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Bringing institutions into evolutionary economics: another view with links to changes in physical and social technologies*

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Abstract: Like Nelson (2002), I make a case for bringing institutions into evolutionary economics. But unlike Nelson, who defines institutions as social technologies consisting of rules-routines, I define them in agreement with North (1990) as humanly devised rules-constraints — such as formal law and informal social norms — but also view them, to accommodate most of Nelson's approach, as constraining the variety of rules-routines employable by agents. I show that this definition has advantages for communicating with modern institutional analysis, for clarifying how institutions can influence, and be influenced by, changes in physical and social technologies, and for producing policy implications.

Key words: institutions, rules-constraints, rules-routines, social technologies, economic evolutions

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1 Introduction

Like Nelson (2002), I am convinced of the need to bring economic institutions into evolutionary growth theory, and more generally, of the need to connect institutional economics with evolutionary economics, not only for further development of theory, but also, and perhaps above all, for reliable assessment of policies. The question how best to do so has also preoccupied me for several years.[1] But what I have found to be the most fruitful way of doing so differs from Nelson's.

The roots of this difference are in the old conceptual dilemma encountered by several economists who have searched for an operationally clear definition of institutions, which can roughly be stated as follows: should institutions be defined as constraints, comparable to "the rules of a game," or as routines, meaning "specific ways of playing a game"? Nelson (2002), drawing on Nelson and Sampat (2001) with references to Schotter (1981) and Sugden (1989), opts for the latter, and moreover denotes such routines as "social technologies." In contrast, I have found strong reasons why evolutionary economists should definitely prefer, in agreement with North (1990), the former. The purpose of this paper is threefold: to present these reasons, to consider the consequences for evolutionary economics of bringing into it institutions qua "the rules of a game," and to show how this will help evolutionary economics to deal with two important but so far insufficiently explored issues: namely, how technological and institutional changes may depend on each other, and how the performance of economies may depend on their institutions and be improved by feasible policies.

No substantial conflict with Nelson's approach is implied: after a terminological adjustment, it is offered a well-defined place in a broader theoretical framework. The adjustment is that Nelson's term "social technologies" is recognized as useful, but not, as he also suggests, as a synonym for "institutions." His approach is thus approved of for dealing with changes in physical and social technologies, including the often intricate relationships between the two, but not directly with institutions.

At first sight, as authors are usually granted the freedom to define the terms they use according to their preferences, provided they stick to their definitions throughout their entire arguments, such a terminological difference may seem to be a matter of personal taste. But for

[1]More precisely since 1984, when I joined the Industrial Institute for Economic and Social Research in Stockholm, where the role of institutions in the dynamics of market economies was then in the focus (see, e.g., Day and Eliasson, eds., 1986, and Eliasson, ed., 1987). For main stages of this search, see Pelikan (1988, 1992, 1993, 1995, 1999); the link to policy analysis is elaborated in Pelikan (2003b).

the question of how to bring institutions into evolutionary economics, this is definitely not the case. There is a large set of theoretically interesting and practically important problems that suitable combinations of evolutionary and institutional analyses can potentially handle, but how much of this set becomes visible and actually accessible to analysis strongly depends on the way in which the key concepts are defined. What I argue is that North's definition of institutions provides for analysis of a significantly larger part of this set, including all the problems of social technologies addressed by Nelson (2002), whereas Nelson's definition hinders access to many of its important areas, such as those concerning property rights, law and economics, and reform policies.

In other words, most of my disagreement with Nelson can be seen to concern the efficiency in the allocation of terms to concepts. In particular, I entirely agree with him that the concept of routines which guide agents' communicating and transacting with each other, and which can thus be regarded as the "ways of playing the economic game," is very important. But I argue that it fully suffices to name it "social technologies." To name it moreover "institutions" would be a terminological waste, as this concept would thus be labeled by two different names, while no suitable name would be left for the no less important concept of "the rules of the economic game," such as formally codified laws and culturally evolved ethical norms.

To be sure, there is also the possibility to use the term "institutions" for both. In the literature, indeed, this term has been used in both these meanings — and in many more! — and often by the same authors.[2] But these are definitely not good examples to follow. Operationally clear analysis can hardly be built on ambiguous terms, of which each may mean several conceptually different things. The ambiguity with which this term was used in the old institutional economics must also be seen as one of the main reasons why that economics — in spite of the great importance of the problems which it was bringing to economists' attention — lost much of its influence when theoretical economists began to require operational clarity. As considered in more detail below, one of the greatest merits of North's (1990) definition is precisely its ability to put institutional economics on an operationally clear basis and allow all the important problems of the old institutional economics to be treated with analytical precision.[3] If many evolutionary economists have waited until now to import institutions into their theories, it

[2]An instructive survey of most of these meanings is in Nelson and Sampat (2001).

[3]Allow me to mention, without claiming it to be relevant evidence for my argument, that North's contributions to the development of modern institutional economics were rewarded by Nobel prize.

would be wise to profit from the only advantage of such a long delay — the opportunity to import the newest and most successful model, free from the defects of the old ones.

This paper is organized as follows. Section 2 introduces and clarifies the present definitions: following North (1990), institutions are defined as rules-constraints and divided into formal and informal; following Nelson and Winter (1982), technologies are defined as rules-routines; and following Nelson (2002), technologies are divided into physical and social. Section 3 points out the main differences and possible overlaps between institutions as rules-constraints and technologies as rules-routines. Section 4 surveys the advantages for evolutionary economics of defining institutions as rules-constraints. Section 5 turns attention, as also Nelson (2002) does, to the evolutionary relationships between technologies and institutions, but the different definition of institutions leads to different relationships. These include the influences of changes of technologies on changes of institutions, as can be seen, after a terminological adjustment, to be pointed out by Marxists, and the influences of institutions on changes of technologies, as was studied by North and Thomas (1973). To conclude, Section 6 connects the influences in both directions into a rough feedback model, deduces from it some necessary conditions for evolutionary stability of economic institutions, shows why knowing which institutions could meet these conditions is of importance, and uses all of this as evidence that evolutionary economists, if they are not to impair their vision seriously, need to import institutions as rules-constraints, and not rules-routines.

2 Choosing the definitions

The definition of institutions which I argue is most suited for uses in evolutionary economics is, as noted, the one given by North (1990, p.3): "Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interactions."

For economic analysis, this shaping can be made operationally clear by viewing an economy's institutions as constraints reducing the choice sets of its agents. To provide for compatibility with Nelson (2002), they can also be viewed as reducing the variety of rules-routines that the agents are allowed to use for guiding their behavior and making their choices. The reasons why an agent would effectively respect such constraints include cultural conditioning, sanctions that punish their violation, and self-discipline based on rational awareness of their benefits.

The benefits of institutions are usually seen to concern social interactions: if all agents accept the costs of letting institutions constrain their choices, then the benefit for each is a higher predictability of the choices of others. But there is also an extra bonus, as this may effectively *enlarge* their sets of *promising* choice alternatives. Namely, many potentially advantageous alternatives would never be so actually, unless certain institutional constraints — such as respect for property rights and contracts — were generally respected. Moreover, as pointed out by Heiner (1983), some of the benefits may also be purely individual: if a person's competence for making some difficult choices is limited, institutions may usefully simplify such choices by reducing the number of choice alternatives, thus saving her from committing possibly costly errors due to what Heiner terms "competence-difficulty gaps." Of course, as will be considered below, all these benefits also depend on the specific form of institutions: different institutions may be differently beneficial for different agents and for the entire economy, and this may strongly influence the reasons for respecting them.

It is often important, as done by North (1990), to divide institutions into *formal*, such as written laws, and *informal*, such as unwritten social norms. Both are indeed humanly devised, but in different ways: formal institutions originate in deliberate legislation, or deliberate verdicts of courts, and informal institutions in spontaneous cultural evolution (e.g., as described by Hayek, 1967). The two can be, and often are, closely interrelated: informal institutions can become formally codified, as is the case of common law, and formal institutions can become culturally assimilated — and must indeed be so, if they are to be effectively respected without an extensive police state.

From an evolutionary point of view, an important difference between formal and informal institutions is in the speed at which they can change (evolve): while a determined policy-maker (legislator, reformer) can change formal institutions overnight — e.g., as happened in the former East Germany after reunification — informal institutions cannot but evolve relatively slowly and are more difficult to influence by policy. In consequence, informal institutions often constitute a severe constraint on how fast an economic reform, however urgent it might be, can effectively proceed. This does not mean, however, that the needed changes of formal institutions should deliberately be slowed down and spread piecemeal over a long period — e.g., as the opponents to rapid transformation of the formerly socialist economies used to

argue. This constraint only means that the favorable effects of such changes may be slower in coming than may have been naively expected (Pelikan, 1992).[4]

An important effect of North's definition is that the large mixed bag of possible meanings that the word "institutions" has been given, both in common speech and in the social sciences, is reduced to an operationally clear nucleus. Such a radical reduction is indeed necessary for allowing institutional economics to become rigorously analytical, with well-defined connections to other parts of economic analysis — in particular the theory of property rights, constitutional political economy, and the entire field of law and economics, where some of the most important practical applications of theoretical economic analysis are now being produced.

That institutional analysis based on this definition need not oversimplify real-world problems deserves to be spelled out. Namely, all the other possibly important things which institutions have sometimes been seen to include, but North's definition excludes, can very well be taken into account under different names, and with more conceptual precision than when mixed together under the same label. In addition to Nelson's (2002) "social technologies," considered in more detail below, perhaps the most important examples are money and organizations. Money is simply seen, much like in standard economics, to be a scarce resource which can be exchanged for other scarce resources or saved. But institutions are recognized to be decisive for determining what things may or must be used for these purposes, and how they can be produced. These institutions may be formal, such as the law that makes it obligatory to accept as means of payment certain paper notes which only a state bank is permitted to issue, or informal, such as the culturally evolved custom to use as such means certain real resources, for example, gold or cattle.

The example of organizations is somewhat more complex. Intuitively, the relationship between institutions and organizations can simply be seen to correspond, as noted by North (1990, p.4), to the one between the rules of a game and its players. But one difficulty is that the

[4]One anonymous referee appeared to disagree by arguing that "evolutionary institutional analysis and respect for divergent values inherent in established informal and to-be-established formal institutions may, in fact, present problems for constructivist big-bang reforms." But the disagreement is less important than it may appear to be. My point is not to deny that such problems exist, but only to claim that in spite of them, formal institutions should be established as rapidly as possible in the final form in which they may be expected to provide for reasonably efficient economy in the long run. To change the formal "rules of the game" slowly through several successive changes can hardly have other effects than substantially increase learning and transactions costs. Solid empirical evidence now also shows that the more slowly a formerly socialist economy has been reformed, the worst its actual situation. Concerning the constructivism of such reforms, it should be seen as political effort to repair the damages caused by the constructivism with which the economies were made socialist, damages for which purely spontaneous healing through actions of individual economic agents is highly unlikely.

two have often been confused not only in the old institutional economics, but also in most natural languages, in which many organizations — especially large lasting ones, such as ministries, central banks, or universities — are often also called "institutions." In consequence, using this term in the unambiguous meaning of rules-constraints also requires overcoming some old and widespread habits. Another difficulty is that to make the relationship between institutions and organizations entirely clear, it is necessary to distinguish between institutions of different organizational levels — in particular the overall institutions of a national economy and the internal institutions of each of its organizations, such as firms and governments bureaux.

An example of the problems in which clarity requires such a multilevel view is the evolution of large firms, as described by Nelson (2002, pp. 23-24). Some of the new institutions that were then appearing are indeed new rules of the game within firms — e.g., dividing them into divisions and specifying the rights and obligations that different divisions have vis-a-vis each other and vis-a-vis the headquarters — whereas others belong to the national level — such as the corporate law that sets limits to what the internal institutions of firms are allowed to be. In spite of this difference, however, they are both institutions, in the sense that they are both inanimate rules-constraints, which must be distinguished from both firms and individuals within firms, the active agents that follow their specific routines for choosing their specific actions under these rules.[5]

An additional difficulty may be caused by the fact that organizations and institutions are intimately interrelated: as each organization has its institutions, this implies that institutions are also parts of organizations, which may give the impression that they cannot be clearly separated. But it suffices to observe the chosen definition to see that these parts are clearly separable. This separability becomes particularly clear in evolutionary analysis: as considered in more detail below, institutions evolve in different ways and usually also at a different speed from the other parts of organizations.[6]

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[5]More generally, such a multilevel view of institutions is also needed for connecting two important branches of modern institutional economics — the study of institutions of entire economies, as conceptually clarified by North (1990), and the study of internal institutions of firms, with implications for corresponding segments of national institutions, as pioneered by Williamson (1985) — which, somewhat surprisingly, has not yet been properly done. For more notes on multilevel institutions, see Pelikan (1992, 2003b).

[6]The economists who like biology may find it helpful to think of the intimate relationship between an organism and its genes. They are also a part of the organism, but this is a clearly separable part, which also has an entirely different dynamics: it usually remains constant, while the rest of the organism undergoes a long series of changes. Although in economics, the difference between the two dynamics is not as sharp, the logical similarities, when suitably interpreted, are instructive. For more notes on what can be learnt from these similarities, see Pelikan (1992, pp. 45-46).

Turning to technologies, their definition is chosen to agree with Nelson and Winter (1982) and to provide for their division into physical and social according to Nelson (2002). They are therefore defined as collections of routines — possibly also referred to as programs, procedures, or algorithms — which guide, step-by-step or operation-by-operation, the behavior of the agents using them.

That viewing the behavior of agents as routine-guided does not mean reducing it to simple mechanical responses, but makes it possible to comprehend all the complex and flexible behaviors of which the most talented and creative people might be capable, deserves an emphasis and may need a clarification. As Nelson and Winter (1982) carefully explained, each agent — be it an individual or a firm — may, and usually does, possess an entire hierarchy of routines, of which only the lowest level guides the actually observable behavior, while the higher levels may contain routines for choosing, assembling, or modifying lower-level routines — for instance, by learning from past experience or by innovating through a mental trial-and-error search. More recently, the progress of computer science and neurophysiology has made it increasingly clear that all real information-processing systems must in fact be routine-guided — or, in other often used equivalent terms, program-based. While this does not a priori exclude optimizing — for many programs are now known to be able to find optimal solutions to many problems — the important implication is that all optimizing must be program-based and can therefore only take place within the limits of available programs (routines).[7]

Perhaps the most fundamental difference between technologies and institutions is that institutions are social or collective in the sense that, by definition, they always belong to an economy or another collection of agents, whereas technologies are in the first place individual: the entire hierarchy of the rules-routines that guide the behavior of an agent, be it a person or a firm, is in the first place his/her/its own. To be sure, as pointed out by Nelson (2002, p. 21), reasonably skilled producers of the same type of products often converge to sharing basically the same technologies. But this is far from always being the case. Such collectively shared technologies form only a limited subset of all the technologies used within an economy: the remaining subset of the idiosyncratic technologies developed and monopolized by single agents is never negligible and often important.

[7]Instructive descriptions of some of the programs (routines) that may produce highly complex innovative and learning behaviors are in Holland (1996). An interesting recent discussion of the relationships between rational choice theory and the paradigm of program-based behavior is in Vanberg (2002).

Many of the factors by which technology-sharing is limited are well known: they include the incentives to guard profitable production secrets, and the fact brought to light by M. Polanyi (1967) and amply emphasized by Nelson and Winter (1982) that important parts of technologies belong to the realm of tacit knowledge, and cannot therefore be directly transferred even with the best intentions to do so. Empirically, the existence of important limits to technology-sharing can be inferred from the often large and persisting differences between the best practices and the not so good but still used ones within the same industry. While it is possible and often helpful to speak of "an economy's technologies," defined as the collection of all the technologies that at least one of the economy's agents is able successfully to employ, it is important to keep in mind that the distribution of this collection among these agents may be, and often also is, very unequal.

To define the distinction between physical and social technologies in agreement with Nelson (2002), an agent's behavior must be divided into two areas: (1) the transformations of physical inputs into outputs during the agents' own consumption and production, and (2) the interactions and transactions with other agents. Physical technologies are then defined as the agent's routines for Area 1, and social technologies as the routines for Area 2. To be precise, this distinction can be sharp only for the low-level routines that are close to determining agents' actual behavior in those two areas, but much less so for the higher-level routines that guide agents' learning and innovating, many of which are of the kind "general intelligence," and may thus be common to both areas. But at the low levels, this distinction is certainly possible and moreover, as Nelson (2002) shows, fruitful.

The present view of institutions as "the general rules of a game" and of social technologies as "the specific ways of playing the game" implies that the two are intimately related in the sense that the ways of playing the game must respect its rules, which means that the routines of social technologies must also internalize, in addition to possibly many idiosyncratic components, the respect for the socially shared constraints of institutions. But, as explained in more detail below, this takes nothing away from their fundamental conceptual distinction.

To conclude this section, let me reiterate that I fully agree with Nelson (2002) that the distinction between physical and social technologies is possible and fruitful and that there are many important problems which the notion of social technologies can help us to understand. I only object to equating social technologies with institutions. I argue that, in essence, this equation adds nothing to our understanding of the many important problems in which "specific ways of playing the game" are central, but, as will become clear below, makes us lose the grip of

the many other not less important problems for which "the general rules of the game" hold the key.

3 Rules-constraints and rules-routines: differences and overlaps

According to the chosen definitions, both institutions and technologies can be regarded as rules, but of two different kinds: institutions as rules-constraints, and technologies as rules-routines.[8] While much of my present argument builds on the differences between the two kinds of rules, a problem may be that they may not always be clearly seen, as there are important cases in which the two kinds of rules may appear to overlap. This makes it necessary to clarify the differences and to show why the two kinds of rules, in spite of their possible overlap, remain conceptually separated.

The basic differences are directly implied by the above definitions. To recall, an agent's rules-routines guide step-by-step, or operation-by-operation, the agent's behavior, with the lowest-level routines determining, possibly in function of some present or past conditions, the agent's actual actions. In contrast, rules-constraints only set limits to possibly large varieties of permissible behaviors and actions, but usually — with exceptions considered below — not as severe as to permit only one specific behavior. This means that within the constrained varieties, the agents are free to search, guided by their largely idiosyncratic higher-level routines, for specific rules-routines that would enable them best, or at least sufficiently well, to reach some by them desired outcomes. The two concepts thus also provide a convenient framework in which both optimizing and satisficing theories of economic behavior can easily be accommodated.[9] As an additional mark of distinction, the contrast between the two can be enhanced by speaking of "rule-following" only for rules-routines, and use the term "rule-respecting" for rules-constraints.[10]

For an additional insight, consider that social technologies relate to institutions much like physical technologies relate to natural laws: both these laws and institutions constrain the spaces

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[8]Hayek (1973) makes a similar distinction between "positive rules" and "negative rules." I prefer the terms "routines" and "constraints" because they more clearly indicate what the two kinds of rules are about and lead more directly to Nelson's and North's definitions.

[9]Eggertsson (1990) divides modern institutional economics into two strands, labeling "neoinstitutional" the one which preserves the standard optimization assumption, and "new institutional" the one which admits bounded rationality.

[10]This is a refinement of Hayek's (1973) and Vanberg's (1994) terminology, who speak of rule-following for both types of rules.

within which agents can search for advantageous routines for guiding their behaviors, which they can subsequently try to improve, still within these spaces, by various innovations. An important difference is, of course, that nature as we know it keeps its laws constant (a possible exception now appears to be a relatively brief period after the Big Bang), while institutions, because of their human origins, can, and sometimes also do, change. Moreover, while no innovations in physical technologies can change natural laws, some innovations in social technologies may also cause changes of institutions — e.g., the innovator may lobby legislators, and thus cause a change of formal law, or be imitated by other agents, and thus cause a change of informal social norms. In spite of such possibilities, however, changes of institutions and changes of social technologies, as considered in more detail below, belong to conceptually different types of evolutions.

There are two areas in which the rules-routines and rules-constraints may be seen to overlap, but only one of them is of interest for the institutions vs. social technologies issue. This area contains those rules-constraints which are so strongly restrictive that they reduce the variety of permissible rules-routines to just one member, and may thus be seen to degenerate into a single rule-routine. For example, a formal law may be so restrictive that it allows only one specific way of respecting it; or an informal, but socially sanctioned custom may require that a not very restrictive formal law be respected only in one specific way.

But such overlaps take nothing from the fact that the two kinds of rules are *conceptually* different: there exist both rules-constraints that are not rules-routines, in the sense that they do not tell individual agents how to proceed to respect them, and rules-routines that are not rules-constraints, in the sense that the agents following them are free to change them. Moreover, it is possible to claim that even in the overlaps, the two still remain to be of different natures: rules-routines prescribe how to proceed to obtain certain outcomes, whereas rules-constraints only put requirements on the outcomes. Thus, even if rules-constraints require outcomes which only one routine can obtain, they need not specify what routine this is, but leave it to the agents concerned to find this out.

To complete the picture, let me also mention the other area of possible overlaps, which is of less interest for the present argument. This area consists of the highest-level routines with which all agents must in one way or another be initially endowed to be able to develop, receive, learn, store, and actively use all the lower-level routines — such as the hardware routines in computers, or the basic learning routines ("talents") in human brains. Such routines may indeed

quite sensibly also be called "constraints," as they internally constrain the abilities of each agent to handle and use all other routines. What makes such rules-constraints of little interest here is that they are individual, possibly and even most likely quite different for different agents, and cannot therefore in any case be confused with institutions, which consist of rules-constraints that are collective or social.

4 Advantages of defining institutions as rules-constraints

When choosing the definition of institutions, evolutionary economists should also consider the fields of economic analysis with which different definitions allow them to correspond and cooperate. For the rules-constraints definition, these fields include, as already noted, theory of property rights, constitutional economics, and the entire area of law and economics. Moreover, as explained below, they also include comparative economics and policy analysis, especially the parts concerning economic reforms and system transformations. In contrast, defining institutions as rules-routines, or "social technologies," appears only to provide for one significant correspondence, namely, as noted by Nelson and Sampat (2001), with theories of repeated games.

By itself, of course, the number of correspondences may not be decisive. As game theories have gained enormous popularity among today's economists, comparable to the popularity of static equilibrium analysis among their somewhat older colleagues, many might value the correspondence with games theories more than the correspondences with all the other fields put together. But there is a more decisive argument, following from the asymmetry with which the two definitions make it possible to deal with each other's correspondences. The clear advantage of defining institutions as the rules-constraints of a game is that this hospitably accommodates all studies of rules-routines as ways of playing the game, and thus allows all meaningful results of repeated games theories to be put to work. In contrast, defining institutions as rules-routines puts all the fields that concentrate on rules-constraints out of reach.

To illustrate, consider that property rights also provide a helpful frame for deducing what rules-routines the agents concerned, given their behavioral characteristics, are likely to develop and use, or would do best using. But from the agents' actual routines, it is much more difficult, if not impossible, to deduce the form of property rights under which these routines have been developed. For an intuitive insight, think how relatively easy it is to understand what players are

actually doing in a game of which we know the rules, and how much more difficult it is to deduce the rules of an unknown game from observations of what its players are actually doing.

Nevertheless, Nelson (2002, p. 22) may appear to have a compelling objection against defining institutions as rules-constraints: emphasizing that institutions are to be helpful, he compares them to a paved road which helps to cross a swamp and concludes that to view the road as a constraint is to miss the point. But a closer look reveals that it is on the contrary this objection that misses the point. In this comparison, institutions are not constraints on getting across a swamp, but on building roads across it; their help is to prevent road-building where the swamp is too deep and to concentrate it to places where it is easiest to build.[11]

Let me now turn to the promised explanation of how defining institutions as rules-constraints opens the way for fruitful cooperation with comparative economics and policy analysis.[12] For comparative economics, such institutions have two important features: they are relatively easy to observe and describe as combinations of codified laws and culturally evolved ethical norms; and they prove to be the least variable and for economic performance most significant features of different economies. The first advantage is taxonomical: these features make it possible to classify economies in relatively standard terms as finely as might be needed, from the no longer very interesting "capitalism-socialism" dichotomy, to the finest taxonomy of variants of capitalism, including all the detailed institutional differences that may cause significant performance differences — such as variants of private property rights, labor law, antitrust law, corporate governance, social security schemes, and the policy instruments that government is allowed or required to handle.

The second advantage is that the two features are precisely what allow comparative economics to become evolutionary. To see why it should do so in the first place, recall that its traditional method has been to characterize each of the economies compared by a constant "system" of given markets and/or given organizations using given technologies, and to assess such systems for the resource-allocation equilibria to which they could be shown to converge. That this method has not been very fruitful can be empirically documented by its failure to

[11]But Nelson (2002) is not entirely consistent with this objection: while in Sections 3 and 4, institutions are explicitly equated with routines, in Section 5, the new institutions that are found to be called for by new technologies also include new laws, which agrees with North's definition, but contradicts the objection.

[12]This explanation draws on Pelikan (1988, 1992, 1993, and 2003b).

predict and explain any of the major system crises that hit so many real world economies during the last decades.

What I see to be the most compelling theoretical explanation of this failure can be inferred from Schumpeter's (1942/76) discussion of creative destruction, in particular from his observation (p. 84) that "[t]he problem that is usually being visualized is how capitalism administers existing structures, whereas the important problem is how it creates and destroys them." A slight generalization can make it clear that the ways in which resources are allocated by constant systems are indeed much less important than the ways in which such systems themselves change and evolve — e.g., by formation, development, or closures of markets; entry, growth, reorganization or exit of firms; and introduction and spread of new technologies. In comparative analysis, however, this slight generalization raises the great problem of how to extend attention from an unspecified "capitalism" to different types of economies, including different types of "capitalism," if they can no longer be characterized by constant systems: by which relatively more stable features could they be characterized if their systems change and evolve?

It is to this problem that institutions as rules-constraints turn out to bring the best solution. Indeed, much like the rules of a game are typically more stable than its actual players with their specific ways of playing it, an economy's institutions in the sense of North are typically more stable than its actual system of markets, organizations, and technologies. They can thus indeed be considered at least temporarily stable while this system may keep changing and evolving. Moreover, what confirms that they are really suitable for comparative analysis is that they bear a high responsibility for both how the system works and how it evolves. As considered in more detail below, the institutions on which this evolution turns out strongly to depend include the constraints on the freedom of enterprise, the competition law, the labor law, the bankruptcy law, the patent law, and the extent to which government is allowed to subsidize or otherwise protect poorly performing firms. Of course, institutions must also be expected eventually to change and evolve. But this is a conceptually different evolution, which analysis can keep clearly separated from the Schumpeterian evolution of markets, organizations, and technologies.[13]

[13]Those economists who like biology may find it again helpful to compare the institutions of an economy to the genes of an organism, as suggested in fn. 5 above. To characterize organisms, modern biology prefers indeed their virtually stable genes to their often importantly changing bodies. In each organism, it is also its genes that are highly responsible for both the functioning and the development of its body. While this comparison appears

In policy analysis, the first advantage of defining institutions as rules-constraints is that this introduces an important classification principle into the otherwise difficult to survey variety of possible types of policies. Namely, this implies a useful distinction between *institutional policies* that affect, usually by means of legislation, the prevailing institutions themselves, and the *resource-allocational policies* that the prevailing institutions allow or require government to conduct, such as certain mixtures of monetary, fiscal, industrial and welfare policies.[14]

This distinction is useful by making it clear that institutional policies are the most fundamental policies which determine all the other policies that government may or must conduct. This is because the prevailing institutions — in addition to the rules-constraints on the behavior of all economic agents, such as certain forms of property rights — also include specific constraints on the economic behavior of government itself. In other words, it is institutional policies that put in the hands of government a certain set of instruments for other policies.

Intuitively, government can thus be seen to act in two different roles: as a co-designer of a complex and to a large extent self-organizing and automatically working device, whose tasks include designing the more or less extensive manual controls that are put in the hands of politically selected operators; and as the operators who actually handle these controls. The tasks of the co-designer include verifying whether the manual controls do not overtax the abilities of the operators and/or allow the operators to misuse them over the limit where their net benefits for the working of the device become negative. If this is the case, the co-designer should, ideally, redesign the manual controls in order to limit them to an easier to manage and more difficult to misuse extent. The big problem then is, of course, whether the co-designer, such as a legislative body, will have the needed knowledge and sufficiently different interests from the operators, such as executive politicians and government bureaucrats, in order actually to do so. Here,

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formally impeccable, there is an important quantitative difference between the relative stability of genes and the one of institutions: the former is obviously much greater.

[14]This distinction closely corresponds to the one between 'Ordnungspolitik' and 'Prozesspolitik' made in German Ordo-Liberalism. It is also similar to the distinction made in constitutional economics, following Buchanan (1975), between the basic policy decisions that concern the form of the constitution and the current policy decisions that are being taken within the limits allowed by the constitution. The difference is that an economy's constitution is a particularly formal and particularly rigid part of its institutions. In contrast, the present view admits that even the institutions that limit government policy-making may be in part informal, transforming past bad experiences with certain policies into lasting constraints on future policy-making that the subsequent governments do not dare to violate, even if these constraints are not formally added to the constitution — e.g., as considered by Wegner (2003).

however, the point is not to solve this problem, but only to show that defining institutions as rules-constraints has the advantage of allowing it to be identified and formulated with clarity.[15]

That institutions as rules-constraints are both important factors of economic performance and directly belong, through their formal components, to the instruments of economic policies is perhaps their greatest advantage — at least for all the evolutionary economists who care for the economies in which they live and are therefore also interested in practical policy implications of their theories. While Nelson (2002) and Nelson and Sampat (2001) are undoubtedly right that agents' rules-routines are also important factors of economic performance, the crucial difference is that there is much less that policies can do about them if they happen to be defective.

This difference can most sharply be seen in crises that require a radical economic reform, or a system transformation — such as those that hit the former USSR in the 80's, Japan in the 90's, and Argentina more recently, and more of which may be expected to hit, in a more or less distant future, other countries. While the causes may be found both in the rules-routines used by their agents and in the rules-constraints under which the agents act, it is only the latter that reform policies can directly influence. To be sure, as noted, the direct influences are mostly limited to legislating changes of the formal rules-constraints, while the informal ones, much like the agents' rules-routines, cannot but be left to change more slowly, through largely spontaneous evolutionary processes. But it is crucial to have a well-defined point from which the reform process may effectively start. This process then moreover implies two important tasks for evolutionary economists: to learn about the influences of formal institutions on the evolution of the informal ones, and to learn about the influences of both kinds of institutions on the evolution of the agents' routines. A good understanding of both these evolutions is indeed necessary to resist the temptation to which many, even well-meaning, reformers succumbed in the past: to choose reform policies that appear advantageous in the short run, but prove disastrous in the long run.[16]

Last but not the least — and this is what these two tasks may be seen more generally to imply — defining institutions as rules-constraints has the advantage of introducing a useful order into the growing research agenda of evolutionary economists. This allows economic evolutions to be usefully be divided into two categories: (1) the evolution of agents, their technologies and

[15]Well-known attempts to solve this problem are in Buchanan (1975), Hayek (1979), and Buchanan and Congleton (1998); for a more recent discussion, see, e.g., Wegner (2003) and Wohlgemuth (2003).

[16]The tasks of evolutionary economists in policy analysis are extensively discussed in Pelikan (2003b).

their interrelationships under given institutions, e.g., as studied, for the institutions of standard capitalism, by Schumpeter (1912/34), Alchian (1950), and Nelson and Winter (1982); and (2) the evolution of the institutions themselves, e.g., as studied by Hayek (1967), North (1990), and Vanberg (1992).[17] This makes it possible to develop evolutionary economics into a broad, but nevertheless well-ordered field, which can accommodate and clearly interconnect all the different studies of social and economic evolutionary processes that have so far remained largely separated. It is also in this broad field that Nelson's (2002) study of the evolutions of physical and social technologies can be accommodated, and that in the part concerning Category 1 evolutions.

The issues of learning, selection, diffusion and path-dependence, on which many evolutionary economists have focused their attention, deserve a special note. All of them remain important, in both categories of evolutions. In addition to their frequently studied roles in the evolution of technologies as rules-routines, they turn out to play not less important roles in the evolution of institutions as rules-constraints. Moreover, the studies of their roles in Category 1 evolutions can be made more precise: the frequent mistake of comparing these evolutions to Darwinian natural selection can be avoided, and their strong dependence on the prevailing institutions, as produced by Category 2 evolutions, can be properly taken into account.[18]

5 Institutions and technological change: which depends on which?

The relationships between institutions and technological change, although generally recognized as important, are still only poorly understood. It is also on them that Nelson (2002) focuses most of his attention. Now, however, if institutions are defined according to North (1990), Nelson's contribution must be reclassified as concerning the relationships between changes in physical and social technologies. The rest of this paper is about the relationships between institutions and technological change in the present meaning of these terms.

In the literature, when these relationships have been considered at all, attention has usually been paid only to one of their directions. The one from technological changes to institutional changes can be said, when the terms used are suitably interpreted, to be one of the

[17]The reader interested in biology may like to compare the two categories of economic evolutions to ontogeny and phylogeny.

[18]As one anonymous referee saw these issues to go only with the concept of rules as routines, and appeared not to see their roles in the evolution of rules-constraints, it should be noted that these roles have been brought to light by North (1990). My studies of these roles are in Pelikan (1995, 2003a, 2003b).

main concerns of Marxists. This interpretation is to see technological changes in what Marxists call "development of the forces of production," and institutions in their notion of "superstructure." Marxists can then indeed be said to be concerned with this direction, and ignore the opposite one, as the essence of their argument is, in present terms, that technological progress is exogenous, as if automatically falling from the sky, that technologies and institutions must keep adapted to each other, and that, therefore, as technological changes keep progressing, they must sooner or later be followed by corresponding institutional changes, which may in some cases require revolutions.[19]

The study of the opposite direction was inaugurated by North and Thomas (1973), whose argument appears to be the first serious challenge to Marxist views. This argument shows that far from being exogenous, technological changes crucially depend just on the prevailing institutions: it is these that largely determine how fast, if at all, technological changes will actually progress. By paying attention to differences in the prevailing property rights, and to their impact on incentives and transaction costs, this argument credibly explains what the Marxist argument cannot: why technological progress is rapid in some economies and slow or nonexistent in others. As empirical evidence, North and Thomas show that differences in these aspects of property rights provide indeed the best explanation why, during the 17th and 18th centuries, England and the Netherlands benefited from rapid technological progress which yielded strong economic growth, while the previously much richer and more powerful Spain declined.

My present argument is that both directions matter and must therefore be taken into account. Before doing so, however, let me first take another look at each of them. Returning to the Marxist direction, this can be anatomized into two main links:

Link 1: The production methods and/or the products of a new technology, to be used efficiently, require new institutions — such as suitably redefined or extended property rights — which may have to be more or less differently tailored for different methods and different products.

Link 2: A new technology makes it physically possible and socially advantageous to implement some superior institutions that were previously unfeasible or prohibitively expensive.

[19]To be more precise, Marx did recognize that capitalism had a positive influence on the rate of technological change, but ascribed it to a class of its actors — the "bourgeoisie" — which he saw as a historically necessary product of previous technological changes, and not to its institutions.

An example of Link 1 is the influence of information technologies on property rights, which turned out to require refinements and complements to provide for efficient production and uses of new products of an information nature. Link 2 can be exemplified by the technological innovations that have made it possible to allow entry and reasonable competition in markets for electrical energy and telecommunications, which with the old technologies were close to the state of natural monopoly.

That the causality of both links is only indirect, and thus does not imply, contrary to Marxist theses, any historical determinism, is worth emphasis. Thus, it may not be a priori known which specific institutional changes are required by a given technological change, nor which superior institutions a given technological change makes socially advantageous to implement. Moreover, even if all this were known, there is no guarantee that such changes will actually take place. In both cases, the corresponding institutional change may actually take place only if some agents, "institutional entrepreneurs," have the knowledge to design it and the initiative to put this design to work — either through political ways, by means of formal legislation and enforcement, or through their own innovative behavior, by introducing a new informal norm in their industry.

While neither link is thus guaranteed to result in actual institutional change, Link 1 appears more likely to do so than Link 2. Namely, if the prevailing institutions lack some of the rules needed for efficient uses of a new technology, the agents using it usually suffer relative or absolute losses. This provides these agents with strong incentives to search for the design and enforcement of such rules. For example, as long as property rights for information products are not suitably designed and enforced, producers in information industries may suffer large losses from piracy. Even in such cases, the causality involved is only indirect: the actual realization of suitable institutional changes requires again innovative designs by economically educated lawyers and legislators, and possibly — as no suitable design may initially be known or easy to find — a more or less long episode of institutional evolution consisting of a series of trials and errors.

On the other hand, the incentives to realize the socially advantageous institutional changes that are made possible by Link 2 are often weaker, and in many cases, there may even be strong incentives *not* to realize them. This is likely to happen in those cases in which the new institutions would facilitate entry and competition in previously monopolistic or quasi-monopolistic markets. While the agents who would benefit from the new institutions are often

still small or entirely absent, the large incumbent monopolists and quasi-monopolists have strong incentives to protect their easy life and excessive profits by retarding or entirely blocking their realization. This blocking can be particularly effective if such monopolists are state-owned, and thus have direct political influence on the legislators on whom the implementation of the new institutions crucially depends.

An actual example is the resistance in France to the institutional changes that would allow socially efficient and since a few years ago technologically feasible competition in her markets for energy and telecommunications. This resistance is clearly a result of political pressures of her still largely state-owned monopolistic producers in these markets, and is supported, with the help of economically irrational pro-monopolistic propaganda and socially costly strikes, by their employees' trade unions.

In a closed economy, relatively narrow group interests may indeed block the socially advantageous institutional changes that have been made possible by Link 2 for an indefinitely long time. But an open economy may sooner or later be forced to implement them, if some competing economies start to gain important comparative advantages by exploiting them. Another way in which resistance to such changes may be overcome is by means of international political pressures and trade agreements, particularly effective if the economy is a member of an economic union. For example, this is the way in which help is now slowly coming to French consumers and taxpayers from Brussels — even if many of them, due to the pro-monopolistic propaganda and lack of understanding of basic economic relationships, appear not to see it as help.

In the opposite North-Thomas direction, the influences of an economy's institutions on technological changes appear to be of many more types, which raises the first difficult question of how to survey them in an orderly way. As a tentative answer, let me divide them into four links. The relatively best known and most often considered influences can be summarized in the first two:

Link 3: The influences on the freedoms of enterprise, and thereby on the variety of permissible technological innovations that the economy's agents may potentially try to realize.

Link 4: The influences on the incentives and disincentives, including transaction costs, and thereby on how many of the different permissible innovations will actually be tried — such as the reliability and enforceability of contracts, the level and structure of taxes, and the costs of

obtaining from government bureaucracies all the permits that the prevailing institutions may require.

It is with these links that the North-Thomas direction started to be studied by North and Thomas themselves, and it is also these links that are usually put in the focus when institutions are studied as a factor shaping economic performance.[20] An important example of such studies is Rosenberg and Birdzell (1986), who point out that institutions, to provide favorable conditions for technological change, must marry extensive freedoms with strong incentives for experimenting with organizational and technological innovations. It is the widespread use of such institutions in Western economies that they found to be one of the main reasons why, as they put it in the title of their book, 'the West grew rich.' A parallel argument can be found in Eliasson (1988), who shows that an important advantage of competitive markets is to provide the freedoms and incentives for what he terms "experimentally organized economies," the only ones where substantial innovation activities can take place.

The other two links summarize the influences that may not be less important than the previous two, but have so far been less often considered — most likely just because they require evolutionary analysis to be fully exposed and properly examined:

Link 5: The influences on the rigor and the speed of the elimination, among all the actually tried innovations, of the likely large majority of the technologically unsound and/or economically wasteful ones.

Link 6: The influences on the correctness of the selection, and on the speed and the breadth of the dissemination, of the relatively few (at least temporarily) sound trials.

As these two links have been in the center of several of my earlier studies (Pelikan, 1988, 1992, 1993, 1999), let me summarize what I consider to be a particularly important finding — namely, that much of additional insight can be gained by splitting both of them into two layers: one concerning technological innovations themselves, and one concerning the agents that author and invest in such innovations. The additional insight is, in essence, that when the distribution of relevant competencies and talents is unequal, as it always appears to be, the proportion of the sound innovative trials among all the generated ones, while always much smaller than one, can nevertheless greatly vary as a function of the competencies for which the innovators and

[20]Among these studies, Nelson and Sampat (2001) appear to be alone in not doing so. But the inability to see these important links is precisely one of the consequences of defining institutions as rules-routines rather than rules-constraints.

investors are being selected. As this proportion is an important factor on which the social costs of the entire evolution of technologies strongly depend — obviously, the more of unsound trials are likely to be generated, the higher the costs — it is possible to obtain important additional information about the merits and demerits of different institutions by assessing their impact of on this selection. In particular, this makes it possible to discover significant differences between the selection of innovators and investors by market competition and their selection by politico-administrative ways within a government bureaucracy.

Let me add to this brief and likely incomplete summary of influences of institutions on technological change a few general remarks. First, note that the causality of all the four links is again only indirect. Institutions may effectively influence technological changes only if there are some agents — such as innovators, entrepreneurs, and risk-capital investors — who take the initiative to respond to the freedoms and incentives implied by the prevailing institutions by actually trying to realize some of the institutionally permissible and economically well-rewarded technological changes. Without such agents, the influences of all institutions, however favorable to technological changes, would remain in the state of an unrealized potential.

Note also that the four links do not correspond very closely to any taxonomy of institutions themselves. Many institutions — in particular property rights, taxation law, competition law, and the policy instruments that government is allowed or required to use — strongly participate in all these links. Only some institutions appear to be more specialized — such as the laws regulating the entry to different industries in Link 3, the labor law and the costs of government permits in Link 4, the bankruptcy law and the policy instruments that allow government to subsidize or otherwise protect failing enterprises in Link 5, and the patent law in Link 6, although this law is also strongly involved in Link 4.[21]

To examine which institutions are involved in which links, and how different forms of institutions may thereby influence the performance of economies in general and technological change in particular, is among the main tasks of modern institutional analysis. It is also to this analysis that evolutionary economists could most significantly contribute — provided they define institutions as rules-constraints, and not rules-routines. What offers them such opportunities is that so far, institutional analysis has been limiting most of its attention to the influences of Links 3 and 4 on the efficiency of resource allocation. Thus, much as in the old

[21]Here is another point that economists interested in biology may like to note: similar many-to-many relationships also appear to be frequent between the genes of an organism and its structural and behavioral features.

comparative economics, the Schumpeterian evolutions of markets, firms, government bureaux, and technologies have also been largely neglected. It is therefore by exploring the influences of all four links on these evolutions — both on the generation of innovative trials and on the selection processes by which errors in such trials are ex ante limited and/or ex post discovered and forced to be corrected or eliminated — that evolutionary institutional analysis can be expected to make some of its theoretically most interesting and socially most important discoveries.

6 Evolution of technologies and evolution of institutions

To take into account both directions in which technologies and institutions can depend on each other requires a theoretical model with feedback loops. The purpose of this last section is roughly to outline how such a model can be built and indicate what it may be expected to imply.

The cornerstone of any feedback model is the variable in which the two directions can be seen to intersect. Here, the best variable for this purpose appears to be the variety of technological changes. This is indeed involved with institutions in both directions. Links 1 and 2 of the Marxist direction imply that there is a certain variety of technological changes that the prevailing institutions can absorb without themselves having to change: a pressure for institutional changes is produced only by technological changes from outside of this variety. Let me denote this variety as the institutions' *innovation absorptivity*. Links 3, 4, 5 and 6 of the North-Thomas direction imply that there is a certain variety of technological changes that the prevailing institutions allow and make likely to be generated. Let me denote this variety as the institutions' *innovation potential*.

In general, technologies and institutions may be seen to co-evolve along the following lines. The innovation potential of the prevailing institutions may allow some technological changes which exceed the institutions' innovation absorptivity. Whenever one of such changes is produced, it will create a pressure for an institutional change that would allow it to be institutionally absorbed, which must be expected sooner or later to happen. The story will then be repeated for the new institutions. The result is a stream of two evolutions, in which technological changes alternate with institutional changes.

But there is also an important possibility that technological changes will continue while institutions may at least temporarily stabilize. An obvious necessary condition for this to happen can be put as follows: An economy's institutions can be able to remain stable over time only if

they do not allow more technological changes to be generated than what they are able successfully to absorb. In other words, their innovation potential must not exceed their innovation absorptivity.

As the property of stability is not always fully appreciated in evolutionary economics, where the usual focus is on processes of change, it may be useful to clarify why institutional stability is important, and why, if certain institutions were so successful that they could remain stable in many economies over a long period of time, this would still be far from implying — contrary to Fukuyama's (1992) thesis — any 'end of history.'

The first point to realize is that an evolution is less a process of incessant change than a search for workable solutions, and may therefore stop, or at least take a long pause, whenever such a solution is successfully found. An instructive example is the evolution of the genetic pool of homo sapiens, which is now known to have remained basically stable since at least 40 000 and possibly 100 000 years ago. This makes it reasonable to infer that also the evolution of institutions, after many centuries of trials and errors, might find some evolutionarily successful, and therefore relatively stable institutions for modern economies, which would allow it to take a pause. Such institutions would, moreover, have a high social value for all the economies that would be lucky enough, thanks to a mixture of wise policies and a favorable cultural evolution, to obtain them. Indeed, both the advantages of stable "rules of the game" and the social costs and risks of any of their necessitated fundamental changes (radical reforms, transformations) are, as is now well known, substantial.

The example of the evolution of homo sapiens can also help to clarify why institutional stability need not mean any end of history. The fact that the more than 40 000 year stable human genetic pool, with its highly stable rules for the building of human brains, has nevertheless made room for important changes and variations in the development of human thinking both for each individual and over generations, makes it reasonable to infer that however stable the institutions of human economies might become, this would still make room for a great variety of other historical processes, including important changes and developments of both physical and social technologies.[22]

Returning to the above condition for institutional stability, note that, by itself, it can be met for both high rates and low rates of technological changes. This may also explain why, in

[22]This example also illustrates that the present reasoning in terms of rules-constraints can fully accommodate, but cannot be reduced to, Nelson's (2002) reasoning in terms of rules-routines.

the past, the institutions of many economies could have both low innovation potential and low innovation absorptivity, and yet remain stable for very long periods of time. But a low rate of technological change is sustainable only in isolated economies that are not exposed to economic or military competition of economies with a higher rate of technological change, and that moreover find themselves in stable and sufficiently generous environments — in the sense that traditional technologies suffice to keep providing enough output for maintaining physical and mental health of their populations.

The problem is that such isolation is now increasingly difficult to obtain. Moreover, important technological changes may urgently be required for coping not only with international competition, but also with growing local population and/or increasing scarcity of basic resources. Hence in today's world, institutional stability requires a high rate of technological change, and is therefore limited to those institutions whose both innovation potential and innovation absorptivity are high.

To know which institutions have, and which ones have not, these abilities is of both theoretical interest and practical importance. The latter because such knowledge would be an important piece of information for economic policies, especially in poorly performing economies, where economic activities in general and technological change in particular are being wrongly shaped and/or stifled by defective institutions, and which therefore urgently need a substantial institutional reform (transformation). To be sure, as noted, to know which institutions would do a better job is far from sufficient. As follows from the difference between formal and informal institutions, even if the policy-makers did know such institutions, the dead weight of the actual informal institutions, which usually share much of the responsibility for the poor performance, must be expected to hinder their rapid implementation. But this knowledge could still importantly help, as it would indicate in which direction the reform policies should strive to proceed, and it could thus also replace at least some of the false ideological beliefs which, in the absence of solid analytical results, can still misguide the choice of this direction in many economies.

It is not the task of this paper actually to search for this knowledge. This I tried to do in several earlier papers, where I believe a few rough pieces of it can also be found (in particular in Pelikan, 1993, 1995, 1999, and 2003a). Here I only need the simple fact that this search is among the issues to which evolutionary institutional economics can substantially contribute, but only if it defines institutions as rules-constraints. As this definition does not prevent it from also

handling any problem involving changes of rules-routines, whereas defining institutions as rules-routines would prevent it from participating in this important search, this fact is a sufficient evidence that evolutionary economists, not to seriously impair their vision and analytical capacities, need to import institutions as rules-constraints.

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