comparative advantages or a skilled labour force.

- There seems to be no point in educating workers beyond the rather limited space defined by the simple exporting activities.

- There is a vicious circle of lack of education, capacity-building and diversification which reinforces inequality (in the economic and political fields).

- Political tensions will be high in such a structure. From the workers standpoint, besides emigration (which in many countries has been and still is an important mechanism for reducing tensions, as it was in Italy by the end of the XIX Century and beginning of the XX Century, and in Mexico and Central America in the post-war period), the only way out of poverty is the redistribution of the rents derived from natural resources.

- The response of the elite would be repression to avoid the distribution of rents and power, and the building of an encapsulated system of education, health and services for its members.

- The political economy that will prevail is a zero-sum game that revolves around pure redistribution and conflict.

The political tensions of economies with very high levels of land and income concentration are the focus of a rich scholarly tradition in political economy in Latin America (Sunkel and Paz, 1970; Cardoso and Faletto, 1977; for a more recent appraisal of political and economic interactions at work in the Latin American history, see Bertola and Ocampo, 2012).

Certain political structures help reproduce (and are reinforced by) less dynamic economic structures. For instance, slow growth in many regions of Brazil has been related to the weakness of the education system where European immigration was not significant and where land concentration was higher 100 years ago. Colistete (2017) shows that in Brazil in most of the XIXth Century, "*the richest sectors (landowners or not) provided for their children private schools or private tutors, and they did not depend on public schools. Inversely, public schools were to provide education for the large majority of the people, many of them illiterate. (…) The combination of poverty, illiteracy and centralization imposed a very high barrier for collective action for those with no access to primary schools*". As put by Arretche (2017) in the debate over latifundia, power and education in Brazil: "*You have three or four 'coroneles'* [big land owners]*, say, in each province, who own the latifundia and have control over the lives of the people. They control what these people need to survive. You may assume that the people want a school for their children. The "coronel" does not want to finance it. How could these people impose their will to the 'coronel*?"".[13]

Imagine instead a diversified, complex production structure in which all agents have a specific tangible or intangible (knowledge) assets which are critical for the level of productivity and competitiveness of the system. The complexity of the structure and the diversification of capabilities encourage cooperation between firms, governments and workers. The need of coordinating a large variety of capabilities —that must be put together to make the economy function— creates an environment which is much more conducive to cooperation than one which confronts the owners of natural resources with a destitute unskilled labor force. Coordination, cooperation and industrial policy (building the NSI) flourishes when there are capabilities that must be assembled to keep a complex structure competing in world markets. This kind of "Schumpeterian political economy" gives rise to positive-sum, cooperation games that produce more stable, democratic politics.

Conflict in the enclave economy may be softened when terms of trade are favorable, but becomes acute —to a degree which may threaten the stability of the political regime— when there is a negative

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[13] Interview, Marta Arretche, Piauí 124, January 2017, on the factors that limited the spread of basic education in Brazil in the XIX Century.

shock in the external markets. These shocks compromise the prevailing distribution of wealth and power and give way to major political and economic changes. A couple of examples for Latin America suffice to illustrate this point. In the 1930s the Great Depression eroded the economic basis of the oligarchic systems in place in many Latin America countries and gave way to new political coalitions that encouraged industrialization. In the 1970s, the end of the Bretton Woods, oil shocks and high international financial liquidity era favoured the emergence of dictatorships in the Southern cone (Argentina, Chile and Uruguay) that fostered rentier interests in the financial sector (the heydays of open capital accounts and the "monetary approach to the balance of payments", that prepared the ground the 1980 crisis).[14]

The Schumpeterian view summarized above goes well beyond the almost exclusive emphasis on property is that one usually finds in the literature (see the critical review of Chang, 2006). Indeed, to the extent that the NSI is defined by institutions that aims to maximize the diffusion of technology, and make it available to most producers, sometimes a strict protection of property rights cripples (instead of foresting) the NSI and development. If property rights are related to a monopoly power over land, capital or knowledge, then an explicit policy of challenging such rights is part and parcel of a development policy. State ownership has played a crucial role in the successful experiences of catching up: see for instance the nationalization of the financial sector in Korea in 1961, or the role that state enterprises play today in the Chinese industrialization.

In sum, rents from natural resources are redistributed through conflict between polarized agents (the "have" and the "have not") in an enclave economy; rents from knowledge are created though cooperation and more easily diffused to the whole economic system by rising employment and the bargaining power of workers. The politics of productivity is crucial in the long run to sustain the politics of redistribution and the stability of the system.

Institutions and power: the political trilemma of globalization

Rodrik (2016, chapter 3) suggests a simple framework to analyze the political economy of trade and integration in the global economy. He argues that there is a tension between the rules required for deep economic integration (or hyperglobalization), national states and democracy. He presents the argument in the form of a trilemma, reproduced below (diagram 2).

A trilemma is a situation in which there are three elements that can be combined in pairs, but the three cannot be present at the same time in full. Take for instance the combination of national states and deep economic integration. The latter implies the unimpeded movement of capital and labor across borders for which transaction costs must be reduced to a minimum. Rodrik argues that as most transaction costs arise from the existence of different legislations and rules across countries, they are created mainly by the nation states. Therefore, nation states are incompatible with deep economic integration, *unless* national governments fully adhere to free market rules and only legislate to minimize transaction costs and encourage trade and financial integration. But if national governments only do this and tehre are no policy options, then there will be a tension with democratic politics or, more generally, with an inclusive and competitive political system.

In effect, voters will not necessarily agree with the rules of deep integration. In particular, trade, labor and capital flows create winners and losers, and losers will resist —or to the very least strive to moderate— the impact of external shocks on jobs and welfare. If governments are responsive to voters, they will raise barriers, offer subsidies or impose taxes to redistribute income. All of these measures heighten transaction costs and eventually erode deep economic integration. To put it bluntly: deep economic integration requires either no national sovereignty or a national sovereignty which is just formal, in which the government does not have other choice than to apply the rules fully compatible with the globalization forces.

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[14] There is nothing automatic in the association between economic power, political power and institutions. The abovementioned change in the rules of the game by the dictatorships of Argentina and Chile was an extremely violent process in the 1970s. As regards the 1930s in Latin America, the Great Depressions led to either authoritarian rules to keep in place the "old" system or new social pacts that encouraged industrialization and in some cases income distribution.

Diagram 2
The political trilemma of the world economy. Globalization, nation states and democracy
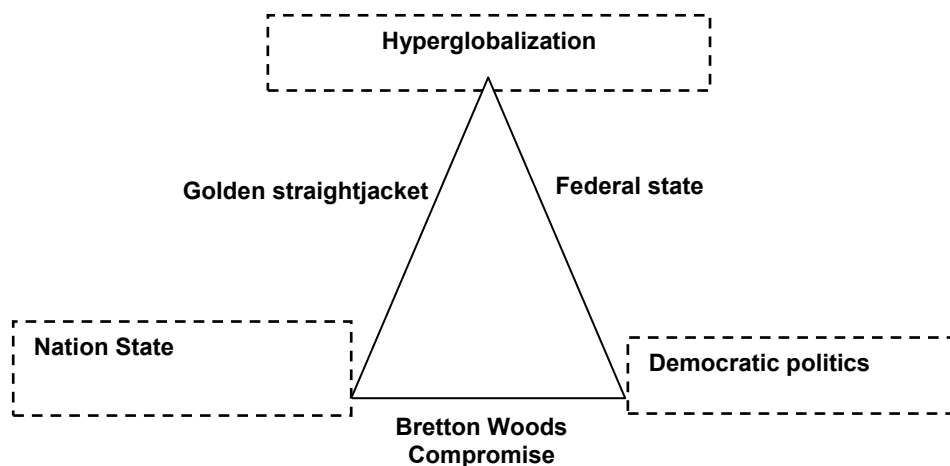
Source: Rodrik (2016), p. 182.

This scenario may be illustrated by the abovementioned cases of Argentina, Uruguay and Chile in the 1970s, when trade and financial liberalization was implemented *manu military*. In a less dramatic fashion, it could also be seen in some developing economies in the 1990s. These were the years of the Washington Consensus in which many analysts adopted the motto "*there is no alternative*" (TINA): free trade and deregulated financial markets were considered not only the main avenue for prosperity, but the *inevitable outcome* of powerful economic forces that constrained policy decisions in such a way that countries had one —and only one— possible course of action. The only option was to fully embrace the rules of free markets and abandon any attempt at regulating finance, trade and labor markets. This scenario is labeled by Rodrik as the "golden straightjacket" (see diagram 2) as it reminds of the rigid rules that constrained economic policy in the gold standard era. However, offering one and only one option to the voters is in contradiction with a competitive political regime. National states and democratic politics became a kind of empty shell under the TINA, which made this scenario politically instable.

The second scenario is one in which countries choose to keep the nation sate and democratic politics at the expense of deep integration. This scenario is labeled the "Bretton Woods compromise". In the 1944 Breton Woods Conference, 44 countries agreed on a new set of rules that would govern the international economy after World War II. These rules were based on a system of fixed exchange rate and the principle of the most favored nation (MFN) in international trade. The idea was to avoid discrimination in trade and prevent protectionism and currency wars from escalating. At the same time, Bretton Woods provided safeguards and preserved spaces for the nation states to temper the disruptive impact of trade and capital flows. The IMF and the World Bank were devised precisely as instruments that would help the nation states to adjust to international shocks, while the General Agreement on Trade and Tariffs (GATT) sought to encourage multilateral trade liberalization. In this sense, the Bretton Woods regime (until it collapsed in August 1971) represented a compromise: it combined international rules with some room of maneuver for the countries to manage their monetary, fiscal and trade policies.

The last scenario is one in which the nation state disappears and the world is organized as a federal democracy. This would ensure deep economic integration (there are no frontiers and hence minimum transaction costs) and political democracy (citizens may vote, for instance, for whatever tax system they prefer).[15] But would the emergence of a democratic global federal state represent the

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[15] The global federalism scenario would look like a strengthened version of the European Union.

ultimate victory of deep integration across federal regions? Not necessarily. Rodrik argues that a stable international economy demands more and not less state intervention in the markets —a point that Polanyi had already made in the 1940s.[16] Rodirk (2016, p. 36) argues that "the welfare state is the flip side of the open economy. Markets and states are complements in more ways than one." (Rodrik, 2016, p. 36). How does this approach apply to a highly asymmetric world in which the market dynamics generates polarization?

Even within a world of global democratic federalism, if there are substantial differences across regions in capabilities, there will be unbalances and tensions demanding specific responses at a regional level. Indeed, the dynamics of polarization *within* the nation state is the bread and butter of regional economics and of its core model of cumulative causation and multiple equilibria (see Brakman et al, 2009, chapter 3). Deep economic integration would crumble under the defensive responses of the regions to the disequilibria produced by heterogeneity in capabilities. Unless it is assumed that there is swift and frictionless labor migration across federal regions, transaction costs will have to be raised to prevent extreme polarization and inequality from destabilizing the political system. This perspective can be applied to analyze the special problems posed by sustainable development and the specific challenges faced by developing economies,as discussed below.

The sustainable development trilemma

Diagram 3 depicts a world in which heterogeneity in capabilities prevail at both the regional and international levels. It underlines the need of having global public goods and domestic industrial and technological policies that correct disequilibria stemming from increasing returns, path-dependence and lock in learning paths.

Diagram 3
The development trilemma. Hyperglobalization, heterogeneity in capabilities and sustainable development
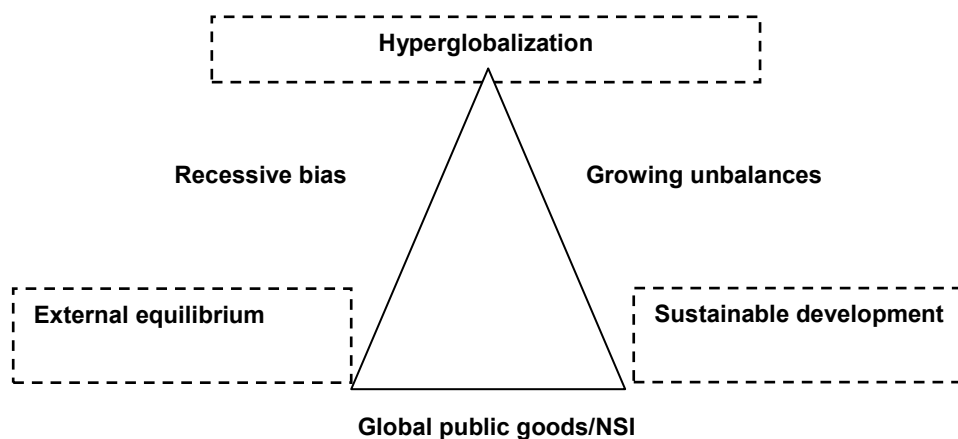
Source: The authors.

Diagram 3 presents the trilemma between *sustainable development*, external equilibrium and deep economic integration (hyperglobalization). Sustainable development is defined taking into account the economic, social and environmental dimensions (ECLAC, 2012). It implies fast growth in the developing economies so as to produce convergence in income per capita with the developed world. At the same time, the country must pursue active policies in favor of full employment, equality and environmental protection.

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[16]   In Polnayis' (1944, p. iii) words: "Our thesis is that the idea of a self-adjusting market implied a stark utopia. Such an institution could not exist for any length of time without annihilating the human and natural substance of society; it would have physically destroyed man and transformed his surroundings into a wilderness."

This combination of growth and enhancing social and environmental protection for development will boost the demand for imports. In a developing economy —a technological laggard— this will lead to a deficit in current account and growing indebtedness, which eventually compromises sustainable development (and may lead to global unbalances). To avoid this outcome (and to keep the current account in equilibrium, or at least to keep the deficit constant as a percentage of the GDP), the international system must provide global public goods and the national state must invest in the NSI to foster technological catching up. The concept of NSI will be used here as a shortcut to the crucial role that technological and industrial policies play in catching up and structural change.

In the case of the global public goods, they have to be produced through international cooperation aimed at: i) facilitating both technological spillovers to and rising exports from the developing economy; ii) international standards for labor and social protection that prevent developed and developing economies from engaging in a "race to the bottom" type of competition; iii) standards and agreements over CO_2 emissions and the destruction of the common goods; iv) regulations for financial capital flows that limit their destabilizing effects in the price of currencies and commodities, and domestic financial markets. These global public goods must complement and facilitate the adoption of industrial and technological policies for sustainable development. In more abstract terms, the NSI may be seen as producing a public good for the domestic economy, which is the creation of local knowledge.

The previous discussion is summarized in three scenarios represented in diagram 3.

- If there is neither global public goods (hyperglobalization) nor a strong NSI, and the developing economy embraces sustainable development, then it will face growing deficits and debt problems;

- If there is neither global public goods (hyperglobalization) nor a strong NSI, and the developing economy focuses on keeping the current account in equilibrium, it will reduce its rate of economic growth and the international economy will show a recessive bias (sluggish global growth);

- If there are both global public goods and a NSI that contribute to diffuse technology, and establish standards for labor and environment protection, then unbalances will be tamed and the global economy grow at a higher, more stable rate—and there will be no hyperglobalization.

The key role played by international public goods in shaping a stable, open international system is related to the discussion of institutions and political power developed above. In principle, the political obstacles to produce international public goods are higher than those that constrain the production of domestic public goods. For at the domestic level governments can impose taxes and finance the production of these goods, while there is no centralized power at the world level[17]. But this is not always the case: in some developing economies, power structures are so concentrated that it is almost impossible for a government to effectively tax the highest percentile of the population and provide, for instance, universal public education and health for most of the citizens.

The previous scenarios are Weberian types; in the real world more complex combinations of them are present. The Latin American countries, and Greece and Portugal in Europe, are representative of cases in which growth is recurrently halted by the emergence of external disequilibrium. China in turn is representative of countries having a strong NSI but which so far have not priorized environmental or workers' protection. Moreover, diagram 3 might be seen as a dynamic system, not just as an equilibrium outcome, which implies that some countries shift positions in a systematic way. For instance, a developing economy which stresses growth and social protection during a certain period will run a deficit and contribute to global unbalances; in the next period an external and financial crisis will force it to reduce growth, hence contributing to the recessive bias.

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[17]   The classical discussion of international public goods is Kindleberger (1986). For a recent analysis, see Smith (2017).

V. Combining the supply side and the demand side: a graphic interpretation

## Supply side and demand side

Micro-macro interactions were crucial in the previous discussion. Learning drives technical change and hence how the production structure is shaped through competition in open economies. Learning redefines patterns of specialization which have a strong impact on macro outcomes as the Keynesian (growth) efficiency and Schumpeterian efficiency of the structure evolve. Faster growth feeds back to investment which further stimulates learning. Micro-macro interactions give rise to either virtuous circles or growth traps which are at the core of the development process.

Development requires productivity growth and employment growth, along with the redefinition of the structure of employment. In a development process a significant part of productivity growth comes from the reallocation of labour across sectors. Otherwise high-productivity sectors become an enclave, as most of the labour force remains in low-quality (lower wages, lower knowledge-intensity) jobs. The average (and median) labor productivity will rise at very slow pace unless the workforce is reallocated towards higher productivity jobs —and more generally to what labor economists call decent jobs. But in order to generate better jobs and avoid the risk of having an enclave economy, structural change is necessary, i.e. the diversification towards more technology intensive activities. The quality of the new jobs depends on the quality of the activities and sectors that are created or expanded.

Structural change towards activities with higher demand growth and higher technological intensity brings about the cumulative, virtuous process envisaged by Kaldor, based on the various forms of increasing returns discussed in the previous sections. Figure 1 illustrates this point by putting together the evolution of labour productivity (π) and the evolution of total employment (N) in the economy. Aggregate demand/production (Y) will equal $Y = \pi N$. In the π-N space, the points a and d indicate the prevailing levels of productivity and employment in the developing (a) and developed economy (d), respectively. To simplify, it is assumed that the total number of workers is the same in the developing and developed economy and that there is full employment in the developed economy. The difference

between N_a and N_d is therefore tghe number of workers unemployed or underemployed (subsistence and informality) in the developing economy.

Figure 1
Assembling supply efforts and demand-lead mechanism
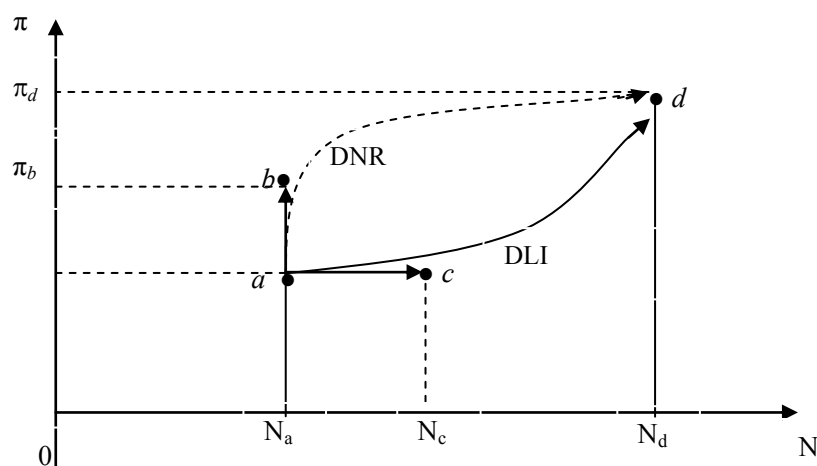
The arrows show different growth trajectories that illustrate the links between microeconomic learning and the expansion of aggregate demand.

Productivity without jobs. The path from point *a* to *b* represents an extreme case in which all economic growth is driven by productivity growth with no rise in employment. This is the case of an economy that responds by rationalization to an increase in competition (for instance, due to an appreciation of the real exchange rate) or to a period of contractionary policy or recession in the global economy (which heightens uncertainty as regards future growth). Technical change and adaptations aim at surviving in a context of slow expansion of aggregate demand. Another scenario that may generate the path *ab* is that of an enclave economy, in which productivity growth only takes place in few export activities which are very intensive in natural resources and capital (such as mining) and which have weak linkages with the rest of the economy. Such a pattern of growth fails to stimulate aggregate demand and therefore to boost the demand of labour in the domestic economy (Cimoli & Porcile, 2012).

Jobs without productivity. The move from point *a* to *c* in figure 2 is the opposite case, in which all growth is horizontal, driven by employment growth. Such a scenario is that of an economy in which low-productivity activities predominate, whose technological opportunities are weak and hence innovation and learning by doing do not play any substantial role. The economy expands but this does not create a fertile ground for learning. An illustration of this path is that of a maquila-led growth, with all but nil technological spillovers to the domestic economy. It is also the case of countries in which low technological capabilities and/or an appreciated RER compromise the expansion of exports, and employment is created mostly in low-quality services which are non-tradable and where productivity is stagnant.

The dynamic-efficiency path. Finally, the move from point *a* to point *d* describes an economy that traverses a path of increasing returns and positive demand and supply side interactions. In this economy there is a virtuous interaction between micro learning and macro growth. The economy is driven by structural change: new activities emerge that spurs technological innovation, capturing higher shares of domestic and external demand, which encourage investment and technical change. International competitiveness increases as the economy approaches the international technological frontier and reduces the technology gap. In a few words, this is an economy in which the Kaldor-Verdoorn law of

increasing returns and the Harrodian foreign trade multiplier (and the Thirwallian elasticities) mutually reinforce each other. For this to occur, production, employment and specialization patterns should change towards sectors that feature higher technological opportunities (Schumpeterian efficiency) and higher rates of growth of demand (growth and Keynesian efficiency). Both efficiencies go hand in hand.

A successful path from *a* to *d* can adopt different forms. Two examples are given in figure 2 neither of which are exclusive (other paths are possible). In one of them (dashed curve) the economy takes advantage of the comparative advantage provided by the country's endowment of natural resources to build capabilities around them and gradually move to activities with higher technological content. This is a process of diversification from an initial basis of natural resources (DNR). The importance of these resources for international competitiveness leaves its place over time to technology and knowledge, as diversification progresses, based on the exploration of forward and backward linkages from the export sector. Moreno-Brid (2012) has called the densification of the production structure as "Hirshmannian Efficiency".

In the other case (full curve), the starter of the virtuous circle is the initial competitive advantage provide by cheap labour in labour intensive activities (DLI). Demand growth stems from exporting to world markets based on cheap labour, in some cases coupled with redistributive policies that integrates a larger share of the population to the domestic market and raises the demand for consumer goods. Increasing returns mechanisms —the Kaldor-Verdoorn forces— steadily encourages investment and the upgrading of the production structure towards new activities, reallocating labour to them.

None of these successful routes from *a* to *d* is automatic or spontaneous (Chang, 2002). They do not come out endogenous changes in relative prices, but from the coordination of public and private investments to create linkages and technological spillovers (Rodrik, 1994). The industrial policy is crucial to make possible moving to a virtuous path.
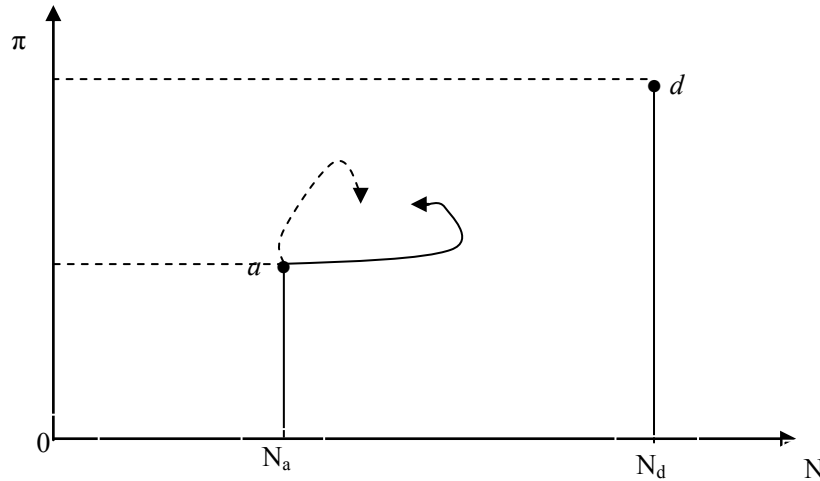
The traverse and the political and economic viability of growth paths

It was mentioned the key role of the political economy of structural change. Three aspects should be mentioned when comparing points *b*, *c* and *d*. The first point to consider is the convergence / divergence in GDP per capita. Compare points *b* and *d*. Productivity growth finds a barrier when it is solely driven by micro stimuli and does not interact with aggregate demanf. Firms may invest in technology, but this rate of investment and the rate of learning are weak when they are not supported by a vigorous expansion of effective demand and employment. The difference in productivity between *b* and *d* is an illustration of such a barrier to learning, while the difference between the areas defined by $O\pi_b b N_a$ and $O\pi_d \underline{d} N_d$ is a measure of GDP lost for not exploring micro x macro interactions. A similar conclusion can be drawn from comparing points *c* and *d*, where the GDP loss from slow learning is reflected by the difference between areas $O\pi_d \underline{d} N_d$ and $O\pi_a \underline{d} N_c$.

The second aspect is related to the political and economic sustainability of each of these possible growth trajectories. Growth based on the dynamic behaviour of few enclave activities entails the persistence of unemployment and growing inequalities between sectors and workers in terms of labour productivity. If there is a link between productivity and wages in each sector, ceteris paribus inequality will grow as the economy moves from *a* to *b*. The government may seek to correct this by taxing the high productivity, booming sector and redistributing income towards those in the low productivity activities and the unemployed. Such a strategy is in principle viable and there are examples in the real world. However, its implementation depends on very special political conditions, institutional and even cultural traditions. The political economy of redistributing oil rents in Norway and Venezuela, mining rents in Australia and Chile, or diamonds rents in Angola varies widely. The degree of conflict and political instability related to redistribution policies is in some cases very high.

The traverse from *a* to *d* counts on positive feed backs that lend momentum to the growth process. But the process is not smooth or free of setbacks. Figure 2 shows two growth paths which fail to achieve the virtuous circle path. Periods of recession, negative shocks in the international economy, systematicovervaluation of the real exchange rate and (political and institutional) weakness of the NSI may set the economy in a low-growth trap.

Figure 2
Traverse and hysteresis

The dashed curve represents a trajectory in which the economy cannot overcome its dependence on natural resources, while the full curve represents the failure of building up capabilities out of labour intensive activities. In both cases the economy fails to move from static comparative advantages to dynamic comparative advantages. The diversification path is —as put by Fajnzylber (1983)— "truncated". Hysteresis phenomena —the property of economic systems to "remember" past shocks— may imply that what seemingly are just minor setbacks to growth generate a long term decline in growth. A sharp fall in investment rates, the loss of some sectors with potential for faster productivity growth, and/or the absence of key supportive institutions for R&D, leave the economy more vulnerable to falling behind in the technological race.

Debt and currency crises may produce lasting effects. The fall in investment and growth in periods in which the economy must "tight the belt" to pay for the debt has consequences that extends beyond the adjustment period. This is the so-called Red Queen Effect: "it takes all the running you can do, to keep in the same place. If you want to go somewhere else, you must run at least twice as fast as that!" A slower pace of investment or institutional failure places the economy in a position which is increasingly distant from the international technological frontier.

VI. Concluding remarks

This paper discussed the microfoundations of learning and the importance of micro x macro interactions for convergence and divergence in GDP per capital —and more generally for sustainable development. It is intended to be a primer for a few key concepts used (implicitly or explicitly) in evolutionary modeling. The ongoing debate on micro x macro is complex and shows no signs of receding. There is still a long way to go in the methodological discussion on how to build economic theory on solid basis. One should not expect full agreement in the near future and it is indeed unreasonable to hold such expectation. Economics is a plural discipline in which different approaches and schools of thought coexist.

However, pluralism does not imply that all models and explanations are valid. Rigor in model building and empirical testing are crucial. The ultimate arbitrator should be the empirics —not only in terms of econometric tests, but also in terms of adherence to the rich evidence produced by economic historians and other social scientists. The discussion presented in this paper suggests that bounded rationality, satisfying behavior and institutions/rules of thumb/heuristics offer a better starting point to understand a "micro" behavior consistent with the very high levels of heterogeneity and divergence that can be found both in the international system and domestic economies. As argued by Farmer (2013, p. 384): "*Economics would be a more successful science if it were both more empirical and more open minded. These two go together: when empirical confirmation is the arbiter of success or failure, theories are judged on their merits rather than on their cultural lineage*".[18] We believe that this argument should be used as the keystone for selecting between different theories and economic models.

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[18] Milton Friedman famously argued that a good model is not one that has realistic assumptions but one that produces good predictions. In this sense there should not be a problem that perfect knowledge is conspicuously absent in decision-making in the real world if the predictions based on this assumption are validated by the empirical evidence.

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212

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