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J.A. Schumpeter and the Theory of Economic Evolution
(One Hundred Years beyond the Theory of Economic Development)

by

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J.A. Schumpeter and the Theory of Economic Evolution (One Hundred Years beyond the Theory of Economic Development)[1].

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Abstract

The centennial of the publication of Schumpeter's Theory of Economic Development is an occasion to look back in appraisal and an opportunity to look forward in anticipation to consider anew the challenges that remain unfulfilled for Schumpeterians. Along with Marx and Marshall, Schumpeter's great achievement was to formulate an evolutionary, open system perspective on modern capitalism, to explain why it could never be at rest and to link its emergent properties to the capacity to change from within. In terms of appraisal, I shall focus on three aspects of Schumpeter's scheme: the link between knowledge, enterprise and the meaning to be attributed to a knowledge economy, the nature of the competitive process in the presence of innovation, and the transient, out of equilibrium nature of all economic arrangements. In looking forward, I shall consider what is missing from evolutionary economic dynamics, pointing to the role of factor markets in the competitive process, the significance of differences in firm's investment strategies and the fine grained nature of competition in markets where differences in the qualities of goods and services matter, and, lastly, on the evolutionary dimensions of international competition. Two lessons are particularly pertinent to advancing the Schumpeterian enterprise. First, that the familiar one-dimensional models of economic evolution are useful but incomplete. Secondly, that, while much evolutionary thinking has naturally focused on the connection between the micro and the meso, we need also to

[1] A first draft of this paper was read to the Conference on "Schumpeter's Heritage: The Evolution of the Theory of Evolution", Vienna, October 29th 2011.

consider the connection between the meso and the macro and in so doing connect to rich literatures in the field of economic growth and development.

I. Introduction

The centennial of the publication of Schumpeter's *Theory of Economic Development (TED,* henceforth*)* provides an occasion to look back in appraisal as well as an opportunity to look forward in anticipation, to consider afresh the challenges that remain unfulfilled for Schumpeterians and evolutionary minded economists alike. Along with Marx and Marshall, Schumpeter's great achievement was to formulate an evolutionary, open system perspective on modern capitalism, a vision on a grand scale to explain why it could never be at rest and to link its emergent properties to the capacity to change from within.

The *Theory of Economic Development* is Schumpeter's signature work, it encapsulates the contours of an economic vision that he never thought necessary to revise in any fundamental way[2]. Its topography is repeated with only minor amendment in *Business Cycles,* albeit with greater resort to historical illustration, and refined and restated in *Capitalism Socialism and Democracy* to take account of the changing economic sociology of enterprise and the emergence of a corporate economy. My view is that TED is a deeply evolutionary piece of work, a dramatic illustration of the power of language unencumbered with formulae or data, and I can only marvel at its capacity to stimulate new thoughts at every fresh reading. At the most basic level, it raises fundamental questions about the processes of change in modern capitalism, change expressed in terms of the occurrence of novel events and the subsequent adaptation of economic structures to realize the possibilities immanent in economic novelty. It is not to population growth and capital accumulation that we are directed in order to comprehend the economic record, for they are grey, derivative phenomena, but rather to enterprise, innovation and economic leadership, the vibrant colours that introduce qualitative

[2] Compare two of his last essays, Schumpeter, 1947a and 1947b with the 1928 essay, the latter being one of the first papers to bring Schumpeter's ideas to the English speaking world..

transformation in its most fundamental terms- the doing of things that have never been done before. As in Marx and Marshall, the scheme is evolutionary in a very precise sense, in that it reflects the uneven, selective response of an economic system to the uneven generation of variation from within. Capitalism develops because it stimulates and allows individuals to dare to be different but it does not and perhaps cannot require everyone to behave in this way; the few are sufficient to establish the outlines of an ensuing history in which the many add the fine details.

Schumpeter was always an economic sociologist for whom the instituted frame of rules and conventions mattered, and this becomes ever more apparent in his later work. We may state this concern as a question. How is it that the rules of the game that give coherence and pattern to economic life are the same rules that induce and accommodate to the transformation of economic life? If we can answer this question we will comprehend the depth of Schumpeter's theory of open-ended economic change.

We must confront at the outset Schumpeter's apparent coolness towards evolutionary methods as expressed in *TED*. Darwinian schemes are rejected not least because of the hasty generalisations associated with the word "evolution" (p58) but this hesitancy is more apparent than real. Leaving aside the fact that evolution is a mode of thought that is domain free; the whole structure of his argument is evolutionary in form. His innovations are the novelties that invade an existing population of production methods and the system responds by the new displacing the old, competition in tooth and claw. You can see how museums make sense in his world; they are there to remind us that, whatever conventions we adhere to, the future will be different from the present. By the time he is writing *Capitalism, Socialism and Democracy* this is self evident, capitalism is by nature an evolving system that never can be stationary. As an aside, when Schumpeter wrote his semi-centennial appraisal of Marshall's *Principles* he made it quite clear that he considered Marshall's economics to be entirely evolutionary in form and method[3]. I suspect only Schumpeter could take that view precisely because he, of all

[3] Schumpeter (1941)

economists of that generation, understood what economic evolution amounted to[4]. This is so despite the fact that, in the *Theory of Economic Development*, Marshall is cast in the role of Schumpeter's foil, the economist he rests upon in order to differentiate his own approach.

It is simply the case that TED is an evolutionary account of economic change precisely because of its resort to a variation-cum-selection mode of reasoning. Innovations are variations, the introduction of rival goods and ways of producing them, the new combinations of existing resources. They encompass much more than technical innovation in the narrow sense, new forms of organising business, new forms of organising the marketing process are just as valid sources of economic variation. If one wanted a generic description of innovation in Schumpeter's work it is surely that every example constitutes a different model of business. Yet innovation is only a necessary potential for transformation, it is not of itself sufficient. We also require the system to respond, to adapt to the possibility created by innovation and to do so through a competitive process in which resources, formerly used in the production of the old goods and services, are switched to the production of the innovations. This is necessarily a matter of structural change; it cannot be captured in any framework that insists on balanced, equi proportional expansion of all the activities in an economy, as if it were a regularly expanding circular flow. Uneven development is the necessary corollary to this story of creative destruction; it is a matter of understanding why different activities grow at different rates, of the birth and death of different activities, so that quantitatively and qualitatively the system in view is transformed by economic processes. These processes can with care be recorded in the movement of broad economic aggregates but they can never be understood in terms of macroeconomic reasoning. The logic is microeconomic and mesoeconomic, the Schumpeterian method is a population method, it is marked by the coexistence of rival ways of acting and the task is to understand why and how those differences matter for the development of the economic system. The variations are not to

[4] Gerald Shove, writing at much the same time (1942), is the other exception who grasped the deeper content of Marshall's thought.

be treated as noise, as stochastic aberrations, as ephemera that hide from view the essential features of economic life; the variations are the essential features.

Like all theory we can treat Schumpeter framework as a conceptual model and ask. "What is the target of explanation to which the model is addressed?" The answer is the internal dynamics of capitalist economies, understood not in terms of sequences of specific outcomes but rather as the way a particular set of processes operate. It is the explanation of spontaneous, discontinuous, qualitative change that is the target. *TED* is a theory of self transformation embedded in a theory of self organisation, a scheme to understand history but not to predict history. There is no point enquiring as to the predictive power of Schumpeter's scheme other than to insist that the past and the future will be different in unspecifiable ways. Rather it is the structural similarity of his theory to the properties of a capitalist economy that matters, for this enables us to understand the threads connecting classes of phenomena despite the great differences that are recorded in particular instantiations. Moreover, structural similarity allows the conduct of "realistic" counterfactual experiments, allows us to conceive of consequences of events that never will be realised, to work through the broad impact of innovations that can only be dimly perceived[5]. Perhaps the central insight is that economic growth is always a product of uneven economic development, that development induces development, that variation is itself induced by the working of the system. Perhaps it is not too bold to claim that Schumpeter's *Theory of Economic Development* is the economics of positive feedback, open, restless systems.

I shall explore this claim by considering briefly three particular aspects of Schumpeter's scheme: namely, the relation between knowledge and enterprise; the process of competition; and, the transience of economic order. The retrospective part of my task over, I can then turn to the future development of Schumpeterian evolutionary thought and the challenges it faces.

[5] This is the point at which algorithmic methods such as those implicit in agent based modelling have a great deal to contribute.

II. Three Schumpeterian Elements

Enterprise and Knowledge

Schumpeter's treatment of knowledge is a particularly important and distinctive part of his scheme and it is grounded in the contrast between routine action and economic leadership. The broad flavour is as follows. In the circular flow of economic life action is a matter of routine, a habitual response to value data within the context of reliable understanding of cause and effect relationships. This accumulated wisdom has the properties of a capital good (we are invited to equate it with a railway embankment!) the use of which economises on the need to calculate and enables the daily round of decisions to be accomplished in well worn tracks according to custom and experience. To the extent that this is a matter of doing the best one can in the perceived circumstances it is rational but the rationality need only be subconscious not explicit. This does not mean that the data do not change and induce different actions, only that their changes never imply qualitatively new events. So risk is fully part of the system but risk implies a complete understanding of the spectrum of possibilities and the likelihood that gains and losses will be of a temporary, reversible nature. On average the structure of the system is stationary, sufficiently so that time has hammered economic logic into decision making. Nor does this degree of rationality imply unbounded calculative skills, only that the skills are a sufficient match for the task of the moment. But there is a problem under the surface, the problem of scarcity of means in relation to ends. Indeed, the implication is that reliable knowledge of means-end relationships is scarce; scarcity is a problem so why should not attempts be made to solve this problem and broaden the underpinning knowledge for economic action. Very idea of scarcity calls into question any notion that economic knowledge will be stationary.

Enter the entrepreneur, whose function is to exercise economic leadership not on the basis of prevailing knowledge but on the basis of conjecture that our reliable knowledge of the world can be rendered different. The entrepreneur thinks beyond experience, operates within the realm of unknowledge as George Shackle expressed it..

The act of enterprise is sharply distinguished from routine management (perhaps too sharply from management in general), sharply distinguished from invention, enterprise is action that cannot be based on what is known, it requires decision in the face of ignorance[6]. Innovation may be usefully thought of as blind variation, in that its consequences cannot be known in advance but this does not mean it is thoughtless variation. In Schumpeter's scheme innovation is consciously and explicitly rational; the entrepreneur must calculate the consequences of his imagined conjectures without the support of past experience and act on the basis of answers that cannot be more than guesses. We need rationality in precisely those circumstances where knowledge is absent, when action cannot be explained in terms of known principles. Rationality comes to the fore precisely when we cannot act as efficient automata, when decision requires not mere calculation but imagination of alternative course of action and their consequences. Just as the human capacity to imagine alternative economic worlds varies across individuals, so does their capacity for calculation. Since calculation is based on rules why should it be thought that these rules are equally within everyone's grasp? Why should entrepreneurs model the effect of their conjectures in the same way? The answer is that they do not and so Schumpeter's appeal to rationality is an explanation of the founding principles of economic variation, an invitation to inquire into the ways that entrepreneurial decisions are made in practice[7].

This capacity for economic leadership is rare, entrepreneurs are a special type, many more find it easier to follow than to venture and it is no surprise to find Schumpeter pointing to the hostility that awaits anyone who seeks to challenge the status quo. Leadership is action in the face of resistance; it is much more than the exercise of imagination *simpliciter* and it matters that the instituted economic frame is open so that

[6] Marshall, (1919, 1920) provides a far more extensive treatment of managerial tasks and organisation than does Schumpeter, and makes innovation one of the tasks that marks a good managerial team. Like Schumpeter he recognises that there are leaders and followers when it comes to economic action but he also sees innovation as part of the daily routine. This is the continuity theme, the emphasis on the gradual and cumulative as contrasted with the discontinuous and entirely novel. But every innovation that has major transformative effects emerges not *de novo* but in terms of long sequences of gradual improvements as a design space is explored. There is less of a difference between the Marshallian and the Schumpeterian views than might otherwise be imagined. See Metcalfe (2007a & b) for further discussion.

[7] This is the terrain of the capabilities theory of the firm grounded in the work of Penrose (1959) and Nelson and Winter (1984).

the status quo can be challenged. This is not true of every society but is a peculiarly important feature of the institutions of capitalism that very few activities are rendered sacrosanct from the effects of innovation. The outcome is the importance not of rationality itself but that rational thought underpins the diversity of possible courses of action. Rationality in this sense is certainly not the equivalent of Olympian perfect foresight shared in common but rather the highly local, differentiated and fallible understanding of what could be[8].

We begin now to see the link with the wider evolutionary frame. Entrepreneurs are different because they (rationally) believe differently and, while they may base these beliefs on differential knowing of technical possibilities, the fundamental point is that they perceive different economic possibilities and act on the possibilities[9]. This is why invention is not to be equated with innovation, or innovation with matters of physical technique alone. The test for an invention "is does it work?" and this test must be passed before any use of it as an innovation is possible. The test for an innovation is "is it profitable?" a quite different matter. As Schumpeter went on to express it in *Business Cycles*, most inventions never get off the ground as innovations and, of those that do, ninety percent are unprofitable failures (p.117). So it is not the supply of inventions that is the rate determining constraint on economic development but rather the supply of innovations. One is the domain of science and the human built world, the other is the quite different domain of economic action and its social context. Consequently, innovation requires an understanding of more than scientific and technological phenomena. Understanding of how to organise the production process and acquire the requisite inputs, understanding of what customers will pay for, understanding of how customers are to be made aware of the innovation, these are vital elements in any entrepreneur's scheme. We may note that deficiencies of knowledge in relation to the prospective customers in particular are perhaps the most frequent sources of failed

[8] While expectations are important in Schumpeter's scheme they are not the uniform expectations of modern macroeconomic discussion. How could they be? No entrepreneur hopes to make a profit by doing what the purported rivals do. As G B Richardson (1960) made clear in a different context, a profit opportunity expected by everyone is a profit opportunity available for no one.

[9] Ulrich Witt (1998) has rightly insisted on the need for entrepreneurs to mobilize the contribution of others if they are to succeed.

innovation. In sum, there is much more to innovation than research and development and much more to research and development than science and technology.

That knowledge and its limitations are central to Schumpeter's vision is perhaps not surprising but what is more surprising is that this connects him not to Walras but to the classical economists and to Smith and Marshall in particular. By treating innovation in the context of the division of labour, Smith was drawing attention to the highly specialised, uneven nature of human knowing. Even though it may be convenient to call capitalist economies knowledge economies, it is more accurate to say that they are described by a distribution of ignorance rather than a distribution of knowing. In a modern society, common knowledge is only a small part of the picture required for economic action. Instead, all individuals are distinguished by knowing a great deal about a narrow sphere of human action and, as a consequence, being reliant on the knowing of others for their standard of life. The economy takes on the property of an open, connected system precisely because human understanding is an open, connected system. The distributed, uneven nature of knowledge cum ignorance is the economic fact that provides the context for entrepreneurial imagination. Thus a world in which many individuals know many different things is a world in which innovative conjecture is likely to arise in many different contexts. Consequently, it is a matter of record that incumbents in a particular market are often surprised when innovations come from quite unanticipated directions and undermine their business model, or when the market for an innovation turns out to be in a quite unanticipated domain. I don't think it at all accidental that Schumpeter emphasised the role of outsiders in the innovation process, it is a phenomena that is commonplace in business history and a deeper reflection of the nature of human knowing.

Schumpeter's scheme further implies that the possibilities for innovation are combinatorial and we might say that we are collectively rich in the economic sense precisely because we have learnt how to profit from our individual ignorance and specialised knowing. If an economy is to function on the basis of distributed ignorance it is necessary that its individual actors are connected and connection requires organisation. Marshall too knew this, when he claimed that knowledge and organisation are the most powerful of engines of production. It is only because we have built the multiple forms of

organisation required to benefit from our differential knowing that we are able to benefit from the epistemic division of labour. We connect to benefit from specialisation, and the firm and the market are two of our principal forms of organised connection. This brings me conveniently to Schumpeter's take on markets and competition as the complement to his theory of innovation.

The Competitive Process

The essential point to grasp about *TED* is that the economic effects of innovation flow not from the innovation *per se* but from the response of the economy to the potential for change opened up by innovation. Now Schumpeter's scheme is a market economy scheme and the significance of the market is the particular way in which it channels the process of adaptation. It is a process in which the price system is central, for it is the price system that induces change and makes available the resources for change; this is the context of Schumpeterian competition. Of course, Schumpeter places his markets within the context of the institution of money and puts the banking and credit system, the money market, at the core of his theory of innovation. The instituting of money and credit gives important flexibility to the economy and through its non neutral effects on enterprise makes innovation the basis for competition. How does competition work?

Well, it is no dull matter of perfect competition, of market structure in an equilibrium circular flow. As in Marshall it is a matter of open competition, driven by differences between rival producers it is the economic game as sport. If innovation is the basis for economic differentiation then it is the competitive process that resolves those differences into economic development. The test for competition becomes not the number of competitors but rather the rate at which innovators take business from their established rivals, the rate at which the new displaces the old. This is the way in which selection occurs on a particular pattern of variation, it is the process of competition that imparts to economic evolution a velocity and a direction.

In Schumpeter's scheme, this process is deeply connected to the existence of the pure profits that attach to an innovation because of its superior productive characteristics;

they are a category of realised economic return which is quite inconceivable in the equilibrium circular flow. But profits presuppose prices and the prices in question are the prices that sustain the old technology, or more generally, the least effective of the productive alternatives that are available, as Marshall taught. It is because the new is evaluated economically in terms of the methods it will displace that it is possible to conceive of profits as a surplus above contracted payments for inputs. Consequently, when the new has entirely displaced the old those profits will have disappeared and the price system will be adjusted in support the characteristics of the new technology. Profit is conditional and transient, it "has the most lamentable similarity with the drying up of a spring" (*TED*.p.209). If it is to be sustained, it can only be because of further innovation somewhere in the economy. Like all evolutionary processes, competition consumes the fuel that sustains it and, unless yet further innovations occur, competition comes to an end and with it economic development. This is the vision that emerges later in *Capitalism, Socialism and Democracy*, capitalism decays because the conditions for sustained innovation are undermined.

Schumpeter is less forthcoming than he might have been about the precise nature of this evolutionary process. His preference is to rely on imitation, once the innovator has pointed the way the less venturesome are induced to follow by the prospect of the profits in view. This is not unimportant, especially when we take account of the possibility that imitation itself imposes some new innovative twist, but it masks the real issue. This is the need to build productive capacity to produce with the innovation, investment is the core process and this is as true for the innovator as it is for the imitators. The link between prices, profits and investment behaviour is the centre piece of Schumpeterian dynamics that is how he explains the uneven nature of economic development. No wonder Schumpeter does not fit within the neoclassical picture, he cannot; his is a quite different world.

Structural change is one aspect of the picture but it is not the complete story. Of itself this would be consistent with the survival of old methods, they simply diminish in relative importance but they remain in play. Schumpeter's process is different; the old

methods are eventually driven from the market as inputs are reallocated to the innovators. Just as innovation can be portrayed as entry into the market, so the decline of the old leads to their exit. This is why the rules of the game in relation to business failure are an important part of the instituting frame of modern capitalism, a point we return to below. What has disappeared, the world we have lost, is as telling as what has emerged and is yet to emerge

There is a further connection between Schumpeterian competition and the price system that merits discussion. The prevailing price system is not only the basis for the current innovator's profits it is also the value scheme against which future innovations are rationally judged. As the spread of innovation displaces and destroys old methods, it changes the terms on which future innovations will be judged. There is an inevitable historical dependency about such a process, even if production is conditioned by constant returns to scale the system as a whole operates with feedback

How can one sum up the nature of Schumpeter's competitive process? It is that one cannot understand economic change solely in terms of movements in average behaviours. Competition is a matter of deviant behaviour; it is the far from average outliers that drive the evolution of the system. Such a system is clearly not a system of equilibrium relations. What then is it?

The Transience of the Prevailing Economic Order

The fact that Schumpeter is dealing with an economy that is out of equilibrium does not mean that economic principles have ceased to be relevant, quite the contrary. Schumpeter's world is not chaotic, it is strongly ordered by market forces but the order that ensues is not to be treated as an equilibrium structure. Equilibrium states are states or sequences of states that have exhausted all reasons to deviate from those patterns, they cannot by definition bring into play further change from within, they can only reconfigure via the action of external forces. What Schumpeter is coming to terms with is a system in which every pattern of economic order is transient and the problem is to uncover the rules that transform one order into its successor. Schumpeter gathers his sense of order from

the Walrasian scheme in which, at each moment in time, preferences, technologies and the available resources interact to give coherence to economic action. The resultant order is caused, it has the inner logic of demand and supply relationships but, in the presence of innovation, it cannot endure. Investment and innovation provide the twin long period processes of self destruction.

Profits are the sign that the system is out of equilibrium but the issue runs much deeper than that and connects with the theory of economic knowledge discussed above. We have alluded already to the fact of scarcity as an economic problem but it is the dynamic significance of scarcity that underpins Schumpeter's scheme. Scarcity as a problem invites the search for solutions in the expectation that effective solutions will reap entrepreneurial profits. The solutions modify the pattern of scarcity but do not eliminate it; they only suggest new problems on which to work. Thus every solution changes the way in which future problems are posed and solved, not only because it alters relative prices but because it has also altered the prevailing pattern of understanding. Knowledge and ignorance are differently distributed after each innovation. This is why we cannot satisfactorily capture Schumpeter's thought in terms of exercises in comparative statics, enumerating the properties of a post-innovation equilibrium with the situation before the innovation. We are not dealing with a transition between fixed points but rather with a process of transformation that in its movement alters the knowledge that underpins the end point and the beginning state. Movement generates information, information revises beliefs and reliable knowledge and it is an irreversible process[10]. So all we ever have is the order of the prevailing moment and the forces of innovation and investment that seek to transform it. Indeed it is this insight that brings Schumpeter and Marshall much closer to one another than might otherwise be expected.

We are led to a striking contrast. The stability of the prevailing order in terms of the immediate solution to coordination problems of demand and supply is part and parcel of Schumpeter's scheme. Yet every order is unstable in the sense that it is open to invasion by novelty in the form of innovation. If it were stable in the second sense,

[10] It is the process sketched in Marshall's (1920) Appendix H.

variety could not be generated and economic evolution would be impossible. How then to comprehend the rate and direction of economic change when we cannot specify points of rest independently of the path of movement? That is the question that Schumpeter poses, the deeper meaning of his insistence that change is taking place from within.

III. Modern Evolutionary Dynamics.

Let me turn now to my second theme, the prospective agenda. How does Schumpeter's scheme stand up after a century of development in evolutionary thought? It stands up extremely well and we can see his scheme is one in which wealth is created from knowledge, a scheme of self transformation in the presence of self organisation. Let me explain.

From the 1930s onwards evolutionary theory developed at a renewed pace as a deepening understanding of genetics was integrated into the structure of Darwin's theory of evolution in the natural world. Now economic evolution has nothing to do with biology, it rarely helps to mention Darwin because it is not a Darwinian process. Evolution it is a mode of thinking in its own right and its characteristic feature is the variation cum selection logic that we call population dynamics. Innovations are the root source of the variations in economic behaviour which are then selected for or against by specific processes. The evolutionary outcomes may or may not be progressive in a wider sense. Economic evolution reflects a greater command of human knowing but, as we have seen, solutions merely lead to new problems, and we simply do not know, for example, whether our reliance on inanimate energy and the knowledge that underpins it will prove to be sustainable for our children's children. As in any open, emergent system the imponderables are too great, we have, as it were, entered into a Faustian bargain with knowledge and we cannot know where this leads. What will happen to the employment generating capacity of capitalism, how will the distribution of income, nationally and internationally develop are just two of those questions that should temper any discussion of progress. But that is not my concern here; it is rather to get to the challenges flowing from the modern Schumpeterian picture.

What are the facts of the matter, taking for granted the pervasive fact of innovation itself and the wide variation in the capacity of individuals and organisations to act entrepreneurially? We are never surprised when two individuals or organisations innovate in different ways, not least because they will differ in terms of their access to resources to innovate, incentives to innovate, capabilities to manage innovation, and, of course, their imagined innovation possibilities. The idea of a representative, or rather a uniform, innovating agent is really a step too far. However, is not innovations *per se* that we need explain but rather the distinctive features of the generating process under different forms of economic organisation and, just as important, the different adaptive responses of each given economic system to the challenge that innovation represents to the status quo.

This adaptive response gives rise to two interrelated phenomena, structural change and the differential growth rates this necessarily implies. The facts of structural change are self evident; no economy has ever developed in the balanced proportional way that makes a macro economic analysis possible. The more we disaggregate the more we find the evidence for the persistent alteration in the relative importance or economic weight, of different goods and methods of production, different business units, different firms, different industries, and different economies. The motion is unceasing, it transforms our ways of life almost beyond recognition, so that successive generations live in increasingly different worlds. Even the most cursory understanding of economic and business history makes this plain.

To speak of structural change is to speak in the same breath of differential growth. Evolutionary economic theory is dynamic theory and its purpose is to explain why the growth rates of different activities differ at a point in time and vary over time. This is where we reach the concept of economic fitness. In modern evolutionary theory fitness is not simply viability in a given environment but differential growth in that environment. Fitness presupposes viability but it is not to be equated with viability. Moreover, in any modern economy the growth of some entities always corresponds to the absolute decline

of others, growth rates are negative as well as positive and the distributions of growth rates around some relevant population average are frequently quite remarkable. The following table provides an illustration taken for a recent decade in the US economy, they are value data that combine price and quantity movements but they are no less instructive for that. They provide a striking picture of very far from average rates of growth and decline. Of course, the very rapidly changing activities have to be a small part of an economy that expands in the round at single figure rates, so that weight and economic fitness are not the same thing, but it is obvious what changes in structure these data imply. They are Schumpeterian data (or Kuznetsian data for that matter) and they are easily replicated for different periods and different data sets, the phenomenon is pervasive it tells us that growth is never found without development.

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If the fundamental phenomena are divergent growth rates and their casual underpinnings, this points to the fundamental role of investment processes in an evolving economy: not only investment in innovation but investment in the capacity (human and material) to realise the effects of innovation. It is through the role of investment that Schumpeter's story is necessarily a long period story and here we connect with Marshall. When we talk of the long period we do not simply mean the study of events that will be realised in the future, that is not the point at all. In Marshall's scheme there are different forces acting with different velocities today and today is all we ever observe and live. Differential growth rates arise because of the forces represented by the present investment decisions made by firms, decisions that may be realised over different time scales but always in their own particular present. The long period nature of the argument is of paramount importance and here we may find it useful to develop the argument in terms of long period normal conditions abstracting from the day to day vicissitudes of economic live. This can only be a first step, especially in a positive feedback world, and a world of distributed ignorance and restless knowing is a positive feedback world. The fluctuations affect the path of evolution; they are not always to be treated as mere noise. But it will not matter to work as if they are, at least as an initial step.

The Fisher/Price Dynamics

How does evolutionary theory treat the divergence of growth rates? It does so by working in terms of populations of entities, entities that are different in numerous dimensions but are acted on by common selective forces. The result is that the structure of the population, the relative importance of the different entities it contains, is changing over time and these changes are the signature of evolution. The Schumpeterian connection is to make the entities particular business units producing distinctive goods with distinctive methods of production and to tie investment in capacity in those activities to differences in their profitability. In turn, differences in profitability are explained in terms of the differing performance characteristics of each business unit and the particular features of the market order in which they operate. This is the variation cum selection logic that is embodied in the Fisher/Price principles of evolutionary dynamics.

It will help to begin with relations that are true by the meaning of the terms they encompass. Tautology is often helpful and it is certainly helpful here for it provides the clear basis from which to proceed to deeper theoretical explanation. To fix ideas let the businesses in a given population be producing a uniform good, so there is no ambiguity about what we mean by real output in the population and so we can measure the relative importance of the firms in terms of their shares in aggregate production. It is simply a matter of arithmetic that the proportional rates of change of the output shares are equal to the difference of each growth rate from the industry average growth rate. A business that grows at the average rate maintains a constant share, faster growing business units increase their share and conversely for slower growing units. These are simply matters of what we mean by growth and relative importance but they contain the core of the process.

It is because structural change depends on deviations from average growth that we are led unavoidably to the idea of a replicator dynamic process and to what Marshall meant by economic flux. The crucial and elementary point is that the growth rate of the population is a weighted average of the growth rates of the individual members, the weights being the shares in output of each business. When the average is changing, it

follows that the deviation of each firm's growth rate around this average is also changing so that change alters the dynamics of change. How quickly does the average growth rate change over time? Since the average is defined by, $g_S = \sum s_i g_i$, the values, s_i, being the output shares and the values, g_i, being the firm (exponential) growth rates, it follows that,

$$\frac{dg_S}{dt} \equiv \sum \frac{ds_i}{dt} \cdot g_i + \sum s_i \cdot \frac{dg_i}{dt}$$

CHANGE IN POPULATION AVERAGE ≡ FISHER EFFECT + PRICE EFFECT.

In modern evolutionary theory the first effect is known as the Fisher effect, the consequence of the selection process, and the second effect is the Price effect, the consequence in this case of changes (or innovations) in the individual firm growth rates (Anderson, 2009, Andersen and Holm, 2012, Hodgson and Knudsen 2010, Frank, 1998, Metcalfe, 2008). Elaborating further, it follows as a matter of definition from the replicator principle that

$$\frac{ds_i}{dt} \equiv s_i(g_i - g_S)$$

Whence, we can write the Fisher/Price formula as

$$\frac{dg_S}{dt} \equiv V_S(g_i) + E_S(\frac{dg_i}{dt})$$

The first term, the Fisher term, is the variance in the growth rates; the second term, the Price term is the expectation of the acceleration or deceleration in those growth rates. This statistical structure runs through all variation cum selection-cum innovation models of economic evolution. It tells that the direction and velocity of change is conditional on the present variety contained within the population. If for example, some other process maintains the average population growth rate constant then it would follow directly that

$$E_S(\frac{dg_i}{dt}) \equiv -V_S(g_i)$$

Even though the aggregate growth rate is fixed by assumption, the individual growth rates cannot then be constant but must decline at an average rate equal to their variance. This has long been known in heterodox growth theory as the retardation principle, first enunciated by Kuznets and Burns in the 1930s. Consequently, when the aggregate growth rate is constant, the growth rate of the representative business cannot be constant. By representative, I mean analytically representative just as in Marshall's theory of the competitive process, in which the representative business serves as the fulcrum around which the industry is evolving. We might also reflect that declining growth rates connect us to logistic processes and to the patterns of structural change that are so frequently uncovered in studies of innovation diffusion. It should not be lost on the reader that logistic processes play a significant role in evolutionary thought more generally (Lotka, 1924/1956)

If for some reason, all the business growth rates are held fixed, the Price term disappears and we have Fisher's fundamental theorem

$$\frac{dg_S}{dt} \equiv V_S(g_i)$$

The average growth rate (what Fisher calls average fitness) increases over time even though the growth rates of all the businesses in the population are constant. So far this is mere tautology; it all follows from the definition of output shares and (exponential) growth rates. In this sense the Fisher/Price principles play the same role as Harrod's fundamental identity does in growth theory, that is to say, it becomes the basis for deeper explanation.

What is perhaps less fully appreciated is that the Fisher/Price logic applies to the higher moments and co moments of the population distribution. Thus, for example, with respect to the variance of growth rates it is the case that

$$\frac{dV_S(g)}{dt} = S_S(g)^3 + C_S(g_i - g_S, \frac{dg_i}{dt})$$

The Fisher effect reduces to the third moment about the population mean and the Price effect to the covariance between the rates of change in the growth rates and the first order deviations of the growth rates about the population mean. As we move to the change in

higher moments the same logic applies but instead of working in terms of moments it is more instructive to work in terms of the cumulants of the distribution of growth rates, so that the general rule for the n'th cumulant, $\kappa_S(g)^n$ can be expressed as

$$\frac{d\kappa_S(g)^n}{dt} = \kappa_S(g)^{n-1} + n \cdot C_S[(g_i - g_S)^{n-1}, \frac{dg_i}{dt}]$$

Since the first three cumulants correspond to the first three moments about the mean, we can work in terms of moments for these lower orders of change. But for the higher orders the cumulant formula is far more compact and direct. The rate of change of any cumulant is proportional to the value of its immediate predecessor in the chain, the Fisher effect, while the Price component is equal to the covariance between the changes in the growth rates and the deviations of the growth rates around the when mean raised to the power, $n-1$.

The Fisher/Price structure permeates all the possible instantiations of the variation cum selection dynamic with degrees of sophistication that are at the analyst's command. The central lesson is that the economic system changes because of the variety that is contained within it, that homogeneity, uniformity are the antithesis of evolution. .Its analytical content then depends on the manner in which we explain the differences in growth rates in terms of the underlying variation in various selective characteristics of the business units, namely those characteristics that appertain to the generation of profit and the disposal of profit, whether in investment in capacity or investment in further innovation. A distribution of growth rates is linked to a distribution of profitability and onto the distribution in unit costs and the determinants of the prices set by rival business units. In turn these distributions are traced back to the selective characteristics of each business and the processes that generate them. Variety cascades into variety so the approach is naturally operative at multiple levels but always dependent on an underlying theory of order to generate the prices and costs on which profitability depends.

Beyond One-Dimensional Selection

The simplest, classroom versions of this process have the rivals differing in one dimension only, typically their unit production costs so that the fastest growing firm is necessarily the least cost producer. Valuable though these parables are they are far too

limited to be of other than heuristic value. In particular, the focus needs to be on the variations between business units in multiple dimensions and on the consequent correlation of different characteristics across the population of competitors. Let me highlight some aspects of this more general framework.

First, variations in product quality, themselves a reflection of potential differences in many underlying product attributes, take us to the evolutionary version of monopolistic competition. The lowest cost producer is no longer automatically the most profitable producer; it all depends on how costs and qualities are correlated across the population. Moreover, product variation does not imply the irrelevance of price competition but it does tell us that the pattern of prices and profitability in an industry cannot be explained by cost data alone. Unless we can take product quality differences into account we are likely to misperceive the fine-grained nature of the competitive process in which local context matters greatly. Of course, what we mean by differences in product quality and how they might be measured are well known conundrums that practically minded industrial economists and management scholars have worked on for many years, and we can learn from them.

Secondly, competition is not simply a question of processes working only in the markets for goods and services. Labour markets influence the process of competition as much as do the product markets in which the rival businesses compete for customers. As a general rule, the less perfect are these markets (in the sense of partially ignorant customers and employees and barriers to switching supplier or employer), then the slower will be the pace of evolutionary change and the wider the dispersion of prices and wages in any given context. Furthermore, since the degree of market imperfection is shaped by the regulatory structure of the relevant markets, we can enquire how the instituting of market relations shapes the rate and direction of economic evolution. How regulation biases and slows economic evolution is one of the aspects of the evolutionary picture which is of immediate policy relevance. Thus, for example, legislated barriers to the transfer of labour between more rapidly and less rapidly growing firms are alleged to be obvious differences between “Anglo-Saxon” and “Continental” or “Asiatic” models of capitalism and these differences have real effects on the course of economic change. We are likely to find a good part of our understanding of comparative rates of economic

evolution in the working of the labour market, and on the factors generating the supply of skills and human capital in general.

Thirdly, there is not the slightest reason to believe that two rivals of equal profitability will invest and grow at the same rate. They may reasonably have different investment strategies, they may have access to the capital market on different terms, they may be part of larger firms that can cross subsidise investment across business units, and they may differentially have access to state support for investment. Capital markets and financial systems matter too, they are part of the more general economic order that shapes the connection between growth and profitability but this is exactly from where Schumpeter started. Capital markets and banks were his headquarters of the capitalist system, the instituted alternative to central planning. Even if he placed too much emphasis on innovation and the supply of credit, we ignore these links at our peril. We should not be at all surprised to find highly profitable businesses that have a low or zero propensity to grow, or conversely, low profitability firms whose strategic ambition far exceeds the free capital at their disposal. As a matter of logic, there is nothing to rule out the most inefficient of rival producers rising to dominate a market, unlikely though it may be in practice.

Fourthly, entry and exit, the birth and death of businesses, fit naturally into this scheme. Empirically they are a small part of the evolutionary picture but they are important aspects of its operation. Exit is usually a failure of viability; the business is no longer able to generate the customer revenue to meet its contractual obligations. We think of this particularly in the case of early entrants but well established firms are at risk too and, in a world of constant returns to production scale, size is no protection against business failure. But the connection between lack of profitability and exit is elastic. Exit will depend on the attitude that creditors take as to whether a particular business can be restructured, on whether its misfortunes are deemed to be temporary or irredeemable, on whether a benevolent state is willing to subsidize the marginal fringes of production. It is rather obvious that, to the extent that marginal operations are protected from exit pressure, this necessarily slows down the rate of evolution. Not all businesses that disappear from the register do so for negative reasons, many are purchased strategically by other producers and so the market for corporate control comes to have an important

role in shaping the overall rate of business experimentation. Entry too turns out to be of minor importance quantitatively but of great importance qualitatively. At some point entry created the businesses that rise to dominate a market. Needless to say, Schumpeter's model of entry is entirely driven by innovation and what matters in his scheme is not the numerical rate of entry but rather the way in which the entrants differ from the incumbents. As always, the impact on variation is the key so that entry becomes just another dimension of innovation.

Cleary, we have within our grasp evolutionary frames that capture many of the important aspects of real world competition and their wider consequences. As an example, consider how an evolutionary explanation of the change in total factor productivity might look. Suppose we let x_i denote total factor productivity in each business in an industry population and let there be a set of other selective attributes affecting the growth rate of the businesses, labelled, y_{ij}, such that each attribute has a positive effect on the fitness of its host organisation. Then the application of the Fisher/ Price Principles leads directly to the change in total factor productivity in the representative business, which we can express as

$$\frac{dx_s}{dt} = \sum \frac{ds_i}{dt} \cdot x_i + \sum s_i \cdot \frac{dx_i}{dt}$$

How the output shares change depends on the distribution of productivity through its link with prices, wages and profitability and, as a genera rule, we can express the concatenation of relations in the following way which brings out the statistical nature of evolution and the importance of the correlation of selective attributes.

$$\frac{dx_s}{dt} = \Delta_0 \cdot V_S(x_i) + \sum_j \Delta_j \cdot C_S(x_i, y_{ij}) + E_S(\frac{dx_i}{dt})$$

In this expression the symbols labelled, Δ, are the selection coefficients, which follow from the particular theoretical structure assigned to order formation in product, labour and capital markets and they play a crucial role in capturing not only the direction of change but also its velocity. The variance term indicates the progressive side of the competitive process, firms with higher total factor productivity tend to grow faster but the effect of the other selective dimensions (the covariance terms) can work in the opposite direction depending on their correlation with total factor productivity. The distribution of

rates of innovation adds to the statistical picture and the relative importance of each innovator matters for the outcome. If we further added feedback processes from market selection to rates of innovation (as in the Salter-Verdoorn laws linking productivity growth to capital stock growth) we would have a thoroughgoing account of how evolution works from within.

The lesson from all of this is the value of a fine-grained appraisal of the evolutionary process in industries and their specific markets. The details matter and so we need to complement statistical analysis of broad data sets with far more attention to case studies and an historical appreciation of how particular evolutionary populations work. It is in the nature of these processes that we cannot predict outcomes but rather understand the working of processes. In any particular case, the identity of the business that might rise to dominance is a contingent emergent phenomenon. Powerful empirical studies such as Peter Murman's study of the German Dye industry or Mark Dodgson's recent account of the entrepreneur Josiah Wedgewood, are exactly the kinds of studies we need to comprehend the subtle connections between order and transformation.

Aggregate Growth and Foreign Trade

I come finally to the two dogs that didn't bark, aggregate growth and international trade. I have been focussing on the link between the micro and the meso, to use the Dopfer/Potts terminology; we need also to build upwards to link the meso to the macro. This is not macroeconomics in the conventional sense, the portrayal of an economy as an undifferentiated unit of production and demand, but rather a story of the appropriate aggregation of industries growing at different rates, each industry composed of businesses growing at different rates. Of course, the rates are not independent, they are connected by the rules of the prevailing order and amongst these rules two are to be highlighted. The first is the connection between growth rates at the industry level and the growth of per capita income mediated by income elasticities of demand. Growth in productivity at the industry level contributes to aggregate productivity growth according to the weight of the industry in the aggregate economy and this in turn feeds back via income elasticities of demand to the growth rate of the industry. If innovation is stimulated by capacity growth (as it is in the Smith/Young/Kaldor framework) then we

have a self exciting system (the phrase is Frank Knight's) in which growth generates growth but always in the context of structural change. How growth stimulates growth is itself an emergent feature of an evolving system.

The second rule, the Harrod rule, follows from the aggregate requirement that saving equals investment, a rule that constrains the aggregate growth rate to obey the constraints imposed by the aggregate saving ratio and the aggregate productivity of capital ratio. But these ratios are not given data, they evolve too, as industries with different capital output ratios wax and wane and as the distribution of income across occupational classes varies to reflect the shifting economic order. Schumpeter made this latter effect very explicit when he linked savings to aggregate entrepreneurial profits and he was surely correct to do so.

I want to reflect as well on the obvious fact that these micro-meso-macro processes do not operate in the context of closed national economies. International competition follows the same evolutionary logic as national competition but mediated by exchange rates and trade policy and those sources of competitive advantage that are nationally specific. Trade and international investment data provide rich evidence on this evolutionary process and allow us to connect the familiar notion of comparative advantage within and between industries to the ever changing pattern of world production. Comparative advantage now speaks to the dynamics of production it explains why some national industries grow at the expense of others and ultimately finds its source in international differences in rates of innovation and imitation. If we add in the evolution of world consumption we arrive directly at patterns of trade and balance of payments phenomena and so link the argument back to exchange rates and comparative costs. Familiar facts fall into place. Import penetration, for example, as consumers buy from overseas suppliers, has been central to the recent economic history of Western Europe and the USA. Whole national industries, never mind individual producers have disappeared as Japan, Korea, China and India have successively entered the evolutionary game. My claim is that these changing patterns of international commerce can be fruitfully analysed in terms of Fisher/Price processes too.

IV Reprise

I hope I have convinced you of the worth of a modern evolutionary agenda and of its foundations in Schumpeter's great work it was a very important lesson, the value of deviant behaviour. Evolution is not a product of average behaviours but a product of the outliers that are distant from the prevailing averages. Average fitness has no evolutionary potential and neither do the trade-offs between selective characteristics that produce it. Evolutionary potential increases as one moves further from average but asymmetrically, in that the average is drawn towards the businesses with the highest, not the lowest growth rates. As an industry concentrates, internationally as well as nationally, so the averages increasingly approximate to the characteristics of the fittest competitor, which is why evolutionary drive is eventually exhausted. But innovation can interfere with this process quite fundamentally. Imagine an industry in which two competitors innovate sequentially to establish the same competitive advantage, first one ahead then the other. In this "flip-flop" world neither has a sustained advantage and the market share of each rises and falls in an unending sequence. Yet at each moment in time the Fisher/Price Principles give an exact account of the process of industry evolution. Consequently, it is the persistent innovators, those who stay ahead of the majority of their competitors, who are likely to dominate over the long term, being good at innovation for a brief while is not sufficient.

It is of no service to say that Schumpeter solved the problem of economic evolution for he did not. As with Marshall the conceptual tools were not available to him but that does not matter at all. What he did do was point economic reasoning down an evolutionary path, a path which is only partly trod a hundred years on. In this he was a deviant, a leader and an entrepreneur. It is for this reason that his place in the canon of economic thought is secure.

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Fitness Variations in the US Economy, 2000-2009

Best Performing Industries In the Past Decade (2000-2009)

Rank	Best Performing	Growth
1	Voice Over Internet Protocol Providers (VoIP)	See Note
2	Search Engines	1655.9%
3	e-Commerce & Online Auctions	468.9%
4	Online Dating & Matchmaking	248.8%
5	Tank & Armored Vehicle Manufacturing	244.7%
6	Petrochemical Manufacturing	221.2%
7	Mining Support	186.7%
8	Wireless Telecommunications Carriers	183.4%
9	Biotechnology	182.1%
10	Warehouse Clubs and Supercenters	146.5%

Worst Performing Industries In The Past Decade (2000-2009)

Rank	Worst Performing	Growth
1	Men's & Boys' Apparel Manufacturing	-89.1%
2	Clothing Accessories Manufacturing	-76.2%
3	Money Market & Other Banking	-73.3%
4	Broad Woven Fabric Mills	-72.7%
5	Women's & Girls' Apparel Manufacturing	-71.4%
6	Apparel Knitting Mills	-70.9%
7	Leather Tanning & Finishing	-70.0%
8	Manufactured Home Dealers	-67.4%
9	Circuit Board & Electronic Component Manufacturing	-63.9%
10	Recordable Media Manufacturing	-63.7%

Source: IBIS World, Inc, California, Santa Monica.