Evolutionary Political Economy in Crisis Mode

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The world economy is in crisis. Though the diverse manifestations of this critical development differ in scope and timing the global character of the phenomenon cannot be denied. For OECD countries a slowdown in real growth combines with rising unemployment, the rest of the world is dragged into the same self-amplifying dynamics. Decades of economic modeling efforts, which focused on stable equilibrium growth paths suddenly look incredibly inadequate. Theoretical systems designed to describe a stable growth path cannot really inform economic policy in times of crisis. The only remaining attitude is the advice to wait until the self-regulating forces have led the world back on the stable track of welfare growth. But for policy-makers as well as for the many victims of the economic crisis such an advice is unacceptable. Since mainstream economic theory was unable to predict this crisis nobody believes that it can be of much use in finding ways for recovery. The crisis in the real economy thus implies the crisis in mainstream economic theory. The obvious reaction of the protective belt of the mainstream paradigm is the search for disturbing elements, which then simply would have to be eliminated. To the usual suspects – unions and other labor movement organizations – more recently some other types of critical agents have been added. In particular there has been a revival of the discussion on business ethics, a difficult topic in the light of the original mainstream assumption that profit maximizing behavior is the only necessary and sufficient assumption on a firm's goal to guarantee stability.

It is in the context of this double crisis of the global political economy and the mainstream economic theory describing it that alternative theories suddenly become attractive. These challengers are diverse though in several respects overlapping. One of the oldest and most established competing paradigms in political economy is evolutionary political economy. This stream of thought reaches back to classical authors like Malthus and can be traced along an illustrious line of important economic scholars till the present day. With the important book of Richard Nelson and Sidney Winter (Nelson & Winter, 1982) a new generation of contemporary evolutionary economists was initiated: Geoff Hodgson in the United Kingdom, Ulrich Witt in Germany, Masahiko Aoki in Japan, and Peyton Young in the United States are just some outstanding representatives of a movement which continuously gained breath and power[1]. For all of the different strands of evolutionary economics the idea that the economy is to be conceptualized as a pulsating, disequilibrium generating system could be considered as the smallest common denominator. And it is exactly this characteristic which should provide the key to the answer why evolutionary political economy can give answers to the questions of

[1] It is interesting to see the wide range of perspectives on appropriate evolutionary methods propagated by the new generation. It ranges from exclusive, sophisticated use of prose text (Hodgson) to the use of algorithmic language (Young).

economic policy in times of economic crisis. Isn't the crisis just an extreme case of disequilibrium, just a pulsation which got out of control, broke through its usually observed borders? Looking back at the more recent history of evolutionary political economy the answer proves to be not that simple. In their quest for an increasingly endogenous explanation of the dynamics evolutionary economists typically tended to neglect the possibilities of macroeconomic policy intervention.

Macroeconomic Policy – the emergence of the concept

There is a striking paradox in the history of evolutionary economic theory: While most of its proponents held very explicit, and often heretical views on macroeconomic policy, a theoretical treatment of these issues is almost completely missing in their theoretical works[2].

To a certain degree this contradiction can be explained by taking a closer look at the history of the concept macroeconomics. Indeed for the majority of modern economic theorists macroeconomics as an independent field of economics was introduced with John Maynard Keynes 'General Theory of Employment, Interest and Money' in 1936 (Keynes, 1936). Keynes' major methodological innovation consisted of a twofold shift of focus on economic theory:

1. Economics has to concentrate on the short-run rather than looking for the eternal laws governing the long-run (since '… in the long-run we are all dead').
2. Macroeconomics should use aggregated variables (collected and measured by statistical offices) – including those describing actions of institutions (e.g. the state, unions) – rather than constructing variables describing innate properties of economic micro-units (individuals and firms).

Keynes' framework of macroeconomic policy, which focusses on intervention into short-run dynamics of nation states, indeed limits the meaning of macroeconomic policy. In the sequel Keynesians, following Hicks' canonical reformulation of some of Keynes' ideas, then divided policy measures into two groups of state interventions: fiscal and monetary policy. The rigid independence of both measures implicit in the formalized treatment further narrowed the scope for evolutionary considerations in the following sense: The essential formal characteristic of an evolutionary approach consists of making explicit how two dynamics – a fast one, and a slow one – interact; well-defined dynamic interdependence of the different instruments of economic policy therefore constitutes the core of an evolutionary model. Contrary to such a view the basic versions of the Keynesian economic policy model were just exercises in comparative statics: For a given (static) equilibrium set of endogenous variables one of the impacts of a marginal change of an exogenous instrument variable was considered, and compared to other analogous experiments. Though after the high tide of the so-called 'neoclassical synthesis' of the 60-ties[3] much more refined versions of comparative (short-run)

[2] Ulrich Witt comes to a similar conclusion: 'However, what has so far only rarely been addressed as an own object of theoretical reflections in evolutionary economics is the theory of economic policy making.' (Witt, 2003, p.77)

[3] The idea of a synthesis of microeconomic and macroeconomic theory under a common umbrella, called

dynamics emerged, the basic dichotomy between monetary and fiscal policy measures was retained.

This already very limited meaning of the concept 'macroeconomic policy' was even further restricted by Keynes' most influential innovation with respect to the dynamics of the object of economic investigations: Economies are driven by effective demand. Even today most macroeconomic models still stick to the assumption that in developed economies growth is limited by the boundaries set by a slowly expanding aggregate demand rather than by restrictions on the supply side. The neglect of supply side dynamics evidently implies a neglect of supply side macroeconomic policies. At the end of the period of dominance of the neoclassical synthesis – in the late 70-ties - this disregard of the supply side then became the entry point for the severe attacks of the so-called 'new classical macroeconomics', a more conservative economic school led by Thomas Sargent and Robert Lucas. If state intervention in times of crisis is reduced to a policy of injection of government demand, then the repercussions induced by increasing government debts are getting out of sight[4]. The new brand of macroeconomic theory and policy which surged with the upswing of conservative governments in the early 80-ties at first sight could concentrate on a simple message: If supply side processes are added to Keynesian macroeconomics, then the old image of a self-regulatory private market economy is possible – no need for a state with aspirations beyond the surveillance of market rules. On a deeper, more subtle methodological level the new macroeconomics was not retrograde but rather progressive. To substantiate their claims on the ineffectiveness of economic policy Sargent and Lucas assumed that the agents in their models used internal models of the world they were living in. Simple as this idea might sound to a non-economist it nevertheless could count as a methodological revolution in the macroeconomic theory of that time. Keynes had only thought of 'psychosocial' constants of a population, which he called 'propensities', and which he used as basic elements of his theory. Now, in new classical macroeconomics, full-fledged internal models were assumed to guide an individual entity's economic actions. To be sure, this methodological advance has to be distinguished from the unjustified additional assumption that all these internal models were assumed to be identical with an assumed true model of the economy. It has been this latter assumption, labeled 'rational expectations hypothesis', which enables the strong results on policy impotence. An unpleasant consequence of this broad attack on the usefulness of economic policy was that theoretical work by and large turned away from the field. The

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neoclassical approach, can be traced back to Paul Samuelson's PhD thesis (Samuelson, 1947). Its principal goal, namely to combine Keynes' macroeconomic policy suggestions (as formalized first by John Hicks) with a consistent microeconomic formalization of a Marshall-oriented theoretical variety, has never been reached. Nevertheless this fragment of a neoclassical synthesis has been extremely influential with respect to the actual policy process.

[4] The obvious symmetric argument that during the boom budget surpluses have to be used to restore the stock level of government debt has not been justified by experiences made in the past. In many cases rather an accumulation process of government debt took place, the build-up of aspirations of social groups (e.g. workers, farmers) financed by annual layers of overshooting public deficits not only helped to maintain the increase of purchasing power necessary for capitalism – they also transformed exploitation into a promise of future exploitation, a contract guaranteeing the creditors of public entities that they can count on a secure return on government bonds. This process had been completely neglected by Keynesians - and was rediscovered by 'new classical macroeconomics' propagating its immediate stop.

increasing sterilization of economic theory went more or less unnoticed as long as business men and politicians were self-confident enough to take correct decisions in a moderately growing economy. Only when in 2008 the heavy global downturn hit all countries quickly and simultaneously the attention of public opinion turned towards (mainstream) economic theory – and only could see stupefying silence. The distance between the theoretical work necessary for an academic career in economics and the original object of investigation could not be bridged any more.

It is not at all surprising that evolutionary economists after Keynes[5], who considered themselves as part of the still heterogeneous camp of economics, usually were not inclined to contribute to macroeconomic policy, a subject that in its Keynesian mainstream definition looked strange to them: excluding the interplay between short-run and long-run, between entities (institutions and agents) of different power and size, between production and demand[6]. So this solves one part of the above mentioned paradox.

Dropping the narrow Keynesian definition of macroeconomic policy it remains open to explain why many evolutionary economists by their very focus are driven to draw conclusions, often strong conclusions, for economic policy. For this purpose it is instructive to take a look at two representatives of classical evolutionary economics, two economists representing the two opposite poles of the political spectrum: Thomas Malthus and Karl Marx. The common basis that makes them comparable is that both consider the evolution of human society as the final outcome of the long-run evolution of life on earth, thus following some 'natural' trajectories to be discovered and described. The difference in their views on intervention in this process stems from the different dynamics they propose to have discovered. Malthus sees more and stronger 'natural' forces governing the process than the policy measures of his times (partly based on Rousseau's visions) pretended to overcome. As a consequence his policy conclusions are defensive, i.e. proposed interventions are useless, and they should be abandoned. Note that this is a strong – and nowadays very familiar - policy recommendation. Not to intervene by public policy measures is itself a policy recommendation. It not necessarily is always conservative or progressive[7]. Marx, building on Hegelian dialectics, views social evolution less 'natural' in the sense that self-organizing revolutions lead to ever new emergence of forms. In this framework more or less aggressive intervention of social entities at all levels are the prime motors for emergence rather than being a disturbance of a

[5] Schumpeter, Keynes' contemporary intellectual competitor, always refused to be classified as evolutionary economist – nevertheless a history of economic ideas certainly would see him as a representative of exactly that category. Though he clearly had a policy agenda, his approach to policy seemed to turn Keynes' approach upside down: For Keynes political intervention (of the state) on the demand side was necessary to save the economic system of capitalism, while for Schumpeter the pulsating nature of capitalist system's was their very characteristic. Political regimes in Schumpeter's view were just a slowly changing epiphenomenon that in general followed the faster pulsating economic dynamics. For Schumpeter politics thus typically would constrain economic development.

[6] More recently there, of course, exist several exceptions to this rule, e.g. (Silverberg & Verspagen, 2002).

[7] The proposal of Witt to let financial market dynamics find their own trajectory – without interference of public bodies – could well be interpreted as a progressive advice as soon as it is amended by an appropriate action space for a redefined set of agents.

'natural' process. Again this is (and always was conceived as) a strong policy recommendation. Both political poles refer to a long-run dynamics that includes important, intervention inducing short-run developments – either conceived as disturbances or as constituent elements. Macroeconomic policy thus for both consists of a mix between long-run and short-run measures. For Malthus type trajectories the short-run prescription is hands-off and the long-run policy consists of the installation of an institutional framework that promises to further the stabilizing processes of the hypothesized 'natural' state best. Inverting this mix, Marx type trajectories call for short-run and medium-run interventions of social entities driving the system towards something called 'progress', which is a long-run development that only can be understood in retrospect, and therefore escapes any long-run intervention[8].

Viewed in front of this background, Keynes position indeed is a strange brew. Insisting on short-run intervention reminds on a Marx type of background, but there is a trajectory aimed at, and it surely looks rather like a Malthus-type path. Upsetting this mix, Keynes' antipode Schumpeter was closer to Malthus' short-run laisser-faire but saw no long-run teleological perspective for capitalism.

So while the Keynes-Schumpeter generation of economists was rather reluctant to consider themselves as evolutionary economists – the glamour of Darwin's evolutionary theory was a topic of the last century and revolution seemed to be the more acute theme of their time – the last great ancestor of evolutionary economics in the 19th century, Thorsten Veblen, had judged macroeconomic policy issues as follows:
'*The outcome of the method* [marginalist economic analysis, H.H.], *at its best, is a body of logically consistent propositions concerning the normal relations of things -- a system of economic taxonomy. At its worst, it is a body of maxims for the conduct of business and a polemical discussion of disputed points of policy.'*(Veblen, 1898)

In other words, Veblen had identified the hidden policy agenda of the marginalist revolution of Menger, Jevons and Walras, and denounced it. At the same time he was well aware that their logical consistency was clearly an advance, in particular as compared to the 'naturalistic' type of economics of his time. An approach that much too often referred to presupposed 'normal' circumstances to which economic systems always should return[9]. This latter attitude was the very reason why he thought that 'economics is not an evolutionary science' yet.

Taking a great leap forward in time to consider the positions of contemporary evolutionary

[8] This interpretation of Marx contradicts what careless journalism usually ascribes to Marx' theory - namely the promise of a communist utopia to be found in Marx' works. In all central statements Marx remains in the realms of a critique of the political economy of capitalism. His 'vision' thus is strictly bound to the analysis of the contradictions of the current state of affairs. Methodologically it is the opposite to a utopian vision of perfect competition and omniscient agents in equilibrium on all markets – a contrast to every aspect of economic reality in contemporary economies.

[9] As Witt carefully describes (Witt, 2008a), Veblen seems to have been impressed by the German historical school's work on collecting specific institutional detail. He thus was trying to prepare the historical data for a future evolutionary theory – and due to the lack of such a theory had necessarily to remain on the level of polemics with respect to policy recommendations.

economists towards macroeconomic policy it is striking to see how little the broad spectrum of basic attitudes – from Malthus to Marx – has changed. Despite the enormous advances in formal tools used to express these policy views, their broad diversity even became a characteristic of contemporary evolutionary economics. But at the same time it is precisely this advance in analytical and in simulation tools that makes a difference in the intellectual intercourse between the diverging streams within evolutionary economics. Taking all those aspects that were excluded by Keynes' definition on board (i.e. all three above mentioned interplays), the new language elements help to construct an evolving theory of macroeconomic policy. This perspective, namely to take the shortcomings of received neoclassical approaches with respect to empirical observations serious, and then to be forced to use a variety of new (formal) language elements to be more adequate, this perspective has been impressively demonstrated by several economists well-trained in traditional techniques and later in their life turned into heretics, e.g. Alan Kirman, Duncan Foley, or Paul Ormerod. In (Kirman, 2011) a set of important areas of economic reasoning where standard approaches fail is used to explore how to apply new and original techniques. As Kirman modestly concludes in the end of his book this only is the first step in an evolutionary process of theory building, the generating of variety. To become a veritable new school of economic thought – evolutionary economics - some *selection of new combinations*, a second step of a new synthesis, is needed. Like Alan Kirman also Paul Ormerod is emphasizing failure as a main source of progress (Ormerod, 2005), which directly implies that the old Hegelian idea of considering history as a sequence of solving and (in an inverted form) newly emerging contradictions has to be revived by economists. In a sense Duncan Foley took this reappraisal one step further by interpreting Hegel's left-wing pupil Karl Marx with the help of modern formal methods (Foley, 2009). Most of these heretics could not find much use in applying Hicks' interpretation of Keynes' writings on macroeconomics though. Be it the aggregation problem, the missing supply side dynamics, or the stowaway of methodological individualism in Keynes macroeconomics, each one has its own style to discard the celebrated neoclassical synthesis that emerged in the postwar academic mainstream.

It is thus evident that under such circumstances a certain division of intellectual labor had to appear. Some contributors, who are rooted in a Keynesian tradition (e.g. (Foster, 1987)), tried to augment Keynesian macro-models[10] by adding evolutionary features. In particular the availability of macroeconomic data collected by statistical offices which often were a by-product of Keynesian economics surely is an incentive to produce evolutionary models along these lines. Others (e.g. (Hodgson, 1988), (Hanappi, 2002)) try to include emergence and exit of institutions in such macro-models as well. For a large group of evolutionary economists (compare the early contribution of (Mensch, 1979)) the emphasis on technology policy as a most important part of macroeconomic policy has become their central concern. Another group has taken up the old Malthusian questions of linking demographic developments to

[10] Some recent contributions in disequilibrium macroeconomics that combine the Keynesian approach (e.g. (Flaschel et al.,1997)) with Goodwin, Schumpeter and Marx traditions (e.g. (Foley & Michl, 1999)) are important for evolutionary macroeconomic policy too – even if the authors do not consider themselves as evolutionary economists.

economic aggregates (e.g. (Day, 1999, pp.157-360)) - a burning macroeconomic policy topic if one considers current debates on social security funds and pensions.

A particularly interesting treatment of the topic of economic policy can be found in Ulrich Witt's work, since there the close interdependence between underlying methodological premises and economics proper[11] are expressed explicitly, become immediately visible. As an entry point for the economic policy debate it is useful to take a look at Witt's evaluation of Hayek's contributions (Witt, 1997). In this paper Witt distinguishes between two phases, Hayek I and Hayek II. In the first phase Hayek's object of investigation is the economic business cycle and his method is equilibrium analysis; in the second phase Hayek's focus rather abruptly turns to a methodological concern, namely the limits of information processing[12], while the immediate political discussion[13] lets him jump on topics of social philosophy. What makes Witt's analysis of the 'Hayekian puzzle' particularly interesting is the conclusion he draws:

'*Thus, given continuing innovative activities and the agents' simultaneous searching, experimenting, and maneuvering, fluctuations and cyclical patterns in aggregate economic activity may be quite natural phenomena in the spontaneous order of the markets. In fact, from a logical point of view there is no reason why a spontaneous order should be associated with a steadily developing aggregate economic activity. Yet this appraisal may be cold comfort for agents who experience the struggle and threat of bankruptcy during each cycle. A demand for 'stabilization policy' is popularly raised and eagerly taken up by political entrepreneurs and advocates of vested interests. Unfortunately, there may be little hope for remedy. Limited knowledge and information processing capacity are no less binding constraints for policy makers. An attempt at engineering a deliberately unsteady choice of fiscal or monetary measures in the hope of being able to just 'compensate' unsteadiness emanating elsewhere is likely to result in a, probably more refined, searching, experimenting, and maneuvering on the part of the respective authorities. Accurate (not to speak of optimal) control of the time path of measures intended to compensate fluctuations in aggregate economic activity is most doubtful under these conditions.* (Witt, 1997, p. 56)

Witt thus not only shares Hayek's skepticism, he even promotes the emerging continuous disorder of actions and agents – including uninformed reactions of policy-makers - as the creative potential necessary to cope with the rapidly changing environmental chaos which these actions permanently produce. A pulsating flux of economic conditions therefore is not to

[11] Despite the fact that the distinction between micro- and macroeconomics is commonly used in the profession, it remains one of the prime tenets of evolutionary economics to dissolve this artificial – and mostly misleading – separation. Neither of the two fields can, and should be conceptualized as the 'foundation' of the other. Witt's emphasis on describing expectation formation of traditional microeconomic entities might give the false impression that he positions his version of evolutionary economics at a purely microeconomic level first. A more careful reading immediately reveals how unified (linking traditional micro-topics with macro-themes) the character of his arguments is.

[12] Such a break in confidence concerning rigid formalisms could also be found in Wittgenstein's writings, just compare his famous Tractatus Logico-Philosophicus (Wittgenstein, 1922) to his later work (Wittgenstein, 1953).

[13] Hayek closely observed and took part in the discussion on the possibilities of macroeconomic planning (see (Lange, 1936)). His new scepticism with regard to the information processing capabilities of micro-units did fit perfectly to his fight against socialist planning. And it certainly was the latter, which in his old days lead him to the meta-level of social philosophy.

be considered as the result of disturbances caused by institutional rigidities (e.g. feudal institutions, religious attitudes) or sinister political agents (e.g. unions), it quite to the contrary is the typical form of aggregate behavior, which can be expected for a capitalist system.

'*Exposure to cyclical fluctuations may thus turn out to be the price the economic agents have to pay for participating in a system of markets which, though not developing steadily, have been able to generate an unprecedented growth of material wealth.*' (Witt, 1997, p. 56)

Sixteen years later - with that modest perspective on the possibilities of policy consulting still in mind - Witt argues on a much broader methodological basis that evolutionary economics still is in its infancy and just should continue to collect a variety of theoretical experience linked to empirical research. Only based on such a rich foundation a bottom-up approach reaching out for more general principles of evolutionary economics for human societies can be erected[14]. Nevertheless Witt insists that evolutionary policy consulting is not merely accumulation of empirically relevant piecemeal engineering, it includes the introduction of theoretical novelty, which in turn then demands collecting new statistical time series[15]. So while there is an exploding amount of singular evolutionary models trying to explain with partially new concepts well-defined economic phenomena, an overarching canonical model to agree upon is not in sight yet[16].

As a consequence it is not surprising that evolutionary economics considers macroeconomic policy to be a wide field. It still includes fiscal and monetary policy[17], but it adds long-run dynamics, sector dynamics and sophisticated price-wage-interest dynamics, to name just a few. It still includes aggregate variables, but it adds micro-political interventions by influencing the expectations of smaller social entities. It adds other policy fields: technology[18], exchange rates, immigration, demography and many others. It can do all this - and even study non-linear disequilibrium scenarios of them by using the new simulation tools available. As Giovanni Dosi in a recent publication (Dosi, 2012) vividly shows this alternative to the mainstream approach rests on the synthesis of two important pillars: a recast of the history of economic thought, and a set of new combinations of formalization techniques (agent-based modeling, network analysis, fractal analysis, econophysics, new game theory, etc), The following chapter provides an outlook on what can be expected from simulation-based evolutionary economic policy in the future.

Evolutionary modeling strategies for macroeconomic policy

More to the technical detail, an evolutionary macroeconomic policy model consists of four

[14] This research program is explained in (Witt, 2011) to contrast the top-down approach of ‚Universal Darwinism', see (Hodgson and Knudsen, 2010). To use a comparison with astronomy: Kepler was only possible after Tycho de Brahe, and progress in economic theory building has still not advanced enough to enter the second stage.
[15] An example of such a proposal can be found in (Witt, 2008b).
[16] Again it was Witt who tried to structure the field, see (Witt, 2008a).
[17] An impressive case for the enduring importance of fiscal policy was recently made by Philip Arestis and Malcolm Sawyer (Arestis and Sawyer, 2003).
[18] An excellent example showing how agent-based simulation can build a bridge between a Schumpeterean perspective on technology and Keynesian views on macroeconomic policy is provided in (Dosi et al, 2010).

sets of variables linked to each other by relations, which usually are formulated as computer programs, equation systems or (in a preliminary stage) as text.

The ***first set*** consists of the goal variables, those aggregates that enter what is usually called a social welfare function. Standard macroeconomic theory traditionally considered five such aggregates: the (real) GDP growth rate, the unemployment rate, the inflation rate, the net export share in GDP and the budget deficit as share of GDP. Even for short-term considerations the combination of these variables into a single welfare measure is far from trivial, they usually are strongly interdependent, often in a non-linear way, and even the sign of several relations still is open to debate. For some aggregates the optimal level seems to be obvious (no unemployment, zero inflation) but even that might not be true: Structural unemployment might increase welfare by enhancing technical progress, some small inflation rate might induce money owners to carry their money to the bank to participate with a small interest rate in productivity gains, and thus increasing available funds for new investment. Other variables do not have evident optimal levels at all, not to speak of the asymmetric dynamics around these levels. Evolutionary economics adds further problems. To mention just the more important ones:

Including the long-run time horizons implies to take care of J-curve effects, i.e. there is a dynamic trade-off that can make short-term welfare loss smaller than long-term welfare gain of the aggregated and discounted vector of goal variables[19]. In open economy models an immediate further complication arises as the interdependence of the considerably larger set of goal variables cannot be ignored, and has to be formulated explicitly.

Another particular difficulty is that time horizons can be long enough to allow for emergence and disappearance of goal variables[20]. This indeed is one of the core topics of evolutionary theory. With respect to disappearance this has been dealt with under the header of 'selection of the fittest', while with respect to emergence this is elaborated in the important field of innovation theory, or the more broadly defined field of 'the emergence of novelty'. Since this is the most important theoretic element that extends evolutionary methods beyond the scope of just adding more adequate variables to models of received theory, it will be dealt with in more detail after the discussion of sets of variables.

Furthermore it has to be considered from a micro- as well as from a macroeconomic point of view. What appears as a new goal of microeconomic agents might well be invisible for macroeconomics, whereas a macroeconomic objective often can look irrelevant for micro units. Several interesting types of evolutionary economic models deal exactly with the simulation of policy processes which make goals visible - or invisible[21].

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[19] Aggregation of the standard set of goal variables is a separate problem touching on several scientific disciplines: Technically the square root of a weighted sum of squared deviations from optimal levels is a common starting point. The weighting scheme evidently has to be assessed by a less technical procedure – from economic reasoning to simple opinion polls of the concerned population. A similar problem arises with discounting. The time preference rate of a society cannot be directly observed and from an evolutionary perspective even its sign might depend on the context.

[20] The introduction of endogenous preferences, in particular in evolutionary economics, has been the topic of volume 97 of the Journal of Economic Theory (L. Samuelson, 2001a), see also (L. Samuelson, 2001b).

[21] Even in Keynes' now classical argument for using monetary expansion to lower real wages, the idea that workers are only recognizing their nominal wage, and thus are willing to accept the additional job offers of

The new areas of possible goal variables, technology policy, environmental policy (more general: endogenous utilities), information policy (taking account of sustained expectation disequilibria, and all types of game theoretic lock-ins) and the recently booming renaissance of directly coercive policy measures (i.e. cold economic war and constrained hot war) really open up a broad spectrum of possible goals.
The choice of the set of goal variables for macroeconomic policy, including a welfare measuring procedure that combines them, is not just a matter of setting a standard. For evolutionary economists it necessarily is rather an art that the model-builder has to bring into the picture, choosing with care and intuition.
Since any model is used to understand changes in goal variables, all goal variables are endogenous variables.

The ***second set*** of variables consists of exogenous variables not controlled by the entities modeled. In mainstream macroeconomic theory these variable are often considered to be of minor importance, since they influence goals only by their assumed, exogenous values. In the Keynesian macroeconomic policy concept they typically represent slowly changing, though important influences. Certain propensities of social psychology of groups are typically assumed to remain constant in the short-run, or a population is assumed to grow at an exogenously given constant rate. Since in this concept only the short-run is modeled, the role of auxiliary variables is very limited. The essentially richer approach of evolutionary economics assigns a much more important role to this set of variables. In a sense they designate the border line between what is modeled and what is not modeled[22]. Because evolutionary views do have the tendency to include more and more neighboring problem areas, often crossing borderlines between traditionally separated fields of political economy, the choice of where to stop is far less trivial than in old-style Keynesianism. Since a longer time-period is involved, these borders eventually can shift, their specification really is as important as any other part of the modeling work. It can be the rather common case that uncontrolled exogenous variables might become endogenous goals (e.g. carbon dioxide emissions), but sometimes important endogenous variables might also suddenly vanish (e.g. exchange rates between European currencies after the introduction of the Euro).
This sheds some light on the methods preferred by evolutionary macroeconomic policy: While the Keynesian tradition typically was based on comparative statics, i.e. two static equilibriums with different sets of exogenous variables were compared, evolutionary economists compare different sets of dynamic trajectories with possibly changing roles of variables and with no special emphasis on equilibrium paths. Moreover, since sudden changes in relationships might occur due to a sudden change in the status of a variable at certain points in time, these changes are rather inconvenient to model by use of the standard mathematical apparatus (difference-differential equation systems) – but they almost naturally lend themselves to algorithmic formulations in computer simulations. So instead of distinguishing domains where different

employers (who very well recognize the fall in real wages) this visibility issue was already present.
[22] A model is nothing but a solution to the useless statement that everything depends on everything else. It thus is the borderline between what is modeled and what is not modeled, which determines it. Auxiliary variables are positioned on that borderline, they ***are*** the borderline.

functional relationships are valid, the algorithmic formulation simply contains a jump to a new sub-program that is conditioned by the variables hitting thresholds. The switch from the continuous developments in one regime to a sudden break towards a new regime – from quantity to quality, as the older methodological discourse would call it – thus looks quite plausible if algorithmic formulations are used.

Now turn to the ***third set*** of variables, the exogenous variables controlled by social entities, those variables that often are referred to as instruments of macroeconomic policy. Again the evolutionary approach dramatically increases the number as well as the specification details of these variables, in particular if compared to the Keynesian framework. The latter typically starts with just two variables in this set, government expenditure and money supply, and then proceeds mainly to include a few refinements. Tax rates, instruments influencing repercussions in open economies, and instruments that enter behavioral equations of wage and price setting are typical candidates for such refinements. As mainstream Keynesian economists try to include more and more of these improvements to provide a better picture of what happens in real economic policy, they more and more are doing what evolutionary economists do. If they finally drop the technical trick of introducing equilibrium conditions to get rid of hard to describe dynamics, then this asymptotic methodological convergence comes close to a qualitative jump towards evolutionary economics. But there still is something missing.

One element that is missing is the micro-macro relation referred to earlier[23]. Indeed, the conservative reaction to Keynesian macroeconomic policy that surfaced in the eighties as the theoretical branch of Reaganomics, the so-called new classical macroeconomics, pointed at exactly that problem: If micro-units anticipate the actions of macro-units (the setting of instruments), then the standard results of Keynesian macroeconomic policy can easily be reversed. This is the economic content that the rational expectations school (compare e.g. (Sargent, 1980)) emphasized. The merit of this school doubtless was to highlight the importance of the expectation processes of economic micro-units, a task that it shares with evolutionary economics. But as Herbert Simon, one of the most innovative scholars of the social sciences, realized long before, anticipation of real-life micro-units takes place with rather limited information processing capacities of the latter. The overriding economic policy objective of the rational expectations school, namely to prove that an increase in government expenditure will not increase real GDP but will only lead to more inflation[24], seduced the proponents of this school to sacrifice realism, to assume a counterfactual world where knowledge is complete and all micro-units are hyper-rational and unconstrained in their problem-solving capacities. Of course, in such a world there is no room for Keynesian politics, and there is no room for evolution. So with respect to the content of the anticipation models

[23] A similar consideration can be found in (Foster, 1987, p. 204), where the notion of micro-macro consciousness is introduced.

[24] Conservative economic policy was directed mainly against Keynes' idea to increase effective demand by increasing government expenditure. In particular, the higher propensity to consume of poorer parts of the population would have implied to direct additional expenditure towards these social strata. Ironically enough, Ronald Reagan initiated an enormous increase of government expenditure in 1980 – though not by increasing social transfers but by military expenditure on the Star Wars Initiative - making him an extraordinary Keynesian.

that are suggested to describe micro- and macroeconomic entities there is a sharp contrast between the rational expectations school and evolutionary economics. The latter insists on models that are adequate to the actual, heterogeneous information processing possibilities of economic actors.

In fact, this view held by evolutionary economists opens up an extremely important new area of instrument variables: Since models used by entities can evolve and are learned, there exist two major sources where they come from. They are either developed in direct interaction with the non-human environment, or they are learned from other social entities[25]. To teach others, or in a less friendly language, to manipulate their models, is only a straight-forward extension of the concept of coercive power. By making perception and communication processes as well as their capacity constraints explicit evolutionary economics in principle is prepared to grasp the peculiarities of the current global information and communication technology revolution – something totally out of reach for the new classical macroeconomics.

This latter aspect, namely manipulating models and using models manipulated by others, evidently calls for a game theoretic consideration. Much of the work done in the area of macroeconomic game theory started with simple extensions of the usual comparative statics approach to comparisons of Nash equilibriums (e.g. in games played by central banks, ministry of finance, unions, …). More recently, the new interpretation of Nash equilibriums as evolutionary stable strategies has given these extensions an evolutionary twist. Nevertheless, the further development hinted above, the inclusion of dynamic strategic manipulation of models from macro- to micro-agents and the counter-running political feedback processes, are still only rarely touched upon by recent research papers. The potential of such work for actual macroeconomic policy, of course, is tremendous. In a sense, one pre-condition is to develop applied game theory in an appropriate direction, that is taking information process characteristics serious, shaping formal tools according to the needs of the content of our discipline rather than vice versa[26]. Another pre-condition surely consists of extensive empirical work concerning the actual model-building and decision-making process of social entities. If manipulation (teaching) enters the scene as an instrument variable, then its effects – as perceived, communicated or even actually existing – have to be empirically disentangled to allow for a first set of model hypothesis. After more than 200 years the French Enlightenment thus could be re-interpreted as evolutionary macroeconomic policy!

The ***fourth set*** of variables to be considered has the seemingly uninteresting label of auxiliary variables. For many economists the introduction of these variables is just a matter of notational convenience: They are names for results of simple, repeatedly occurring sequences of computations (e.g. deriving ‘disposable income’), or names used to ease the understanding for researchers working in neighboring disciplines (e.g. ‘primary deficit’ for accounting people), or names invented and used by those providing empirical data (in particular those working in central statistical offices). From an evolutionary perspective these variables are far

[25] The overwhelming majority of economically relevant human behavior stems from this second type of learning process.

[26] In a recent book (Hanappi, 2013b) this proposed turn in future game theory is interpreted as a return to the original research project of John von Neumann and Oskar Morgenstern.

less arbitrary than is usually assumed. First, several important concepts that finally lead to measurable essential variables made their first appearance as some vague auxiliary influence (the best known example comes from physics: the concept of 'heat'). Second, auxiliary variables, though easily replaceable by a sequence of calculations involving other variables, might bear an important meaning for a social entity using it, a meaning, which could explain the actual action taken, better than anything else (e.g. the derived variable 'budget deficit quota' explains numerous saving decisions, though an actual causal relation usually is not understood).

These considerations suggest that evolutionary macroeconomic policy should look at the set of auxiliary variables as a kind of pool for potentially important variables. Sure, they are just of latent importance in the model at hand, but there is a reason why they are in this pool – and there is every reason to handle entry and exit from this pool very consciously. Building evolutionary macroeconomic models is itself an evolutionary process: Once a model is set up, it is continuously further adapted to advice the on-going policy process. It never is designed to work on the basis of eternal economic laws, it necessarily has to change with changing views of modeled entities, entry and exit of variables and agents in the course of disequilibrium processes that hit thresholds[27]. In this endlessly pulsating flux the pool of auxiliary variables serves as a buffer, keeping vanishing variables for some time alive before they finally are discarded or experience a renaissance, or storing new ones for testing their importance[28]. In short, the pool of auxiliary variables enhances the flexibility of evolutionary macroeconomic modeling.

All four sets of variables are connected by relations that link them over time. Since any reaction in the real world takes time – not only in physics the notion of contemporaneity is a fiction – a large part of a macroeconomic policy model[29] will be dynamic. Using the model for the study of comparative dynamics then also involves assumptions about starting values to derive quantitative as well as qualitative general results[30]. In the latter case it nevertheless should be kept in mind that the purpose of an evolutionary econometric model always is the exploration of possible futures, of implications of diverging and converging processes, bottlenecks, quantitative and qualitative change and break. Since the foundation of the approach is not the discovery of the one and only correct model that governs the actual system behavior[31], it would be misleading to judge models only by their forecasting accuracy. Though prognostic quality surely still is a virtue, it is just one ingredient. What is of central importance for evolutionary macroeconomic policy is their usefulness with respect to welfare

[27] In a recent paper Brian Arthur argues for a new science of 'Complexity Economics' which strongly resembles my proposal for 'evolutionary economics' (Arthur, 2013).

[28] The luxury to maintain a non-empty set of auxiliary variables replaces the usual dictate of Ockham 's razor: A certain amount of redundancy can stimulate creativity.

[29] Only some definition statements of variables can remain static.

[30] From an evolutionary perspective the distinction between qualitative and quantitative aspects is of minor importance, since in an evolutionary treatment both elements always coexist.

[31] Behind that modest statement an important methodological issue is hidden: Contrary to modeling of non-living systems of 'nature', evolutionary modeling is not concerned with the discovery of eternal laws of motion; it rather is trying to enhance a discourse on how rule systems have been and can be designed by living entities creating their own fate.

increase. They can throw some light on possible future states of the world and show some trajectories that without the use of the model would not have been noticed. They also help to assess quantitative magnitudes involved in the dynamics, something often ignored even by the specialists in the field. And once they are used, these models easily can change the course of events they forecast, they can be self-fulfilling or self-destroying prophecies. While this does terrible damage to their forecasting accuracy it sometimes can be welfare increasing[32], so the latter notion – welfare increase - is the only ultimate measure for an evolutionary economic policy model.

Having emphasized the implicit tendency of evolutionary economic model building to reach out for economic policy issues[33] there nevertheless remains the question if there is not a common methodological structure, a common ground on which models are built. The most probable candidate for such a feature seems to be the general shape that characterizes the evolution of living systems, i.e. the way how increasing neg-entropy paves its way through (more precisely: against) physical time. This indeed is at the same time the link to a more general evolutionary theory[34]. Cum grano salis in the moment two different general shapes are on offer:

- One of them (the **traditional**, 'quasi-religious' view) considers the overall evolution to converge to a well-defined final state. On the way to this state exogenous (devilish) shocks can occur but with the help of science, which successively discovers the rules which define the final state, the system can always – more or less quickly - avoid to fall in the abyss.
- The other one (the **evolutionary**, scientific and thus anti-religious view) negates any idea of a final state or eternal laws ruling in this final state. It assumes that not only human history is man-made but that also the ideas about the laws governing all living and non-living systems are man-made and therefore have to be strictly seen as preliminary. Beyond the negative answer with respect to a definite point of attraction of all evolution this view (at least since Darwin) also provides a suggestion on the shape of evolutionary processes of living systems: The historically observed sequence of species advances in the form of a pulsation! Periods of slow change and relatively stable, self-repeating dynamics of the same elements alternate with shorter, revolutionary periods, where the overall evolution usually *changes its direction*, and in sometimes surprising speed eliminates old elements and breeds new ones.

Figure 1, shown below, captures the evolutionary view. Even during the more stable phases of evolution many fast processes occur which are necessary to keep the system on track. These fast processes are regulated by *policing entities that are exogenous* to them. For the human

[32] A typical example is the model of the Club of Rome, which in the 60-ties predicted a quickly approaching environmental disaster. When the latter did not occur (a forecasting error) this happened also because the prediction had induced a growing movement of environmentalists.
[33] A recent contribution trying to apply evolutionary macroeconomic methodology to questions of the current global crisis is (Hanappi, 2013a).
[34] See (Hanappi, 1992) for a more detailed discussion of this point.

species Dopfer and Potts would consider them partly as meso-level entities, see (Dopfer and Potts, 2008), others would characterize them as 'institutions', compare (Hodgson, 1988), others again would argue that such institutionalized agreements are built on preliminary compromises between opposing class forces, freezing class struggle during a period of a prevailing 'social system of accumulation' (SSA), see (Gordon, 1980). During a revolutionary break the set of the exogenously fixed regulatory mechanisms and their carrying entities – in figure 1 dubbed a 'regime' – is transformed by a process *different* to the stabilizing processes that take place during the stable era: there emerge *revolutionary dynamics*[35]. An evolutionary model, starting with assumptions on the four sets of variables described above, thus has to combine these variables in a way that allows for at least two different models (stabilizing dynamics and revolutionary dynamics) and as a consequence has to be characterized by a sophisticated time structure. Stabilizing fast dynamics work on a fast scale (though not the infinite speed assumed in some general equilibrium approaches), while progress that takes place from one revolutionary break to the next advances on a much slower scale.

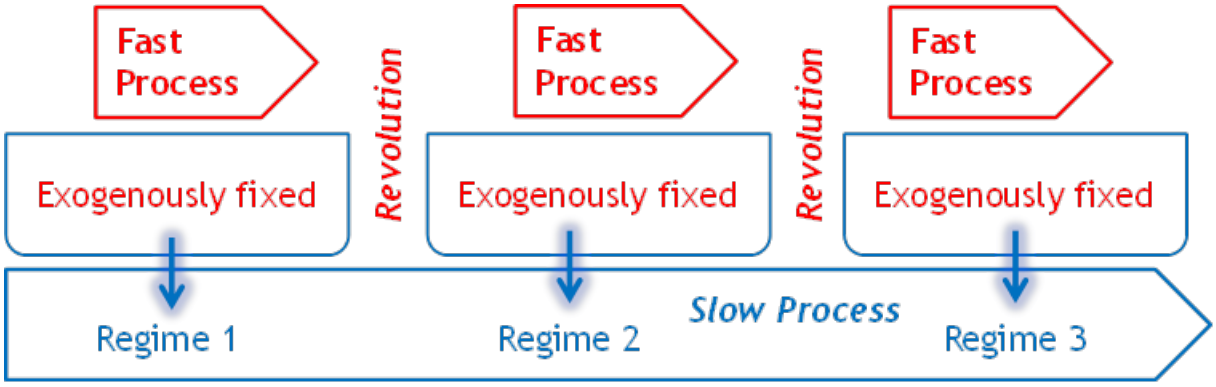

Figure 1: The template of evolutionary theory (source: (Hanappi, 2013c))

Unfortunately enough, only little theoretical work in evolutionary theory has been focusing on finding common features for the mechanisms of revolutionary dynamics. In particular the idea of selecting the properties (or elements) out of an existing variety, which fit best to some pre-defined exogenous environment typically concerns stabilizing processes; one is reminded on the adaptive dynamics of the birds living on the Galapagos Islands visited by Darwin, or the proposed need of Greece and Portugal to adapt to a postulated productivity growth regime of Germany. On the other hand the blind spot of revolutionary dynamics lends itself perfectly to an exploration of the concept of novelty. In evolutionary terms it is closer to the idea of generating variety and producing a large set of possible new combinations out of existing older (sometimes almost forgotten) elements. In the case of modern human societies this is the topic of innovations, innovations which in this context are always a conglomerate of technical and social innovations. They constitute novelty because the perception process itself is

[35] E.g. in biological evolution after the Cambrian a new interaction between life forms rapidly produced an exploding variety of species. It is easy to find analogue developments after sharp breaks in the evolution of the human species.

endogenous: The innovator walks out into the dark, usually in several directions, and only after he or she has hit gold it can be stated what indeed had been an innovation. Nevertheless the variety generating process can be studied and imitated by simulation techniques, what really is a hard problem is to specify how a test, which indirectly points into a new direction can be formulated. Here Schumpeter's vague idea on visions comes into play. To put a long story into a short sentence: Evolutionary economists during times of revolutionary dynamics are forced to produce visions. It is no surprise that in that respect they resemble the image Schumpeter had of entrepreneurs in business life, creative destruction is the name of the game to be played during the phase transition of revolutionary dynamics. Moreover, as in primary economic activity the synergy of the different technologies used is a significant component.

One of the involved new techniques of evolutionary economics is fractal analysis – and it concisely shows how to use self-similarity (in the dimensions of space and time) of shapes like figure 1. This technique clearly gives evolutionary modeling of social phenomena a new kick[36]. It shows how social interactions as a network of self-similar nested processes, which at first sight look difficult to grasp (in Mandelbrot's words 'rough') can formally be made simpler. On a different frontier, network theory proper has blurred and enriched its borderline to traditional dynamic input-output analysis as well as to simulation enhancing theories of algorithms, compare (Newman, 2010). More recently an overlapping body of theory is developing there. Another rapidly growing group of scientists participating in this methodological quest identifies itself via its object of investigation: complex adaptive systems (CAS). The concept of complexity unfortunately for many scientists remains hard to nail down - and to agree upon. Half a century ago Andrei Kolmogorov and Gregory Chaitin had provided an information theoretic proposal for a definition of complexity, which in principle linked its degree to the length of the algorithm needed to produce a bit string representing an object of investigation[37]. What Mandelbrot had proposed in this sense was a scientific method to reduce complexity. Chaitin went much further and extended Gödel's proof of incompleteness (Gödel, 1931) to his own algorithmic information theory: 'With Gödel it looks surprising that you have incompleteness, that no finite set of axioms can contain all of mathematical truth. With Turing incompleteness seems much more natural. But with my approach, when you look at program size, I would say that it looks inevitable. Wherever you turn, you smash up against a stone wall and incompleteness hits you in the face!' (Chaitlin, 2001). It is tempting to interpret Chaitlin's findings as a mathematically rigorous support for a future evolutionary method that accepts its own ***radically preliminary character***; e.g. even with the most sophisticated heterogeneous agent based simulations every result proposed remains bound to its immediate historical context. Needless to say that above all elements of this much too short tour de force across the toolbox of evolutionary modeling there still are felt some intuitions of John von Neumann and the computer age his work initiated.

This takes the argument back to where it started from, to the contrast between the two possible

[36] The father of fractal analysis, Benoit Mandelbrot, has characterized it as the formalized treatment of roughness: 'I had engaged myself, without realizing it, in undertaking a theory of roughness. … Before my work on roughness, it was either undefined or measured by too many irrelevant quantities (emphasis by H.H.). Now it can be measured by one, two or a few numbers.' (Mandelbrot, 2012, pp.285-286)

[37] See (Gleick, 2011, pp. 324-352) for some background on the emergence of this definition.

shapes on offer. For the second proposal, evolutionary theory, recent research seems to advance in a promising way: Several pieces of a grand puzzle seem to fall into place, surprisingly leading not to a finally correct scientific picture but rather to a more accurate understanding of what the scientific enterprise itself is. It remains an open game, it remains accumulation of knowledge.

The Crisis Mode of Evolutionary Economics

Of course, detailed and multi-facetted work in evolutionary economics (fractal work!) therefore does not result in an overall general policy prescription. What it actually does, is to transform ill-posed and often too general questions into operational and clearer options to be chosen from. E.g. the question of more market processes or less market processes in a policy field leads to an algorithmic specification of possible market mechanisms to be combined with several types of non-market mechanisms. Properties of simulated combinations of these can be compared in their short- and long-run implications - and instead of a grand ideological decision down-to-earth options become visible.

Indeed this property of being specific, close to the dis-equilibrated, non-linear world we are living in, is the great advantage of evolutionary economic policy. This is exactly what makes it attractive for political decision makers – at least those interested in improving decisions. It is, or at least tries to be, the opposite of a religious economics, a system of faith in general principles that are fitted (often by obscure mathematical extensions) to every newly appearing situation.

In times of a general economic crisis – as is currently the case – this potential of evolutionary economic policy is amplified. In an economy in crisis mode the need for quick and innovative advice is of utmost importance. Rather than forecasting equilibrium constellations that market forces might lead to in the long-run, it becomes necessary to explore short-run implications of actions, which are necessary to save the system from a short-run collapse. Such a collapse typically is characterized by certain imbalances surpassing a threshold; suddenly a set of agents recognizes that a swing back to normal pulsation has become extremely improbable and therefore performs a qualitative change of behavior. The purely economic mode of reaction, i.e. reaction via market mechanisms, switches to a political mode of reaction, i.e. political re-design, institutional breakdown and new political coalition forces foreshadowing new institutions. Since few of the forces suddenly at work can be grasped by looking at a long time series of its past – there usually is no past – the intuitive part of the art of model-building receives a boost. Nevertheless it is precisely this type of constellation, the urgent need for intuition, which needs the experience of the researcher most. A broad background, knowledge about the history of economic ideas that reaches beyond the fashions of the day, all that has to be mobilized, and has to be brought to the table of state-of-the-art simulation model-building.

This, of course, is a highly demanding task set[38].

Time for interfering is getting short, and despite its most promising future, evolutionary economic policy must said to be still in its infancy. The tasks and methods of evolutionary economic policy described so far certainly bypass Keynesian macroeconomic policy, not to speak of (the avoidance of) policies implied by the nowadays almost forgotten 'new classical macroeconomics'. The necessary synthesis of the social sciences, the openness to new approaches of political economy as well as to new formal methods to be used; all that makes times of crisis an extremely prosperous period for advances in theory, despite the risk of a disastrous breakdown of the real economy outside the window of the scientist's office. If we survive in the short-run some ground-breaking scientific advances for a future long-run welfare enhancement might have emerged.

[38] In the light of the current crisis Ulrich Witt's most important scientific contribution so far certainly consisted in his ability to stimulate with his work and to form with his science policy a scientific community of researchers, which is prepared to tackle certain aspects of such tasks.

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