Endogenous Needs, Values and Technology

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Evolutionary economic modelling to replace microeconomics and macroeconomics

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> ***Es erscheint also in der Konkurrenz alles verkehrt**. Die fertige Gestalt der ökonomischen Verhältnisse, wie sie sich auf der Oberfläche zeigt, in ihrer realen Existenz, und daher auch in den Vorstellungen, worin die Träger und Agenten dieser Verhältnisse sich über dieselben klarzuwerden suchen, sind sehr verschieden von, und in der Tat verkehrt, gegensätzlich zu ihrer innern, wesentlichen, aber verhüllten Kerngestalt und dem ihr entsprechenden Begriff.*
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> [Marx: Das Kapital, S. 2956. Digitale Bibliothek Band 11: Marx/Engels, S. 6265 (vgl. MEW Bd. 25, S. 219)]

Introduction

Standard economic textbooks usually start with the assumptions that there exists

- a set of representative consumers with exogenously given, fixed preference structures,
- a set of representative production units with exogenously given, fixed production functions,
- a set of identical market mechanisms determining a vector of endogenous prices enabling coordination of optimisation of the former two types of representative agents.

Economic history shows that the last two hundred years of evolution in most advanced was mainly characterized by

- an incredible change of dimensions and quantities of goods and services keeping preference structures in permanent flux,
- an enormous amount of entry, exit and modification of production units and their corresponding production processes,
- market mechanisms are constantly diversifying; the actual, observed price vector being the result of a multitude of market institutions that represent locally and temporarily frozen political and economic forces.

Standard economic textbooks thus are simply inadequate to deal with economic facts, critique from science and practice righteously is booming.

The following arguments will sketch a modelling framework that turns these inadequate methodological assumptions upside down:
Needs that motivate consumers are explained endogenously. The growth of the heterogeneous set of households is made explicit. Evolution of ***technology*** is endogenously determined namely as strategic necessity of a changing structure of production units. Finally the ***forms of social organisation*** are assumed to be modelled explicitly, or, more precisely, the framework enabling the model-builder to formulate a specific, temporarily valid set of fixations regulating interactions in a society[1] is characterized.

While this last module concerns the more or less institutionalised outcome of struggling and bargaining of the involved agents – thus is meant to render at least some temporary stability by being itself stable – the other two modules (needs and technology) are far more volatile. Of course, in the long-run they all are interdependent. It follows that from a logical point of view the forms of social organization - i.e. the temporary stable arrangements of a given society for a given historical era – are the starting point to be developed first.

1 – Forms of social organization of capitalism reconsidered

Capitalism as a new mode of production has emerged from feudal societies by implementing the growth of labour productivity as a systematic force that permanently – in recurring pulsations – leads to new forms of social relationships. The old, sporadic and accidental advance of technical and social progress of feudal systems, which only rarely made it to remain a permanent feature, was successively replaced. This change was brought about by disequilibrating actions carried out by entrepreneurs, by revolting working classes and by several kinds of institutionalized agents at the meso-economic level. Destruction of equilibrium in that respect means that societies become organized in a way that allows – even furthers – that traditionally observed forms of behaviour are systematically challenged.

As developed more to the detail somewhere else (see Hanappi [1989a, 1989b]) capitalism came in three stages: merchant capitalism, industrial capitalism and integrated capitalism. Each of these stages is characterized by a certain macroeconomic policy framework that encompasses the disequilibrating actions at meso- and micro-levels.

[1] These fixations include many mechanisms, in particular the rules of mark-up pricing and exchange rate policy, i.e. price structures.

To be more specific take first a look at the agrarian societies, the starting point for capitalist processes. There are two major conceptual frameworks to describe their political economy:

(1) Accounting of exchanges

After each time unit, e.g. each year, exchanges of goods and services at logical locations called markets can be reported and aggregated to derive a flow matrix in money terms. The fact that each market exchange has two-sided consequences allows the formulation of interesting relationships, in particular for closed monetary systems.

(2) Evolution of growth

The growth of the human species, of human society, is a biological growth process too. In this perspective a clearly structured periodic activity, the conscious labour process, is the feature, which defines the specific growth of the human species – as opposed to other animals. This growth process follows an interesting pattern: it pulsates in the time domain, and it oscillates in the space domain. From a formal viewpoint this means that the disturbance of a linear expansion system is a necessary condition for its very existence. Only the time between two deep qualitative changes – i.e. a historical episode – can be approximated by a linear expansion system and its ruling institutions. Moreover this is true on all essential scales.

First consider the state of affairs from **perspective (1)**. Arrange the reported market transactions in a matrix F that resembles the well known input-output flow matrix:

(1.1)
$$F = \begin{bmatrix} d_1 & fm & fs \\ mf & d_2 & ms \\ sf & sm & d_3 \end{bmatrix}$$

In an agrarian society towards the end of the middle ages there are at least three economic sectors: farmers (f), manufacturers (m) and the state (s). Matrix F reports the sums of monetary payments between these sectors during one year. The entry fm is the sum total of all farming products sold in this year by farmers (f) and purchased by manufacturers (m), the element ms is all the money transferred in this year from manufacturers (m) to the state, and so on. The diagonal elements denote purchases within one of the sectors.

Taking a look at d_2 it is immediately clear that it summarizes transfers between all the n enterprises that constitute the manufacturing sector, i.e. an input-output matrix E that describes these interdependencies:

(1.2)
$$E = \begin{bmatrix} e_{1,1} & e_{1,2} & . & . & e_{1,n} \\ e_{2,1} & . & . & . & . \\ . & . & . & . & . \\ . & . & . & . & . \\ e_{n,1} & . & . & . & e_{n,n} \end{bmatrix}$$

The matrix elements have the same interpretation as above; they are the sum of all sales between enterprises in a year. Therefore

(1.3)
$$d_2 = \sum_{i=1}^{n} \sum_{j=1}^{n} e_{i,j} \ .$$

In other words the sum of the elements of the vector of row sums, call it vr, and the sum of the vector of column sums, call it vc, are equal. The vectors themselves, of course, in general are unequal, that is

(1.4)
$$\sum_{i=1}^{n} e_{k,i} \neq \sum_{i=1}^{n} e_{i,k} \ .$$

Recall that this sequence of purchases between two firms (at logical locations called markets) during a year consists always of the product of some quantity measure with the respective price achieved in this market. An average price for the product of a firm k in this year, call it p_k, therefore can easily be computed as quantity weighted average price. Since for given quantities the vector of average product prices can be seen as being responsible for inequalities (1.4), one could interpret this price vector as a redistribution device that leads to surpluses of some firms and debts of other firms. But note that in this closed system all surpluses and debts necessarily cancel out: Overall profit of the class of manufacturers cannot be explained by prices of intermediate purchases.

Analogue relationships hold for matrix F:

(1.5)
$$\begin{aligned} \Delta_f &= (fm + fs) - (mf + sf) \\ \Delta_m &= (mf + ms) - (fm + sm) \\ \Delta_s &= (sf + sm) - (fs + ms) \end{aligned}$$

and

(1.6)
$$\sum_{i \in \{f,m,s\}} \Delta_i = 0$$

Of course, in this case a closed economy with no possibilities to use stock variables (savings or credit capabilities) has to be assumed to assure (1.6)[2].

While the mechanics governing matrix E are typically market rules, the specification of the working of matrix F characterizes the political economy of a certain phase of social development, e.g. of a certain phase of capitalism.

Consider now **perspective (2)**, the evolution of growth. A simple formal description of the growth process of a population is

(1.7) $$h_t = (1 + g_{t-1}^h) \cdot h_{t-1}$$

Thus the average number of individuals in a population during period t, called h_t, depends on the average number of the previous period times the average growth rate g_{t-1}^h during that time[3]. Consideration of the existence of different species leads to the notion of ***dynamic exploitation***[4]. Assume that there is interaction between two growth processes, one for population h ('humans') and one for population c ('corn'). A rather general form to describe this interaction is

(1.8) $$\begin{aligned} h_t &= (1 + g_{t-1}^h + x(c_{t-1},...)) \cdot h_{t-1} \\ c_t &= (1 + g_{t-1}^c + y(h_{t-1},...)) \cdot c_{t-1} \end{aligned}$$

For both growth processes the population level of the interacting, respective other population enters via a function, $x(c_{t-1},...)$ and $y(h_{t-1},...)$, directly into the own growth rate. So if 'humans' reduce the growth rate of 'corn' to increase their own growth rate, this is taken care of by an appropriate specification of these two functions. Also new technologies increasing 'corn' growth would be taken care of by such this specification.

Note that taking the simplest specification for the two interaction functions, namely

(1.9) $$\begin{aligned} x(c_{t-1},...) &:= \alpha \cdot c_{t-1} \\ y(h_{t-1},...) &:= \beta \cdot h_{t-1} \end{aligned}$$

after some elementary transformations leads to the well-known Lotka-Volterra equations (1.10) (in discrete time) that are widely used to describe biological systems:

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[2] These assumptions will be loosened in the next step of the argument.
[3] 'Average' clearly does not necessarily mean ,arithmetic average'.
[4] It is necessary to underline that this concept concerns *dynamic* exploitation since in perspective (1), the accounting framework, a different (static) concept of exploitation is widely used.

$$h_t = (1 + g^h_{t-1} + \alpha \cdot c_{t-1}) \cdot h_{t-1}$$
$$c_t = (1 + g^c_{t-1} + \beta \cdot h_{t-1}) \cdot c_{t-1}$$

thus

(1.10)
$$h_t - h_{t-1} = g^h_{t-1} \cdot h_{t-1} + \alpha \cdot c_{t-1} \cdot h_{t-1}$$
$$c_t - c_{t-1} = g^c_{t-1} \cdot c_{t-1} + \beta \cdot h_{t-1} \cdot c_{t-1}$$

In other words, unstable oscillations are one simple archetype of co-evolution[5]. With continuous time every given parameter set leads to a well specified limit cycle of a certain frequency; adding some evolutionary selection dynamics it is easy to model the adaptive dynamics that enable such oscillating systems to establish themselves in environments oscillating with exogenously given frequencies (e.g. day-night cycles, seasons, etc).

In this setting dynamic exploitation reduces to a comparison of the overall net effects of the two interaction terms during a certain time period:

(1.11)
$$\left(\sum_{t=t_0}^{t=t_m} \alpha \cdot c_t > \sum_{t=t_0}^{t=t_m} \beta \cdot h_t\right) \Leftrightarrow h \text{ exploits } c \text{ during time interval } [t_0, t_m]$$

Even in this simplest case of interactions it is evident that the exploitation status might be reversed as time passes by.

Return now to the more general formulation (1.8). Indeed the essential feature of the capitalist mode of production has to be formulated in view of the evolutionary perspective - by specifying this interaction. Augmenting the exploitation of nature - given by (1.8) – by the exploitation of man by man allows for the perspective of a possible reversal: The design of a consciously oscillating human species, i.e. the negation of dynamic exploitation.

The economic story behind the capitalist form of interaction functions in (1.8) has been vividly propagated by Karl Marx, Josef Schumpeter and their followers: Dynamic exploitation of nature and working class enhances profits which in turn, via competitive pressures on markets, have to be invested in technical and social innovations which increase labour productivity. As a consequence the growth rate of the exploited populations is not only reduced by direct redistribution, there is also a counter tendency of technical progress that increases it. The crux of the overall movement thus is hidden in the concise amplitudes and time structure of these countervailing forces.

[5] The original interpretation of Volterra, i.e. a description of fish populations in the Adriatic sea, is close to the interpretation here; while the interpretation in Goodwin's classical cycle model concerns shares of an accounting framework and therefore is fundamentally different.

2 – Methodological implications

At this point of the argument the details of the interaction system start to become important. As will be seen, they imply a change of methods for formal description. The single most important feature of the growth process of human societies is the ***emergence of new dimensions of growth***. This means that not only new products and services are created[6], but that with these new offers the utility space of households is continuously explored and extended. But since production and consumption are embedded in a rich network of social relations, which in turn is supported by all kinds of infrastructure (e.g. transport, education, information) it is evident that these emergent dimensions imply corresponding emergent dimensions in these areas too, call their implementation ***social innovation***.

Though this property of human societies' growth is deeply rooted in the particular ability of human individuals to store and to use models of perceived processes, to communicate and to improve model-building and model use systematically and as a group, it nevertheless was only with the coming of the capitalist mode of production that the feature of systematic innovation (including social innovation) became the essence of social life.

For contemporary, trained economists it is sometimes hard to see what a radical methodological change is implied by such a perspective on social development. Instead of focussing on getting the intrinsic properties of a representative smallest entity, a social atom, correctly pinned down – this was the scientific role model of 19th century natural sciences imitated by economists – it now is important to mimic emergence of diversity, of success and failure of diverging modes of behaviour, of extremely complicated networks of interdependent, heterogeneous agents; to describe entry and exit of agents - some of them being social institutions. This methodological turn indeed goes down to the roots of scientific insight. The major question now concerns emergence of new structure rather than discovery of predetermined (elementary) structure in smallest universal entities[7].

Fortunately enough formal language itself is not a given structure that only could be discovered. It is the temporary product of an ongoing process, an emergent toolset that is produced (and only partly reproduced) by scientists who are challenged by real world developments. One big step forward in this process has been the development and use of ***symbol processing machines***, of computers, that enabled social scientists to do ***simulations***. The above mentioned (and only vaguely described) interaction that leads to the emergence of

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[6] The dimension n of matrix E in (1.2) is in permanent flux.

[7] The clearest and most abstract statement of this research program has been developed by mathematics itself – the axiomatic approach. It culminated at the turn of the century, in 1900, when David Hilbert designated the last difficulties to be mastered – his famous 23 problems - before the final victory of this approach could be driven home. As the following century showed, some insurmountable hurdles limit the possibilities of the axiomatic method. It could be speculated that methodological advance now might come from other scientific quarters.

new dimensions of the growth process of human societies thus can nowadays be translated into a formal representation as computer simulation. As a matter of fact there is no alternative formal representation since analytical methods for such large and complicated, non-linear systems are not available. Having said that one has to admit that the systematic treatment of the results of the new tools still is an embryonic state – evolutionary theory is in itself in a process of emergence.

Returning again to the two interaction function (compare specification (1.9)) of the last chapter the above arguments show that it is advisable to formulate them as programs describing heterogeneous agents. Producers are innovators that try to explore possible utility spaces of prospective consumers; producers are necessarily to a certain degree heterogeneous – some fail, some succeed – their monetary environment regulates their entry and exit conditions. The heterogeneity of producers implies a substantial heterogeneity of consumers, i.e. via social relations and communication the mass of consuming families and input-consuming firms is continuously transformed.

Therefore the two interacting programs - previously known as interaction functions – not only describe technological advance, they actually transform the nature of consuming entities! While h_t in a biological context simply measures the success of a species by counting the average number of individuals in time unit t (compare (1.7)), there now arises the difficulty of measuring along all newly achieved dimensions of consumption. This is the essence of the ***problem of determining social value***. Each element of the population thus carries different utility dimensions which correspond to product and service innovations it encompassed. From the point of view of measurement aggregation of individuals' utility vectors having varying dimensions is bluntly not possible. The assumption of innate preference orders - so common in mainstream economics - is simply inadequate for the description of human societies.

A much more modest refinement of the biological head count of a population is to look at the physiological input-output process of the single individuals. Quantities of food, materials processed for housing and the like could count as inputs measured in their respective physical units. The output of an individual typically could be refined as its age measured in time units. With these refinements the success of a species can be measured by the use of some additional qualities like average life expectancy[8] and physical amount of immediate subsistence goods consumed. Still the adding up of different physical quantities, including time, makes it impossible to value a consumption vector with less than all quantities increasing as an improvement.

[8] Note that such an increase not necessarily leads to an increase in population if it coincides with lower birth rates.

Aggregation only comes into sight of the social value problem as soon as consumption vectors and lifetime are viewed as social processes, i.e. as processes that only could be understood and measured in the context of overall social reproduction. As the first generation of classical political economy already correctly sensed a good guess for a measure of social value of a good would be the average labour time used up in its production. Labour time units would differ from ordinary physical time units as they have to be time spent by a human individual in an input-producing activity - called labour - that typically involved the activities of other individuals. Adding up all individual labour time still means to ignore the quality (e.g. education) of each individual as well as the specific character of co-operations (e.g. non-linear input effects), but at least ex post one overall labour value index for the vector of quantitative outputs could be constructed. If from one year to the next the mentioned distortions would not change too much the development of this index relative to the vector of output quantities gives a hint on the increase of the productive ability of a population – vulgo the development of labour productivity. This approximation procedure works for the whole society as well as for single goods, in the latter case the development of relative social values can be described.

Note that the short time horizon just introduced makes it necessary to take care of the relative social value of intermediate inputs. In a ('pre-capitalist') ideal type model-world with no interaction programs the standard input-output formalism would describe relative labour values of a constant technical coefficient matrix A as follows (compare [Pasinetti L., 1977, pp. 57-69] and [Kurz H. & Salvadori N., 1995, pp. 110-126]). Let z denote the activity vector describing the extent of activity in each of its $n+1$ elements, the last element describing reproductive ('household') work. Then for proportional reproduction of society the following relationship must hold:

$$(2.1) \qquad \begin{bmatrix} z_1 \dots z_{n+1} \end{bmatrix} \begin{pmatrix} a_{1,1} & \cdots & a_{1,n+1} \\ \vdots & \ddots & \vdots \\ a_{n+1,1} & \cdots & a_{n+1,n+1} \end{pmatrix} = \begin{bmatrix} z_1 \dots z_{n+1} \end{bmatrix} \cdot A = \begin{bmatrix} z_1 \dots z_{n+1} \end{bmatrix}$$

Since the last row is defined as the amount of labour time necessary to produce one unit of each of the other inputs it is clear that the last column shows the needs of one unit of labour time for its own reproduction. Only n equations of system (2.1) are independent, thus direct labour time inputs[9], row n+1, and quantities to reproduce one unit of labour time provision, column n+1, are considered to be exogenously given. Solving for the n remaining independent equations (z^0 and A^0 now denote z and A of dimension n) gives

[9] The diagonal element of n+1 is taken as own use of direct labour time input, e.g. reproductive work. For a detailed analysis discussing feminist issues see [Hanappi & Hanappi-Egger, 2003]

(2.2) $$z^0 = \left(I - A^0\right)^{-1}$$

The so-called viability condition of a society is the assumption that goods in column n+1 of A are sufficient to reproduce the carrier of labour time spent in row n+1. An evident choice for a unit of labour time provision is the amount provided by an *average* individual of the population. Note that this formalization leaves open at least three important questions:

i. How big is the difference between total available physical time, i.e. 24 hours a day, and labour time?[10]
ii. How big is the difference between the available and the output necessary for reproduction?
iii. How does the mix of this surplus vector look like?
iv. How are actual individual, as opposed to the construct of a hypothetical average individual, organizing the production process?

To enable aggregation via labour time units - and taking care of intermediate goods – a vector of labour values λ of the n goods can be computed. Since

$$\lambda = A^0 \cdot \lambda + l$$

with l being the vector of the first n elements of the last row of A, called direct labour time inputs, it follows that

(2.3) $$\lambda = (I - A^0)^{-1} \cdot l$$

Finally notice that the power series expansion of the so-called Leontieff - inverse $(I - A^0)^{-1}$ has an immediate economic interpretation as summing up direct labour time inputs for all past rounds of production:

(2.4) $$(I - A^0)^{-1} = I + A^0 + (A^0)^2 + (A^0)^3 + (A^0)^4 + ...$$

Using the valuation λ to compute the total labour value of net outputs for every period gives the same constant amount, namely $Y := \sum_{i=1}^{n} \lambda_i \cdot a_{i,n+1}$. The sum of direct labour time inputs, $L = \sum_{i=1}^{n} \lambda_i$, remains constant over time as well, productivity (measured in labour time) $\frac{Y}{L}$ of the average individual of this model world does not change. Indeed, as in the formulation

[10] The fact that total physical lifetime is a strict limit, i.e. the most relevant scarce resource, has only recently been rediscovered as an important topic for economic theory. Consumption takes time (compare [Steedman I., 2001]).

inspired by biology, i.e. (1.7), growth only means growth of the *number* of individuals in a population.

Does this mean that there is no dynamic exploitation in such a simple reproduction model? No, it only means that dynamic exploitation does not work via the productivity enhancement channel, as it would have to be specified for capitalist societies, e.g. by the use of (1.8). As is obvious from the accounting perspective specified in matrix F exploitation in money terms can be made permanent as specified in (1.5) - of course, without hurting (1.6) – by the use of an appropriate price vector. With money revenues higher than money expenditures a feudal class can always be enabled to buy and consume all physical surpluses that exceed the physical subsistence needs of the other classes. If it uses this additional input to extend its coercive powers to conquer more territory, then even with constant productivity dynamic exploitation between classes can occur. This argument clearly shows the political roots, i.e. the importance of direct coercive power, of economic relationships. The rule set that governs exchange is imposed by those who command coercive power. Classical economists have called these money flows rents and have rightly argued that the downturn of feudalism can be described as the abolishment of a specific rule set for exchanges.

With capitalism a new rule set for exchanges enters the stage of history. Now changes in the organization of production, secondary distribution and consumption start to play an essential role for dynamic exploitation. Only primary distribution, i.e. who imposes and guards the new rule set, is kept constant - politics becomes politics proper, i.e. the monopoly of power with respect to rule setting allows for a free-wheeling *market economy* within its borders. More technically spoken, formalisms (heterogeneous agents' approaches) for (1.9) have to be specified, technical coefficient matrices A in (2.4) will have to be dated and will change from period to period, and so will labour values – and even the dimensions of these matrices will be in permanent flux. Remember that this state of affairs is not correctly taken care of if one simply allows for occasionally disturbances of a static setting. Permanent flux of technology and needs is at the core of the capitalist mode of production. And as a consequence the total labour value of net outputs as well as the sum of direct labour time inputs will vary also. For each period these values as well as their ratio, i.e. labour productivity, can in principle be computed – despite changing dimensions and changing technical coefficients[11].

In the capitalist mode of production growth of labour productivity (measured in labour time) is an emergent property of a rule set that enables and even ensures static exploitation (measured in money terms) in an accounting perspective. After a second look at (1.1) and (1.5) the new accounting scheme for capitalist societies can easily be constructed.

[11] It is this universal applicability that makes the labour time valuation system a very special system. It is the only valuation system that provides a direct link between a measurable physical quantity, time, and the very specific application of it in the reproduction process of a species, *labour* time.

$$(2.5) \quad G = \begin{bmatrix} g_1 & we & ws \\ ew & g_2 & es \\ sw & se & g_3 \end{bmatrix}$$

The flow we is the total amount of money given by workers to entrepreneurs in a year measured as sum of nominal prices; the flow ws is the amount of money given by workers to the state. In an analogue way the second row shows yearly expenditures of entrepreneurs and the third row those of the state. Diagonal elements show money circulation within the respective group. Note that farmers have vanished since they now are part of the category 'enterprises' while workers are a new entity on the stage of history.

Corresponding to (1.5) and (1.6) there now is

$$(2.6) \quad \begin{aligned} \Delta_w &= (we + ws) - (ew + sw) \\ \Delta_e &= (ew + es) - (we + se) \\ \Delta_s &= (sw + se) - (ws + es) \end{aligned}$$

with

$$(2.7) \quad \sum_{i \in \{w,e,s\}} \Delta_i = 0$$

The rule set in power reflects the goals of those in power and thus profits Δ_e plus expenditure for maintaining the power relations Δ_s are

$$(2.8) \quad 0 < \Delta_e + \Delta_s = -\Delta_w$$

Therefore the absolute size of Δ_w is a first measure of static exploitation.

Still the most intriguing feature of capitalism is the property that part of the surplus is used to activate the transformation functions that evolve technology and needs. At that point of the story the accounting perspective has to be linked to the evolutionary perspective by the use of agent based simulation.

Capital is just the name of the process (in algorithmic language called a program) that links immediate profit motives with functions like $x(c_{t-1},...)$ and $y(h_{t-1},...)$ in (1.8). To be understood this process has to be conceptualized as involving physical amounts, quantities of goods, quantities of time, quantities of labour time to enable aggregation of the former. But it also has to involve the model-building processes of capitalist entrepreneurs, which use nominal monetary variables and are characterized by bounded rationality[12]. It is evident that a detailed specification of capital goes beyond the scope of this paper.

Merchant capital (~1500 to ~1770) leaves structures, i.e. matrix G, in local trading locations untouched - or more precisely it boosts manufacturing in matrix F and thus transforms F into G - and accumulates by increasing labour productivity via pushing the division of labour between trading points[13].

Industrial capital (~1770 to 1914) predominantly worked on the elements in matrix A and enhanced labour productivity by changing the technical coefficients on every production location.

Finally integrated capitalism[14] (1916 to the present) is characterized by extending systematic changes of technical coefficients to all parts of the flow matrix G and the transfer functions x and y, i.e. also including workers, the state and information and communication processes like model-building. As a consequence elements and dimension of final demand change extremely fast and permanent exploration of the space of needs becomes a routine. In a sense the core function of capital - exploring new sources of increased labour productivity - becomes self-contradictory.

3 – Neoclassic Theory upside-down - Towards Applications

From the point of view of economic policy consulting the starting point of any argument therefore is the rule set that governs matrix G. In industrialized economies this set usually consists of the mark-up factors of industries, fiscal policy features and the essentials of a centralized wage bargaining process that determines wages.

Furthermore open economies are characterized by exchange rate regimes and trade rules that embed them in the global economy.

Given this institutional setup - which is sticky but malleable in the mid-run – entrepreneurs, both capital and social entrepreneurs, do their disequilibrating work. The former create production techniques, new goods and services and in the end new needs expressed via final demand. The latter make and break coalitions, form more or less durable co-operations and

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[12] Most interpretations of Marx fall short of taking care of the many ideas in his work pointing in the direction indicated here. They same, of course, is true for the critics of this interpreters, both refer only to what Keynes has dubbed the work of a minor neo-Ricardian. To appreciate Marx' contribution it is indispensable to understand it in line with Hegel's methodological foundations as well as Schumpeter's further elaboration of disequilibrating entrepreneurship. Finally the formal apparatus to treat the involved issues in amore rigorous way, i.e. heterogeneous agent based modelling; only emerged in the last ten years.

[13] As economic historians have pointed out, the restoration of secure transport conditions after the Middle Ages was an important prerequisite for merchant capital.

[14] For a definition compare [Hanappi, 1989a].

provide mental models that support them in these mundane activities. All these processes are on the same time scale – if not even a little faster – than changes in the institutional setup.

The modelling language to be used to give a more precise picture of that interaction is agent based simulation. Given the just mentioned guidelines a model of this type not only helps the model-builder to clarify and to structure the interpretation of well-specified past events; it also enables some modest forecasting the example at hand. To get the flavour of the strength of this approach take a look at the following two examples.

There seems to be a problem with pensions in Europe if the average age of the population increases while its total number decreases and the number of years of economic activity remains constant. As several economic consultants have concluded the prolonged period after active work life will need financial support that cannot be provided by a constant (or even slightly shrinking) economically active population.
As an evolutionary agent based model (starting with the currently observed institutional setup) easily shows, the expected increase in average life expectancy can always be compensated by the continuation of labour productivity increase that was observed in the past. The currently almost hysterical policy alarm can be revealed as an attempt to shuffle a considerable amount of money from sw to se (in matrix G). Put in a global perspective, the advice to be given to European economic policy turns out to be as follows: Shift the period of economic activity by five years, leaving its duration constant, and use the increased time span before that for more education. The sacrifice to better educate the work force will be – consider the global division of labour – easily rewarded later. In particular the true sacrifice, i.e. to pre-finance education by public institutions, currently is not too hard since (as the singular historical event of twenty years of exceptionally low interest rates shows) capital funds abound.

Second, model the accession of a large country like Turkey to the European Union. Given the current institutional setup including mark-ups and fiscal policy stance in all involved countries, there is no doubt that an impressive increase in Europe's average labour productivity would be an immediate short-run effect. Of course, a certain institutional shake-up in decision processes of the European Union would also be necessary at least in the mid-run – not only because of Turkey, but due to all the recent enlargements of the EU. Nevertheless a growing surplus always eases the pains of social innovations on a European level. Agent based simulation (now including parts of voting theory) can help to explore the possible action space for social innovation in Europe's new political economy mechanism.

It suffices to compare the potential results of these two examples to see how shallow and superficial many of the results of neoclassical theory are. The scientific revolution in the social sciences that currently is on its way has only shown little of its potential; but even this tip of the iceberg is tremendously encouraging.

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