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A Conceptual Agent-Based Model for the Foundations of Analytical Institutional Economics

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Abstract: Economists are increasingly realizing that the performance of economies crucially depends on a non-tradable asset, intuitively comparable to the rules of a game, but analyzed under different names – including ‘institutions,’ ‘constitution,’ ‘law,’ ‘property rights,’ and ‘social norms.’ This paper proposes an operationally clear conceptual model which can help these analyses unify and advance. Based in Institutional Economic (IE), the model terms the asset ‘institutional framework’ (IF), consisting of all the institutional rules of an economy, both formal and informal. The term ‘institutional rules’ replaces the ambivalent term ‘institutions’ in the meaning defined by Douglass North. ‘Analytical Institutional Economics’ (AIE) is defined as a subfield of IE, specialized in analyzing IFs’ effects on economies, IFs’ changes over time, and the policies influencing these changes. An economy’s IF is distinguished from, and interrelated with, its ‘organizational network’ (ON), comprising all its markets and organizations with individuals and interconnections. The IF-ON model advances AIE beyond transaction costs and other incentives to rationality inequalities and processes of economic change, stratified into ON-development and IF-evolution. The model logically corresponds to the genotype-phenotype model of evolutionary biology, suggesting that AIE should be as central in economics as genomics in biology.

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1 – Introduction

More and more economists are now realizing that each economy possesses a crucial non-tradable resource, intuitively comparable to the rules of a game, on which its performance and development most importantly depend. So far, however, the studies of this resource have been highly fragmented. Different economists study it in different fields under different names – including ‘institutions,’ ‘constitution,’ ‘law,’ ‘property rights,’ and ‘social norms’ – without properly referring to each other and without fully realizing that they are studying basically the same problems.

This paper has two aims: (1) to help these fields unite by allowing their questions to be stated in the same well-defined terms; and (2) to help them advance towards important new questions that have not yet been properly addressed. As the main tool for pursuing these aims the paper proposes an operationally clear conceptual agent-based model. Since the questions involved are many, it may be useful to emphasize, not to suspect the paper of overambition, that the task of a conceptual model is only to allow them to be stated with precision, and not to answer them.

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As it would be difficult to start from several fields simultaneously, it is necessary to choose one. The present choice is ‘Institutional Economics’ (IE), which appears to have the longest history and the most rapid actual growth. But this choice should not matter: the model should be easy to interpret in all the other fields.

In IE, the crucial resource is usually denoted, although not always in a clearly defined way, as ‘institutions.’ The essential dependence of the performance of economies on their ‘institutions’ has empirically been shown by many authors, of which Rodrick et al. (2004), Shirley (2008) and Acemoglu and Robinson (2012) are particularly important examples.

But the first problem is, as recently pointed out by Hodgson (2016), that IE is highly fragmented itself. It is not only the many times debated rift between the mainly critical ‘Old IE’ and the more analytical ‘New IE,’ but important fissures appear even within the latter. Some of its most prominent proponents employ different terms and study different problems, without making it entirely clear what their works have to do with each other.

As a clear illustration, consider the three seminal contributions by Williamson (1986), North (1990), and Acemoglu et al. (2005). Very roughly, Williamson mainly speaks of firms,

with the focus on their sizes, types of organization, and governance, but is not very clear on what exactly he means by the term ‘institutions.’ A paradox of his 1986 book ‘The Economic Institutions of Capitalism’ is that this term appears only in the title – where it broadly refers to firms, markets and relational contracting – and nowhere in the text.

North says little about firms, and focuses instead on entire economies. It defines ‘institutions’ quite clearly as ‘the humanly devised constraints that structure political, economic, and social interaction,’ and divides them into ‘formal,’ such as constitutions, laws and property rights, and ‘informal,’ such as taboos, customs, traditions, and codes of conduct. He compares them to the rules of a game, and distinguishes them, but somewhat less clearly, from organizations as the players of this game. An important common point of Williamson’s IE and North’s IE is that both may be considered ‘economic’ in the sense that they both directly deal with economic processes, with particular attention to transaction costs.

Acemoglu et al. extend IE by including the political processes that select the government, and then assume that ‘economic institutions’ are chosen by it. They classify economic institutions into ‘extractive’ and ‘inclusive,’ and define them as “social decisions, chosen for their consequences.” But this definition causes a problem: it makes their ‘political’ IE difficult to cohabit with the ‘economic’ IE of North and Williamson. By assuming that the consequences of different economic institutions are already known, it makes the ‘economic’ IE, where this knowledge is still being laboriously sought, appear retarded and superfluous. Moreover, according to North, only formal economic institutions can be chosen by social decisions, whereas the often more important informal ones are outcomes of complex evolutionary processes that any social decisions may influence only partially.

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These internal fragmentations of IE appear to complicate the first aim of the paper: it is necessary first to bridge them before it may be possible to bridge those between the different fields. It is therefore important to make the proposed model able to help with both.

In the model, the crucial resource is termed ‘institutional framework’ (IF) and defined to consist for each economy of all of the economy’s ‘institutional rules,’ both formal and informal. The term ‘institutional rules’ replaces the ambivalent term ‘institutions’ and, in a first approximation, keeps the above-quoted definition of this term by North. This replacement protects the conceptual clarity of the model by excluding the many other

meanings that the term ‘institutions’ continues to be given – such as in financial economics, where it often denotes large banks and other financial *organizations*.

The IF of an economy has another important role, in addition to the constraining (shaping, guiding, enabling) individual behaviors. It also determines the type of the economy in the usual rough classification of different forms of ‘capitalism,’ ‘etatism,’ ‘socialism’ and ‘welfarism.’ While the precise criteria of this classifications have not yet been firmly established – so far, no economic Carl Linnaeus has appeared to introduce a definitive order – there are some basic principles according to which the IF determines the type, even when this is not very precisely defined.

To see these principles, it is necessary to distinguish two possibly overlapping segments of the IF: IF_{mkt} , the rules constraining market participants, and IF_{gvt} , the rules constraining government. Different economies may differ in the one, or the other, or both. For instance, the differences in IF_{mkt} may concern economic freedoms, or forms of property rights. The differences in IF_{gvt} are mainly those in the number and the types of the policy instruments that the government is allowed or required to use.

For full clarity, it is necessary to recall the classical distinction between the legislative and the executive branches of government. The former chooses (designs, codifies) the formal part of the economy’s IF, including IF_{gvt} , whereas the latter uses the policy instruments that the former, via this IF_{gvt} , allows or obliges it to handle. This brings to light the most basic, but rarely properly addressed policy question: what policy instruments should the legislature allow the executive to handle, to enable it to help the economy, while preventing it from doing more harm than good?

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As IE is a very broad field, it may be doubted that one conceptual model might embrace all of it. To avoid such doubts, the paper limits the model to a subfield of IE, termed ‘Analytical Institutional Economics’ (AIE), and defined as dealing with only three questions:

Q1: What are the effects of different IFs on economies?

Q2: How do IFs change and evolve over time?

Q3: How can the changes of IFs be influenced by policies?

The adjective ‘analytical’ diplomatically avoids the ‘New IE’ vs. ‘Old IE’ controversy. While most of AIE will turn out to be ‘New IE,’ it does not a priori exclude ‘Old IE,’ which

some institutional economists are now trying to rehabilitate (see, e.g., Hodgson 2004). Any part of IE that can help analyze any of the above questions, whether ‘Old’ or ‘New,’ is welcome in AIE. On the other hand, all the critical, ontological, and philosophical debates about ‘institutions,’ without denying their possibly great intellectual interest, are left aside.

In existing literatures, large parts of each of these questions have already been analyzed and many important pieces of their answers have been found. But much work still remains to be done: many other important pieces are still unknown, and some are only believed to be known, but are in fact mistaken.

To help specify this extra work belongs to the second aim of the paper. Much of this work requires AIE to address other effects of IFs than the usually studied transaction costs and other incentives. With references to some of the author’s earlier research, the model brings to light two such effects: (a) on the dealing with rationality inequalities, with main references to Pelikan (2007, 2010); and (b) on the processes of economic change, with main references to Pelikan (2011, 2012).

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The rest of the paper is organized as follows. Section 2 presents and clarifies the main parts of the model separately. Section 3 interrelates them and thus puts the model together. Section 4 uses the model to decompose economic change into layers, and to structure AIE into corresponding static and dynamic analyses. Section 5 summarizes the main results and indicates promising directions for further research. Section 6 concludes by a brief discussion on what the model implies for the future status of AIE in economics.

2 – The IF-ON model: the main concepts

The model is built around two central concepts. One was already presented: the IF of a given economy. The second is the economy’s ‘organizational network’ (ON), defined as all of the economy’s markets and organizations, both private and governmental, with individuals and interconnections. The model can therefore be referred to as ‘the IF-ON model.’

ONs may assume a great variety of forms: both the markets and the organizations may be of different numbers and different types. The markets may be differently competitive or contestable, and the organizations may be different kinds of private firms, cooperative firms, government firms, and government policymaking agencies. To grasp this variety in a

relatively orderly way, start with the imaginary extreme form consisting only of markets, and then classify all the other forms according to the number, the sizes and the types of the organizations that have internalized different parts of different markets – up to the other imaginary extreme, in which one enormous organization internalizes all of the markets. This imaginary organization might be a state command economy, but possibly also a large private corporation.

An economy's ON is its 'working body' that produces and distributes its output. It is this working and this output that much of standard economics has been about. But the IF-ON model is non-standard in two respects: (i) instead of the usual assumption that the ON is constant, this is admitted to change – to grow and develop, or shrink and decay; (ii) instead of assuming all organizations to be optimal – such as efficiently organized and the best technologies using firms – they are admitted to be more or less poorly organized and more or less technologically obsolete. As explained below, some of the most important and least examined effects of IFs concern precisely these two respects. ...

For many problems it is necessary to take a more detailed look at an ON and bring to light the individuals who form and operate it. This means to view each market and each organization as a network of individuals with their jobs (positions). This view brings to light the important problem of competence-difficulty gaps (c-d gaps), appearing when the difficulty of jobs exceeds the competence of the individuals occupying them (Heiner 1983). For a first idea of its importance, consider that two ONs may appear similar in a global view of their markets and organizations, and yet greatly differ in the c-d gaps within these markets and organizations. For instance, in one ON the firms' managers may be selected and continuously tested by markets, while in the other, by friends or family in the government. The c-d gaps will likely be greater and the overall performance likely worse in the latter ON.

The IF-ON model is only partly novel. Both its key concepts have old roots: IF in North's (1990) definition of 'institutions,' and ON in Williamson's (1975) view of economies as combinations of markets and hierarchies, with his subsequent qualification that economic organizations need not be hierarchies, but may also assume other forms. The novelty of the model can therefore be only in how the two are interrelated. But this is not without merit. As noted, these two seminal contributions to IE have been largely disconnected, and despite the great importance of both, their interrelations have not yet been fully clarified.

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The concept of ‘organization’ is included in the concept of ON, but for making this inclusion clear it needs a definition of its own. In the literature, organizations have been defined in many ways, but for other needs. Most of them contain details that the IF-ON model does not need, and do not express clearly enough what it does need: the features that connect an organizations to the entire economy and identify its place in the model.

For this need, it is necessary to define each organization as a smaller economy with its own internal IF and ON. Its IF consists of the rules that constrain the behaviors of its members, including its owners, managers and other employees. In the case of government organizations, these members are leading politicians (ultimately the people) and government bureaucrats (public servants) of different levels. An organization’s IF includes the form of its governance, and its ON may be seen as its organizational chart with the individuals that occupy its different jobs. To come into existence, each organization needs some initial entrepreneur or entrepreneurs – private or government appointed – who design and assign the first jobs in its ON, define its initial formal IF, and sow the seeds of its informal IF.

The organization is connected to the economy through both its IF and its ON. The form of its IF is usually constrained by certain rules of the economy’s IF – for instance, the form of a firm’s corporate governance is usually constrained by the economy’s corporate law. Its ON may be seen as an islet within the economy’s ON, connected to it by various inputs and outputs.

Contrary to what is sometimes assumed, the members of an organization need not share any common objectives. Such sharing is limited to the special kind of organizations called ‘teams.’ In general, and in agreement with modern theories of the firm, the individuals are classified into two possibly overlapping categories: the principals and the agents. Only the principals can be assumed, often only with qualifications, to have common objectives. The organization with all of its agents, including its managers, is only their tool. This is formally the case even if the organization is a cooperative where all members are both its agents and its co-principals.

To the extent that the agents’ own objectives (preferences) differ from those of the principals, these need to provide the agents with suitable incentives. As considered in more detail below, creating such incentives, and/or making sure that such incentives will be created by the principals and/or the agents themselves, is one of the main tasks of the internal IF. The less well the IF fulfills this task, the poorer the incentives, and the greater the agency losses within the organization, with growing threats to its continuing existence.

An important subtlety that economists do not always properly realize is the difference between institutional unity, meaning that all members of an organization obey the same internal IF, and the extent of its central management and hierarchization. Important to realize is that the two need not go together. Institutional unity need not produce a hierarchy nor any central management. It is its IF that determines whether or not an organization will have some central management, and if yes, what powers this management will have.

For the economists who have some knowledge of biology, the logic of this difference may quite precisely be illustrated by the difference between genomes and central nervous systems: each organism has a genome, but only some have a CNS – and it is the genome that determines what CNS, if any, the organism will have. For a less precise, but more economics-friendly illustration, it appears possible to use the terms ‘spontaneous order’ and ‘organization’ in the sense employed by Hayek (1973), but without his sharp black-and-white distinction between the two. According to the present definition, each organization is to some extent a spontaneous order, which emerges when all of its members obey its internal IF, and it may only possibly (even if most usually) have a more or less extensive central management as an integral part of this by the IF implied order.

The suggestive but imprecise comparison of institutions (in the sense of institutional rules) to the rules of a game and organizations to its players, suggested by North (1990) and criticized by Hodgson (2016), can now be made precise. The key is to recognize that each organization within an economy must involve IFs of at least two levels: the economy’s IF imposed on it, and its internal IF imposed on its members. Organizations must then be regarded as smaller games played within the large game of the entire economy. Members of organizations must be seen to play both these games. To put it formally, their choice sets are constrained both by the economy’s IF and by their organization’s IF, which is itself constrained by the economy’s IF.

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The basic units of the IF-ON model are individuals. The model is built on the recognition that whatever an economy is or does must ultimately be due to some of them. The model makes it clear that it is only through their behaviors that IFs can influence economies – including the forming, the operating, and the development of ONs – and is only by their actions that IFs can change. Collective behaviors are admitted, but only as nothing else than complex aggregates (not simple sums!) of individual behaviors. This is why the model may be denoted as ‘agent-based’ with the agents being human individuals.

For an illustration, consider the often quoted, but not entirely clear statement that ‘institutions provide the incentive structure of an economy’ (North 1991). To make this statement fully clear, it is necessary to recognize that most incentives are provided by individuals for each other, while the economy’s IF only constrains (shapes) the ways in which they are allowed or obliged to do so.

The model stratifies individual behaviors into three layers:

- *resource-allocating*, including producing, consuming and transacting, within a given ON under the constraints of a given IF, which contributes to the production of the economy’s outputs;
- *organizing*, including job-designing and job-assigning to oneself and/or others, under the constraints of a given IF, which contributes to the development of the economy’s ON;
- *rule-making*, including changes of both formal laws and informal social norms, which contributes to the evolution of the economy’s IF.

For most purposes, it suffices to characterize individual behaviors by the two standard features, but without the standard assumptions: (a) the individuals’ *preferences*, or objectives, sometimes possible to express as an objective function; (b) their *rationality* in the sense of economic competence, meaning their cognitive abilities for reasoning, computing and deciding about the uses of available resources for the pursuit of their preferences.

Why AIE need not as precise assumptions about these features as standard economics is that it asks different questions. Standard questions typically aims to predict the states or the working of larger entities – such as markets or entire economies – for which a precise knowledge of individual behaviors is necessary. If real knowledge is unavailable or unmanageable, as it usually is, standard analysis replaces it by fake knowledge in the form of simplified artificial assumptions – such as the classical ones of ‘homo economicus.’ In contrast, AIE’s questions are about IFs, for which it suffice to know actual individual behaviors only roughly, as belonging to a more or less broad range of possible behaviors. The central question is: for what range of individual behaviors can a given IF be and remain successful – that is, help the economy obtain preferred outcomes, or at least avoid serious crises? This question brings to light a crucial, but rarely considered condition, and an important warning. The condition is the breadth of this range: the broader this is, the more robust the IF. The warning is against examining IFs for idealized ranges of favorable behaviors – such as those limited to pro-social preferences and perfect (unbounded)

rationality. An IF found successful only for such a range would be dangerous to the health of any real-world economy: a small number of self-regarding and/or too boundedly rational individuals – who appear always present – would suffice to subvert it.

To minimize the risk that an IF might be shown successful in theory and prove detrimental in practice, the most unfavorable behaviors must receive the greatest attention – for logically similar reasons for which engineers must pay the greatest attention to the weakest materials and the heaviest loads on their constructions. This logic leads AIE close to standard economics in one direction, and to a great departure from it in the other direction.

The closeness to standard economics is needed for the issue of preferences. The most unfavorable behaviors, which pose the hardest problems for any IF, correspond to the standard assumption that individuals are self-regarding and seek to do the best only for themselves. To succeed in the real world where such individuals undoubtedly exist, an IF must secure the creation of suitable incentives that could induce them to do the best for themselves by also doing the best for the economy. This is indeed the classical problem of standard economics. What its critics do not always fully realize is that such incentives, needed for coping with the undoubtedly existing self-regarding individuals, do not require individuals to be self-regarding. Individuals with pro-social preferences are always welcome to do the best for the economy out of their own will. Ironically, however, even they may need such incentives – not for economic rewards, but for the information on what this best actually is. A well-known example is the profit incentive: many successful entrepreneurs credibly claim to appreciate their profits more for the information that they are doing the right things than for the money, most of which they often use for doing more of such things.

The great departure from standard economics is necessary for the issue of rationality (economic competence). The most unfavorable states, which pose the hardest problems for any IF, vastly differ from the standard assumption that all individuals are equally perfectly rational, able optimally to solve all economic problems. In the real world, everyone's rationality is not only significantly bounded (e.g., Simon 1955, 1979; Kahneman and Tversky 2000), but moreover unequally so: more for some individuals than others (Pelikan 2007, 2010). Some may even be so little rational (incompetent, unskilled) that they are unaware of *how* little (Kruger and Dunning 1999). The smaller departure that admits unequal individual abilities but assumes that everyone perfectly knows his or her own, such as in Murphy et al. (1991), is therefore insufficient. While learning is often emphasized as an important means for improving everyone's rationality, it need not diminish rationality inequalities: more

rational (competent, talented) individuals are typically also better learners, so that more learning may even cause the inequalities to increase rather than decrease.

The main problems for IFs caused by rationality inequalities may roughly be summarized, in a first approximation, by two questions:

- (a) How to help the economy benefit from the abilities of the least boundedly rational (most relevantly competent, talented) individuals?
- (b) How to protect the economy from the incompetence of the most boundedly rational individuals?

As explained below, these two questions indicate one of the two ways in which the IF-ON model can help AIE advance beyond today's frontiers of IE.

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For some of its problems, AIE needs a deeper description of individual behaviors than by the preferences-rationality couple. It needs to take into account the cognitive rules, instructions and programs encoded in human brains, on which all human behaviors, together with their preferences and rationality, are ultimately based (see, e.g., Pelikan 1968, Holland et al. 1986, Vanberg 2002).

But it is necessary first to dispel three still widespread misunderstandings about program-based behaviors. First, the programs need not be mechanistic and deterministic. They may use more or less random steps, and thus be stochastic, able to guide even such advanced behaviors as trial-and-error searches and creation of novelties. Second, they need not be fixed, but may keep changing by learning, to the extent provided by available learning programs, which may themselves keep changing by meta-learning to the extent provided by available meta-learning programs. Third, they need not lack intentionality, but may contain complex feedback loops, which allow them to pursue objectives and thus be fully intentional. That all these features can be realized by program-based behaviors is now amply illustrated by sophisticated computer simulations in the field of artificial intelligence.

Logically, that all human behaviors must ultimately be based on programs in human brains can no longer be doubted. Empirically, however, despite the great technological advances in neurophysiology, what these programs are and where in the brain they actually reside is still only little known. But even without this knowledge, their mere existence is an important starting point for several fruitful inquiries. Without conducting any of them here, it is instructive to realize one of their main principles, which may roughly be put as follows:

each use of information requires another information for guiding this use, and the use of this information requires yet another information for guiding this guiding. This principle implies that all uses of information must repose on a more or less high hierarchy of programs, which must ultimately repose on some basic constant programs. These programs are what both enables and limits the forming and working of the entire hierarchy.

For a long time this principle appeared difficult to grasp: many social scientists even believed that complex information can be received and processed by a blank slate (*tabula rasa*). Today, however, the widespread working with computers should make it clear that each information-processing requires a software, which requires one or several levels of underlying software, all of which ultimately requires a sufficiently sophisticated hardware. It is the wired-in circuits of the hardware that store the computer's basic constant information, which both enables and limits the computer's information-processing abilities.

The case of human brain is more complex, but the same principle applies. As opposed to the constant wirings of the computer hardware, the neural networks of the brain keep developing and adapting. Its basic constant information cannot therefore be in its actual programs, as these are changing. But all brains also have deeper programs that do stay constant, and on which the forming and changing of all of their actual programs, including their possibly sophisticated uses of possibly rich environmental information, are ultimately based. Such deeper programs are now known to exist in the genome of the brain's owner – mostly in certain genes, but possibly also in some non-genic DNA and some epigenetic markers. The genome stays indeed constant during the brain's entire life, while it is both enabling and limiting the brain's information-processing abilities (rationality, talents, competencies). Far from any form of genetic determinism, this principle may suitably be termed 'genomic limitism.'

The existence of genomic limits is important for at least two AIE's problems: (a) the dealing with the c-d gaps of individuals; and (b) the reforming of the IFs of economies. Problem (a) may have three solutions: (i) demote the individuals from the for them too difficult jobs; (ii) simplify their jobs; (iii) allow them to stay and hope that they will decrease the gap by learning. If it is admitted that individuals more or less differ in their genomic limits (inborn talents) – as will be found necessary to admit below – some jobs may be so difficult that many individuals could never learn to master them. For such jobs and such individuals solution (iii) cannot therefore work. In problem (b), the existence of genomic limits implies that humans may not be able to adapt to all the different IFs that they are able to

imagine and try to implement. To lastingly succeed, an IF must be compatible with what may be denoted as ‘human nature’ or ‘human social instinct’ – regarded as an extension of the human language instinct described by Pinker (1994).

As the IF-ON model is only conceptual, it can only show that genomic limits exist and often matter, but cannot identify their actual positions nor determine when exactly they matter. This must be left to a combination of extensive empirical research and a more precise theoretical analysis.

3 – Putting the IF-ON model together

The model is built around two basic relationships: ‘IF-individuals,’ and ‘individuals-ON,’ which together form the overall relationship ‘IF-ON.’ Each of these relationships is two-way, containing partially causal chains in both directions. The adjective ‘partial’ means that in the chain $A \rightarrow B$, A is a very important, but possibly not the only cause of B.

The IF-ON relationship has important properties that will be possible to consider without always mentioning the individuals. But it is important to keep their key roles in mind and be ready to bring them to light whenever some aspect of the IF-ON relationship needs additional clarifications.

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In the ‘IF-individuals’ relationship, the most challenging is the chain ‘IF \rightarrow individual behaviors,’ meaning the ways in which individuals internalize and learn actually to respect institutional rules. As this chain is hidden in human minds, only more or less plausible hypotheses can be made about it. But its consequences are quite clear: these rules do what is usually described as constraining, shaping, guiding and enabling of the individual behaviors. This may be described more formally by ascribing to each individual a certain feasible choice set, which the economy’s IF reduces to an institutionally permissible subset. To avoid the mistaken belief that the enabling contradict the constraining, it suffices to recognize that individuals are not always fully aware of their entire choice set, and may realize the possibilities of some of their choices only when these are explicitly allowed by the IF.

More challenging are the causes: What makes individuals allow an IF to reduce their choice sets? A well-known hypothesis is that they are accepting a favorable trade-off: they are willing to limit their freedom if they can trust the others to limit their freedom

correspondingly. This allows them better to predict what the others will do, and consequently improve their coordination and increase their expected gains. But much depends on the trust: the lower it is, the weaker the willingness, the more uncertain the predictions, and therefore the lower the gains. This role of trust deserves emphasis: it appears to be the only clear connection between the increasingly popular studies of trust and IE.

Another well-known hypothesis is that the respect for an IF is caused by sufficiently strong sanctions for violating it. The sanctions may be formal, such as fines and prison terms for violating formal laws, and/or informal, such as ostracization for violating informal social norms. Important roles may also be played by beliefs in intangible sanctions imposed by some supernatural being or beings, often with tangible sanctions for not sharing these beliefs.

A more recent and more sophisticated hypothesis is that the actual IF represents a Nash equilibrium from which no perfectly rational individual wishes to depart. But this may only be a Panglossian ex post explanation, and not an ex ante cause. Most people do not know what a Nash equilibrium is, let alone can calculate what institutional rules they should adopt to realize it and stay in it. Moreover, all known IFs appear to frustrate some individuals, who may therefore rationally wish to depart from them.

The IF-ON model supports yet another, more fundamental hypothesis, referring to the principle of program-based behaviors. As institutional rules, to be effective, must be included into the behavioral programs of each individual, this principle implies the need for deeper programs, which could make this inclusion possible, and ultimately for some basic programs in human genomes – possibly referred to as human social instincts – on which such a multilevel programming, with all of its possibly extensive uses of environmental inputs, could repose. The comparison with computer programming is again instructive. Intuitively, the adopting of institutional rules by an individual may be compared to the downloading of an additional software into a computer: this also requires and is limited by the previously downloaded software, and ultimately by the computer's hardware. In this sense, institutional rules may also be viewed as cognitive rules – as in Greif and Mokyr (2017) – but they must be denoted as 'social' and distinguished from the individual cognitive rules on which the social ones need to repose.

It is instructive to compare the human social instinct with the one of other social species. The latter, in addition to causing societies to form, also specifies what may be denoted as their IF. For instance, the genome of each ant species also specifies the IF of its anthills. The human social instinct also causes societies to form, but leaves their IF largely

unspecified. It only delimits the broad set of genomically feasible IFs, and provides humans with the abilities to create, adopt, and adapt to, any of them. In the short run, the first generations of each society are free to choose from this variety its first IF. In the long run, however, as this choice cannot but depend more on chance and fantasy than on the knowledge of its consequences, many will inevitably fail – economically, or politically, or both. But this is another story on which more below.

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The opposite chain ‘individual behaviors → IF’ is more transparent. In principle, it is possible to observe, or at least conceptually imagine, all the rule-making individuals who directly contribute, or have contributed, to the forming and changing of an economy’s IF – such as the legislators and judges who are changing the formal IF, and the anonymous socio-economic innovators who are changing the informal IF. Many other individuals may contribute indirectly, by more or less strongly influencing, economically or politically, some of the direct rule-makers.

An important feature of this chain is the key role played by the knowledge that requires AIE for its production. To see this role, consider the behaviors of all the direct and indirect rule-makers in terms of their preferences and their knowledge of the consequences of different IFs. Their preferences may partly be over IFs as such – for instance, they may value economic freedoms as such, regardless of the consequences. But many individual preferences typically also concern the economy’s outcomes – including own income, the income of others, and the economy’s overall output and growth. The individuals will therefore strive to realize an IF with by them preferred consequences. For this, they urgently need the knowledge of what consequences different IFs would have. Without it they may help realize an IF that they mistakenly believe to have by them preferred consequences, while they will hate the true consequences that it will turn out to have.

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The chain ‘individuals → ON’ has two main branches: operating and organizing. The operating branch contains the individual behaviors that make a given ON operate by producing, transacting, and consuming (which may all be counted as transacting if production and consumption are regarded as transactions with nature). This branch is what most of standard economics is about, although usually with simplifications that put in doubt many of its results: the ON is assumed to be constant and all of its production organizations to be

optimally organized and technologically most advanced.

The organizing branch contains the individual behaviors by which the ON is formed, changed, developed or destroyed. This branch is closely related to what Schumpeter (1942) called ‘creative destruction’ and Hayek (1973) ‘spontaneous order.’ All individuals may be seen to contribute, although some more than others – in particular innovators, entrepreneurs and investors. The main contributions consist of imperfectly informed entrepreneurial trials, and corrections or eliminations of the inevitably committed errors. The resulting ON may therefore be viewed as an outcome of a tentative spontaneous ordering – in another word, self-organizing – of the individuals, under the rules of the economy’s IF.

In a more detailed view, an ON may be seen to consist of individual jobs (positions) together with the individuals occupying them, both on markets and in organizations. This view appears to refer to three literatures: (1) on job-design, (2) on job-assignment, and (3) on competence-difficulty gaps. Here, however, literatures (1) and (2) are not very helpful. They only deal with either job-designing or job-assignment, but not with both simultaneously – and moreover make several oversimplifying assumptions. In the IF-ON model, in contrast, job-designing and job-assigning are two intertwined sides of the same self-organizing process by which ONs form, reform, develop or deteriorate – while every stage of this process may suffer, depending on the individuals and/or the IF, from important imperfections.

More helpful is the above-mentioned literature on c-d gaps following Heiner (1983). The IF-ON model draws on it with two modifications: the concept of differently high relevant competence is interpreted as differently bounded relevant rationality, and c-d gaps are admitted to be of both signs. Heiner only considers negative c-d gaps, in which the difficulty of jobs exceeds the competence of the individuals occupying them. The IF-ON model adds the possibilities of positive c-d gaps, in which individuals of high relevant rationality (competence, talent) are socially underemployed: occupy too easy jobs, or no jobs. Both these cases are socially wasteful – in other words, cause the ON to be inefficient.

The concept of c-d gaps makes it possible to establish a universal success indicator for comparing the performance of economies – namely, the ‘total’ of the c-d gaps across the ON, defined as a rough ‘sum’ of the absolute values of all the individual c-d gaps, both positive and negative. The smaller this total is and keeps to be, the better the performance. What makes this indicator universal is that c-d gaps are always wasteful, independently of the social values adopted and the policy objectives pursued..

It appears possible to object by pointing out that c-d gaps can rarely be precisely measured and that their sum cannot therefore be established. While this objection is certainly valid, the indicator can nevertheless be used. Without knowing its actual size, it is possible to compare different IFs for their impact on the responses to non-zero c-d gaps. The key question is: To what extent, if any, will negative c-d gaps be responded by simplifying the too difficult jobs and/or demoting the insufficiently competent individuals, and positive c-d gaps, by allowing and motivating the highly competent individuals to find or create for themselves correspondingly more difficult and socially more valuable jobs? The answer makes it possible to draw important conclusions about the merits and demerits of different IFs.

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The 'ON \rightarrow individuals' chain is more standard. It includes the usually studied ways in which the economy's ON provides opportunities for employment, entrepreneurship and investment on the production side, and produces and distributes goods and services on the final consumption side. According to their preferences, the individuals will be differently satisfied or dissatisfied, depending on both their own situation and the situation of others. Their preferences may moreover distinguish and differently appreciate individualistic and collectivistic forms of both the production and the consumption.

Attention to programs of human behaviors, including programs for learning, makes it possible to extend these standard ways to the less standard, although now increasingly often considered preferences changeable by learning, sometimes referred to as 'adaptive preferences.' For instance, preferences for many kinds of consumption are known to change in function of the very consumption, with drug addiction as the most extreme example. But the model's genomic limitism implies that this learning is not boundless. As the many failures of political propaganda and advertising campaigns indicate, there are types of consumption and states of societies that hardly any humans can learn to like, and other types that hardly anyone can learn to stop liking.

Another important extension is the impact of the satisfaction or dissatisfaction with the ON's performance on political and socio-cultural behaviors, including the efforts to maintain, or on the contrary change, the actual IF. This is the main connection between the two key chains of the model: 'ON \rightarrow individuals' and 'individuals \rightarrow IF.'

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It is now possible to interconnect the basic relationships 'IF-individuals' and 'individuals-ON'

with their two one-way chains into the two-way overall relationship ‘IF-ON.’ In a first approximation, the result may be outlined by the following sequence of partially causal chains, where the end returns to the beginning and thus forms a circle:

The actual IF → individual behaviors → the operating and the development of the ON
 → the size, the contents, and the distribution of the economy’s output → the political
 support of the IF → the preservation or a change of the IF → the next IF.

While the causality in all these chains is only partial, in some it is less partial than in others, which is marked by differently thick arrows. The causality is much stronger for the first three arrows – that is, between the economy’s IF and its output – than for the last two – between this output and changes of the IF. The reason is that IFs are key factors of the performance of economies, independently of the knowledge that people may have about them. In contrast, the political and socio-cultural processes that decide how, if at all, the IF will change strongly depend on this knowledge: if this is poor or false, a tolerably imperfect IF may mistakenly lose support and be changed into a far worse one. Moreover, both the political processes changing the formal IF and the socio-cultural processes changing the informal IF work only unreliably and often slowly.

The differences in the strength of causality have an important implication for the theory of technologies-institutions co-evolution pioneered by Nelson (1994). The model agrees that technological change and institutional change are interdependent, but points out that the interdependence is far less symmetrical than the Nelson theory suggests. It implies that technological change is a developmental process that depends more strongly and more directly on the ruling IF than IF-evolution depends on technological change. Namely, the IF directly imposes hard constraints on technological change: unless allowed and encouraged by it – as North and Thomas (1973) were the first clearly to show – no significant technological innovations may take place for centuries. In contrast, the impact of new technologies on changes of IFs is more indirect and much softer. The new problems that the technologies cause must be perceived and analyzed by some imperfectly informed and boundedly rational rule-makers, who may for a long time leave the IF unchanged, or change it in the wrong way.

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For policy applications, this first approximation must be refined by distinguishing the private and the government parts of both the IF and the ON. The distinction between IF_{mkt} and IF_{gvt} was already made in the introduction. It is now necessary also to distinguish between ON_{mkt} , containing the private market participants, including private organizations, and ON_{gvt} , containing government agents and government organizations. Within the ON_{gvt} , it is moreover necessary to make the classical distinction between the executive, say ON_{gvt-ex} , and the legislature, say ON_{gvt-lg} , and within the IF_{gvt} , between the corresponding IF_{gvt-ex} and IF_{gvt-lg} .

The main questions of policy analysis concern the IF_{gvt-ex} . These are the institutional rules that define the agenda of the executive, with the policy instruments that the executive is allowed or required to use and the limits of these uses. Most of the government vs. market controversies has been about the contents of this agenda. To determine it is the task of the ON_{gvt-lg} (the legislature) under the constraint of the IF_{gvt-lg} – in other words, the constitution. But this is a self-imposed constraint: a constitution usually also contains institutional rules for its own changes.

When all these refinements are included, the partial causations circle of the model may be outlined in more detail as follows:

The actual IF \rightarrow individual behaviors within ON_{mkt} and within ON_{gvt} \rightarrow the working and the development of both the ON_{mkt} and the ON_{gvt} , including the economic policies conducted by the latter \rightarrow the size, the contents, and the distribution of the economy's output \rightarrow the political support of the IF \rightarrow the preservation or a change of the formal IF by the ON_{gvt-lg} , and of the informal IF by anonymous sociocultural innovators from anywhere within the entire ON \rightarrow the next IF.

In this refined outline, the causality between the IF and the economy's output is split into a direct way and an indirect way. Namely, the output also depends on the policies chosen by the executive, for which the IF_{gvt} only defines a more or less large choice set (policy agenda). Much then depends on the executive's actual policy choices. The larger this set (agenda), the more depends on them.

It is these choices that make the economy's output strongly depend on the executive's motivations and relevant rationality (competence). But the IF remains ultimately responsible. It may cause the economy to underperform in two ways: (a) by making the policy agenda too

small, and thus hindering a competent and pro-socially motivated executive from conducting helpful policies; or (b) by making the agenda too large, and thus allowing a little competent and/or rent-seeking executive to harm the economy. The key questions then are: What qualities can the executive be expected to have? What policies should the IF allow the executive to conduct, in function of these qualities? Following the above-noted principle that a successful IF must be able to cope with the most unfavorable individual behaviors, it appears safest not to expect the motivations to be very pro-social, nor the relevant rationality to be very high. There are ways of supporting such gloomy expectations analytically – such as Public Choice economics for the motivations, and Pelikan (2010) for the rationality – but they cannot be pursued here.

4 – Layers of economic change and types of institutional analyses

Economic change has been attracting attention of the growing numbers of economists who have grown dissatisfied with static equilibria. In IE, one of the most important attempts to deal with it is in North (1990, 2005). But economic change is a complex phenomenon. It consists of several layers of processes that have not yet been clearly ordered and interrelated, not even by North. There are still disagreements about their names and their definitions – including the frequently discussed but seldom clearly distinguished ‘economic evolution’ and ‘economic development.’

The IF-ON model suggests a clear and intuitively appealing stratifications of economic change into three layers:

L1: Resource-allocation – including production, transactions and consumption – within a given ON, guided and constrained by a given IF.

L2: The development of ON – including entry, growth, reorganizations, or exit of firms, adopting or rejecting technological innovations, opening or closing of markets, and expansion or slimming of government administrations – all this guided and constrained by a given IF.

L3: The evolution of IF – consisting in part of changes of formal institutional rules by legislators or judges, and in part of changes of informal institutional rules by socio-cultural innovators and imitators – under the above-mentioned hypothetical constraint of compatibility with the human social instinct.

How the three layers are interrelated follows rather directly from the above-outlined partially causal chains of the IF-ON model. But the concepts of ‘economic development’ and ‘economic evolution’ deserve a special note: the model makes it logical to reserve the term ‘development’ for changes of ONs, and the one of ‘evolution’ for changes of IFs. It clearly interrelates them by showing that ON-development is shaped and constrained, through individual behaviors, by the prevailing IF, and that IF-evolution significantly depend, also through individual behaviors, on the performance of the ON.

What may obscure the difference between ON-development and IF-evolution is that both are run by boundedly rational individuals facing an imperfectly known future. Both must therefore proceed by trial-and-error searches – that is, must tentatively generate a variety of more or less random (imperfectly informed) trials and select from them a possibly small minority of successes. Not to confuse the two layers, it is necessary to realize that the developmental trials tentatively change the markets and/or the organizations and/or the technologies within the economy’s ON under the guidance and constraints of the prevailing IF, whereas the evolutionary trials tentatively change the IF.

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This stratification of economic change makes it possible to structure AIE into types of statics and dynamics. Each layer has its own variant of both: there is allocational statics and dynamics, organizational statics and dynamics, and institutional statics and dynamics.

Institutional statics deals with the effects of given, assumedly constant IFs on resource-allocation and ON-development. Institutional dynamics deals with institutional change, or, in other words, with IF-evolution.

Organizational statics deals with the effects of given, assumedly constant ONs on resource-allocation. This is what most of standard economics is about, assuming the ON to be of a market type. Organizational dynamics deals with ON-development within an assumedly constant IF. This is, roughly, what Schumpeterian economics is about, assuming the IF to be of a standard capitalist type.

Organizational dynamics appears difficult to study otherwise than under the assumption of a constant IF – in other words, as part of institutional statics. The only analytically manageable way to study changes of both ONs and IFs appears to be discrete time, alternating two types of short periods: changes of an economy’s ON while its IF is held constant; and changes of its IF while its ON is held constant.

Allocational statics deals with the equilibria of resource-allocation, the holy grail of most of standard economics. Allocational dynamics deal with the processes of resource-allocation – such as the textbook example of cobweb convergence to an equilibrium price. To be analytically manageable, resource-allocation dynamics must be both institutionally and organizationally static.

In general, the statics of one layer includes the dynamics of the lower layer(s). A particularly important case is institutional statics, which includes the dynamics of both resource-allocation and ON-development. All this implies that the long-lasting pro-equilibrium vs. anti-equilibrium controversy is futile, stemming from basic misunderstanding of the processes-equilibria relations. Namely, each process with negative feedback must have at least one equilibrium, even if this is never actually attained, but all the time only chased. As each of the three layers has its own feedback, it must therefore also have its own processes and its at least potential own equilibria, possibly interpreted as attractors.

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What economists interested in evolutionary processes and interdisciplinary relationships may like to note – and all the others may ignore – is that the three layers of economic change logically correspond to the three layers of biological change: L1 corresponds to metabolism, L2 to ontogeny, and L3 to phylogeny. The IF-ON model logically corresponds to the genotype-phenotype model of evolutionary biology in at least two ways: (i) how the development of an economy's ON is guided and constrained by the economy's IF corresponds to how the ontogeny of an organism is guided and constrained by the organism's genome; and (ii) how the lasting of the IF and its different institutional rules depends on the performance of the ON corresponds to how the lasting of the genome and its different genes depends on the performance of the phenotype.

That these correspondences are only logical deserves emphasis: important quantitative differences must also be noted. One is in the degree of guiding and constraining: genomes guide and constrain ontogeny more sharply than IFs do with ON-development. Another quantitative difference is in the relative speeds: phylogeny is much slower than ontogeny, whereas the speed of IF-evolution may be close to, and sometimes even higher than, the speed of ON-development. A third important difference is that a new genome typically starts from scratch with a new phenotype, whereas a new IF must start with the ON that has developed, or declined, under the rule of its predecessor.

5 – The main results and directions for further research

The main result of the pursuit of the first aim is the IF-ON conceptual model. It provides AIE with a well-defined and well-interconnected terminology and a clear overall organization. It thus makes it possible clearly to state and interrelate all the important questions that AIE may have to address. It also decreases AIE's fragmentation: clear interconnections between the Northian and the Williamsonian variants of economic IE are directly built into it, and it makes it clear what political IE following Acemoglu et al. has to do to interconnect with the economic IE without friction – namely, to admit that 'economic institutions' are more than mere social choices, that their consequences are still largely unknown, and that for learning about these consequences the political IE must turn to the economic IE.

The main result of the pursuit of the second aim is the extension of the list of IFs' effects on economies from the usually considered effects on transaction costs and other incentives to two kinds of other effects: (i) on the allocation of differently bounded rationality to different uses in society; and (ii) on the processes on economic change, stratified into resource-allocation, ON-development, and IF-evolution.

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Each of these results indicates several directions for further research. Many today's economists will perhaps first think of mathematization: expressing mathematically and quantitatively the relationships and limits that the IF-ON model outlines only conceptually and qualitatively. This direction is certainly most recommendable. Whenever mathematics can increase the precision of analysis, it must be most welcome – but with the warning that it must not require oversimplifications of the questions analyzed. In other words, it must not assume away 'for analytical convenience' some of their critical aspects. Otherwise the answers might be most precise, but fundamentally wrong. This warning is obvious, yet in economics not always respected. There, the old wisdom attributed to John Maynard Keynes that it is better to be roughly right than precisely wrong is still sometimes (often?) ignored. When it is respected, however, economists can hardly expect problems of real-world economies to be mathematizable more completely than medical problems of human bodies.

Several other directions lead to specific fields – perhaps most directly to theories of economic growth, evolutionary economics, comparative economics, and policy analysis. The IF-ON model appears to have rough, but important implications for each them. Much of

further research is needed to refine these implications and determine their real importance.

The main implication for economic growth theories appears to be the hard constraint on the growth of each economy imposed by its IF. While IFs are now increasingly often recognized as key factors of economic growth, a puzzle is how come that so many until recently successful economic growth theories could ignore them. To propose an explanation, the model admits that there are periods during which this constraint is not binding, and may therefore be ignored. The growth of very poor economies may indeed be more severely constrained by their lack of the resources that the older growth theories are about – such as material and human capital, finances, infrastructure, technologies and education. The IF-constraint emerges as binding only over a certain threshold, when a certain minimum of all of these resources is provided. This may indeed plausibly explain what has often caused a surprise: why a successfully growing poor economy suddenly loses its growth, despite the large aid it may continue to be receiving.

In practical economics, the IF-constraint on economic growth is now known. Most of the international aid and loan providing agencies started to condition their help by requiring IF-reforms. But many parts of these reforms still lack a solid analytical support and are therefore often challenged as ideological. An important task of further research is to produce analytical support for those IF-reforms that deserve it, but still lack it.

The economists understanding biology may gain an intuitive insight by thinking of a mouse's embryo: it needs a certain minimum supply of materials and energy, without which it cannot grow into a mouse, but when this need is met, its genome will prevent it – no matter how much more food it might be given – from growing into an elephant.

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The main implication for evolutionary economics is the distinction between IF-evolution and ON-development. It helps define this field with more precision, but in a way that many economists who call themselves 'evolutionary' may dislike: it implies that many studies called 'evolutionary' should be reclassified as 'developmental.' This is especially the case of Schumpeterian and neo-Schumpeterian economics, most of which is indeed about different aspects of ON-development under a given capitalist IF. But this reclassification should not be controversial: it makes such studies more, and not less, 'Schumpeterian'! Namely, Schumpeter himself was not concerned with 'evolution,' but called his main work 'Theory of Economic Development' (Schumpeter 1912/34).

More controversial may be the earlier noted implication for the Nelson theory of technology-institutions co-evolution. As explained, the IF-ON model dismantles the apparent symmetry of this theory by exposing the fundamental difference between the strong direct effects of IFs on the technological part of ON-development, and the weaker indirect effects of new technologies on IF-evolution. An important task for further research is to clarify this difference in more detail. One possible way is outlined in Pelikan (2011), in which evolutionary economics is broadened into evolutionary-developmental (evo-devo) economics.

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For comparative economics, the main implication is that the performance of economies, with the exception of a very short run, depends much more on ON-development than on current resource-allocation. This implication may be seen to generalize Schumpeter (1942): “The problem that is usually being visualized is how capitalism administers existing structures, whereas the relevant problem is how it creates and destroys them.” The generalization is replacing ‘capitalism’ with ‘different types of IFs.’ Among other things, this implication makes it clear in theory what have been known for a long time in practice: that obtaining excellent firms is more important and more difficult than coordinating their activities when, and if, they happen to exist.

The impact of this implication is radical. It causes most of the existing comparative economics, including the famous Great Socialist Controversy, to lose much of its relevance. It cannot indeed be very relevant to study the less important processes of resource-allocation, assumed to work in an idealized ON full with excellent, optimally organized and technologically most advanced firms, while neglecting the more important ON-development, on which the real qualities of real-world firms essentially depend.

A particularly striking empirical example of this implication can be seen in the unification of East and West German economies in the beginning of the 1990’s. The greatest problem was not the East German socialist planning, but the poor qualities of East German firms: most of them were grossly overgrown and far less productive than their West German counterparts.. For the IF-ON model, this was a logical consequence of the 40 years of ON-development within the East German socialist IF, which was both severely restricting entrepreneurial trials and generously permitting subsidies of the committed errors. It was indeed relatively easy to replace planning by markets – this was done practically overnight – but how to conjure up well organized and technologically advanced firms is a conondrum that has been scourging the eastern part of German economy for a very long time.

All this implies that in comparative economics, the task of further research is enormous: it includes a substantial rebuilding of much of this field. Main attention must be turned from comparing different ONs for their ways of resource-allocation to comparing different IFs for their ways of ON-development. The IF-ON model suggests two rough tests for this comparison: (i) for the IFs' effects on the generation of tentative entrepreneurial trials, which are strongly correlated with the effects on economic freedoms; and (ii) for the IFs' effects on the relevance, precision and speed of recognizing and forcing the correction of the inevitably committed errors, much of which act through bankruptcy laws. It is for refining and elaborating these two tests that further research appears most needed. The ways of resource-allocation remain important, but only as endogenous properties of the ONs with which they co-develop. Essential is to stop comparing them for their imaginary working in an assumed idealized ON that they could neither allow to develop, nor be able to maintain.

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There are several policy issues for which the IF-ON model has important implications that call for further research. They include the macroeconomic policies of quantitative easing (QE), antitrust and competition policies, and industrial and innovation policies.

For the QE policies, the main implication is the reminder that "institutions matter," which so many macroeconomists still ignore. Yet it is easy to see, and is now also fully recognized by virtually all international financial organizations, that it matters enormously whether the economy's IF can channel QE towards productive entrepreneurship and investment, or allows it to be dissipated in higher pensions and an overgrown government administration. Intuitively, the macroeconomists who debate the austerity vs. QE debate issue without considering the IFs involved may remind of doctors who debate what food to give to an undernourished patient without considering the health of his or her digestive tract. But much of further research is needed for identifying with precision the institutional rules on which the difference between productive and wasteful uses of QE most strongly depends.

The main implication for antitrust and competition policies is the importance of keeping ON-development going and effectively counteracting both negative and positive c-d gaps. This implication leads to a new analytical argument for preventing firms, including investment banks, from growing 'too big to fail' – in other words, from becoming immune to exit however poorly they might be managed and however large losses they might be causing. Such firms can stop correcting their internal negative c-d gaps and hinder entries of competitors who could diminish positive c-d gaps. Much of ON-development could thus be

petrified in a state that might have been initially efficient, but grows increasingly wasteful. In the question of how large firms can be socially efficient, this implication qualifies the transaction-costs arguments pioneered by Williamson (1975). While these defend the growth of firms as long as it is saving on transaction costs, the implication brings to light that some of this saving must be sacrificed to keep ON-development going. As the long-term losses caused by an impaired ON-development can be enormous, many statically suboptimal antitrust policies must be recognized superior to no antitrust policies at all. But much of further research is needed to determine which policies these are and how much suboptimal they might be.

The main implication for industrial and innovation policies concerns their problems with c-d gaps. The common denominator of all these problems is the relevant competence (bounded rationality) that government policymakers may be expected to have. As shown in theory by Pelikan (2007, 2010) and empirically documented by Dal Bó et al. (2017), in reasonably democratic societies with reasonably educated voters, this competence may be quite good, well above the average competence of the electorate, but – and this is a key point – most likely far from the best. This makes the c-d gaps depend on the difficulties of different policies. Leaving aside the relatively easy ones that do not cause any significant c-d gaps, the question is what can be done about the more difficult policies.

The answer depends on whether or not the problems that these policies should solve could be solved by private actors. If this is impossible and the problems still need to be solved – as in the above-considered case of antitrust policies – the c-d gaps and the following suboptimality of policies must be accepted as a second or third best. But this is not the case of industrial and innovation policies. Their common basic problem is how to distinguish future winners from future losers, among industries, firms, and innovations. For this problem, there is no analytical reason why it could not be solved by private actors. Their important advantage follows from the difficulty of this problem, for which an above-the-average relevant rationality (competence) is not enough, but social efficiency needs the relatively best. As shown in Pelikan (*op. cit.*), this best can never be attained by a democratic or other political process, but requires economic competition and selection by both product and financial markets, in which only private actors can fully participate. These also suffer from more or less large c-d gaps, but market competition, provided it keeps going, tends to select those with the smaller gaps. No such favorable selection works among public policymakers.

What this implies for industrial and innovation policies may roughly be summarized in

three points: (1) do not select industrial investments; (2) do not select industrial investors; but (3) help keep by general institutional rules the market competition and selection of both the investments and the investors both going and relevantly orientated. Helpful intuition may be gained by imagining what government policymakers could do for national success in an international chess olympiad. This can be summarized in analogous three points: (1) do not go there as chess players; (2) do not select the chess players yourselves; but (3) help organize chess tournaments that would allow the best chess players to be found and selected. The logic is obviously the same, but the three points may be intuitively clearer for chess-playing than for industrial and innovation policymaking.

6 – A concluding comment on the future status of AIE

To the institutional economists concerned with the status of their field the IF-ON model comes with good news. It implies two good reasons – one for all of them and the other for those who understand biology – why AIE is due for the promotion to the center of entire economics. The first reason directly follows from the great social value of the knowledge of the consequences of different IFs, noted in Section 3, which only AIE can produce. The second reason follows indirectly from the logical correspondence between the effects of IFs on economies and the effects of genomes on organisms, noted at the end of Section 4. What these effects also have in common is that they were for a long time ignored. At first, biologists knew even less about DNA than economists about institutional rules. In modern biology, however, it is clear that genomes contain the most fundamental constraints on, and guiding principles of, all biological processes in all kinds of organisms, and that genomics is therefore the center of entire biology. The IF-ON model makes it clear that IFs contain the most fundamental constraints on, and guiding principles of, all economic processes in all types of economies. That AIE is due to be the center of entire economics then logically follows.

References

Acemoglu, D. and J.A. Robinson (2012), *Why Nations Fail: The Origins of Power, Prosperity and Poverty*, Crown Publishers, Random House: New York.

Acemoglu, D., S. Johnson and J.A. Robinson (2005), “Institutions as a fundamental cause of

- long-run growth,” in P. Aghion and S.N. Durlauf, eds., *Handbook of Economic Growth*, Elsevier B.V.: Amsterdam.
- Dal Bó, E., F. Finan, O. Folke, T. Persson and J. Rickne (2017), “Who becomes a politician?” *The Quarterly Journal of Economics* 132: 1877-1914.
- Greif, A. and J. Mokyr (2017), “Cognitive rules, institutions and economic growth: Douglass North and beyond,” *Journal of Institutional Economics* 13: 25-52.
- Hayek, F.A. (1973), *Law, Legislation and Liberty, Volume I: Rules and Order*. Routledge & Kegan Paul: London.
- Heiner, R. (1983), ‘The origins of predictable behavior,’ *American Economic Review* 73: 560-95.
- Hodgson, G. (2004), *The Evolution of Institutional Economics: Agency, Structure and Darwinism in American Institutionalism*. Routledge: London and New York.
- Hodgson, G. (2016), “On Fuzzy Frontiers and Fragmented Foundations: Some Reflections on the Original and New Institutional Economics,” *Journal of Institutional Economics* 12: 591-611.
- Holland, J.H., K.G. Holyoak, R.E. Nisbett and P.R. Thagard (1986), *Induction: Processes of Inference, Learning, and Discovery*, The MIT Press: Cambridge (Mass.).
- Kahneman, D. and A. Tversky, eds. (2000). *Choice, Values, and Frames*. Cambridge, U.K. and New York: Cambridge University Press.
- Kruger, J. and D. Dunning (1999). Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessment, *Journal of Personality and Social Psychology*. 77: 1121-1134.
- Murphy, K.M., A. Shleifer and R.W. Vishny (1991), “The allocation of talent: implication for growth,” *Quarterly Journal of Economics* 106: 503-530.
- Nelson, R.R. (1994), “The Co-evolution of Technology, Industrial Structure, and Supporting Institutions,” *Industrial and Corporate Change* 3: 47-63.
- North, D.C. (1990), *Institutions, Institutional Change, and Economic Performance*, Cambridge University Press: Cambridge and New York.
- North, D.C. (2005), *Understanding the Process of Economic Change*, Princeton University Press: Princeton and Oxford.

- North, D.C. and R.P. Thomas (1973), *The Rise of the Western World*, Cambridge University Press: Cambridge.
- Pelikan, P. (1968) 'Programmes for human decision-making,' in K. Borch and J. Mossin, eds., *Risk and Uncertainty*, MacMillan: London, Melbourne and Toronto, and St. Martin's Press: New York.
- Pelikan, P. (2007), 'Allocation of scarce resources when rationality is one of them: some consequences of cognitive inequalities for theory and policy', http://mpra.ub.uni-muenchen.de/3657/1/MPRA_paper_3657.pdf, Munich Personal RePEc Archive: Munich.
- Pelikan, P. (2010), 'The government economic agenda in a society of unequally rational individuals,' *Kyklos* 63: 231-255.
- Pelikan, P. (2011), 'Evolutionary developmental economics: how to generalize Darwinism fruitfully to help comprehend economic change,' *Journal of Evolutionary Economics* 21: 341-366.
- Pinker, S. (1994), *The Language Instinct*, Penguin Books, London.
- Rodrik, D., A. Subramanian och F. Trebbi (2004), "Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development", *Journal of Economic Growth*, vol 9, s 131–165.
- Schumpeter, J.A. (1912/1934), *Theory of Economic Development*, Harvard University Press: Cambridge, Massachusetts.
- Schumpeter, J.A. (1942), *Capitalism, Socialism, and Democracy*, Harper & Brothers: London and New York.
- Shirley, M.M. (2008), *Institutions and Development*, Edward Elgar: Cheltenham and Northampton.
- Simon, Herbert A. (1955). A behavioral model of rational choice, *Quarterly Journal of Economics*. 69: 99-118.
- Simon, Herbert A. (1979). Rational decision-making in business organizations, *American Economic Review*. 69: 493-513.
- Vanberg, J.V. (2002), "Rationality choice vs. program-based behavior," *Rationality and Society* 14: 7-54.

Williamson. O.E. (1975), *Markets and Hierarchies: Analysis and Antitrust Implications*, The Free Press: New York

Williamson, O.E. (1986), *The Economic Institutions of Capitalism*, The Free Press: New York, and Collier Macmillan Publishers: London.