INTERCONNECTING EVOLUTIONARY, INSTITUTIONAL AND COGNITIVE ECONOMICS:

Six Steps towards Understanding the Six Links

Contribution to the 10th Meeting of J.A. Schumpeter International Society in Milan, June 9-12, 2004

Pavel Pelikan

Prague University of Economics and The Ratio Institute, Stockholm

e-mail: pavel.pelikan@ratio.se

Key words: Institutions – evolutions – unequally bounded cognition – program-based behaviors – information accounting - basic policy issues

JEL Classification: A10, B15, B52, N01

Abstract: Many students of evolutionary, institutional, and cognitive economics have been aware that important links among these fields exist, and several authors have worked on bringing these links to light. Nevertheless, large parts of these links still remain poorly understood. Low interest in inter-field cooperation may be one reason, but difficulties in making these links accessible to meaningful analysis appear more constraining. After surveying the links, this paper proposes six steps towards overcoming these difficulties. It then examines how the three fields together may affect methods and results of economic analysis, in particular those concerning certain basic policy issues.

1 Introduction

The main purpose of this paper is to outline how to interconnect in a clear and fruitful way three relatively young, but rapidly growing fields of economic theorizing — new institutional economics, evolutionary economics, and cognitive economics — and to consider how the resulting synthesis of these fields could contribute to the methods and results of economic analysis.

However, to prevent misunderstandings, still frequent in all these fields, sufficient terminological clarity must be secured first. One of the greatest problems with all of them, which has slowed their development and supplied many arguments to their critics, is indeed that the key terms — 'institutions,' 'evolutions,' and 'bounded cognition' — still lack generally adopted clear definitions; different authors use them in more or less different and more or less well-defined meanings. Let me therefore begin with their brief definitions. While the briefness prevents the definitions from being entirely precise, they appear to suffice for the present purposes.

- 'Institutions' are understood in the modern restricted sense of humanly devised formal and informal rules-constraints, or 'rules of the game,' — such as written law and unwritten moral norms — and are strictly distinguished from organizations, seen as teams of agents playing the game (cf. North, 1990; Pelikan 1988, 1992, 2003).
- 'Evolutions' are understood as trial-and-error processes which create and change forms — such as genes, technologies, organizations and institutions — through a variety of imperfectly informed (possibly, but not necessarily, entirely random) trials and systematic elimination of errors (relative to certain success criteria), together with selection and retention of the usually small minority of successes (see, e.g., Dawkins, 1976, 1982); each type of the evolving forms will be considered to have an evolution of its own, which explains why this term is used in plural (cf. Pelikan, 1992, 2001).
- 'Bounded cognition' means the limited abilities (competence) of human minds to perceive and process available information, which imply constraints on the difficulty of the problems that humans can solve optimally and of those that they can solve in an suboptimal, but nevertheless satisfactory way; it may also mean 'bounded rationality,' if this is understood to refer to imperfections of the *ways* of processing available

information, and not to imperfections of this information (cf. Simon, 1978; Pelikan, 1989, 1993, 2001).[1]

That there are important links among the three fields have been clear to many of their students, and some work on bringing these links to light has been done (see, e.g., Denzau and North, 1994; Knight and North, 1997; Droback, 2000; Pelikan, 2003c). But large parts of these links still remain poorly understood and the fields still remain mostly isolated from each other. Communication is often poor even among different strands of the same field.

For instance, institutional economics rarely considers evolutionary processes, while most of evolutionary economics neglects institutions. And although there is a strand that does study the evolution of institutions, this strand does not have much contact with either the mainstream of evolutionary economics, which focuses on the evolution of technologies, or the mainstream of institutional economics, which is preoccupied with the effects of given institutions (laws, constitutions) on static resource-allocation. Moreover, most of modern institutional economics is built on the standard assumption of perfect rationality, or perfect optimizing abilities of all agents, and thus ignores problems with bounds of human cognition. Symmetrically, the studies of these bounds are mostly limited to individual problem-solving, outside any institutional context.

The present search for clear and fruitful ways of interconnecting the three fields is organized as follows. Section 2 surveys the six one-way links by which the three fields can logically be interconnected. Section 3 proposes six methodological steps for clarifying the six links and thus synthesizing the three fields into one. Section 4 considers why, besides pure theoretical curiosity, such a broad composite field should be built, and finds the most important reason in the needs of reliable analysis of basic policy issues, in particular those concerning the institutional forms of economies, including the extent and contents of government economic agenda. Turning to problems of methodology, Section 5 considers how, in such a complex field, a fruitful analysis could be conducted, and concludes that its basis must be comprehensive structural modeling, in which all causes and consequences that are relevant to the question

[1] Although ways of processing information are also kinds of information — namely, information on how to use information — there is an important conceptual difference between this information and the one that is being processed. It is ignoring this difference that has lead even some prominent authors to mix bounded rationality with imperfect information.

studied could orderly be included; quantitative modeling is admitted, but only for sub-problems that can be provided with a well-defined frame by a comprehensive structural model.

2 The links

With three fields to be interconnected, the links among them logically fall into three bilateral categories, each of which can be divided into two opposite directions. Although some links may also be seen to involve all three fields, such links can be understood as composed of two or more bilateral ones. Each link is understood to represent possible influences of events or processes studied in one field upon events or processes studied in another, which is denoted by abbreviations of the fields involved (*E, I, BC*) with an arrow marking the direction of the influences. What I see to be the most important components of these links can be surveyed as follows:

I→*E*: The prevailing institutions of an economy significantly shape all its evolutions — such as the evolutions of markets, firms, government agencies, and technologies — including the evolution of the institutions themselves. This also means that all economic evolutions are significantly influenced by the prevailing institutions — such as property rights, corporate law, bankruptcy law, patent law, and the constitution (and are thus far from “natural”).

As already noted, the influences of institutions on evolutions have so far been little studied in either field: evolutionary economists often ignore institutions altogether and simply assume that economic evolutions are natural in the Darwinian sense, whereas institutional economists usually limit their attention to influences of institutions on static resource-allocation through given markets by given firms using given technologies. As a kind of extension of the "creative destruction" argument by Schumpeter (1942/76), I have shown that from several points of view, the influences of institutions on economic evolutions are far more important than their influences on static resource-allocation (Pelikan 1988, 1992, 2003b).

E→*I*: An economy's institutions are themselves evolving, the formal ones by deliberate (but not necessarily well-informed or highly competent) choices of known policy-makers (legislators) and/or judges, and the informal ones by spontaneous cultural evolution, driven by unknown innovators and an increasing number of their imitators (cf. Hayek, 1967; Vanberg, 1992). All these trials are subject to two types of selection: internal, depending on their social and political approval or disapproval by members of the society; and external, depending on the performance that they allow and help the economy to achieve (cf. Pelikan, 2003a). The evolution of institutions may be very slow, and the selection may need long time before the insufficiently efficient specimen are disclosed and discarded (cf., e.g., the 70+ years it took compellingly to disclose the fundamental inefficiencies of all feasible variants of socialist economic institutions).

E→BC: Both the bounds of human cognition and their distribution among economic agents are results of several evolutions: (i) biological, which determines, through the genetic instructions for the building and working of human brains, their individual talents and limitations; (ii) economic, which may constrain the supply of information and other resources that the talents need to be developed and exploited; and (iii) cultural, by which this development and exploitation are shaped and, depending on the prevailing culture, stimulated or stifled. For economists, the most important part of this link consists of the evolutions that keep selecting, allocating and reallocating the unequally bounded cognitive abilities of economic agents to different uses in society. This type of evolution by market competition and selection was first studied by Alchian (1950), Friedman (1953) and Winter (1971); comparative institutional analysis of such evolutions within both markets and governments is in Pelikan (1988, 1993, 1997).

I→BC: The prevailing institutions may influence the bounds of agents' cognition both positively and negatively. Positively, if they contain some accumulated knowledge which leads, or helps to lead, agents' cognition towards efficient solutions of the agents' economic problems; negatively, if they contain irrational prescriptions or interdictions which constrain agents' cognition in additional, counterproductive ways. This is often the case of informal institutions stemming from religious and/or ideological beliefs, which may prevent agents from fully using their initial learning abilities and thus cause their actual cognitive abilities to remain significantly underdeveloped (cf. Denzau and North, 1994). Some of these influences, in particular the long-term ones, may be seen to pass through the previously considered influences of institutions on evolutions, especially parts (ii) and (iii), and be thus decomposed into *I→E* and *E→BC.*

BC→I: The bounds of agents' cognition influence both the form and the effects of institutions. The form, because the agents shaping the institutions — be they legislators, judges, or anonymous innovators — have only limited understanding of the consequences of their contributions for themselves and for the economy (cf. Knight and North, 1997). The effects, because the agents acting under given institutions are only imperfect players of the typically complex game for which the institutions provide the rules (cf. Droback, 2000).

BC→E: All social and economic evolutions must ultimately consist of behaviors and actions of individual agents, and their course must therefore also depend on the bounds of cognition of these agents (cf. Hayek, 1967; Vanberg, 1992; Witt, 2003). However, to the extent that such evolutions also depend on the prevailing institutions, this dependence is partly indirect, also passing through *BC→I* and *I→E*.

3 The steps

The steps that this paper argues are the keys to clarifying the six links are also six, but there are no one-to-one relations between the two: several steps will be needed to clarify one link, and each step will take part in clarifying more than one link. They can be surveyed as follows.[2]

Step 1 — classifying evolutions: This step begins by realizing that each economy is involved in several evolutions, which need to be identified and distinguished from each other. For analysis of their links with institutions, it is of particular importance to identify two of their subsets: (1) those that the economy's institutions are shaping, such as the evolutions of markets, firms, government agencies, and technologies; and (2) those of the institutions themselves, such as the evolution of formal law and the one of informal cultural norms.

In addition to the overall institutions of an economy, it is often important to take into account the internal institutions of its organizations — such as the formal rules of corporate governance and the informal norms of a corporate culture. Although the two levels of institutions are interrelated, they must also be clearly distinguished from each other. While the internal institutions of organizations also may, and often do, evolve, their evolutions logically belong to subset (2): these evolutions are parts of the evolutions of their organizations, and are thus also shaped by the economy's institutions — e.g., by the corporate law (cf. Pelikan, 1992, 2003a).

The two subsets must be admitted to overlap, as the economy's institutions may also shape their own further evolutions. For instance, formal laws typically contain a constitution, which is more difficult to change than other laws and by which the evolution of all laws, including itself, is constrained. Similarly, the cultural evolution of informal norms is typically constrained by some core cultural norms. In different cultures these constraints may be differently more severe, which makes some cultures more rigid, and thus less modifiable by

[2]Parts of these steps have already been taken in my earlier publications (e.g., Pelikan 1988, 1992, 2001). To take all of them and examine where they together lead is the main task of my current research.

learning, than other cultures. Among other things, the overlapping of the two subsets implies that the evolutions of institutions may be strongly path-dependent. But this does not prevent the two subsets from being clearly identified.

This step is necessary for clarifying all the four links involving evolutions. Whether examining the influences of evolutions, or the influences on them, it is important, to avoid confusion, to make clear for each influence which evolution(s) it involves.

Step 2 — mapping influences among different evolutions: This is a continuation of Step 1. Using the classification of evolutions from that step, it adds to it the network of relationships through which they may influence each other. The main relationships appear to be those between the two main subsets of evolutions: (1) the influences of actual institutions on different evolutions, and (2) the influences of the outcomes of these evolutions on the evolution of the institutions. Over time, these influences form a feedback loop: if some of the outcomes cause the institutions to change, these may channel the other evolutions towards different outcomes, which may in return cause other changes in the evolution of institutions.

Two important examples are (1) the influences of actual institutions — in particular property rights, including the freedoms of enterprise and the rewards for successful innovations — on the evolution of technologies, and (2) the feedback influences of actually available technologies, through their impact on the costs of monitoring and enforcing different laws, on the evolution of institutions. Another important example is the influence that a large successful firm, victoriously emerging from the evolution of markets and firms, may exert, through lobbying of legislators, on bending the evolution of institutions in its favor (cf. North and Thomas, 1973; Pelikan, 1988, 2003b).

Step 2 is needed for helping Step 1 to clarify the four links involving evolutions, and more precisely the long-term components of these links, in which also institutions and/or the bounds of cognition must be admitted to evolve.

Step 3 — anatomizing evolutions into individual behaviors: To identify the roles of the individuals by which economic evolutions are driven, it is first necessary to anatomize each evolution into sequences of its two types of stages: (a) the generation of imperfectly informed trials; (b) the tests of the trials made, with the subsequent elimination of errors — the trials that failed to satisfy the evolution's success (fitness) criteria — and the selection, preservation, and possible dissemination of the initially rare successes (cf. Nelson and Winter, 1982; Vanberg, 1992; Pelikan, 1988, 1992, 2001; Witt, 2003).

Next, it is necessary to identify the agents that may participate in these stages — such as the private or public entrepreneurs who may create new firms or introduce new technologies, and the private and/or public investors and customers who may choose to support or not to support different entrepreneurial trials.

Finally, it is necessary to specify how the behavior of these agents will be shaped by the prevailing institutions. In addition to their institutionally implied freedoms, incentives and information, it is also necessary to take into account — and this is how bounds of cognition and their evolution are involved in this step — the cognitive abilities that they are likely to have, considering the institutionally shaped evolutionary processes through which they have been selected for their actual positions (Pelikan, 1988, 1993, 1997).

Step 3 is needed for providing all the six links with a solid microeconomic basis, making it possible to understand all of them in terms of individual behaviors – that is in terms of who does what and why. This understanding is crucial, for it is within individual minds that some of the most important influences among institutions, evolutions, and bounds of cognition take place.

Step 4 — including unequally bounded cognitive abilities among scarce resources: This step significantly extends the usual lists of scarce resources. Its prerequisite is to admit that agents' cognitive abilities ('rationality') may not only be bounded but moreover unequally so — in other words, that the abilities of some agents may be bounded more than the abilities of others. Although agents can usually improve their abilities by learning, it must also be admitted that even their learning abilities may be unequally bounded: in comparable conditions, some agents may be able to learn much more and much faster than other agents.

It then directly follows that such differently bounded cognitive abilities (including learning abilities) must belong among scarce resources, which raises the problem of their allocation to different uses in society. Assuming a normal distribution (“bell curve”) of these abilities, it can be said that the less bounded they are - in other words, the higher and thus the more exceptional competence and learning talents they imply - the higher their scarcity, and the greater their possible contribution, provided they are suitably allocated and motivated, to the economy's performance. The snag, which requires a substantial modification of the usual views of resource allocation, is that the allocation of unevenly bounded abilities is guided by this very allocation itself. This creates what is sometimes called "a tangled hierarchy," which may appear to involve an infinite regression that makes the allocation problem insoluble. In fact, of course, this problem can be solved — as it is indeed being solved, more or less efficiently, in all real-world economies — but only sequentially over time, by corresponding evolutionary processes shaped by corresponding institutions (Pelikan, 1989, 1993, 1997). This allocation problem thus also provides compelling evidence why for difficult economic problems in which the constraint of cognitive abilities may be binding – such as many of the problems that must be solved by entrepreneurs, investors and policy-makers - economic analysis must reject the standard assumption of perfectly optimizing agents, and pay instead attention to evolutions and institutions.

Step 4 is moreover important for clarifying how the allocation of unequally bounded cognitive abilities may influence both subsets of evolutions — in particular, how the evolution of formal institutions may depend on the bounds of cognition of the politically selected legislators, and how the evolution of markets and firms may depend on the bounds of cognition of institutionally admissible entrepreneurs, investors, customers, and government policy-makers. Note that on this point, Step 4 meets Step 3.

Step 5 — recognizing agent's behaviors as program-based: This step means to admit the elementary fact of both computer sciences and neurophysiology that all information-processing — including reasoning, deciding, problem-solving, learning, and creating — requires suitably programmed material devices — such as brains, computers, and organizations — and is therefore inevitably constrained by the availability of suitable programs and operational (computational) capacities of these devices.

The notion of program is of course to be understood in the modern broad sense, which does not limit it to rigid recipes for linear and mechanistic procedures. In this sense, programs can also govern parallel processing and uses of random messages, and can thus also be seen as the basis of all intellectual search, creative thinking and heuristic problem-solving. Programs may moreover be modifiable and adaptable by learning. But — and this is an often forgotten but here emphasized necessary condition — all adaptation and learning must also be program-based, and thus also be subject to the constraints of available learning programs and corresponding operational capacities.

Such programming and computational constraints will be seen to limit the behavior of all agents, both individuals and organizations. To understand these constraints means to understand the bounds of agents' cognition, and that in terms which will also help to understand the mutual influences between these bounds and the prevailing institutions.

Emphatically, however, this step does not exclude the possibility of regarding an agent's behavior as purposeful (goal-seeking) and to a certain extent optimizing. The available programs may often be seen to contain sub-programs for valuating predicted and actual outcomes, and thus realizing certain preference orderings or objective functions. They may also be able to find optimal solutions for a certain set of sufficiently simple problems. In fact, describing agents as goal-seeking entities, striving to maximize certain objective functions or obtain certain most preferred states, is often useful shorthand for indicating the main thrust of their behavior. But this shorthand must not be used for obscuring the fundamental fact that all objectives and preferences must be programmed and that the extent of optimizing is limited by the availability of computable optimization programs.

Elements of this step can be seen taken by Nelson and Winter (1982), in their description of agents' behaviors in terms of routines; a more thorough discussion with references to recent contributions is in Vanberg (2002).

This step helps to understand all the four links involving bounded cognition. As it makes it possible to decompose human cognitive abilities into different types of programs, it also makes it possible to refine and concretize these links by identifying the ways in which the different programs may be involved in them.

Step 6 — identifying and interrelating the information contents of institutions, evolutions, and bounded cognition: This step requires a suitable definition of information, which would make it possible to express the information contents of all these notions in comparable terms. Much of this step is explained in Pelikan (2001), where such a definition is obtained from the one in communication technology elaborated by Shannon and Weaver (1949) and in economics applied by Theil (1967), by simplifying it along the lines suggested for uses in biology by Ashby (1956/63). In this definition, information is always related to a specific choice, whose contents give it its qualitative meaning (context), and whose variety provides a rough measure of its quantity - the more of this variety it can reduce, the greater its quantity. The simplification is, in essence, that the "richness" of the choice is not measured in the mathematically rather complicated terms of entropy, as in the Shannon and Waver definition, but in the much simpler terms of variety. While this allows only rough information accounting, such accounting suffices to clarify the main points of which information can be stored or processed in the three key notions and which information transfers can take place among them. In particular, this makes it possible to follow all the pieces of information that directly or indirectly govern the organizing, the working, and the evolving of an economy, from their different sources to their different uses.

Step 6 thus turns out to provide important additional clarifications to all the three notions and all the six links. For instance, institutions can be understood to contain information that directly intervenes in agents' choices, by limiting both the variety of the choices of own actions and the variety of predictions about the choices of other agents' actions. Evolutions can be understood as information-producing processes with a clear view of both the sources of their inputs and the uses of their outputs. In general, the inputs can be seen to consist of possibly variable mixtures of random messages and already existing information — for instance, stored in the participating agents and/or in the prevailing institutions. Among other things, this can clarify an important difference between the Darwinian evolution of life and the evolutions of human economies and societies — namely, a lower share of random messages in the inputs of the latter. On the other hand, the outputs can be precisely followed as branching into different uses, bringing new information to different parts of an evolving economy — such as its institutions, its agents' cognition, and the specific organizations that the agents, with their actual cognition under the actual institutions, are forming and running. Moreover, as explained in Pelikan (2001), this step can help to clarify two controversial issues: the one of the role of self-organizing in Darwinian evolutions, and the one of group selection,

4 Why

Assume that these six steps can indeed clarify the six links and thus synthesize the three fields into one. But why do so? To be sure, there are two easy answers: to satisfy theoretical curiosity; or to describe with more realism how real-world economies form, work, and grow or decline. But neither is very convincing. Only some economists may be so curious and/or so fond of realism. Many others may prefer to avoid such a complex field, where they would be afraid of losing their way, and, far from liking realism, they may on the contrary prefer theories as stylized and simplified as possible.

But there is a third, more compelling answer, which shows that a minimum understanding of all three fields, including the links among them, is compulsory for all economists who wish to deal with, and avoid mistaken conclusions about, some of the most basic policy issues, in particular those concerning structural change, institutional reforms, system transformations, and the division of economic tasks between governments and markets in general. That standard simplified theories in which these fields are ignored are not very able to deal with such issues can be illustrated by recalling the major economic crises of the last half-century — perhaps the most spectacular ones being stagflation, the collapse of socialist economies, and the Japanese financial crisis. Standard theories not only failed to see these crises coming, but were until the last moment producing formal proofs that the policies by which these crises were later found to be caused are socially optimal.

Perhaps the most fundamental policy issue, the wrong answers to which can be shown to underlie all the above-mentioned mistakes of standard policy analysis, can be formulated as follows:

- What could or should the government in an economy do, and what should it definitely abstain from doing, to make and keep the economy reasonably successful, or at least free from serious crises?

To show why, for correctly exploring this issue, a cooperation of all the three fields is required, three things need to be made clear: (i) that the answer significantly depends on both the past and the future of several evolutions; (ii) that all economic agents, governments included, must be admitted to be more or less cognitively bounded; and (iii) that the answer must concentrate on the economy's institutions.

The need for taking into account evolutionary processes and bounded cognition can be deduced from two elementary Reliability Requirements — obvious in engineering and medicine, but often violated in economics — which any theoretical analysis, to be a reliable guide to practical actions, must meet:[3]

(1) *No* condition on which the success of the actions considered may critically depend should be omitted or wishfully assumed more favorable than it might actually be.

(2) Efforts must be made to take into account *all* the success-relevant effects, including the possibly negative side-effects, that the actions might sooner or later bring about.

[3]The following argument summarizes and extends the one in Pelikan (2003a).

It is indeed obvious to engineers that they must not wishfully assume their construction materials unrealistically strong, if their constructions are not to collapse, and to physicians that they must not ignore any important side-effect of their therapies, if they are not to cure diseases while killing their patients. And note that the two requirements in no way mean abandoning the principle of maximum simplicity of analysis: both engineers and physicians must indeed try to keep their analysis as simple as possible, to be able to handle it. The crucial point is that the analysis must not be more simple than necessary for obtaining reasonable outcomes in the real world, or at least avoiding disasters.

To be sure, the two requirements are not easy to meet, and neither engineers nor physicians can boast about always meeting them. But at least they try. Collapsed constructions and deceased patients are typically used for learning more about the possibly unfavorable conditions and the negative side-effects that must be taken into account. Theoretical economists, in contrast, often violate these requirements systematically, without even noticing it, in the basic assumptions on which they build their theories. A satirical illustration is the old joke about a group of hungry scientists with cans of food on a desert island: while other specialists try to find out how to use available materials to open the cans, the economist suggests that they assume they have a can-opener.

Why, in the above policy issue, the Reliability Requirements imply the need for taking into account evolutions and bounded cognition can be summarized as follows. The initial conditions from which any actual policy would have to start strongly depend on the outcomes of several past evolutions — such as the one that has produced available technologies and the one that has selected differently competent and differently interested agents to their actual positions on markets and in government.[4] And the true welfare effects that the policy would have over time strongly depend on the outcomes of several future evolutions — such as the continuation of the one of technologies and of the one of agents' competencies, on both of which the policy may have strong cumulative effects. All these evolutions must therefore be taken into account, to avoid both wishful assumptions of too favorable initial conditions and naive omissions of some negative policy effects. Concerning the bounds of the agents' cognition, what makes them equally necessary to consider is that their actual state, as produced by their past evolution, is an

[4]Cf. the well-known arguments by Alchian (1950), Friedman (1953) and Winter (1971) that the ability of incumbent firms on competitive markets depends on the outcomes of market evolution and selection.

important part of the initial conditions, while their future evolution will strongly influence, through various learning and selection processes, the policy effects over time.

Turning to institutions, why the answer to the market vs. government issue must concentrate on them follows from the requirement to identify, among all the variables on which the performance of real-world economies may depend, those that real-world governments can effectively control.[5] It is among those variables that institutions play a central role. To be sure, governments can directly control, through their legislative bodies, only formal institutions consisting of codified laws, and not the informal ones, such as culturally evolved moral norms, including business ethics. But even with this limitation, this control is still crucial: in a modern economy, the formal institutions determine most of the basic relationships between markets and government, including the extent and the contents of the government economic agenda. This means that the policies which shape the prevailing institutions — which may be referred to as 'institutional policies' — have the highest status among all government policies, in the sense that they define, among many other things, all the other policies that the government is allowed or required to conduct, together with the permissible limits of this conduct.[6]

For an intuitive insight, an economy can be regarded as a complex and to a large extent self-designing and automatically working device, and institutional policies as the means by which its politically selected government contributes to its design. All the other policies are then the more or less extensive manual controls, by which the government may or must intervene in its operations, but which the design must first include and specify. Ideally, the government-designer should therefore take into consideration the cognitive abilities and the motivations of the government-operator, to exclude all the too demanding controls which, when handled with such abilities and motivations, could do more harm than good to the device. Of course, this ideal is not easy to achieve, and there are even strong reasons why real-world governments may be both unable and unwilling to achieve it, but to consider these reasons does not belong to the task of this paper.

---

[5]Meeting this requirement is a necessary condition for avoiding utopian thinking; it can be beautifully illustrated by the symbolic prayer: "God give me the courage to change what I can change, the patience to bear what I cannot change, and the wisdom to tell the one from the other" (I have found several quotations of this prayer, but not its origin).

[6]The division of policies between institutional, which contribute to determining 'the rules of the game,' and allocative, through which government actively participate in production and consumption, can be seen roughly to correspond to the distinction between "ordnungspolitik" and "prozesspolitik" in German Ordo-Liberalism.

The importance of institutional policies appears with particular clarity whenever an economy suffers from systemic (structural) defects, which no mixture of quantitative policies can lastingly cure, but which require a profound system transformation. Indeed, what such a transformation requires is, in the first place, an institutional policy which would abolish the laws that hinder the economy's agents from taking socially efficient actions and/or induce them into socially wasteful behavior, and replace them by a better economic legislation. This typically includes a reform of property rights and redistribution of economic decision-making between the government and market participants – which in most of today's poorly performing economies means reducing the former and extending the latter.

More generally, whatever the solution of the market vs. government issue might be, institutional policies are *the* tools for implementing it. Interestingly, this elementary truth raises a feasibility problem to the extreme liberalism which advocates an overall weakening of governments all the way down to 'all-market-zero-government' solutions: the problem is that in the real world, starting from the present historical situation, weakening the role of government in resource allocation requires corresponding institutional policies, which in turn need a strong, decisive government, able to design them and implement them, against the possibly strong resistance of different agents with vested interests in status quo, such as trade unions of government employees and rent-seeking politicians.

An interesting implication is that institutional policy analysis must be recognized to be more fundamental than standard policy analysis. The reason can be seen by comparing their ways of dealing with a given policy instrument: the latter asks how an idealized government in an idealized economy could use it optimally, whereas the former ask whether or not a real-world government in a real-world should use it at all. Clearly, it is this question that must be answered first: unless its answer is positive, the search for the instrument's optimal use is all but futile. Emphatically, taking the proof that a policy instrument has an optimal use in idealized conditions for implying that this instrument can therefore be recommended for use in real-world conditions, as theoretical economists have often been doing, disregards both Reliability Requirements and must therefore be rejected as doubtful and possibly misleading.

5 How

At least one more question must be answered to make it possible show that the synthesis of the three fields can indeed be a promising strategy for development of theoretical economics. This is the methodological question of how, in such a complex field, a fruitful analysis could possibly be conducted.

It is easy to see that quantitative mathematical modeling, which has become the prominent, if not the only admitted, tool of modern economic analysis cannot do the job. Hardly any of its requirements can be met: the number of the variables involved cannot be expected to remain within mathematically manageable limits, and many of them and of their relationships may moreover be qualitative, or structural, and not quantitative.

This last section is to show is that there is another type of modeling on which fruitful analysis can be based. It may be called "comprehensive structural modeling" and described as attempts to assemble all variables, parameters and constants *that are of relevance to given questions*, and to map all the ways in which they are *relevantly* interrelated, in order to provide a ground on which the search for correct and meaningful answers to these questions could fruitfully be conducted.

The emphasis on "relevance" and "relevantly" is to make it clear that the adjective "comprehensive" does not mean including everything, but only what may matter for the difference between the correct and the wrong answers to the given questions — which is indeed nothing else than what must be done to meet the Reliability Requirements. The principle of maximum possible simplicity, or Occam's razor, is thus not abandoned, but, as opposed to the usual practice of modern economic analysis where the simplifying depends on the fancy of the analysts and their "analytical convenience," in this modeling the simplifying is crucially constrained by the complexity of the given questions. This means, of course, that for complex questions the analysis may have to be only rough. But, in agreement with Hayek (1967) and sane common sense, one of the present claims is precisely that rough correct answers should always be preferred to precise but wrong ones.

To make this modeling more palatable to mathematical economists, it should be noted that it may admit, and even welcome, quantitative modeling, but only for sub-problems and under restrictions. Namely, a quantitative model, to be welcome, must be well-framed by a broader comprehensive model, and be checked there for meeting the Reliability Requirements. In other words, a comprehensive model may admit oases of sub-problems for which quantitative models are feasible and helpful, but it must keep the upper hand: it must approve of their uses and protect their formal results from illegitimate and misleading interpretations.

To make comprehensive structural modeling intuitively appealing, it should be noted that this is the most natural method of our brains, and indeed of the brains of all surviving species, to represent the real world *with sufficient relevance* for conducting, *with sufficiently frequent success*, the search for ways leading to desired outcomes, or at least avoiding disasters. Most of the time we appear to build and use such models without being aware of it, and when told that we do so, we may be as surprised as Monsieur Jourdan in Molière's play "Bourgeois gentilhomme" when told that all his life he had been speaking in prose.

With one conspicuous exception, comprehensive structural modeling is also the basic method all sciences dealing with complex subjects which involve very large numbers of variables and important relationships among forms (patterns) — such as molecular biology, neurophysiology, and computer sciences. As can now be guessed, the exception is modern theoretical economics. Although its true subject — meaning that part of the real world which it is supposed to study and about which it is supposed to produce useful knowledge — is highly complex and involves important pattern relationships, it has evolved into a state where mathematically solvable, and therefore often strongly simplified quantitative models are the only respected, if not the only admitted, means of expression.

A plausible explanation appears to be that the evolution of economics has taken a typical path-dependent course of any evolution in which internal drift is stronger than external selective pressures. The first steps were most likely useful: the introduction of mathematics allowed economics to clarify with precision many basic economic relationships and to liberate itself from adepts unable of clear logical reasoning. Later on, however, the growing use of mathematics started to attract an opposite type of adepts, more interested in mathematical methods than in empirical relevance. As their number kept increasing, they could succeed in imposing their interests as the norm on the entire profession: problems that could not be mathematically modeled, regardless of how important in the real world they might be, started to be either entirely ignored or, in the best case, recognized to exist, but left aside until suitable mathematical methods for dealing with them are found, wishfully assumed to be only a matter of time. That there may be important economic problems which are too complex to be expressed, without loss of any of their substantial parts, by any manageable mathematical model has not been admitted. The last line of defense has been that no science can be blamed for problems which it has not yet solved, if it continues to expand the set of problems which it can solve. As the set of economic problems that can be mathematically modeled and impressively solved continues indeed to grow, the internal and external pressures trying to deprive quantitative modeling of this exclusive status, and thus bring the analytical methods of economics more in line with the complex nature of its true subject, have not yet been very successful.

But this last line of defense is easy to break. All it takes is to concentrate on its Achilles heel, which is — as can be implied from Section 4 — in the area of basic policy issues. That this area has not been very popular among today's theoretical economists, be they mathematical or not, can perhaps explain why this weak point has not yet been systematically exploited by critics. Yet it is easy to show that purely quantitative modeling is most often unable to comprehend all the important aspects of such issues that their analysis, to meet the Reliability Requirements, must take into account. To be mathematically solvable, as noted, quantitative models must be limited to quantitative changes of a relatively small number of economic variables. In contrast, basic policy issues must often take into account many more variables and more kinds of changes, including those of forms (technologies, organizations, institutions).

In fact, the need to respect the Reliability Requirements is not limited to basic policy issues, but may concerns all economic policies, even the purely quantitative ones. Even such policies may have important side-effects on organizational and/or institutional features of an economy, which must be carefully considered before such policies can be cleared as safe to use. Moreover, much like cancer cannot be cured by blood transfusion, the difficulties of many economies cannot be remedied by quantitative policies alone, but require more sophisticated qualitative policies — such as institutional reforms or system transformations. This is perhaps the most compelling argument for the necessity of comprehensive structural modeling and its primacy over the purely quantitative one.

Two parables may add intuitive support. One is about the proverbial drunkard searching for his lost keys under a street lamp, not because he lost them there, but because he sees there better. His logic is indeed formally identical to the logic of the mathematical economist who chooses problems for his analysis not according to their real-world importance, but according to the mathematical methods he has succeeded to learn. In this parable, the task of comprehensive modeling is to consider the entire area where the keys may have actually been lost, which is indeed what a sober person would do. Only if this area happened to coincide with the one lit by the lamp would she look for them there. Otherwise, she would clearly realize the necessity to look for them (also) elsewhere, even if this meant using much weaker sources of light.

The second parable, which is more specific and may also be seen to offer a lesson for how to fruitfully use comprehensive models, is from medicine. Probably not even the most purely mathematical economist, when sick, would trust an MD who would base his reasoning on simplified quantitative models, in which many possible causes of diseases and many possible side-effects of therapies would be, "for analytical convenience," assumed away. In medicine, complete mathematical modeling of the human body, whose complexity may be roughly compared to that of a national economy, is indeed considered neither possible nor very useful. While quantitative methods are also there highly valued and increasingly used, the basic medical knowledge nevertheless consists, and is expected to do so even in the future, of comprehensive structural models — as can be found in textbooks on anatomy, physiology and pathology — and which remain to be the highest authority for determining when and to what extent quantitative methods may help.

The lesson can be learned from what medicine does when it searches in the large (and still growing) sets of known possibilities for the causes of different diseases, and for the positive and negative effects of different therapies. The implication is that economic analysis, to avoid misleading policy implications, needs to turn from searching for optimal solutions of narrow problems in simplified mathematical models to much broader searching in comprehensive structural models for the true causes of poor performance of economies, and for the important effects, both short-term and long term and both positive and negative, of the policies proposed for improving this performance.

*

References

Alchian, A.A. (1950), "Uncertainty, evolution, and economic theory," Journal of Political Economy 58: 211-222.

Ashby, W.R. (1956/1963), Introduction to Cybernetics, John Wiley & Sons: New York.

Dawkins, R. (1976), The Selfish Gene, Paladin: London.

Dawkins, R. (1982), The Extended Phenotype, W.H. Freeman and Company: Oxford and San Francisco.

Denzau, A.T. and D.C. North (1994), "Shared mental models: ideologies and institutions," Kyklos 47: 3-30.

Droback, J.N. (2000), "A cognitive science perspective on legal incentives," in C. Menard, ed., Institutions, Contracts and Organizations, Academic Press, London.

Friedman, M. (1953), Essays in Positive Economics, University of Chicago Press: Chicago.

Hayek, F.A. (1967), Studies in Philosophy, Politics, and Economics, University of Chicago Press: Chicago.

Knight, J. and D.C. North (1997), "Explaining economic change: the interplay between cognition and institutions," Legal Theory 3: 211-226.

Nelson, R.R. and S.G. Winter (1982), An Evolutionary Theory of Economic Change, Harvard University Press: Cambridge, MA.

North, D.C. (1990), Institutions, Institutional Change and Economic Performance, Cambridge University Press: Cambridge, UK.

North D.C. and R.P. Thomas (1973), The Rise of the Western World: A New Economic History, Cambridge University Press: Cambridge, UK.

Pelikan, P. (1988), "Can the imperfect innovation system of capitalism be outperformed?" in G. Dosi et al., ed., Technical Change and Economic Theory, Pinter Publishers: London.

Pelikan, P. (1989), "Evolution, economic competence, and the market for corporate control", Journal of Economic Behavior and Organization 12, 279-303.

Pelikan, P. (1992), "The dynamics of economic systems, or how to transform a failed socialist economy", Journal of Evolutionary Economics 2, 39-63; reprinted in H.J. Wagener, ed., On the Theory and Policy of Systemic Change, Physica-Verlag: Heidelberg, and Springer-Verlag: New York.

Pelikan, P. (1993), "Ownership and efficiency: the competence argument", Constitutional Political Economy 4: 349-392.

Pelikan, P. (1995), "Competitions of socio-economic institutions: in search of the winners," in L. Gerken, ed., Competition among Institutions, Macmillan: London, and St. Martin's Press: New York.

Pelikan, P. (1997), "Allocation of economic competence in teams: a comparative institutional analysis," WP 480, The Research Institute of Industrial Economics: Stockholm.

Pelikan, P. (2001), "Self-organizing and Darwinian selection in economic and biological evolutions: an inquiry into the sources of organizing information," in J. Foster and J.S. Metcalfe, eds., Frontiers of Evolutionary Economics, Edward Elgar: Cheltenham and Northampton.

Pelikan, P. (2003a), “Choice, chance, and necessity in the evolution of forms of economies,” in U. Cantner and J.S. Metcalfe, eds., Change, Transformation and Development, Springer-Verlag: Heidelberg.

Pelikan, P. (2003b), "Why economic policies require comprehensive evolutionary analysis," in P. Pelikan and G. Wegner, eds., The Evolutionary Analysis of Economic Policy, Edward Elgar: Cheltenham and Northampton.

Pelikan, P. (2003c), "Bringing institutions into evolutionary economics: another view with links to changes in physical and social technologies," Journal of Evolutionary Economics 13: 237-258.

Schumpeter, J.A. (1942/76), Capitalism, Socialism, and Democracy, Harper & Row: New York.

Shannon, C.E. and W. Weaver (1949), The Mathematical Theory of Communication, University of Illinois Press: Urbana.

Theil, H. (1967), Economics and Information Theory, American Elsevier: New York, and North-Holland: Amsterdam.

Vanberg, V. (1992), "Innovation, cultural evolution, and economic growth," in U. Witt, ed., Explaining Process and Change: Approaches to Evolutionary Economics, The University of Michigan Press: Ann Arbor.

Vanberg, V. (1994), Rules and Choice in Economics, Routledge: London and New York.

Vanberg, V. (2002), "Rational choice vs. program-based behavior: alternative theoretical approaches and their relevance for the study of institutions," Rationality and Society 14: 7-54.

Winter, S.G. (1971), "Satisficing, selection, and the innovating remnant," Quarterly Journal of Economics 85: 237-261.

Witt, U. (2003), The Evolving Economy: Essays on the Evolutionary Approach to Economics, Edaward Elgar: Cheltenham and Northampton.