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Abstract

The microfoundations of economic models are a hotly debated topic in the literature. The debate is important because microfoundations —the ways in which agents decide and behave— have implications that go beyond a specific firm, market or activity; they strongly condition macroeconomic outcomes. Microfoundations should address at least three crucial questions: the nature of agents' rationality; how the form expectations and how capabilities are built, used and transformed (allowing for both adaptative and creative responses to a changing environment); the role of the institutional setting in shaping decisions, technological change and market outcomes. The three questions are interrelated; indeed, how the first question is responded determines to a large extent the answers to the other two.

Section 1 addresses the classical problems of rationality, uncertainty and institutions: when there is Keynes-Knight uncertainty and rationality is bounded, decision making adopts the form of conventional rules or heuristics. The hyper-rational representative agent of the rational expectations world could generate highly misleading outcomes in macro models. Section 2 applies this discussion to the study of technical change and to innovation and diffusion of technology in the international system, which transform the patterns of specialization. Section 3 discusses the forces that may trap a country in a low-growth trap and the crucial role of institutions in escaping from this trap.

I. Rationality and institutions in an uncertain world

A. Rationality

To define rationality is necessary to make assumptions about the ability of agents to collect and process information. Based on this ability they form expectations and decide what to do. As regards economic life, they have to form expectations about present and future prices, market shares, consumption patterns, the policy environment, technical change —including the emergence of new goods and sectors in the economic landscape—, just to mention a subset of relevant economic variables. One avenue to model micro decisions is to assume that a) firms have perfect knowledge of the parameters of the economic system and b) are able (at least on average) to make optimal decisions on production, consumption and innovation. Such an assumption is the basis of the rational expectation hypothesis which attributes to economic agents an almost infinite capacity to gather and process information. From this perspective, even if firms do not consciously optimize, the selection process in the market does, in such a way that only firms that behave as if they were following an optimization program would survive.

There are additional assumptions which are critical in the rational expectations approach. First, the artificial world constructed by the modeller herself is the one used by the economic agents to decide; second, this artificial world perfectly mimics the real world. As a result, agents' decisions take place at the same time within the universe of the modeller and in full correspondence with the real world.

In general, setting aside random shocks or short term disturbances, rational expectations place the economy in a path which is Pareto optimal. Transparency in the market place suffices to ensure optimal micro decisions which produce on the aggregate efficient macro outcomes.[1] Rational expectations have little to say about how firms learn, adapt, improve or innovate. Technology is a variable either fully incorporated into the process of dynamic optimization or takes the form of exogenous shocks. However, innovation is about discovering new things which, by definition, are not yet part of the agents' information set. Technical change is neither random nor perfectly predictable. Innovation and diffusion

[1] There is a room, nevertheless, for welfare-improving policies. When there are externalities and increasing returns, the spontaneous working of the markets produces sub-optimal results which need to be corrected.

follow systematic patterns that can be studied and understood, but this analysis requires moving beyond the world of rational expectations (see next section).

A second approach to rationality 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. The world is one of 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 maximization of expected utility or profits; uncertainty on the other hand implies that the distribution of probabilities is unknown and hence uncertainty is immensurable. 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). Some authors argue that it represents a situation in which not even subjective probabilities could be assigned to all the possible states of nature. Others, 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 are personal guesses. The crucial point is that, even if it is accepted the "soft" connotation of Keynes-Knight uncertainty (subjective probabilities), it does imply that expectations are based on guesses not only about the future but also about how other agents perceive the future. Expectations are therefore constructed from an inter-subjective process which has fragile basis, which makes them volatile; such a process could not be encapsulated in the modellers' exercise in dynamic optimization of the 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. This means that uncertainty is at the heart of the two key dynamic forces of the economic system—investment that embodies new production capabilities and technical change that transform these capabilities. For Keynes, the capitalist economy is essentially unstable because of the combination of two factors: firstly, investment plays a crucial role as a source of effective demand, creation of new capabilities and as a vehicle for technical change; secondly, it strongly depends on expectations whose bases are fragile and which may vary swiftly and unpredictably—responding to waves of optimism, "irrational exuberance", panics, herd behaviour and manias.[2] Instability is part and parcel of the workings of the market system, particularly of financial markets, where assets are highly liquid, highly interconnected and can be traded at a very high speed. These features of the financial markets tend to amplify the impact of sudden changes in expectations and the "animal spirit".[3]

[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 as well endogenous but much less predictable. Economic historians like Kindleberger and people deeply involved in 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 the markets. This is also the focus of a growing research field, that of behavioural economics (see Kanheman, 2003).

[3] Recurrent crises and "Minskyan moments" are at odds with the hypothesis that financial markets are efficient. Puzzling enough, Eugene Fama, who defended the efficient markets hypothesis (EMH) in finance, shared the Nobel Prize in Economics with Robert Schiller, who defended the opposite view. The sharing of a Nobel Prize by two authors who are exactly in opposite sides of the debate is somewhat embarrassing and evidences the inability of the profession to agree on some crucial issues (like what explains a major global financial crisis).

B. Institutions

All in all, 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, rules of thumb or heuristics. Perfect knowledge and high rationality are beyond the agent's capabilities; but diffused, socially accepted norms provide a basis for decisions in a context of uncertainty and bounded rationality.

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 decide within a time period that 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 and swept away by high-tech barbarians that redefine the parameters of the model in ways that not even the reckless barbarians could predict. The barbarians themselves discover only gradually where creative destruction is taking them; in the same vein, the routine-driven agents of the Walrasian equilibrium slowly understand that 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.[4] 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, the exchange rate regime or the industrial policy. There is a hierarchy of heuristics in which meta-heuristics are used to change the current ones, responding to the evolution of the external or internal context in which the firm operates.

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)[5] 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 atributes 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, 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. The idea of institutions placing

[4] 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).

[5] For a critical analysis of the different meanings that the word "institutions" has taken in the literature see Hodgson (2006).

constraints to human behaviour is alien to the world of atomistic competition since there is indeed 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 where there are big players.

The "representative", hyper rational agent does not interact with its environment or with other agents in any relevant sense. For she takes decisions at time zero and from this very moment incorporates 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. 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. This is persistent source of heterogeneity in the economic system.

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 would 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, nature and intensity of future environmental crises (Stern, 2013). Neither can they produce reliable estimates of the impact of CO_2 emissions on the temperature of the earth, or of rising temperatures on GDP and consumption. These two relationships (from CO_2 to earth temperature and from earth temperature to GDP losses) form the so-called "damage function", which is crucial for computing the negative externalities of climate change (Pindyck, 2015, p.865).

Although there are many economic models that aim to measure the negative impacts of climate change, they offer little help to decision-makers. More than that, they could even be counterproductive for policy analysis. In a recent review of the findings of these models, Pindyck suggests that they convey a deceiving sense of precision, while grossly downplaying the risks and potential costs of climate change. And yet decisions and actions have to be taken. What is to be done? 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 'plausible'*". From a Keynes-Knight standpoint, this means that one 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, one should adopt conventional or consensual rules emerging from the debates of the scientific community as regards what can be considered reasonable to expect with such a limited amount of solid information.

Summing up, the hypothesis of bounded rationality represents a more realistic approach to how agents behave and to how policies are formulated in a context of uncertainty. In addition, this hypothesis produces better predictions on macro outcomes[6]. What require explanation are large and persistent differences in productivity, in technological capabilities, in the complexity of the production structure, along with divergence in real wages, income levels and institutional arrangements. To understand asymmetries and divergence—pervasive in the real world—, bounded rationality and institutions are a more useful starting point than high rationality.

[6] 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. This is not the place to address this crucial issue in economic methodology (for a discussion see Farmer, 2013).

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

A. Localized learning and tacitness

The previous discussion on rationality and decision-making has important implications for thinking of technical change and structural change. 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 the same quantity with less capital and labour. This view was abandoned in most growth models since the early eighties,[7] although exogenous technical change still pervades empirical work measuring total factor productivity.

Two early dissenters of the isoquant approach to technical change 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. In other words, there is 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 (1982) and the evolutionary literature (for an early review see Dosi, 1998),[8] who suggested the concepts of "tacitness" and routines. Such concepts contain and extend that of localised technical change.

A central theme of Nelson and Winter is that firms´ capabilities are embodied and reproduced in "routines" which in turn have a tacit content, meaning that they cannot be fully translated in words or learnt from manuals. Routines are based on systematic repetitions, on heuristics that agents perform

[7] Endogenous growths models made innovation a function of variables within the economic system, in some cases the result of deliberate efforts by the firm to create monopoly rents.

[8] Nelson and Winter (1982) also stressed the role of heterogeneity and disequilibrium in technical and structural change.

almost automatically. They are the crystallization of experience: as such, they are context-specific, idiosyncratic and could not be encapsulated in or transferred through codified instructions. The role that experience is central in learning gives rise to the well-known increasing returns function, in which production costs fall as the experience in production, investment and innovation accumulates.[9]

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 set of articulated steps which could not be explained in words and which are rooted in the person's experience.[10] 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'*".[11] 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 is not done 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 production routines and adjusted to specific market, technological and cultural conditions

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 addressed below.

B. 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 "leaps" 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. 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 the existing capabilities and production processes (Narula, 2004; Cimoli and Porcile, 2011). In open economies, what the country produces and learn depend on its pattern of specialization. The international division of labour has significant learning consequences: the pioneer contributions of Lall (1992, 2000) and Pavitt (1984) already provided 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 other sectors are "supplier dominated". The perception that some sectors are the crucial loci of innovation is widely acknowledged in the technological and business literature (see for instance a recent assessment in Foresights, 2013), although is less pervasive in the economic profession. An economy whose firms mostly compete in sectors with high technological and growth opportunities will 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

[9] Dynamic increasing returns arising from learning add to other traditional sources of increasing returns, like fixed costs.

[10] 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!!*".

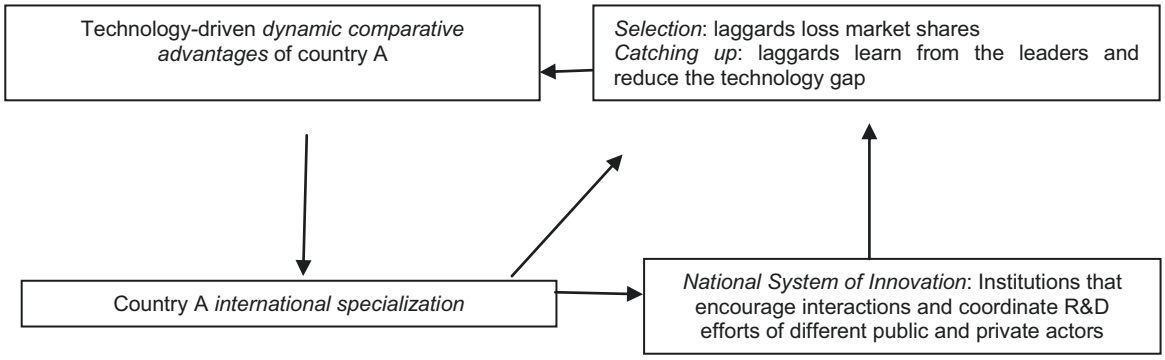
[11] It is interesting to note the similarity between the concept of routines in the firm and institutions in the social system. Both concepts refer to "*standardized patterns of human transactions and interaction*" (Nelson and Nelson, 2002). This makes this authors refer ti institutions as "social technologies".

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 quality between firms located in different countries. 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 fluctuate along with the "commodity lottery" and may experience a decline as technical change reduces the content of natural resources per unit of production, or create substitutes whose dynamics is knowledge-driven (and hence unskilled labour and natural resources loss importance as competitive assets). Conversely, rents based on knowledge and on the ability of moving upwards in the quality and productivity ladders allow the firm to respond faster to economic shocks. Rents from knowledge do not tend to decline, but are continuously recreated through innovation (Reinert, 1995; Saviotti and Frenken, 2008).

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. The pattern of specialization of a catch up economy increasingly relies on dynamic comparative advantages and knowledge-intensive sectors. To move in this direction it is necessary that 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 that redefines what firms and countries do.

Figure 1 offers a schematic representation of the interplay between learning, capabilities, the technology gap and international specialization.

FIGURE 1
THE RACE BETWEEN INNOVATION, DIFFUSION AND SELECTION IN THE GLOBAL MARKET



Source: own elaboration.

Figure 1 tells the story about diversification and technology-driven leads and lags in productivity and quality. Assume that there are asymmetries in productivity between firms in the laggard country A and firms in the advanced country B. 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). These asymmetries entail that firms in country A will be competitive mostly in sectors which are less knowledge intensive, which define country A's comparative advantages. 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 A may be inefficient from a dynamic perspective, as the country production concentrates in sectors or activities with lower

technological opportunities (lower Schumpeterian efficiency) and a lower rate of demand growth (lower Keynesian efficiency).

Assume now that some firms in country A aim to enter a new, more knowledge-intensive sector whose growth prospects and potential profits are higher. Their 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). But the space conferred by static and policy-based comparative advantages decline 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. Sooner than later firms in country A will have to reduce asymmetries in capabilities in order to survive.

There are two kinds of forces that define whether firms in country A will survive or not in the new sector they entered. First, the *selection process* concentrates market shares in the firms closer to the technological frontier. If the initial gap and the intensity of the selection process are high, the new entrants (from country A) in the market will not survive. In the opposite direction, the *diffusion process* allows firms in country A to learn from best practices in country B and reduce the technology gap. If catch up is faster than selection, firms in country A diversify and hence the country changes its pattern of specialization by increasing the share of knowledge-intensive sectors in the production structure. Such an increase will in turn accelerate the learning process, producing a virtuous feedback loop from capabilities to learning. But the efforts of imitators may be impaired by increasing returns that widen initial asymmetries (falling costs of production due to accumulated experience by the first comers). 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.

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, which are related to tacitness, increasing returns in technological change and the institutional setting.

III. Structural inertia, lock-in and the role of institutions in escaping from a low-growth trap

A. Path dependency and structural inertia

Tacit knowledge and experience-based learning gives rise to *path dependence* in the evolution of capabilities. What a firm knows today is a function of the capabilities it created yesterday and of current production patterns (recall that current capabilities define the feasible region of learning). Moving to new sectors or activities that are technologically detached from current production would be difficult, even if there are signals indicating that these new sectors offer higher returns in the future. 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 the accumulated experience. The corollary of increasing returns to learning is that early movers tend to keep their competitive advantage over late comers. 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. (Cimoli and Dosi, 1995).

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. The latter means that the firm will have to compete with firms that have already been moving down the learning curve for a while (of course this would not happen if the firm invests in the sector in which it is an incumbent). 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; see Dosi et al, 1990). The failure to diversify in turn 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 3conomy becomes more integrated to the world economy mostly though intra-industry trade.

A related concept is that of *hysteresis*, which designs a process in which a transitory shock transforms the economy in a persistent way (it cannot be reverted). The effect of a shock lasts in the

hysteresis phenomena well beyond the moment the shock ceased. This concept is useful in discussing the links between the short run and the long run. Changes in policies that are seen by policy makers as affecting solely the short run, or which are adopted under very special circumstances, might alter the long run path of the economy (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. As regards economic growth, in a world of fierce technological competition, hysteresis may be a more general phenomenon than usually acknowledged in the literature.[12] 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. When normal times return neither the ground lost in the technological race nor the firms and capabilities lost in the crisis would be recovered.

The New Keynesian School in macroeconomics 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 the 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 may be false. 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 existing capabilities and 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 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.

B. 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 figure 1; see

[12] 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).

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." Lundvall (2004, p. 7) in turn 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.

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 firms react to specific institutional, market and technological 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, that are the outcome of learning by doing and learning by using, has little impact. But taking their cumulative effects through time they set in motion a transformation that could have a large 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 on formal R&D departments, but in many cases are part of the so-called informal R&D— the resolution of specific problems (related to the specific competitive and technological conditions of the country in which the firm operates) that come up in the production process (Katz, 1987; Cimoli and Katz, 2003). Engineers and workers use part of their part for trouble-shooting which represents an idiosyncratic but significant source of learning. On the other hand, in periods of emergence of new technological paradigms, of swiping transformation in the structure of production —as those brought about by information and communication technology, and increasingly by biotechnology and nanotechnology— this cumulative process of learning could fall short of what is required to participate in global trade. 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, as argued in chapter 1.

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, 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 a negative connotation when refereed to catching up with the technological frontier. Successful imitators took advantage of international spillovers, but success depends on the NSI. Using foreign technology to build endogenous capabilities is an extremely difficult process that requires major local efforts to succeed.

IV. Institutions, power and Schumpeterian political economy

There is behind all the previous discussions a dynamics of power, conflict and cooperation that evolves along with structures and technology. It is necessary to address the political economy of structural change and the building of capabilities. This problem could not be fully discussed in this paper, but some directions for further research will be suggested.

Institutions are the rules of the game and are shaped by those who have economic and political power. If a certain institutional setting 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. Economic power can be translated into political power which in turn is used to strengthening economic power.[13] In the long run there should be a correspondence between them.

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. 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 small exporting sector. 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 productivity and learning within this simple production structure. The owners of natural resources have no stimulus for investing in more knowledge intensive activities for which the country do not have (static) comparative

[13] See Acemoglu and Robinson, 2006; this is a rather old topic in LA political economy, see Sunkel and Paz (1981). The classical book on the interactions between the production structure, political power and institutions is Barrington Moore (1966).

advantages or a skilled labour force. There seems to be no point in educating workers beyond the rather limited space defined by the exporting activities. There is a vicious circle of lack of education, training and diversification which reinforces inequality (in the economic and political fields). Political tensions will be high. From the workers´ perspective, the only way towards higher equity (and out of poverty) is the redistribution of the rents derived from natural resources. This is a zero-sum game that revolves around pure redistribution and conflict.

Imagine now 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 the 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 extremely acute—to a degree which threatens the stability of the political regime—when there is a negative shock in the external markets. These shocks reshape the viability of the existing production structure and compromise the prevailing distribution of wealth and power, giving 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 era favoured the emergence of dictatorships in the Southern cone 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]

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 political system.

[14] The 1930 crisis led to either authoritarian rules to keep in place the "old" system or new social pacts that encouraged industrialization and income distribution. In some cases it led to a cycle in which both kinds of political regimes.

V. Combining the supply side and the demand side: learning and growth paths

A. Supply side and demand side

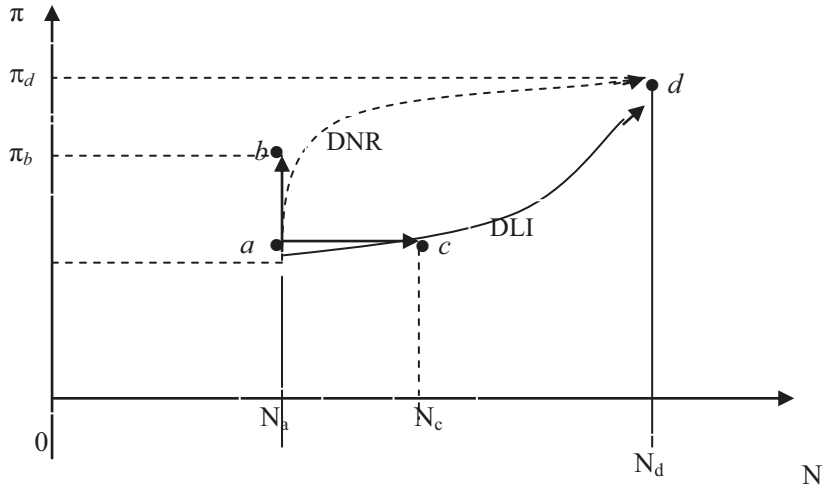
So far the discussion has focused on micro-macro interactions leading to convergence and divergence between firms and countries in capabilities and GDP. Learning redefines patterns of specialization which strongly impact on macro outcomes (out of growth-Keynesian and Schumpeterian efficiencies); there is a feed-back loop from macro performance to investment and learning. Micro-macro interactions generates patterns of growth, growth traps or virtuous circles 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. A significant part of productivity growth must come from the reallocation of labour across sectors and activities. Otherwise the economy will be an enclave, in which productivity concentrates in few activities while most labour remains in low-quality (lower wages, lower knowledge-intensity) jobs. The average (and median) productivity rises only at very slow pace unless the workforce is reallocated towards higher productivity (decent) jobs. But to generate new employment patterns and avoid the enclave economy, structural change is necessary —i.e. the diversification towards a more technology intensive, complex economy. The quality of the jobs depends on the quality of the activities and sectors that are being 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 2 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 space of π-N, the points a and c indicate the prevailing levels of productivity and employment in the developing (a) and developed economy (b), 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_c is therefore unemployment or underemployment (subsistence and informality) in the developing economy.

FIGURE 2
ASSEMBLING SUPPLY EFFORTS AND DEMAND-LEAD MECHANISM



Source: own elaboration.

The arrows show different growth trajectories that illustrate the links between microeconomic learning and the expansion of aggregate demand.

Productivity without jobs. The move 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 policies 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 little linkages with the rest of the economy. Such a pattern of growth fails to stimulate aggregate demand and therefore 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 the real exchange rate compromise the expansion of traded goods, and employment is created mostly in low-quality services which are non-traded 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 complementary demand and supply side efforts. 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 reinforces 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 mutually reinforce each other. For this to

occur, production, employment and specialization patterns should be transformed towards sectors that feature higher technological opportunities and higher rates of growth of demand. Growth-Keynesian and Schumpeterian efficiencies go hand in hand.

There is no unique successful path from *a* to *d*. Two examples are given in figure 2.3 neither of which are exclusive (other narratives are possible). In one of them (dashed curve) the economy dwells on the comparative advantage provided by 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), whose importance as a source of international competitiveness leaves place over time to technology and knowledge. Exports of natural resources support the creation of forward and backward linkages required to stimulate GDP growth. 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 these new activities. None of these routes from *a* to *d* is spontaneous (Chang, 2002). They will not come out endogenous changes in relative prices, but from the coordination of public and private efforts to create linkages and technological spillovers.

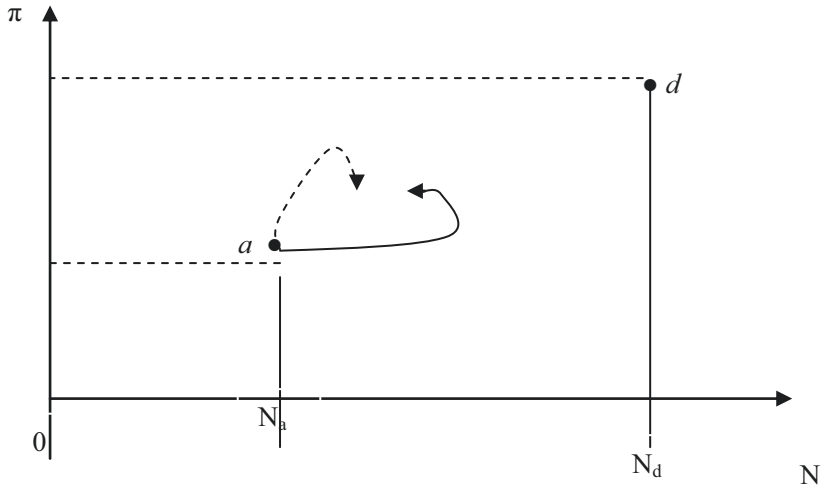
B. The traverse and the political and economic viability of growth paths

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 is the impact of each path on total GDP. Compare points *b* and *d*. Productivity growth finds a barrier when it is solely driven by micro stimuli and does not interact with aggregate growth. 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 $O\pi_b bN_a$ and $O\pi_d dN_d$ 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 $O\pi_d dN_d$ and $O\pi_a dN_c$.

The second aspect is related to the political and economic sustainability of each of these possible growth trajectories. Growth driven by productivity gap in few 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 and profits 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 underemployment. Such a strategy is viable and there are examples in the real world. However, its implementation depends on very special political conditions, institutional and even cultural traditions of the country. The political economy of redistributing oil rents in Norway and Venezuela, copper rents in 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, as mentioned in the previous section.

The traverse from *a* to *d* counts on positive feed backs that lend momentum to the growth process. But it is not smooth or free of setbacks. Figure 3 shows two growth paths which fail to achieve the virtuous circle path. Periods of recession, negative shocks in the international economy, consistent overvaluation of the real exchange rate and (political and institutional) weakness of the NSI may set the economy in a low-growth trap.

FIGURE 3
TRAVERSE AND HYSTERESIS



Source: own elaboration.

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. 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. 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.

C. Concluding remarks

This paper discussed the microfoundations of divergence in macro performance. The paper is intended to be a primer for a few key concepts in the modeling of economic behavior. The ongoing debate is complex and shows no signs of settling. There is still a long way to go in the methodological discussion as regards 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 expectations. Economics is a plural discipline in which different approaches and schools of thought coexist. But pluralism by no means implies that all theories are valid. The ultimate test should be empirical, not only in terms of econometric tests, but also in terms of adherence to the rich evidence produced by economic historians. The discussion presented in this paper suggests that bounded rationality and institutions offer a better starting point to formulate models of "micro' behavior that are consistent with the very high levels of heterogeneity and divergence in the international system and in 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".

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