Micro–meso–macro[*]

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Abstract. Building on the ontology of evolutionary realism recently proposed by Dopfer and Potts (forthcoming), we develop an analytical framework for evolutionary economics with a micro–meso–macro architecture. The motive for reconception is to make clear the highly complex and emergent nature of existence and change in economic evolution. For us, the central insight is that an economic system is a population of rules, a structure of rules, and a process of rules. The economic system is a rule-system contained in what we call the meso. From the evolutionary perspective, one cannot directly sum micro into macro. Instead, we conceive of an economic system as a set of meso units, where each meso consists of a rule and its population of actualizations. The proper analytical structure of evolutionary economics is in terms of micro–meso–macro. Micro refers to the individual carriers of rules and the systems they organize, and macro consists of the population structure of systems of meso. Micro structure is between the elements of the meso, and macro structure is between meso elements. The upshot is an ontologically coherent framework for analysis of economic evolution as change in the meso domain – in the form of what we call a meso trajectory – and a way of understanding the micro-processes and macro-consequences involved. We believe that the micro–meso–macro analytical framework can greatly enhance the focus, clarity, and, ultimately, power, of evolutionary economic theory.

Keywords: Micro – Meso – Macro – Rule – Agent – Trajectory

JEL Classification: B0, C0, D0, E0, O0, P0[1]

[1] Dare we suggest a new category in the JEL classification – (S0) Meso Economics: General.

1 Introduction

In the opening lines of *The Open Society*, Karl Popper had this to say about social scientists:

> It is widely believed that a truly scientific or philosophical attitude towards politics, and a deeper under-standing of social life in general, must be based upon a contemplation and interpretation of human history. While the ordinary man takes the setting of his life and the importance of his personal experiences and petty struggles for granted, it is said that the social scientist or philosopher has to survey things from a higher plane. (Popper, 1945, p. 3).

Popper defined this scientific perspective as *historicism*, namely, the belief that unconditional theories can be propounded about the course of history. He was to spend two volumes attacking historicism for its innate tendency to promote totalitarianism and idealism, and for its inability to comprehend organic change. In economics, we know about this assault on the 'pretence of knowledge' through the work of Friedrich von Hayek, who was a staunch critic of the related methodological conceptions that underlay both microeconomics and macroeconomics as applied by, among others, Leon Walras, Alfred Marshall and Maynard Keynes. Hayek, like Popper, argued that the economy must be viewed as a complex system subject to constant and uneven evolutionary change and, as such, it must have a history that is inherently unpredictable in any unconditional sense.[2] Historicists, such as Karl Marx, and idealists, such as Leon Walras, both came under attack for being dangerously unscientific.

However, it is our view that Hayek's attack of mainstream economics was something more than a variant of Popper's historicist critique of social science. For want of a better word, we shall call it *algebraicism*.[3] Algebraicism supposes that a truly scientific or philosophical attitude towards economics, and a deeper understanding of social mechanics in general, must be based on the contemplation of mathematical logic. The natural expression of algebraicism in economics is in the juxtaposition of formal microeconomic propositions in, necessarily, idealized static states with deduced macroeconomic consequences. Thus, economics involves a micro–macro division of analysis. Micro is individual choice, and macro is its aggregate consequences. The sum of micro is macro, and the decomposition of macro is micro. The 'holism' that Popper attacked in, for example, the context of Marxian group consciousness, is replaced by the 'identicalism' of 'representative agent' economies. Concepts such as general equilibrium, the aggregate production function and the representative agent are all consistent constructions on the higher plane of algebraicism. For any economist interested in the evolution of the economic system or its component parts, the real problem with algebraicism is that it makes it exceedingly awkward to define even primitive notions like 'structure' or 'population' or 'process', concepts that are central to any kind of evolutionary analysis in social or biological science. Algebraicism is purported to provide clarity but, in practice, gets in the way of clear thinking about the nature of coordination

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[2] Schumpeter (1912, 1942) also conceptualized economic change in this way, and seemingly in spite of his ardently professed intellectual debts to Marx and Walras.

[3] Nicholas Georgescu-Roegen (1971, pp. 44ff) called it 'arithmomorphism'.

and change in open systems and thereby seriously limits the powers and scope of economic analysis.

Now in *The Open Society and Its Enemies* Popper railed at length against the specific intellectual criminality of Plato, for germinating historicism in his theory of ideal types, and against Marx, for propagating this concept. However, it is not our purpose here to mount a considered attack on algebraicism. No doubt the usual suspects – Edgeworth, Samuelson, Debreu et al. – might be rounded up; but not here.[4] The origins and nature of algebraicism will not be our primary concern, but instead they shall serve to mark our starting point and indicate the direction in which we shall travel. We seek a better analytical framework for evolutionary economics and we need to start by holding to account the thinking that led to the micro–macro perspective in the first place. So we call it algebraicism, and charge it with irrelevance to open systems analysis. This sets up the question: what is wrong with micro–macro which, on the face of it, seems to be quite versatile in its application and has remained popular for at least half a century?

In proposing a better way of thinking about the fundamental questions of coordination and change in economics, we adopt the perspective that economic evolution is a growth of knowledge process, in the sense implied by Popper and explained to economists by Hayek and, more perceptively in recent times, by Brian Loasby (e.g. 1991, 1999). Beyond the seeming generality of General Systems Theory, beyond the seeming universality of Universal Darwinism,[5] beyond the importance of network connections in complexity theory (e.g. Potts, 2000, 2001), beyond the theory of self-organization in open-systems (e.g. Foster, 1997, 2003) and even beyond the neglect of ontology in evolutionary economics (e.g. Dopfer, 2004a), there remains the basic problem of how to replace algebraicism with a unifying analytical framework that centers upon those aspects of economic evolution that differ from those in biological evolution, namely, those pertaining to the knowledge process.

Our new way of conceptualizing evolutionary economic analysis sets out three analytical domains that we define as micro, meso and macro.[6] In the first part of this paper we shall explain what we mean by micro, meso and macro in terms of a conception of the economic system as a complex system of rules. Our critical take on algebraicism is that it has no meso domain.[7] That is why it is so compatible with engineering and control, and why it fails to account for open system processes of change. In the second part of this paper we outline the analytical concept of a meso trajectory – our fundamental unit of economic evolution – as the evolutionary path of a novel generic rule into, and out of, the economic system. By variously using

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[4] Instead, see Mirowski (1989), Louçã (1997) and Potts (2000).

[5] See respectively Boulding (1978) and Hodgson (1993, 2002).

[6] For a discussion on the problems of introducing the meso into the existing micro-macro framework, see Dopfer (2001, 2004a); for an overall exposition of the micro-meso-macro framework which applies specifically the three phases of the rule trajectory to micro, meso and macro, see Dopfer (2004a). The model suggested integrates the "internal" (agent) and "external" (population) aspects of a meso-trajectory allowing simultaneously for scale and scope.

[7] Georgescu-Roegen railed against the implicit acceptance of the law of the excluded middle in the notion of arithmomorphism and how this excluded dialectic analysis. Our view is different, with the meso domain emphasizing the population aspect of a rule. This is why algebraicism is the enemy of open-system thinking.

micro, meso and macro lenses, we can trace the evolution of the economic system as a growth of knowledge process. In our view, this provides a much clearer view of how the various components of evolutionary economic theory, modeling and applied research fit together within a framework for analysis that can address the restless nature of market-capitalism.[8]

2 The economy as a complex system of rules

An economic system can be viewed as a massively complex structure of rules that have evolved over a long period of time. The process by which new rules originate and are adopted and diffused (with modification) into an economic system constitutes the driving force of economic evolution. The evolutionary economic agent – *Homo Sapiens Oeconomicus* – is a rule-using and rule-making animal (Dopfer, 2004b). Working systems of rules manifest in, for example, the division of labour, an organizational structure, a system of capability, or a pattern of trade, constitute the core structure of the knowledge-based economy. Thus, the growth of knowledge, and therefore the evolution of the economic system and its components, is a process driven by the origination, adoption, adaptation and diffusion of rules that are, in some sense, generic.

A system that is definably 'economic' in nature is reliant upon a structure of rules that are economic, i.e. that relate to the production and consumption of goods and services. However, economic rules are, necessarily, embedded in a broader environment of rules – variously physical, biological, cognitive, behavioural, social, ecological, legal, political, and so forth. The economic rule-system is entangled in a broader context of rule-systems. This simple observation goes some way to explaining why economic systems tend to be fantastically complex systems, and why evolution, rather than 'rational intention', is the principle source of transformational change and development. For evolutionary economists, the main characters in market capitalism are system-building structures that replicate at differential rates in the presence of variety in ideas and in the skills that are brought to bear in a range of different kinds of processes. However, evolutionary economists often present the 'selection in the presence of variety' process as a microeconomic story without proper cognizance of the fact that what is often vaguely referred to as 'knowledge' is, in fact, a rule structure that is of greater importance than the selection process since it defines what 'variety' constitutes.

When we view knowledge as a rule structure, we are dealing with connections between elements that exist both within and beyond the system in question. Rule structures are bundles of rules that bear complementary relationships with each other and these can be analyzed in a range of ways using network theory (see Kirman, 1997; Potts, 2001). The rules that matter for understanding economic systems are those that are generic. Locally, in space and time, idiosyncratic rules exist that reflect the particular conditions that systems face and, although such rules provide a stock of variety from which new generic rules can emerge, they do not provide the connective structure of common knowledge that an economic system

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[8]   See Metcalfe and Ramlogan (2003), Metcalfe et al. (forthcoming).

is made of. In other words, a generic rule is one with a population of actualizations (Dopfer and Potts, forthcoming). We can define a generic rule and its population of actualizations as a 'meso unit'. When we focus upon a single generic rule and a particular carrier, we have a 'micro' perspective on the rule in its local environment. We are concerned with the nature of the connective structure between the carriers of the rule, with the efficiency and efficacy of the rule in relation to particular processes, and with the socio-psychological processes that shape the origination, adoption and adaptation and retention of a rule in a carrier. The meso perspective abstracts from such detail in order to focus on the population of rule actualizations. We are concerned with matters such as the size of the population and the state of development of the meso unit (in terms of what we shall identify as a 'three-phase meso trajectory') and the composition of the carrier population.

The relationship between 'meso' and 'macro' is similarly telescopic with the same criteria coming into play, namely, connective structure, efficiency and efficacy, and change. However, this time, it is entire meso units that are the elements, rather than individual rule actualizations. In the macro domain we abstract from such detail in order to focus upon the aggregate consequences – this is a quasi-statistical exercise that is not connected to the micro domain in an analytical sense even though it is possible to, for example, sum micro value added to obtain macro value added in an *ex post* statistical sense. We can have micro-macro arithmetic but the behaviour of the economic system is best understood in terms of micro-meso-macro.

A rule plus its population constitutes a meso unit. When we view an economic system through a meso lens, what we see are meso populations and their evolutionary moments: such as the size of a rule-population, or the variance in the rule in terms of the variety of its micro actualizations, or the phase structure of a meso trajectory. Both micro perspectives on economic evolution (e.g. the complex structures of rules that constitute systems such as firms) and macro perspectives on economic evolution (e.g. complex structures of rule-populations such as industries or the whole economy) are both views that build upon a meso perspective. When we observe change in the meso, by which we mean a change in generic rules, i.e. in the knowledge base, and/or in their respective populations, we can then analytically focus on both the micro and macro aspects of this process.

Micro involves a change in the composition of rule-carriers and how they interact. Macro involves a change in the coordination structure amongst meso units. Rules are the building-blocks of systems that form the micro-structure, or organization, of an economic system. The macro-structure, or order, of an economic system consists of systems of rule-populations, or meso units. We tend to view the macro through statistical aggregates but these are simply measures of output flow or asset value aggregations that arise from the existence of interacting populations of meso rules. The essential point to grasp here is that macro is not a behavioural aggregation of micro, but, rather, it offers a systems perspective on meso viewed as a whole. Similarly, micro is not the reduced essence of an economic system; it is a 'bottom up' systems perspective on meso when viewed in terms of its component parts. The economic system is built upon meso; micro and macro are two perspectives that reveal the structural aspects of the changes in the meso populations that constitute the elementary units of the economic system.

Micro–meso–macro is certainly a new terminology,[9] but it is a new perspective. We believe that the implicit methodology adopted in much research in the field of evolutionary economics already embodies the concept of meso. Most evolutionary economists have not viewed macroeconomics as connected analytically to microeconomic foundations but, instead, have argued that institutional factors are more important in understanding macroeconomic phenomena (see, for example, Foster, 1992). Adoption of a more explicit micro–meso–macro framework enables us to conceive more clearly how complex systems theory and self-organization theory fit together with population-based thinking to provide evolutionary economists with an analytical apparatus that can embrace the emergence of generic novelty in structured open systems.

The most immediate benefit of this new framework is its capacity to synthesize disparate parts of evolutionary economics into a unified framework, enabling us, for example, to connect evolutionary microeconomic work on organizational learning and adaptation to evolutionary macroeconomic work on, say, institutional coordination or economic growth and development. But a deeper and more subtle benefit is that the micro–meso–macro perspective provides a framework for integrating the two major questions in economics: those concerning coordination and change. Hitherto, neoclassical economists have preferred a strict separation of these questions, with the coordination problem being tackled in terms of equimarginal conditions operating over price signals, and with dynamics relegated to the propagation of exogenous disturbances to equilibrium states. Change, in its true evolutionary sense, has, by necessity, been excluded from consideration in formal neoclassical theory.[10] The absence of meso in the preferred algebraic micro–macro framework made it inevitable that change would be excluded and, without change, such a framework is of little scientific value, despite its scientific gloss.

In the micro–meso–macro framework, the two questions come together again. Change is the defining property of meso (i.e. the origination of new rules and the dynamics of each rule population), and coordination occurs as micro and macro

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[9] The term meso is of course not unfamiliar to economics. Intermediate conceptions of market structures and industry clusters (i.e. bigger than micro, but smaller than macro) have often used 'meso' to describe the domain of that problem. In new classical macroeconomics, the term meso refers to analysis of the implications of intra-marginal actions (e.g. Ng, 1986). Meso is also common terminology in evolutionary sciences – e.g. in paleontology and anthropology – where it is a taxonomic tool for marking periods of transition or intermediacy. Our use of meso, however, is more in the ontological, and therefore analytical, sense rather than in its classificatory sense. In our view, a meso is a thing (a rule and its population) that is made of complex other things (micro) and is an element in higher order things (macro). Meso, then, is not in the intermediate sense of either classification or analysis of disequilibrium market structures, but rather in the specific sense of identifying and conceptualizing the dynamical building blocks of an economic system. Work on industrial districts, regional knowledge clusters, learning regions, inter-firm industrial organization, national innovations systems, networks with weak and strong ties, or technical support communities all falls under the heading of meso economics from the evolutionary perspective.

[10] Potts (2000, chapt. 2) argues that the algebraic reason for this exclusion is the treatment of interactions in the economic system as conforming to the completeness assumptions of an integral space, which then allows wholesale use of the analytical techniques of field theory. Change in an open system implies change in the connections between elements, and therefore a non-integral analytic space (as in graph theory, for example).

structure adapt and constrain meso change. At the hypothetical limit of stationarity in all meso, the analytical framework we have adopted becomes a micro-macro one with an 'invisible' meso. Thus, there is a temptation to argue that there is a tendency towards the traditional micro-macro framework. However, ontologically, this is a serious error for such a system would be, effectively, dead. To omit change is to omit something that is fundamental to the existence of systems as dissipative structures – the only possible equilibrium would be thermodynamic equilibrium, i.e. a state of total randomness (Chen, 2004).

3 The analytical domains of micro, meso and macro

Let us now consider the analytical domains of micro, meso and macro individually before turning to how they relate to each other via the evolutionary concept of a meso trajectory. Perhaps the most important point to understand is that micro and macro in the micro-meso-macro framework are not so much subject domains in themselves, but rather component parts of a general evolutionary analysis of coordination and change. We are interested in the micro analysis of agents originating and adopting rules, and of the complex structures that arise, because this enables us to more clearly understand meso coordination and change by accounting for the behaviours and interactions of agents as they adopt and use rules. Similarly, we are interested in macro analysis of the associative structure of meso units, and the associated statistical dimensions that arise, because this enables us to more clearly understand meso coordination and change by accounting for the emergence of order between meso units as at least one of these changes. Let us now discuss these points in more detail.

Evolutionary microeconomics is concerned with how the economic agent – *Homo Sapiens Oeconomicus* – carries and uses rules, with the complex systems of connections that result, and with the processes by which these change. The evolutionary economic agent is not an isolated datum, nor a representative agent, but rather a specialized component of a system. Each agent interacts with a subset of other agents, and each agent carries only a subset of all economic rules. The evolutionary microeconomic agent, in this sense, has internal and external structure: internal structure is built upon cognitive and imaginative capabilities (the agent has a mind) and external structure is built from specific interactions with other agents (the agent has a society). From the evolutionary perspective, each agent is continually engaged in problem-solving that results in the construction and maintenance of complex systems of rules. The role of micro as an analytical domain, then, is in relation to a 'micro trajectory', which is the process that describes how an agent originates, adopts, adapts and retains a novel generic rule. A micro trajectory is in this sense a component of a meso trajectory of a generic rule that plays out over a population of micro agents.

Evolutionary meso-economics is the conceptual heart of evolutionary economic analysis because it describes the essential thing that is changing in a process of evolutionary economic change. Micro and macro detail the coordination aspects of

this story, but change in the meso is the very reason that such coordination problems arise in the first place. Wherever economists have written of the overarching importance of time in economic analysis – as have Marshall, Keynes, Schumpeter, Georgescu-Roegen, Shackle, Loasby and many others as well – they are referring to the fact that the meso rhythms of change that occur in historical time must be taken into account in formulating theories concerning economic processes. Because the meso must be characterized by change, economic systems, and the processes that they enact, are non-equilibrium in character – this cannot be assumed away. Of course, it is possible that the meso can enter a stationary state where meso unit decline is balanced by meso unit expansion. However, this is not an equilibrium state in the neoclassical sense but, rather, a state of structural instability. The meso can never be entirely still because of the opposing forces of ongoing degeneration in rule structures versus inherent human curiosity and experimentation.

The meso lens on the economic system focuses on single generic rules and their populations of actualizations. It discerns two sorts of variety, in the generic rule itself and in the population. Logistic diffusion and replicator dynamic modelling are characteristic forms of meso analysis. Both examine how the population of rule actualizations changes. For example, in the former, a new regulation or technology creates a niche which is gradually filled through adoption of the rule in a range of innovative contexts (see Foster and Wild, 1999a,b). Replicator dynamics focus upon the tendency for a variant of a rule to become dominant over other variants. This is paralleled at the micro by, for example, the establishment of a monopolistic situation in the supply of a product or products.[11]

Evolutionary macroeconomics shares certain similarities to evolutionary micro, in that it is principally concerned with the analysis of complex structure and associated processes. Two factors give it a macroscopic focus. First, there is no place for rationality, choice or any behavioural aspects that might otherwise be considered aggregations of micro. Rather, it is self-ordering and self-organization, that stem from the meso, that determine macro structure. Second, and in consequence of this, the complex structure under analysis is quasi-statistical in nature because the two principle layers of structure in the macro – surface-structure and deep-structure – are different. These relate to the bimodality of each meso unit, namely, that between a rule and its population of actualizations. Deep structure refers to the associative logic of how the generic rules themselves fit together. Analysis of the deep structure is analysis of how rules coordinate with each other. This relates to the division of knowledge and it highlights coordination problems that arise because rules with different pedigrees do not fit together or because rules are missing. Much of macroeconomics has been concerned with coordination failure but this has tended to focus narrowly on 'market failure' rather than a more general concern with gaps in rule structures (Dopfer, 2004a).

Surface structure refers to how deep structure manifests itself, for example, in income-expenditure flows. Thus, discord in the structure of generic rules leads to coordination problems in matching effective demand with the capacity of the econ-

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[11] See for example Metcalfe (1998), Antonelli (2001), and Metcalfe et al. (forthcoming). Although replicator models also involve a macro dimension in that they require multi-populations (of meso).

omy (Foster, 1987). Keynes's income-expenditure model of the economy deals with surface structure whereas his concern with the determinants of investment expenditure and liquidity preference relate to deep structure. Thus, fluctuations in the economy occur when the structure of meso units loses its adaptability and becomes excessively rigid and begins to fall apart. Recessions are not brought on by rigid wages but, more generally, by rigid rules. Clearly, this kind of evolutionary macroeconomics can be extended to consider how entire meso trajectories, or regimes, can be understood in series and in parallel over extended periods of history. This, of course, connects closely with the work of Joseph Schumpeter and others on the determinants of long fluctuations in economic activity.

4 The meso trajectory

As long argued by Austrian/post-Schumpeterian theorists, neither microdynamics (e.g. learning theory, rational expectations, evolutionary game theory) nor macrodynamics (e.g. growth theory, non-linear dynamics, equilibrium correction econometric modeling) generalize in a way that can address evolutionary change. The reason is simple. The domain of change in an evolutionary process is neither micro nor macro but meso. Indeed, the concept of an experimentally organized economy, or of economic evolution as a self-organizing process, only makes sense from a meso perspective. The growth of knowledge has micro aspects associated with the organization of rules and macro aspects associated with the population structures of rules, but ultimately economic evolution is a process of change in rules and rule-systems. Meso change is the core of evolutionary economic processes, and the generic meso dynamic is called a meso trajectory.[12]

A meso trajectory can be viewed as a three-phase process of origination (emergence), diffusion (adoption and adaptation) and retention (maintenance) of a novel rule in an economic system. A meso trajectory involves a process of creative destruction, disturbing an initial order and organization with a new idea and a new population which is then subjected to forces of variation and selection, adoption and adaptation before stabilizing its structure, both in an associative and statistical sense, on a new order and organization.

A meso trajectory affects both macro order and micro organization in an economic system. We characterize this process in terms of a three-phase evolutionary scheme. The first phase of *origination* is where an agent develops an idea/rule that leads to the design of an organization of people, energy and materials. In this phase, there are many ideas/rules but most fail to be viable (evolutionary economists say that there is novelty or variety in ideas). The second phase of *diffusion* involves adoption and adaptation of the successful rule in a range of organizational contexts. This can involve cooperation when a niche is still sparse and competitive rivalry later on when the niches that the rule can help to fill are exhausted. This is clearly a learning context and the complementary nature of the process dictates that other

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[12] Freeman (1974), Dosi (1982) and Pavitt (1984) are to be credited with centering the Schumpeterian notion of a trajectory in the modern evolutionary economic literature. We view a meso trajectory as a generalization of the concept of a technological trajectory.

variants of the rule will arise that are more peripheral and facilitate adaptations. Thus, we end up with a new micro organization and meso order in the economy, evidenced in transformed market and industrial organizational structures. In the third phase, that of *retention,* replication occurs, with the meso rule being reinforced by constant repair and maintenance, for example, through the embodiment of a rule in law that is enforced.

A meso trajectory involves the spread of a new rule into the micro-organizational domain, with repercussions in the macro domain as populations of rules interact. The first thing to happen in the micro domain is that an agent explores a new rule and its capabilities. This is a phase of learning and experimentation for a single agent, but as other agents also adopt the same rule, adoption, in turn, drives adaptation. This process of evolution re-structures the market and the organizational environment. In the macro domain, the first thing that happens is that a new market is monopolized by the first adopter. This soon changes as subsequent adopters enter and learn about and experiment with the underlying rule. The macro domain is about order and, thus, how a new rule fits with existing rules and, similarly, how the rule population fits with other rule populations. This is the order that is disturbed by the emergence of a new meso-trajectory, and which, by the end of the trajectory, will have been transformed into a new order.

We shall refer to the three distinct phases of a meso trajectory as Meso 1, 2 and 3. The first phase of a meso trajectory (Meso 1) begins when an agent acquires, understands and imagines how to use a novel rule, which is to say with the meso concept of origination and the micro concept of first adoption into a carrier. Meso 1 begins with origination in the sense of global novelty (a generic idea) and local novelty (its first actualization) at once. Meso 2 involves the local adoption and adaptation of that novelty. In Meso 2 the existing order is disturbed and there must be a re-normalization of behaviour to adapt to the new rule. This is the process of institutionalization at the core of the Schumpeterian approach to economic evolution. Meso 3 is the limiting phase and one that can perpetuate over time in cases where rules retain fundamental importance in the economic system. It is a state of meta-stability attained through replication, maintenance, repair and retention. However, most rules are like fashions; they are abandoned prior to Meso 3, and their abandonment enables new ideas to enter the system. Durable rules can also be abandoned. For example, the rules that underpinned horse transportation in the era of the powered vehicle or the shift to Fordist production methods. When this occurs, we get spectacular infusions of novelty of the type that Schumpeter identified. Thus, the meta-stable states in Meso 3 play a major role in the maintenance of variety both in their core, facilitating role and in the opportunities that arise when structural stability is lost.

It should be stressed that Meso 3 is not synonymous with the saturation region of a logistic curve or a Markov attractor – these occur at the end of Meso 2 for particular rules. Meso 3 involves a meta-stable continuity that will only push the system to a stationary-state when minds cease to be imaginative or when populations cease to interact in new ways. We might think of this as some kind of general equilibrium of stationary structures of knowledge, i.e. neoclassical analysis as a special case, a kind of endless repetition of production for a given meso, perhaps
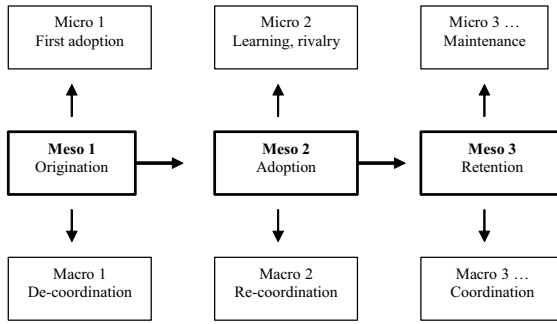
Fig. 1. The analytical structure of a meso trajectory

with a stochastic dimension. However, such an idealization does not coincide with the capitalist system but might be reflective of an end state in a system of socialist planning, but this would, inevitably, be degenerative because of the presence of entropy-like processes in all structures. In a capitalist system, much of the economy is in Meso 1 and 2 for much of the time. And that is why capitalism is naturally restless. Furthermore, in reality, stationary or rigid mesos tend to be maintained with force by totalitarian regimes (variously tribal, corporate, ideological, national or supra-national in character). In evolutionary psychology, it is deep in the character of social agents to be continually tearing down dominance hierarchies and exploring new ideas,[13] and we think this is a natural consilience between the evolutionary adapted micro-meso structure of the human mind and the meso-macro structure of institutions in an evolving market-capitalist system. Our economies are naturally restless because our minds are naturally restless. In sum, a generic meso trajectory consists of three parts – Meso 1: origination, Meso 2: adoption, and Meso 3: retention – each with both micro and macro dimensions (see Fig. 1).

Let us now examine these three parts of the meso trajectory in more detail.

Meso 1. Origination

Meso 1 is a micro-meso process because it involves the introduction of new knowledge into the economic system. From the Schumpeterian perspective, we are dealing with the entrepreneur acting imaginatively in the face of uncertainty. But more specifically we are dealing with an agent with a new understanding of a rule, with skills of persuasion, with the ability to obtain finance and to create an organizational structure. These are all involved in making something new happen. So we are referring to an *active* Schumpeterian entrepreneur rather than a merely *alert* Austrian entrepreneur. In the micro context, this means that deliberate actions lead to changes in the boundaries and interactions of at least one carrier.

The first adopter, or originator, carries a new rule and, thus, has the potential to develop new capabilities and engage in new interactions. This is not confined to producers of goods and services. It may equally refer to a consumer who has found

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[13] See Rubin (2002) and Potts (2003).

a way of satisfying a latent demand (Earl and Potts, forthcoming). Origination and experimentation are more visible on the producer side of the economic system because of the necessity of R&D to generate profitable outcomes in the face of competitive demands for a share of disposable income. On the consumer side, origination and experimentation in the formulation of new preferences are much less visible because they may not be fully reflected in flows of expenditure in the early stages – it is time, more than money, that is required. However, whether origination begins on the demand side or the supply side, the perception of selling opportunities by producers and the imagination of new lifestyles by consumers intertwine to generate flows of novel goods and services. This micro-meso process may involve new products, new consumers, new expectations, new organizations, new interactions, new markets, new laws and new institutions, and perhaps all of these at once.

Meso 1 also gives rise to macro effects. A new meso implies a new market, but the concept of market is infinitely plastic in definition (any new product can always be defined as the basis of a new market). Therefore, we restrict our term to the introduction of a new market in the sense of requiring new institutions, and so a monopoly in the definitive Schumpeterian sense, rather than the infinitely differentiated Chamberlinian sense, comes into being. Monopolistic competition refers to variety in the actualizations of the rule, but not to the rule itself. In evolutionary competition, a new monopoly is a sign of the emergence of a new meso rule: monopolistic competition may or may not arise during this process. Equally, coalitions may or may not form during this process. But Meso 1 is not simply the appearance of a new monopoly or coalition, a view that might otherwise imply an end state. In a meso trajectory, monopoly (or coalition) is only the first phase of de-coordination (or decoherence) of the population structure of rules that were previously phase-locked. All original ideas begin as a monopoly in the first phase of creative-destruction, not because of a collapse of a competitive market form, but because of limited attention and experimentation. Competition tends to collapse into monopoly when knowledge is already fully exploited, but competition tends to grow out of monopoly when knowledge is new and conjectural.

In the presence of variety, order is disturbed. Significant variety allows the formation of a new monopoly or coalition that disrupts the coordinated (ordered and organized) structure of rules. De-coordination begins as connections between actualizations change because of the presence of something new. A new product that impacts on both complementary and substitute products will affect the frequency of both, and so disturb the phase structure of meso-macro. This disturbance of phase-coupling erodes the existing phase-structure, and so begins the process of de-coordination.

Meso 2. Mass adoption, adaptation and diffusion

Meso 2 embraces the core process in Schumpeterian economic evolution. It involves the emergence of a new rule-population and consequent micro and macro changes due to adoption, adaptation and diffusion. In microeconomic terms, Meso 2 involves adoption by those capable of doing so, adapting the rule to many distinct

local environments, and so introducing further meso processes relevant to these local variations. In this phase, rivalry, strategy and economies of scale and scope become decisive, for this is the phase of exploration, differentiation and integration as the restructuring of the division of knowledge. In macroeconomic terms, this is the phase where the relation between the deep structure of the new rule and the appropriate frequency of the new rule and other associated rules is explored. This is the accelerated growth phase where *turbulence* is greatest (e.g. 1924–1929 for radio, 1980–1989 for new financial instruments, 1995–2002 for internet-based-technologies, see Freeman and Louçã, 2002).

From a micro perspective, Meso 2 is the path to full adoption, beginning with those that contest the new monopoly position while there is still much uncertainty, and ending in a process of normalization of behaviours about the new rule, and so uncertainty becomes risk. The micro domain of Meso 2 consists of a layered process of experimentation and learning that gives rise to an ordered structure of leaders and followers. The variety of forms that the rule takes increases as the space of characteristics is explored, as does the variety of actualizations as products are developed (Witt, 2001, 2003). Market growth and segmentation occur simultaneously as actualizations of the rule are dealt with in different markets. This is not necessarily, or even typically, a process of saturating a single market, but rather a process of diffusion through an initial market that then leads to the formation of related markets and support institutions. The deep and surface structure of the macro both drives and constrains this developmental and experimental micro process of meso evolution.

In the macro, we observe an increase (and possibly an explosion) of variety, followed by a winnowing of that variety into a viable set of variants of the rule and its actualizations as a process of de-coordination and re-coordination. This is not the same as path-dependency (selection with feedback), which involves statements about fixed rules and variable adoption with subsequent network effects. Yet economic evolution involves variation in both rules and in statistical rule populations. Path-dependency is in this sense mostly a micro-meso concept. The macro aspect of Meso 2 is a process of de-coordination and re-coordination, which is to say of the creation and destruction of the existing order of (1) associations between rules, and (2) connections between activities. This is a process of search for the best scale of associations and frequencies about the rule and rule-population. Rather than path-dependent, we would call this process *frequency dependent*. For example the internet boom of the late 1990s was frequency dependant on a healthy population of cheap and usable PCs, alienated teenage males good with computers and risk-loving investors. De-coordination and re-coordination involves change in the population frequencies and structural covariances related to a meso trajectory.

Meso 3: Retention – maintenance and replication

The third and final phase of a meso trajectory involves the retention of the rule and its population (the meso) as an on-going process. This is achieved through maintenance in the micro and replication in the macro and in both cases refers to a meta-stable distribution of normalized or institutionalized activities. In the micro, in Meso 3,

all extant carriers that will adopt have adopted. The process of normalization to the new rule is underway and on-going. The boundaries of carriers will stabilize about a new division of labour, including for example structures of knowledge and expectation as well as of regional and industrial organization. This process will itself tend to become institutionalized as knowledge clusters form and grow about stable rule populations. Meso 3 is the world of stable knowledge concepts, such as skill, routine, competence, capability and so forth.

It is important to emphasize that even in Meso 3, by definition the phase of retention and relative stability (the onset of stationarity), there is still only meta-stability, even at the micro level. That stability engenders and maintains instability (the essence of complexity) is for no other reason than that human economic agents are irrepressibly imaginative and prone to disturb any existing order. And, perhaps paradoxically, imagination and conjecture are most powerful when the stability of background institutions makes opportunities more apparent and uncertainties less pervasive (Loasby, 1999). In the classic process of creative destruction, it is a mistake to think that imagining only occurs in crises. Opportunities are surely available in crisis but the imagining has, in most cases, already been done in more tranquil times. Those who do not imagine in Meso 3 are, more than likely, doomed to oblivion.

At the macro level, meta-stability is much more apparent. Meso 3 is the phase in which population structures replicate statistically. This is an ordered state, but one where new orders as components begin to break-off and to replicate along their own trajectories. From the macro perspective, Meso 3 is a statistical order in which a new rule is embedded, profit is at normal levels, uncertainty has been transformed into risk, expectations are in line with experience and aspirations that flowed from the imagination match (surviving) outcomes. There is retention and maintenance of behaviour and retention and maintenance of structure. There will be indicators of stationarity. This meta-stable phase-structure provides the background order and organization from which a new meso trajectory can emerge. This is the fundamental nature of the evolutionary dialectic. Novelty arrives and provides the basis for a new order, from which comes the further possibility of novelty, and so on. Meso 3 is the stationary state that is statistically stable enough for new rules to emerge into, and in this sense is autocatalytic. Stability provides conditions for novelty, and so for an unfolding process of economic evolution. Most problems in socioeconomic systems arise when the emergence of novelty from meta-stable order is prevented by interest groups. Although such groups may gain in the short-run, the inherent entropy in systems means that the suppression of evolutionary mechanisms will lead to catastrophes of some form.

There is a great deal more that could be said on the three phases of a meso trajectory and its relation to micro and macro analysis, but space does not permit us to elaborate further.[14] In particular, we have hardly explored the connections between the micro-meso-macro framework and existing contributions in evolutionary economics. These are many because we do not view the micro–meso–macro per-

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[14] In a forthcoming three-volume set of the Elgar Library of critical writings, Dopfer and Potts will set out what they believe to be the classics in the retrospectively constructed literatures of respectively micro, meso and macro. A textbook (Routledge) is also under construction by the same authors.

spective as a new or synthetic school of economics, but more of a new way of looking at the insights provided by evolutionary economists.

5 Concluding remarks

We began by accusing orthodox economists of algebraicism. Just as Popper's historicism is the enemy of analysis of open societies, algebraicism is the enemy of analysis of open economies, and therefore of evolutionary economics. Instead of micro–macro, we have proposed that the analytical structure of evolutionary economics should be based on a micro–meso–macro framework. At issue is the conception of the very meaning of evolution in economic systems. The micro–macro framework lacks a meso perspective, and so it cannot deal adequately with evolutionary concepts and mechanisms. Micro–meso–macro is a clear way of seeing the economic system in its natural state and so a better framework for evolutionary economic analysis.

We further argued that the meso perspective gives a much needed ontology within which evolutionary economic analysis can be clearly conceptualized. In essence, there are many sorts of change that occur simultaneously in the process of economic evolution and these can be effectively arrayed over the micro, meso and macro domains. The meso perspective deals with system dynamics head on in terms of structural change and open system process; micro-macro does not. We believe the micro–meso–macro analytical framework can greatly enhance the focus and therefore ultimately the integrative power of evolutionary economic theory. Economic evolution involves complex processes of change in both micro and macro structure, but these themselves and the relation between them can only clearly be understood by dealing explicitly with the meso domain.

Coordination and change are both endogenous in the evolutionary framework and inherently defined in terms of meso. First, the coordination problem in the evolutionary context is defined with respect to change in the population of actualizations of a meso unit. This has implications for the structure of micro relations between rules and carriers and also for the structure of macro relations between meso units and the resultant macro order. Change in meso populations disturbs both micro organization and macro order. Second, meso dynamics are based about phases of growth in rule-populations. This is why evolutionary mechanisms such as replication, variation, selection and self-organization are only explicable in terms of meso, and why it is inherently problematic to define evolutionary mechanisms directly in terms of micro or macro. Variation relates to variation in the rule and also variation in the actualizations of the rule. Selection similarly operates on both, and replication refers simultaneously to the replication of the rule as information and to the regeneration of matter-energy actualizations. Self-organization is the meso intermediated relation between these processes as they play out in the micro and macro domain.

The overarching point is that the central evolutionary concepts and mechanisms are only clearly defined in terms of meso, and in terms of the micro–macro relations that are implied. The coordination of micro structure and the coordination of macro structure define the evolutionary coordination problem. But an evolutionary

economic process ultimately depends upon the introduction of a novel generic rule that begins a meso trajectory. This requires the reorganization of micro structure and the re-ordering of macro structure. This results in the growth of knowledge and, therefore, the growth of economic systems.

The widely noted but not-much-explained incommensurability of neoclassical and evolutionary economic analysis is, in our view, a direct consequence of the differences in their ontological and analytical architectures. Neoclassical analytical architecture is based about a micro-macro distinction with dynamics extractable from either. Evolutionary analytical architecture is based about a micro-meso-macro distinction with dynamics centered about meso. And so concepts that are central to neoclassical analysis need not be so to evolutionary analysis. The opposite is equally true. Evolutionary economic analysis is not based purely in microeconomics, and so tends not to focus exclusively about the analytics of equilibrium structures of choice or incentive. Instead, the central concepts in evolutionary economics – e.g. processes, populations, connections, variety, interactions, knowledge, institutions, and capabilities – all refer to the analytical dimensions of open complex systems understood from the meso perspective. Evolutionary economic analysis is centered about the meso domain because, in essence, the economic system is an open, complex and adaptive system.

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