Carl Christian von Weizsäcker

Max-Planck-Institute for Research on Collective Goods

Draft February 2013

Freedom, Wealth and Adaptive Preferences

Abstract: Is welfare economics still possible, when preferences are endogenously determined? The answer is yes, if and only if the hypothesis of adaptive preferences is correct. If preferences satisfy the conditions of continuity, non-satiation and regularity, then adaptive preferences imply that improvement sequences are non-circular (acyclic): Theorem 1. And non-circularity of improvement sequences implies that there exists an exogenous quasi-utility function $V(x)$, such that $V(y) > V(x)$ indicates that y can be reached from x via an improvement sequence: Theorem 2. As a corollary preferences then are adaptive.

I define "pragmatic compossibility" of rights as a condition for a free society. Their specific form can only be obtained by experience, i.e. "piecemeal engineering" à la Karl Popper. For this concept of the "Open Society" to be feasible preferences have to be adaptive. Partial equilibrium cost-benefit analysis remains valid if and only if preferences are adaptive: Theorem 3. This is a requirement for a society which can escape stagnation by means of the "money form" of decentralised decision making. The success of western society through the last several centuries is "proof" that preferences are adaptive.

> Men are called "creatures of reason", more appropriately they would be called creatures of habit.
>
> Charles Darwin

> Der Mensch ist zu einer beschränkten Lage geboren, einfache, nahe, bestimmte Zwecke vermag er einzusehen, und er gewöhnt sich die Mittel zu benutzen, die ihm gleich zur Hand sind; sobald er aber ins weite kommt,

weiß er weder was er will, noch was er soll, und es ist ganz einerlei, ob er durch die Menge der Gegenstände zerstreut, oder ob er durch die Höhe und Würde derselben außer sich gesetzt werde. Es ist immer ein Unglück, wenn er veranlasst wird, nach etwas zu streben, mit dem er sich durch eine regelmäßige Selbsttätigkeit nicht verbinden kann.

Johann Wolfgang von Goethe, Wilhelm Meisters Lehrjahre

Truth is ever to be found in simplicity, and not in the multiplicity and confusion of things. As the world, which to the naked eye exhibits the greatest variety of objects, appears very simple in its internal constitution when surveyed by a philosophical understanding, and so much simpler by how much the better it is understood.

Isaac Newton

Table of Contents

Part I Freedom and Preferences

A Introduction. Normative Individualism: Why homo oeconomicus has Survived for so Long

Traditional Welfare Economics is built on the assumption of the fully rational economic agent, i.e. the assumption of "homo oeconomicus". This assumption also includes the hypothesis that preferences of homo oeconomicus are fixed once and for all. This homo oeconomicus assumption allowed economists to develop normative economics which was fully individualistic. *Normative individualism* (Vanberg (1986)) thereby was possible. By this we mean the following: the measuring rod for the performance of an economic system is fully anchored in the preferences of individuals. There is no "collectivist" value judgment about the worth of particular goods involved. (Of course, distributional justice considerations always require some "collectivist" value judgment – even in traditional welfare economics).

If you admit that preferences are influenced by the economic environment normative individualism faces a fundamental difficulty: the measuring rod of economic system performance no longer is independent of the object that it is supposed to measure. It is like a measuring rod that changes its length as a function of the length of the table it is supposed to measure. Such measuring rod no longer allows a straightforward measurement of the length of objects.

I believe that this difficulty is the reason for the tenacity with which economists have stuck to the assumption that preferences are fixed, are exogenously given. They did not see a way to maintain normative individualism, if they would give up the assumption of fixed preferences. One form this tenacity took was the Stigler-Becker (1977) paper: "De gustibus non est disputandum". There the authors present the hypothesis: every person has the same preferences – and, as a corollary, preferences are fixed, are exogenously given. They reject the traditional method of economists who explain observed differences in behaviour by differences in preferences. They say that this "explanation" really is no explanation at all, but a tautology. Stigler and Becker cling to the assumption of fully rational behaviour.

We should clarify one point at the very beginning. Many critics of the homo oeconomicus assumption depict homo oeconomicus as a complete egoist. But this has never been the opinion of mainstream economists who have used the homo oeconomicus model. Indeed many papers which assume preferences to be fixed do include altruistic or social preferences. The important logical point has been that preferences are exogenously given so that they can be used as a measuring rod of economic performance. Thus, in the following I use the term homo oeconomicus for the model in which people maximise their utility in a fully rational way and in which the utility function is exogenously given, be it fully egoistic or partly altruistic.

In this paper I want to present a theory which allows us to maintain normative individualism and yet to get rid of the assumption of fixed preferences. It builds on a hypothesis about the "laws of motion" of preferences, which I call adaptive preferences. To come back to the measuring rod analogy: if you would know the way in which the measuring rod changes its size as a function of the object to be measured it might still be a useful tool for measuring the length of objects.

Summary of the paper.

After this summary, in sections B and C, I explain the reason why we use the concept of preferences: they represent the idea of free choice of citizens in a society. As such the concept really is part of normative theory and not so much part of positive theory. The concept serves the function to describe the behaviour of free citizens in models of the theorist who pursues a programme of normative individualism.

In section D I give reasons why the assumption of fixed preferences is inadequate for the research programme of understanding the working of a society of free citizens. Such theory needs an idea concerning the meaning of "freedom". Here we need a concept which I call "compossibility" of individual rights.

In the second part of the paper (sections E-S) I present a model of adaptive preferences. Section E introduces the concepts of a "preference system" and of "induced preferences". Thereby in the model preferences are a function of actually consumed commodity baskets. The hypothesis of adaptive preferences then imposes a certain structure on the way preferences are induced by consumption baskets: adaptive preferences essentially mean that people have a kind of "preference conservatism". They have a tendency to resist change. On the other hand, once change has taken place, people adapt to the new position and now resist change from that new status quo.

As preferences change welfare economics encounters a problem of comparability: if preferences have adapted to basket A the person may prefer A to basket B, if preferences have adapted to basket B the person may prefer B to basket A. Which is “really” better? I then introduce the “Improvement Axiom”: people prefer a series of improvements (rises in real income) to a stationary path, if the starting point is the same – and this knowing that during the improvement path their preferences will change.

Under certain assumptions concerning preferences (continuity, non-satiation, regularity) I show Theorem 1: if preferences are adaptive then improving sequences are non-circular. And, the other way round, Theorem 2: The long run demand function is defined taking account of endogenously changing preferences. If all improving sequences are non-circular and if the long run demand for a given budget is independent of initial preferences then preferences are adaptive. Moreover there exists an exogenous “quasi-utility function” which indicates which baskets can be reached from which other baskets by means of an improving sequence. In section Q I give a simple two-good example which illustrates the theory of adaptive preferences. Section R uses the empirical observation of inter-temporal complementarity of demand as a test device for the universal validity of the hypothesis of adaptive preferences. This section is divided in six sub-sections which treat different topics. Part II ends with a short section on the “socio-biological” foundations of the hypothesis of adaptive preferences (S).

In the third part of the paper (sections T-W) I sketch “welfare economics for a society of free citizens”. I have two sections (T and U) describing the close connection between the hypothesis of adaptive preferences and the feasibility of a set of “compossible rights” which are a requirement for a free society. Finally I have two long sections (V and W) which sketch the foundations of welfare economics for a system of decentralised decision making (“market economy”). Here I make use of the compossibility criterion of a society of free citizens and I work with the concept of “improvement” or “progress” rather than with the traditional concept of global optimization. Compossibility of rights is built on the historical experience of the outcome of the earlier structure of rights. Thus, the theory supports a pragmatic and evolutionary view of the world and of the political process. That preferences are adaptive is a crucial requirement for the feasibility of a market economy. The formal part of the theory is contained in Theorem 3 (section V). In terms of “improvement” or “progress” a system of decentralised decision making is much superior over a system of centralized decision making, due in particular to the preference conservatism (=adaptive preferences) which lets democratic majorities decide for the "default" option, i.e. for stagnation (section W). On the other hand in a market economy Schumpeterian "preference entrepreneurs" will implement projects like, for example, new products with the following characteristic: ex-ante preferences of the majority of citizens would induce them to reject the project; but once it has been implemented against the majority preferences, citizen preferences change in such a way that now they agree (by "revealed preference") that undertaking the project was an improvement.

In the fourth part, "Outlook", I take up certain themes which wait being treated for a more complete welfare economics of adaptive preferences. In section X I discuss the case that, for a given budget constraint, the convergence point of demand depends on the initial preferences. In this case it is very likely that the consumer ends up with a basket which is locally optimal, but not globally. Many welfare questions arise here, some of which I mention in this section.

Section Y discusses interpersonal influences on preferences. This is obviously a vast field for future research in the welfare economics of induced preferences. It can be shown that imitation of others corresponds to the hypothesis of adaptive preferences.

Section Z discusses the psychology of adaptive preferences. Here I venture the hypothesis that psychological research will show that adaptive preferences are a general characteristic of human behaviour.

In section AA I wrap up, in a sense. I envisage a general theory of the good economic order. A theory that is based on the ideas of "improvement" and "progress" rather than (static) optimisation. It corresponds to Popper´s idea of "piecemeal engineering". A theory which builds on the assumption of adaptive preferences and on the results of this paper, in particular on the three Theorems.

B Positive economics and preferences

Behavioural economics has shown that human behaviour is not consistent with a literal interpretation of the homo oeconomicus model. I believe that stable deviations from the model of full rationality are all consistent with my hypothesis of adaptive preferences. This will be a topic of future work. In this paper I proceed with the hypothesis that the assumption of adaptive preferences is a realistic assumption. But I do present plausibility arguments for the hypothesis coming from a different line of thought than the prevailing mainstream of behavioural economics. The reason for this sequence of argument is the following: the realism or otherwise of the hypothesis of adaptive preferences can only be appreciated if we better understand its meaning. We can draw certain consequences from the assumption of adaptive preferences which help us to test whether the hypothesis is realistic or not.

Adaptive preferences are a "law of motion" of preferences. Before we can understand the concept of adaptive preferences we need to understand the concept of preferences. Why do economists talk of preferences? In my view this concept is intimately related to the idea of freedom of action. The concept of preferences is the mode by which normative economics introduces the idea of freedom or liberty into its theory of human interaction.

Positive economics does not really need the concept of preferences. Take the Stigler-Becker view of 1977: "de gustibus non est disputandum". Here the authors essentially argue that preferences are an empty concept. Concerning human behaviour preferences do not explain anything. They are used as an explanation only like as a stand-in, as a joker, where the researcher has not been able to explain observed human behaviour. A "true" explanation of the causes of some observed behaviour does not refer to the person's preferences. To say that person A prefers chocolate ice cream over vanilla ice cream does not add anything to the observation that, if given the choice between chocolate ice cream and vanilla ice cream person A will choose chocolate ice cream. Thus referring to the preferences as the cause for an observed behaviour is not a causal explanation of such behaviour. Thus, if positive economics aims at explaining human behaviour it can dispose of the concept of preferences.

Preferences are an important concept in another research programme. It is the research programme asking the following question: how does a society of free individuals work? And how can it be improved? It is the research programme of normative economics, in particular: of normative individualism. This research programme is important – and one can do this kind of research even without having finished the research programme of positive economics. Indeed, it is the research programme of traditional welfare economics. Obviously, there exist interdependencies between the research programme of positive economics and the research programme of normative economics.

C Normative Economics, Freedom and Preferences

To understand the importance of the concept of preferences in normative economics we have to discuss the concept of freedom or liberty as it is implicitly used in normative economics. There we understand liberty to be a situation in which an agent has the choice between different alternatives; moreover her/his choice is justified and legitimate in society simply due the fact that it is her/his choice. The degree to which the agent has a freedom of choice, i.e. the degree to which the agent is free rises as her/his choice alternatives rise. Greater freedom, intuitively speaking, is greater choice.

An important example of freedom of choice is an election for public office in which the voter has the choice among different candidates. No matter what his or her reasons are for his or her voting decision, the ballot is valid and counts. Freedom of choice exists, if the reasons and causes for the particular choice decision are irrelevant for the legitimacy of that decision. Thus, in a sense, it is the very emancipation from the causal chain leading up to the decision, which characterises the concept of liberty.

The set-up of free elections in a democracy can be seen as a model for the general institutional set-up of a society of free people. Ballots are cast in a voting box to provide secrecy of voting. The secrecy of voting is the device by which it is guaranteed that the vote can be cast without any pressure from other citizens. Thereby modern democracies come close to the ideal that individual voting decisions are legitimate irrespective of the causal chain that lead up to the individual's decision. In a similar way - in a free society and within the available choice set of the individual - other decisions by individuals ought to be shielded against legitimising or de-legitimising pressures from others and from the government, irrespective of the causal chain that leads up to the particular decision. We then need a kind imaginary “voting box” or “decision box” for the citizens allowing them to do what they want without interference by others.

No doubt, this “decision box” is a close relative of the privacy rules which are part of the institutional set-up of a free society. But there is a conceptual difference. The set of privacy rules is one of several instruments which enable society to implement that “decision box”. “Due process” in the legal system is another such instrument. A specific “bill of rights” of citizens is a further such instrument. Property protected by law, as John Locke and other social philosophers have taught us long ago, is important to build up and enlarge that “decision box”.

Seen from the point of view of the social philosopher interested in a theory of a free society, the “decision box” is a kind of filter concerning the facts and causal links he or she is allowed to use in this normative theory. This filter has taken a particular form in economics. It is the distinction between constraints and preferences which explain for him or for her the behaviour of the citizens of a free society.

The way the economist incorporates free decisions into his models is by means of the concept of preferences. For the purposes of his modeling the economist treats the agents as determined in their decisions, quasi like automata or machines whose behaviour can be predicted. This determinism is technically useful for the economist's goal of predicting the outcome of any given institutional set-up. Thus, the actual freedom of choice is transformed into a seemingly deterministic outcome by means of the concept of preferences. The behaviour of the agent is determined by two classes of factors: 1. the constraints (like, for example, the budget constraint), determining his/her choice set and 2. his/her preferences which determine the choice within his/her choice set. The first class of factors are the *constraints* of his/her freedom; the second class of factors is the *expression* of his/her freedom. Thus, given the preferences, the person is free and at the same time predictable for the on-looking researcher.

Normative individualism as an approach for economic theory then is the expression of the researcher's goal to understand the working of a society of free persons and to recommend changes in the institutional set-up which raises the wealth and freedom of choice of the members of that society. Normative individualism thus tries to avoid impositions of values by the collective of individuals on each individual. It works observing the citizen only partially and hiding the rest of the causal explanation of their behaviour behind a “veil of ignorance”, to borrow a phrase which has been introduced by social philosophers with a somewhat different meaning. (Rawls (1971), Buchanan (1975)).

D The limits of homo oeconomicus for a theory of a free society

But, if the general norm behind normative individualism is to enhance individual freedom, we see that, in an ideal society, preferences of individuals play a quantitatively important role for the results of this human interaction. This is the opposite of the treatment of preferences in positive economics. There the degree to which one refers to preferences as an explanation of behaviour and thus of human interaction is a measure of our ignorance of the true causes of behaviour. The goal is to minimise the degree to which one relies on preferences as an explanation.

Is there a logical contradiction between the two research programmes? I do not think so. Two basically different concepts of the term "preferences" are involved. Preferences in positive economics are the unexplained remnant of a science that tries to explain as much as possible about human behaviour. Preferences in the research programme of normative individualism represent the realm of legitimate decisions of the individual, irrespective of their causes. It should then be perfectly possible to develop a theory that tries to explain the voting behaviour of citizens alongside with a normative theory of democracy that works with the assumption that ballots count - irrespective of the causes for any particular voting behaviour.

But the freer citizens are, the more is determined in a society by the choices taken by citizens (rather than the constraints), the more we need to acknowledge the fact that choices or preferences are influenced by the social environment of the citizens. It is then a strong desideratum for normative individualism to have a welfare economics that does not have to rely on the assumption of fixed preferences, i.e. a welfare economics that works even with endogenously determined, i.e. induced preferences.

In this paper I want to indicate the way one can do welfare economics when preferences are induced by the economic environment. The crucial assumption or hypothesis is "adaptive preferences".

Before entering this approach towards “induced preferences” it is useful to understand the concept of “constraints” in such a normative theory. As we use this term in everyday life we have a conception that there are possibilities of choosing freely among alternatives. The constraints then determine the choice set of alternatives among which the agent chooses. In the positive theory the “constraints” ideally fully determine the “choice”. The “constraints” then are the “causes” of any given action. To the extent that the causes are not yet fully known, explaining choice by “preferences” is not explaining them at all. “Constraints” in the normative approach are not necessarily the constraints that the agent subjectively would consider limiting his or her choice. They also are not the “constraints” which positive economics would call “causes”. Rather, “constraints” in the normative theory determine the realm of legitimate and thus free choice of the individual. Obviously, any society of free people needs to constrain individual behavior in the interest of the freedom of other people. The rights which are allocated to different citizens must be compatible with each other, must be “compossible”. (Steiner 1977). From there we must derive a set of constraints.

If we want to be quite radical concerning the distinction between the positive and the normative approach we could say: in the normative theory constraints are *exclusively* determined by the limits of the rights which are set by law in the interest of “compossibility”. Physical constraints within each private household can be accounted for by the (ordinal) utility function of the agent. If the agent is unable to jump two yards high we simply designate a “utility” of minus infinity ($-\infty$) to any consumption basket containing a two-yard jump of the agent. The issue of compossibility will be further discussed in section T below.

Part II A Model of Adaptive Preferences With Two Theorems

E Preference Systems and the Concept of Induced Preferences

We need to formalise the meaning of the terms “induced preferences” and “adaptive preferences”. The intuitive meaning of adaptive preferences is the following: individuals have a tendency to value their present position or situation higher relative to alternatives than they would, if their present position or situation were a different one. We also may call this preference conservatism: a tendency of agents to stick to the place where they are. As I shall show in this paper and other papers, this is quite a universal characteristic of human behaviour. Here I proceed to present a formalised form of the hypothesis and some of its implications. In order to formally define adaptive preferences we first have to define “induced preferences”.

Generally preferences of individuals are influenced by their own past and by other people, in particular by the choices other people make. So as not to overburden the reader with too many new concepts and their interrelations I limit myself in this paper to a particular case of induced preferences: preferences of a person are only influenced by her/his own past consumption. In other work the case of inter-personal influences on preferences will be included.

I denote any choice object by x or y or z or A or B or C. For concreteness the reader may interpret any such object as an n-dimensional commodity basket where each component is non-negative. Preferences are then denoted by q. For concreteness the reader may interpret q as a point in some N-dimensional Euclidean space of preference characteristics. N may be larger or smaller than n. We do not impose any restriction on N, except that it is a natural number. But the theory is more general: the space of preference characteristics may even be infinitely dimensional or may not even be defined in terms of dimensionality. But it does need a well-defined topology so that concepts like "continuity" and "convergence" make sense.

Definition 1: A preference system $\{x; q; \dot{q}\}$ is a system consisting of a commodity space containing commodity baskets x, consisting of a preference space containing preferences q, and consisting of a rule $\dot{q}(x; q)$ describing the change through time of preferences as a function of the actually prevailing commodity basket x and the actually prevailing preferences q.

Any particular person is characterised by a preference system.

Definition 2: Induced Preferences. For any given preference system $\{x; q; \dot{q}\}$ preferences $\rho(x)$ are induced by basket x, if, for x constant through time, preferences q converge towards $\rho(x)$.

The function ρ is a mapping from commodity space into preference space indicating the inducement of preferences by actual consumption.

Concerning preference changes I investigate two different models, the "class-room model" and the "real world model". The latter is a continuous time model.

1. The class room model. Here I denote a preference system by$[x; q; \dot{q}]$. The class room model is a discrete time model such that $q(t) = \rho(x(t-1))$. In words: preferences lag behind the basket by one period in the sense that they are the preferences induced by the basket of last period. Obviously the class-room model does not pretend to be a description of the real world preference dynamics. But the class-room model serves an important analytical purpose, as will be seen below.

2. The real world model. Here I denote a preference system by$\{x; q; \dot{q}\}$. But I use this notation also when I talk of a preference system without specifying whether it is of the class-room model type or the real world model type. In the real world time is a continuum. Thus, the real world model is a continuous time model. Here we do not distinguish discrete

time periods, rather time is represented in the model by (a connected subset of) the continuum of the real numbers. The preference dynamics then may be given by the vector differential equation

$$\dot{q} \equiv \frac{dq}{dt} = f(x; q)$$

If x remains constant through time preferences q converge towards $\rho(x)$. For the main results we need not specify the law of motion further. It suffices that the preference space has a topology and that for this topology $q(t)$ converges to $\rho(x)$ for constant x. But a special case which of some interest is the following. Assume that $\rho(x)$ can be inverted, so that $x = \rho^{-1}(q)$ is well defined for any q which is in the set of preference parameters so that a consumption basket exists for which q are the preferences induced by that consumption basket. We may then look at "laws of motion" $f(x; q)$ such that for $z = \rho^{-1}(q)$ we have a linear vector differential equation $\frac{dz}{dt} \equiv \dot{z} = \alpha(x - z)$ which leads to the equation $z(t) = e^{-\alpha t}(z(0) + \alpha \int_0^t e^{\alpha\tau} x(\tau) d\tau)$. Here α is an n times n positive definite matrix so that, for constant x the basket z converges towards x.

<u>F Adaptive Preferences Defined</u>

Having defined induced preferences we now can define adaptive preferences. I use the following notation. If basket y is preferred over basket x under preferences q we write $y(>; q)x$. If basket y is indifferent to basket x under preferences q we write $y(=; q)x$. If basket y is either preferred over x or indifferent to x under preferences q we write $y(\geq; q)x$.

<u>Definition 3: (Adaptive Preferences):</u> Assume that a preferences system is characterised by a well-defined mapping $\rho(x)$ of induced preferences. The preference system$\{x; q; \dot{q}\}$ exhibits <u>adaptive preferences</u> if the following holds: 1. For any two baskets x and y, if $y\big(>; \rho(x)\big)x$ then $y\big(>; \rho(y)\big)y$. 2. For any two baskets x and y, if $y\big(\geq; \rho(x)\big)x$ then $y\big(\geq; \rho(y)\big)y$ In words: Preferences are adaptive, if a basket y which is preferred over x with preferences induced by x, is, a fortiori, preferred over x with preferences induced by y.

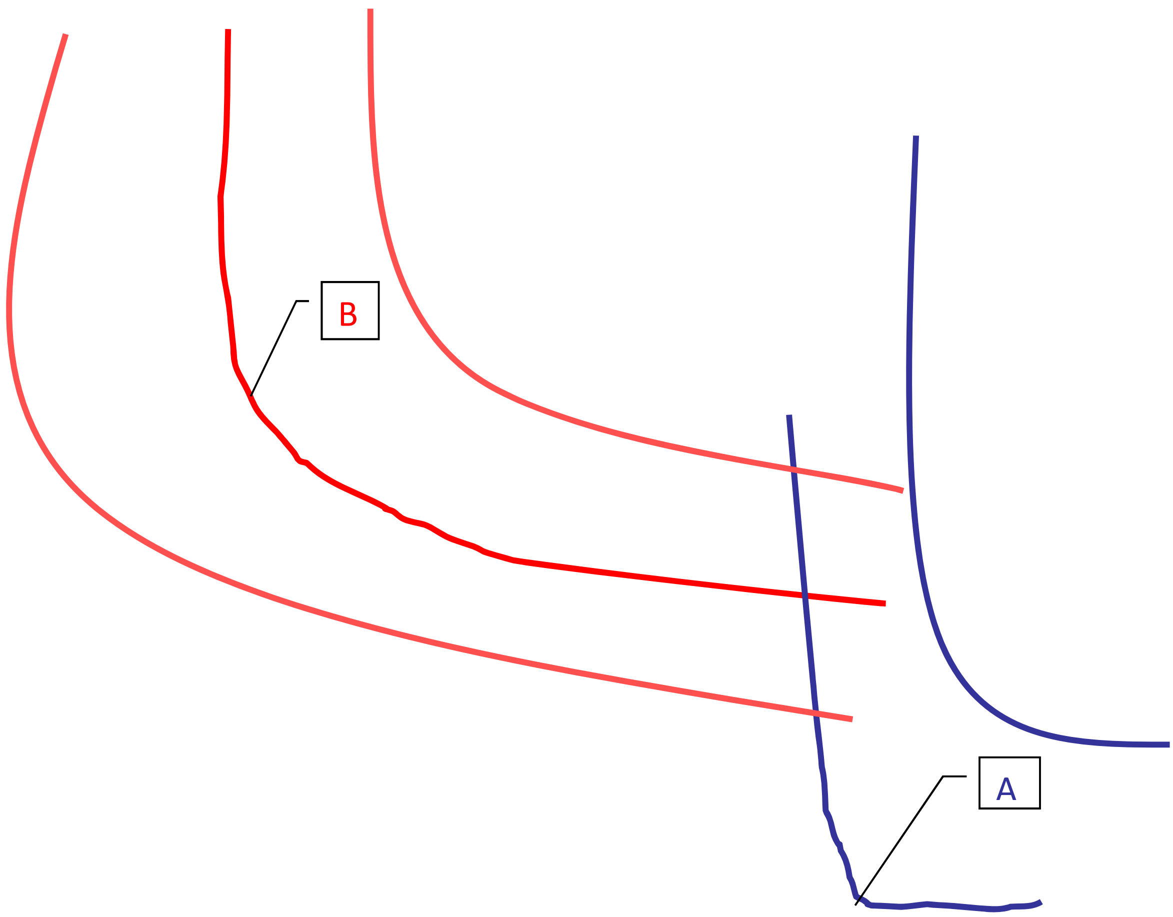
Note that the traditional homo oeconomicus with fixed preferences is a special case of adaptive preferences. The latter thus are a true generalisation of fixed preferences. As Galileo already observed, zero speed of a body is a special case of a positive speed.

To see the connection between this definition of adaptive preferences and the intuitive meaning of preference conservatism think of $\rho(x)$ as the initial preferences inherited from the past. Consider now some change in the consumption from x to y which by preferences $\rho(x)$ is considered to be an improvement. Now keep y constant for a while. Then preferences converge towards $\rho(y)$. Preference conservatism would thus indicate that, given y was already preferred to x with preferences induced by x it would a fortiori be preferred to x with preferences induced by itself. Provided I prefer living in Paris over living in Berlin even though I actually live in Berlin I, a fortiori, prefer to live in Paris over living in Berlin once I have moved from Berlin to Paris.

<u>G The comparability problem</u>

If preferences depend on past consumption we may see a picture like this one

Figure 1: Two different sets of indifference curves for two different baskets of past consumption



Preferences induced by past consumption A may be represented by the blue indifference curves. Preferences induced by past consumption B may be represented by the red indifference curves. As I have drawn the two sets of indifference curves they indicate the property of adaptive preferences. Given the choice between A and B the person chooses A, provided past consumption has been A; and the person chooses B, provided past consumption has been B. Is it then appropriate for economic policy to say: "stay put, wherever you are"? Certainly this would not correspond to the tradition of normative economics. It has always been reform-minded. Even though it generally did not advocate revolutionary changes, it did advocate changes in general arrangements in the hope to improve the welfare of people. After all, economics is a child of the age of enlightenment. Thus, improvement was considered to be possible. As we shall see, it is the very concept of improvement or progress which is closely linked to the concept of adaptive preferences.

In this particular case of the two baskets A and B we can ask the following two questions. First: Although a jump from A to B – given the blue indifference curves – is not an improvement and although a jump from B to A - given the red indifference curves - is not an improvement, is it perhaps possible to move gradually from one point, say A, to the other point, say B, by means of a number of smaller steps each of which is an improvement, thereby exploiting the fact that preferences change along-side during this longer journey? Second: And if that is a possibility, could it be that the reverse improvement journey from B to A is not possible? Could we then – in a certain sense – consider basket B to be superior to basket A? In the following I want to make this idea precise. And I will show that adaptive preferences do play a crucial role for a positive answer to these two questions.

H The Improvement Axiom

I introduce the concept of an *improvement sequence* (or, equivalently, an improving sequence). Basically it is a development of consumption baskets through time such that any change in the basket is considered to be an improvement or at least a change to which the person is indifferent relative to the status quo. Here, for ease of presentation I take the somewhat unrealistic case of discrete time steps with preferences induced by the basket of a time period before. It is the "class-room model".

Definition 4: Let A, B, C,… K be a finite set of consumption baskets which have the following properties. For preferences induced by A the basket B is preferred over A; for preferences induced by B the basket C is preferred over B; and so on. Each basket is preferred over the preceding one with preferences induced by the preceding one. Such a sequence I call an improving sequence. If, in addition, all other baskets in the sequence are different from the starting basket then the improving sequence of baskets is called an improvement path or an improving path.

I now introduce the *Improvement Axiom.* People are aware that their preferences may change as their consumption basket changes. They must deal with this in their decisions. They may not know the details of the change in their preferences, but they do know that a change in their consumption basket changes their preferences. I then assume the following:

Improvement Axiom: Given the choice between an improvement sequence and a stationary consumption path, both starting with the same basket and the same preferences induced by that basket, people prefer the improvement sequence, provided they expect that any improvement sequence is an improvement path.

Although generally people do not know precisely how their preferences will change under new consumption circumstances they do accept an improvement if it is offered to them. And they do assume that they will do the same in the future after further improvement is offered to them and after their preferences then have changed due to the first improvement.

I consider the Improvement Axiom to be a rather weak assumption. Everyday life tells us that by and large people behave in accordance with this Improvement Axiom. People want improvement even if they are aware that their wants will change with this improvement.

The Improvement Axiom is the single point where I introduce something like an evaluative comparison of different preferences, albeit only a quite local one. This is in contrast to approaches by other economists like Becker (1996) or Sen (1982), who talk about meta-preferences, i.e. about preferences over different preferences. In a sense what this meta-preference approach does is to return the theory back to the paradigm of fixed preferences. Indeed, the assumption of the meta-preference approach is that meta-preferences are fixed, are exogenously given. This then again leads to decisions of the individual which can be predicted as if preferences themselves were exogenously given.

I Adaptive Preferences and Non-Circularity of Improvement Sequences

At the core of my theory lies the equivalence of adaptive preferences and of the non-circularity of improvement sequences. This equivalence enables me to generalise welfare economics from the traditional case of fixed preferences to the case of induced preferences, provided the "law of motion" of preferences is characterized by adaptive preferences. Moreover, this equivalence also gives additional "sociobiological" cause for the empirical hypothesis that preferences are adaptive.

This equivalence is not self-evident. To show equivalence requires some substantial mathematical effort. Moreover, it is easily seen that we need further assumptions about the structure of preferences to show this equivalence. Indeed, here is a very simple example which contradicts this equivalence. Consider the following preference system. It is of the "class-room" type. The space of commodity baskets consists of the three baskets A, B, and C. We assume the following table of preferences

$B\big(>;\rho(A)\big)A$	$A\big(>;\rho(A)\big)C$	$B\big(>;\rho(A)\big)C$
$C(>;\rho(B))B$	$B\big(>;\rho(B)\big)A$	$C >;\rho(B))A$
$A\big(>;\rho(C)\big)C$	$C\big(>;\rho(C)\big)B$	$A\big(>;\rho(C)\big)B$

As we compare the entries within a given row (each row representing one of the three different induced preferences) we see that given preferences are "rational", i.e. consistent. Thus, for example, with preferences induced by A (top row) B is preferred over A and A is preferred over C, and also B is preferred over C, which shows transitivity and thus consistency. Also, as we compare the first column with the second column we see that preferences are adaptive. Yet we can construct a circular improvement sequence: A, B, C, A.

J General Assumptions on Preferences

Thus, we introduce the following assumptions about preferences in general.

Assumption I: Continuity: Preferences are continuous, i.e. If $y(>;q)x$ then there exist neighbourhoods $N_1(x)$, $N_2(y)$, N_3(q) such that for $w \in N_1(x)$, $z \in N_2(y)$, $r \in N_3(q)$ we have $z(>;r)w$.

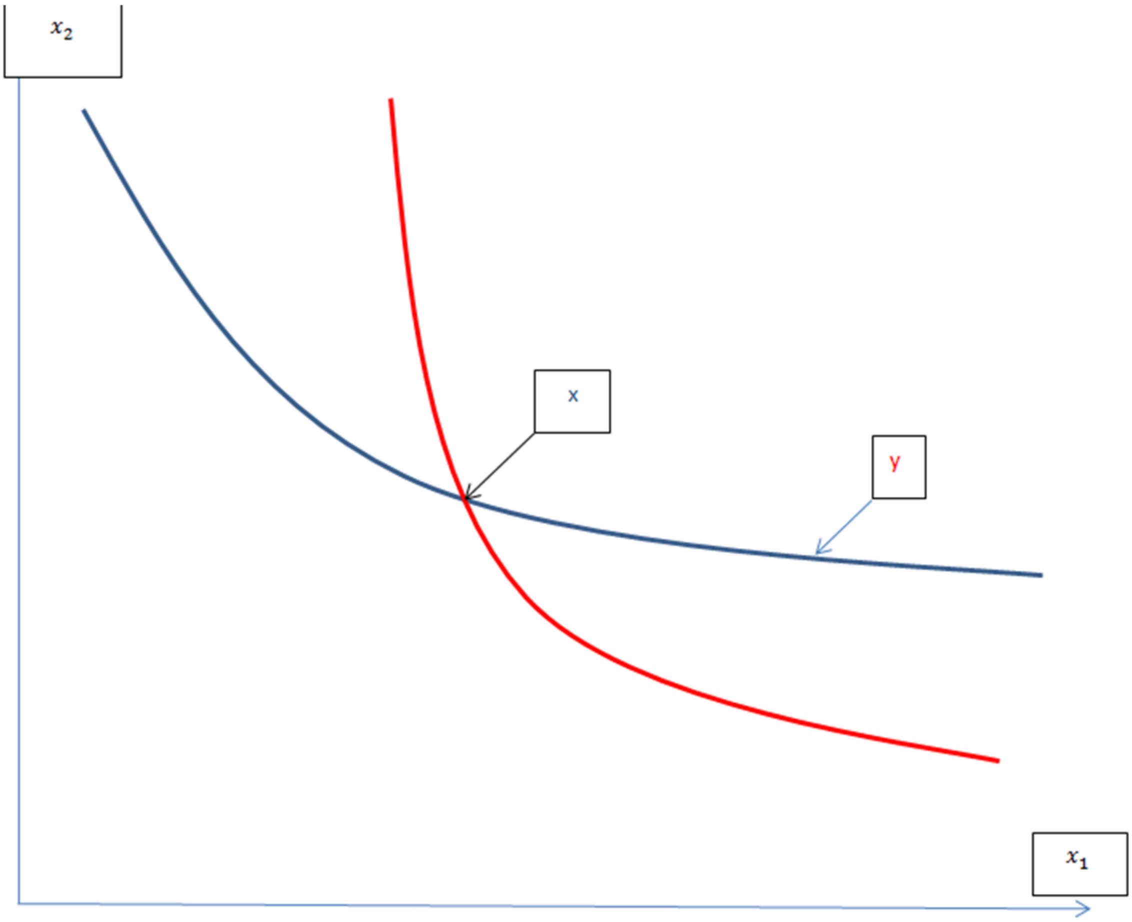
A precise definition of Assumption I is in the Mathematical Appendix: "neighbourhoods" (i.e. "open sets") have to be understood in terms of the relative topology for the subspace of R^n containing those dimensions i with $y_i > 0$.

Assumption II: Non-satiation: Preferences are defined over (a subset of) non-negative commodity baskets in the n-dimensional Euclidean space R^n, which we call $R^n +$. Let x and y be two baskets in $R^n +$. For each component i such that $x_i > 0$ we have $y_i > x_i$. Then for all preferences q we have $y(>; q)x$.

Assumption III: Regularity: First let $n = 2$. For any given $\bar{x}$ and any two different preferences $q^1$and q^2 let $I(\bar{x}; q^1)$ be the indifference curve passing through $\bar{x}$ with preferences q^1 and let $I(\bar{x}; q^2)$ be the indifference curve passing through $\bar{x}$ with preferences q^2. Then for the intersection of the two indifference curves $\hat{I}(\bar{x}; q^1; q^2) \equiv I(\bar{x}; q^1) \cap I(\bar{x}; q^2)$ we either have $\hat{I}(\bar{x}; q^1; q^2) = I(\bar{x}; q^1) = I(\bar{x}; q^2)$ or $\widehat{I}(\bar{x}; q^1; q^2) \equiv I(\bar{x}; q^1) \cap I(\bar{x}; q^2) = \{\bar{x}\}$. In words: if the two indifference curves passing through a given basket $\bar{x}$ and corresponding to two different preferences are not identical then they only overlap in $\bar{x}$. For $n > 2$ the regularity defined for $n = 2$ applies to any two-dimensional subspace of baskets. Moreover, a certain “triangle inequality assumption of adaptive preferences” is assumed to hold which will be discussed below in section L.

One consequence of adaptive preferences under the three assumptions just introduced can be easily seen. Take the class room model. Take the case $n = 2$. Take two indifference curves passing through x. The blue indifference curve 1 corresponds to preferences $\rho(x)$. The red indifference curve 2 corresponds to preferences (y) . Here we assume that y lies to the “south-east” of x. Assume $y\big(=; \rho(x)\big)x.$ We then can infer from adaptive preferences that the red indifference curve 2 passes below (or at most through) y, because adaptive preferences imply $y(\geq; \rho(y)x$. Thus the red indifference curve 2 has a steeper slope than indifference curve 1. This means that with a given budget constraint $p_1x_1 + p_2x_2 = 1$ demand for good 1 is higher, if preferences $\rho(y)$ prevail than if preferences $\rho(x)$ prevail. Thus, if in the class room model past consumption has been y then today´s demand for good 1 is higher than if past consumption has been x. But with y as past consumption, past consumption of good 1 has been higher than with x as past consumption. We then observe that adaptive preferences imply an inter-temporal complementarity in the demand for any given good. This is an important characteristic of adaptive preferences and can be used for empirical tests of the hypothesis of adaptive preferences. The substantial empirical literature on demand systems for consumers corroborates the hypothesis of this inter-temporal complementarity of demand, which is also known as the hypothesis of habit formation (Houthakker and Taylor 1966).

Figure 2: Inter-temporal complementarity when preferences are adaptive



K Theorem 1 for the Class Room Model and $n = 2$

In the following I give different versions of two Theorems. Theorem 1 says that adaptive preferences imply non-circularity of improvement sequences. Theorem 2 shows that non-circularity of improvement sequences leads to an exogenous "homo oeconomicus"-like quasi-preference structure which, as a corollary, implies adaptive preferences.

I now proceed to show the first version of Theorem 1.

Theorem 1A: Assume the three Assumptions I, II and III (continuity, non-satiation and regularity). Assume further the class room model and assume $n = 2$. Then adaptive preferences imply non-circularity of improvement sequences.

The Proof is in section 2 of the Mathematical Appendix. It takes some effort to prove this proposition. What we actually do is to derive a somewhat "global" result from a somewhat "local" assumption. Improvement sequences can be of any length, as long as they have a finite number of steps. Thus, they can lead to baskets which are far away from the starting point and then, one might think, may come back on quite different routes from the ones they have taken moving away. Why should they be non-circular? Thus, the proposition that all improvement sequences are non-circular is a rather "global" proposition. On the other hand the characteristic of adaptive preferences only needs two baskets to be defined. In this sense it is a much more "local" characteristic.

There are of course many examples in science where "local" characteristics lead to global properties. Newton´s mechanics of planetary motion is of course a well- known case. But to prove his theory he had to invent differential calculus and had to integrate a differential equation. So it should not be a surprise that proof of our Theorem 1A requires some effort.

But, to support our intuition, I can show here a very simple proof, if in addition I assume that preferences can be understood to be equivalent so some cardinal utility function. We then can write down a cardinal utility function $U(x;q)$. I now assume that for any given basket x cardinal utility $U(x;\rho(x)) \geq U(x;q)$ for any preferences q. Thus, for a given basket x, utility is highest, if preferences prevail which are induced by x. This assumption is in the spirit of adaptive preferences: for a given basket people are happiest, once they have accommodated themselves to their situation. Of course, this inequality concerning cardinal utility is consistent with the purely ordinal concept of adaptive preferences: for, if $y\big(>;\rho(x)\big)x$ then $U(y;\rho(y)) \geq U\big(y;\rho(x)\big) > U(x;\rho(x)) \geq U(x;\rho(y))$ and thus $y\big(>;\rho(y)\big)x$.

In the class room model consider now an improving sequence $\{x^0, x^1, x^2, \ldots . x^T\}$. We then have $U\big(x^0;\rho(x^0)\big) < U\big(x^1;\rho(x^0)\big) \leq U\big(x^1;\rho(x^1)\big) < U(x^2;\rho(x^1)) \leq U(x^2;\rho(x^2)) <\ldots\ldots\ldots< U(x^T;\rho(x^{T-1})) \leq U(x^T;\rho(x^T))$, in short: $U\big(x^0;\rho(x^0)\big) < U(x^T;\rho(x^T))$. This shows $x^T \neq x^0$ and thus, non-circularity of improvement sequences. Note that for this "cardinal utility case" I did not have to assume that $n = 2$.

L Theorem 1 for the Class Room Model and $n \geq 2$

I now generalise Theorem 1 to the case of any number of distinct commodities. For this I have to make a regularity assumption which applies to any dimension n of the commodity space.

Assumption IIIe ("e" for "extended") of extended regularity: The regularity assumption III for $n = 2$ applies to any two-dimensional subspace of R^n defined (together with the origin 0) by any two linearly independent non-negative baskets x and y. Moreover the following "triangle inequality assumption of adaptive preferences" holds: Slightly simplified (a precise definition is in section 3 of the Mathematical Appendix) it says the following: Consider any three baskets x, y, z such that they form an improving sequence i.e. $y\big(>; \rho(x)\big)x$ and $z\big(>; \rho(y)\big)y$. Then there exists some $\hat{y}$ which is a weighted average of x and z such that $x; \hat{y}; z$ also form an improving sequence.

The "triangle inequality assumption of adaptive preferences" is in the spirit of our intuition about adaptive preferences. They are the expression of a certain preference conservatism. Thus, if, by an improving sequence, one can reach a basket z from a basket x via an intermediate step y then it should be possible to find an intermediate step which is "more similar" to x and z than is y. The "detour" via y should not be necessary, since it involves more change altogether than does $\hat{y}$; and preference conservatism means resistance to change.

We then can prove

Theorem 1B: Assume the three Assumptions I, II and IIIe (continuity, non-satiation and extended regularity). Assume further the class room model and assume $n \geq 2$. Then adaptive preferences imply non-circularity of improvement sequences.

The proof in section 3 of the Mathematical Appendix is rather lengthy. Here I describe its main idea. I start with any given improving sequence $\{x^0, x^1, x^2, \ldots . x^T\}$ in $R^n +$. I then pick that basket x^{t*} in the sequence which is farthest away (by Euclidean distance) from a two-dimensional subspace $R^2(x^0; x^T)$ containing 0, x^0, and x^T . I replace this x^{t*} by some z^{t*} which is in the two-dimensional subspace $R^2(x^{t*-1}; x^{t*+1})$ and is a weighted average of x^{t*-1} and x^{t*+1} such that the sequence remains an improving sequence. This is always possible due to the "triangle inequality of adaptive preferences". Thereby we have a new improving sequence such that its average distance from

$R^2(x^0; x^T)$ has been reduced. We continue with this procedure. The thereby constructed sequence of improving sequences converges to some limit sequence. This limit sequence, due to continuity, is again an improving sequence. It then can be shown that this limit sequence is contained in $R^2(x^0; x^T)$, again by some rather complicated argument which makes heavy use of the continuity assumption. The proof that the limit sequence has the desired properties only can be done by first working with weakly improving sequences. From there we then can show a corresponding result for strictly improving sequences. The fact that the limit sequence lies in $R^2(x^0; x^T)$ and is an improving sequence makes it possible to apply Theorem 1A. Thereby we show that the improving sequence $\{x^0, x^1, x^2, ... x^T\}$ is non-circular.

The Assumptions I,II, IIIe are sufficient conditions for deriving non-circularity from adaptive preferences. I have other sufficient conditions for this result which I do not present in this paper. The question arises whether there is a chance to derive Theorem 1 from substantially weaker conditions. The answer is "no" in one respect: what I basically have done is to use assumptions which give me the result that any improving sequence can be replaced by an improving sequence contained in a two-dimensional subspace $R^2(x^0; x^T)$. But, due to Theorem 2, to be discussed below, I know that any preference system with only non-circular improving sequences has the property that each improving sequence can be replaced by an improving sequence contained in the two-dimensional subspace $R^2(x^0; x^T)$.

M Converse Theorem (Theorem 2): Non-Circularity of Improving Sequences Implies the Existence of a "Homo Oeconomicus"-Like Quasi-Preference Structure and Thereby Implies Adaptive Preferences

An essential building block for welfare economics under adaptive preferences is the fact that non-circularity of improving sequences allows us to find "quasi-preferences" $V(x)$ which are exogenous. The function $V(x)$ does not depend on past consumption. These "quasi-preferences" are an indicator for answering the question, whether some basket y can be reached from some other basket x by means of an improving sequence or not. I therefore also call it an "*indicator function*" for the existence of improving sequences: If and only if $V(y) > V(x)$ is there an improving sequence from x to y.

The ordinal indicator function or "quasi-utility function" $V(x)$ formally then looks like an ordinal exogenously given utility function, even though its precise economic meaning is different. But it also has one property in common with the homo oeconomicus model which makes it so important for welfare economics: it links up with the person´s demand behaviour. Here it is "long run demand", by which I mean the demand function which provides the limit demand as a function of a budget that remains constant over time. It is not the demand function for given preferences q which we may call the "short run demand function". Rather it is the demand function which encompasses the change in preferences induced by the budget constraint. In the tradition of revealed preference theory we are then able to read preferences from demand behaviour; only these are the fixed "quasi-preferences" $V(x)$ rather than the endogenously determined actual preferences.

For $n > 2$ I need an assumption to enable me to prove Theorem 2 by means of the Samuelson-Houthakker revealed preference theorem. For $n = 2$ I can show a more general theorem, which is crucial to demonstrate one of the main differences between traditional welfare economics and welfare economics of adaptive preferences. In this paper I deal with the case $n \geq 2$, but in section X below I discuss the case - without proving theorems - that "long run demand" does depend on initial preferences.

Here I need the assumption that "long run demand" for any given budget constraint converges to a unique point, which is independent of initial preferences $q(0)$. Throughout I assume the budget to be unity (I therefore ignore issues related to money illusion, but I will discuss this topic in later work). Demand then is restricted to the inequality $px \leq 1$.Here $p \geq 0$ is the prevailing price vector. For given preferences q we then have a demand function $x = h(p; q)$. Keeping prices constant through time we may get convergence of demand. Limit demand must have the following property

$$x = h\big(p; \rho(x)\big) = H(p)$$

For any given budget p the demand basket must converge to a particular basket x which has the property that it is the "short run demand" under the preferences induced by itself.

What are the properties of the long run demand function? Under which conditions does it satisfy Houthakker´s strong axiom of revealed preference and thus can be seen as the expression of an underlying utility function? The answer is given by

Theorem 2A: In the class room model under Assumption I (continuity) and Assumption II (non-satiation) assume further that all improving sequences are non-circular and that there exists a long run demand function $x = h\big(p; \rho(x)\big) = H(p)$ which is independent of initial preferences $q(0)$. Then the long run demand function satisfies the strong axiom of revealed preference. Thus there exists an ordinal quasi-utility function $V(x)$ underlying the long run demand function. Moreover this underlying quasi-utility function is continuous and has the following property: If and only if $V(y) > V(x)$ there exists an improving sequence starting at x and ending at y.

An earlier version of Theorem 2A (for $n = 2$) was published in von Weizsäcker (1971). A theorem which has some similarity with Theorem 2A has been published by Munro and Sugden (2003). If I am not mistaken Theorem 2A is more general than the Munro-Sugden Theorem. The set-up of the two models and the methods of proof are quite different. As Munro-Sugden try to draw specific conclusions from results in psychological research I come back to that paper in section Z.

The Proof of Theorem 2A is in the Mathematical Appendix. The main idea of the proof is the reference to the Samuelson-Houthakker Theorem of revealed preference. This works by means of the following

Revealed Preference Lemma of Induced Preferences: If in a sequence of baskets $\{x^0, x^1, \dots\dots x^T\}$ each basket (except x^0) is revealed preferred to its preceding basket under the long run demand function then there exists an improving sequence from x^0 to x^T.

The proof is in the Mathematical Appendix.

Thus, since, by assumption, all improving sequences are non-circular, all revealed preference sequences are non-circular under the long run demand function. Therefore the strong axiom of revealed preference is fulfilled for $x = H(p)$ and we have an ordinal utility function $V(x)$ which corresponds to the long run demand function $H(p)$. Moreover, it also follows from the Samuelson-Houthakker Theorem (I use that theorem in the form given by Sondermann (1982)): if and only if $V(y) > V(x)$ there exists a finite revealed preference sequence under $H(p)$ starting at x and ending at y. Then, again by the Revealed

Preference Lemma of Induced Preferences, there exists an improving sequence from x to y. On the other hand, it is then obvious that for $V(y) < V(x)$ there exists no improving sequence going from x to y: for otherwise we could construct an improving sequence which starts at x, touches y and comes back to x, thereby violating the assumption that improving sequences are non-circular. Using continuity arguments, it can also be shown that $V(y) = V(x)$ makes it impossible to construct an improving sequence from x to y.

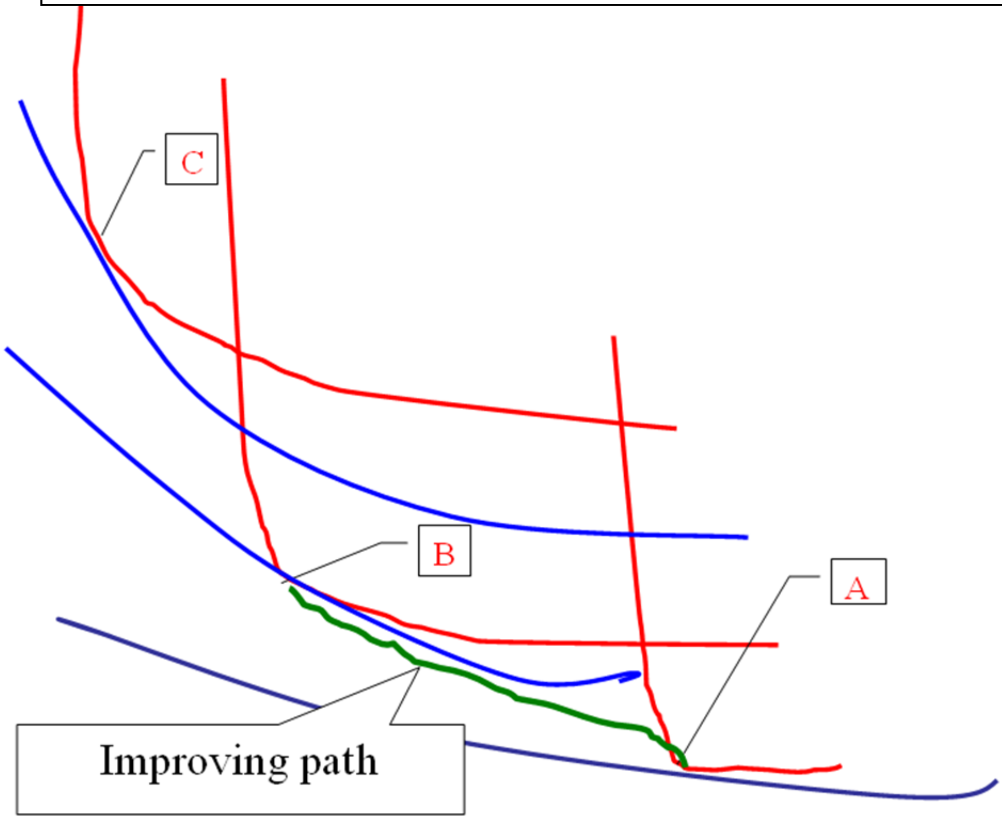
There is a Corollary to Theorem 2A:

<u>Adaptive Preference Corollary:</u> Under the assumptions of Theorem 2A preferences are adaptive.

<u>Sketch of Proof:</u> Consider $y\big(>; \rho(x)\big)x$. Then, obviously, y can be reached from x by an improving path of length $T = 1$. Thus, by Theorem 2A, $V(y) > V(x)$. But we then also must have $y\big(\geq; \rho(y)\big)x$. For, otherwise we would have $x\big(>; \rho(y)\big)y$ and thus $\{x, y, x\}$ would be an improving sequence, contrary to non-circularity. For continuity reasons $y\big(=; \rho(y)\big)x$ also can be excluded. It remains $y\big(>; \rho(y)\big)x$. QED.

In the graph below I depict Theorem 2A and its Corollary. I draw three single indifference curves corresponding to preferences induced by baskets A, B, resp. C and going through A, B, resp. C. They are in red. Then I draw a system of indifference curves, in blue, which depict the “quasi-preferences” $V(x)$. Because B is on a blue indifference curve above the one through A Theorem 2A tells us that there exists an improving sequence from A to B.

Table 3: Short run preferences, long run quasi-preferences and improving paths



Moreover the Corollary shows up in the graph by the fact that the red indifference curves of induced preferences corresponding to a basket is above the blue indifference curve through the same point.

Theorem 2A and its Corollary also have immediate implications for price elasticity. As we know, price elasticity of demand is higher when indifference curves have less curvature. Thus, the price elasticity of demand of the long run demand function - corresponding to the blue indifference curves -is higher than the price elasticity of demand for those given preferences which are induced by the basket under investigation. A change in the budget constraint generates a change in tastes so that the total or long run effect on demand is larger than the immediate effect holding the initial preferences constant. Preference change thus is like a *reaction amplifier*. Or, we may call the interaction between consumption and preferences a *positive feedback loop*, provided preferences are adaptive. Induced preference changes thereby help the person to adapt to changes in the social or natural environment. This is a further reason why I have chosen the name "adaptive preferences" for the main hypothesis of my theory. As we shall see below in section S this then also helps us to understand the "sociobiological" foundations of the empirical validity of the hypothesis.

N Equivalence Theorem 1 for the Class Room Model

After having presented a first version of Theorem 2 I can show an additional version of Theorem 1. This is Theorem 1C. It sheds additional light on the – as yet not fully known - set of sufficient conditions for Theorem 1 type theorems.

I introduce the following

Definition 5: A preference system $\{x; q; \dot{q}\}$ may have the property of "two-dimensional mappings of improving sequences". By this I mean: if $\{x^0, x^1, \dots x^T\}$ is an improving sequence in R^n a two-dimensional mapping of $\{x^0, x^1, \dots x^T\}$ is an improving sequence $\{x^0, z^1, z^2, \dots\dots z^S, x^T\}$ such that all $z^t \in R^2(x^0, x^T)$ where $R^2(x^0, x^T)$ is a two-dimensional subspace containing x^0 and x^T. S , the number of in-between steps in $R^2(x^0, x^T)$, need not coincide with the number of in-between steps of the original improving sequence.

Theorem 1C: Assume the Class Room Model. Assumptions I (continuity) and II (non-satiation) hold. Assume further the existence of a long run demand function $x = h\big(p; \rho(x)\big) = H(p)$. Assume adaptive preferences.

Part A: For a given preference system $[x; q; \dot{q}]$ assume that every improvement sequence has a "two-dimensional mapping". Then every improvement sequence is non-circular.

Part B: Assume that every improvement sequence of a given preference system $[x; q; \dot{q}]$ is non-circular. Then every improvement sequence of that preference system has a "two-dimensional mapping"

The proof of Part A is the same as part of the proof of Theorem 1B. There we show non-circularity of improvement sequences by first deriving the existence of a two-dimensional mapping for each improvement sequence, and then using Theorem 1A to derive non-circularity.

For the proof of Part B I use Theorem 2A which yields a quasi-utility function $V(x)$ as an indicator function for the existence of improvement sequences. But then we can restrict the function $V(x)$ to the subspace $R^2(x^0, x^T)$ where it serves the same indicator function for the existence of improving sequences. Thus $V(x^T) > V(x^0)$ also indicates the existence of an improving sequence in

$R^2(x^0, x^T)$. (A proof that $V(x)$ serves the same indicator function in the subspace as in the full space is in the Mathematical Appendix).

Theorem 1C tells us that by investigating sufficient conditions for the derivation of non-circularity of improvement sequences from adaptive preferences we can concentrate on the existence of two-dimensional mappings of improving sequences.

O The "Real World Model" ("Continuous Time Model"): Theorem 2

I now define and discuss improvement sequences in a model of continuous time. I call it the "real world model", because it mirrors the real world much more closely than does the class room model. The preference dynamics then may be given by the vector differential equation

$$\dot{q} \equiv \frac{dq}{dt} = f(x; q)$$

We assume that $f(x; q)$ has all the properties required to make the differential equation integrable.

If x remains constant through time preferences q converge towards $\rho(x)$.

Before I continue I want to point out to the reader that in section Q below I discuss a simple example of the continuous time model with two goods and computable parameters for the elasticity of substitution and the influence of past consumption on present preferences. Looking at the example of section Q may help the reader understand what is going on in the more general model.

For the following it is useful to introduce an ordinal utility function representing the preferences involved in the analysis. Thus $U(x; q)$ is a function continuous in x which represents the preferences q. Because preferences are continuous we know that such $U(x; q)$ exists (Debreu (1959) p. 56). Moreover, as before, we assume that preferences are also continuous in preference space. We then also can assume $U(x; q)$ to be continuous with respect to q in the topology assumed to exist in preference space.

We now look at a path through time of the consumption basket $x(t)$. According to the differential equation above, for any given initial preferences $q(0)$ we have a movement of preferences $q(t)$ which of course depends on $x(t)$. We introduce the following definition:

Definition 6: For a given movement $x(t)$ a point in time t is an improvement point, if for $q(t)$ there exists $\varepsilon > 0$ such that for $t - \Delta t > t - \varepsilon$ and $\Delta t > 0$ we have $U\big(x(t-\Delta t); q(t)\big) < U(x(\mathrm{t}); q(t))$. A point in time t is a weakly improving point, if for $q(t)$ there exists $\varepsilon > 0$ such that for $t - \Delta t > t - \varepsilon$ and $\Delta t > 0$ we have $U\big(x(t-\Delta t); q(t)\big) \leq U(x(\mathrm{t}); q(t))$.

Consider now a movement of x through time from time zero to some time T. We restrict ourselves to movements $x(t), 0 \leq t \leq T$, such that $x(t)$ is piecewise differentiable with K "jump points" with K$\geq$ 0 a finite integer. Let $J = \{t_1, t_2, \dots . t_K\}$ be the set of jump points. We then assume that $x(t_i)$ is the limit point of $x(t)$ as $t > t_i$ approaches t_i from above. With this restriction we consider any path $x(t)$. Due to this restriction of piecewise differentiability (and hence piecewise continuity) and for a given $q(0)$ preferences $q(t)$ are well defined by means of the integrable differential equation $\dot{q} = f(x; q)$.

.

We then can describe the path by $\{x(t); q(0); T\}$.

Definition 7: A path $\{x(t); q(0); T\}$ is a weakly improving sequence, if $q(0) = \rho(x(0))$ and every t is a weakly improving point for $0 \leq t \leq T$.

Definition 8: A path $\{x(t); q(0); T\}$ is an improving sequence, if it is a weakly improving sequence and if $T = t_K$ is a jump point with $U\big(x(T); q(T)\big) > \lim_{t \to T} U(x(t); q(T))$

Concerning this definition of improving sequences note the following: 1. With $q(0) = \rho(x)$ a stationary path $x(t) = \bar{x}$ is a weakly improving sequence. 2. The definition of improvement points only involve utility comparisons with identical preferences. Thus, we are in a purely ordinal environment. For the utility function $U(x(t); q(t))$ at time t (if $x(t)$ is differentiable at t) we note that $\frac{\partial U}{\partial x}\dot{x} > 0$ if t is an improving point. If $x(t)$ is the result of utility maximization against a budget constraint, defined by price vector p, we know that $\frac{\partial U}{\partial x} = \lambda p$ for some real number $\lambda > 0$. Thus $p\dot{x} > 0$ which means we see a rise in real income. We therefore can understand a weakly improving sequence as a path in which any change in real income is always upwards and never downwards. 3. A weakly improving sequence which has strictly improving jump points or time intervals with strictly improving real income improvements could reasonably be seen as an improving sequence in the strict sense. For mathematical reasons I have defined an improving sequence somewhat more strictly: by requiring a strictly positive utility jump at the very end. Proofs of the theorems are then much easier. But I do not think this to be a big problem, because the final jump in real income can be arbitrarily small, as long as it is positive. For any basket y which can be reached from an initial basket x by means of an "improving sequence", reasonably defined, we can find $\hat{y}$ arbitrarily close to y such that $\hat{y}$ can be reached by a sequence which I define as a strictly improving sequence. This property depends on the assumptions of continuity and non-satiation of preferences.

We now use the results from the class room model for deriving results for the "real world" model. We first introduce the following

Definition 9: For a given preference system $\{x; q; \dot{q}\}$ in continuous time we define the corresponding class room preference system $[x; q; \dot{q}]$ as that class room model which exhibits the same induced preferences mapping $\rho(x)$.

We then show the following

Correspondence Lemma: Assume all improvement sequences of a "real world" preference system $\{x; q; \dot{q}\}$ are non-circular. Assume that there is a long run demand function $x = h\big(p; \rho(x)\big) = H(p)$ for the corresponding class room model. For any basket x^0 let $A(x^0)$ be the set of baskets which can be reached from x^0 by means of an improvement sequence in the "real world" model. For any basket x^0 let $\hat{A}(x^0)$ be the set of baskets which can be reached from x^0 by means of an improvement sequence in the corresponding class room model. Then $A(x^0) = \hat{A}(x^0)$.

The proof is in the Mathematical Appendix

Theorem 2B: Assume the "real world model" with a given preference system $\{x, q, \dot{q}\}$. We then assume further: 1.Preferences are continuous. 2. There exists a long run demand function $x = h\big(p; \rho(x)\big) = H(p)$ 3. Improvement sequences are non-circular. Proposition: Then there exists a continuous quasi-utility function $V(x)$ with the following properties: If and only if $V(x^1) > V(x^0)$ there exists an improving sequence beginning at x^0 and ending in finite time at x^1.

An earlier version of Theorem 2B is contained in my Thünen Lecture (von Weizsäcker (2002))

Proof: Note first that the long run demand function is the same as the one for the corresponding class room model, since it only depends on the mapping $\rho(x)$.

Then, by the Correspondence Lemma, the quasi-utility function $V(x)$ derived for the class room model from Theorem 2A is also an indicator function for the sets $A(x^0)$. QED.

Corollary: In the “real world” model, if there exists a long run demand function $x = h\big(p; \rho(x)\big) = H(p)$ and if all improvement sequences are non-circular then preferences are adaptive. Proof: Due to the Correspondence Lemma, we can apply the corresponding Corollary of the class room model. QED.

For the “real world model” we have inverted the sequence in which we prove Theorems 1 and 2. In the class room model we first have obtained sufficient conditions for Theorem 1: adaptive preferences imply non-circularity of improving sequences. Then, together with the assumption that there exists a long run demand function $x = H(p)$ and the assumption that improving sequences are non-circular we obtain the “exogenous” quasi utility function $V(x)$ as an indicator function for the existence of improvement sequences. This is Theorem 2, which has the corollary that preferences are adaptive. We then use Theorem 2 for the class room model to derive the corresponding Theorem 2 for the “real world model”. The next task is to derive a Theorem 1 for the “real world model”.

P Theorem 1 for the “Real World Model” : From Adaptive Preferences to Non-Circularity of Improving Sequences

For the “real world model” I have so far not succeeded to show that sufficient conditions for non-circularity of improving sequences are the same as in the class room model. The Correspondence Lemma only tells us that if all improving sequences are non-circular then the quasi- utility function $V(x)$ serves as the same indicator function for improving sequences in the real world model and in the corresponding class room model. But with the additional assumption of “smoothly adaptive preferences” we can show that sufficient conditions for non-circularity of improving sequences in the class room model also imply non-circularity of improving sequences in the “real world model”. And the assumption of smoothly adaptive preferences is highly plausible.

I first define “smoothly adaptive preferences” for a cardinal utility function. Then I show that we can define a utility function which looks like a cardinal utility function but which has a completely ordinal meaning.

Definition 10: In the “real world model”, for a given preference system $\{x; q; \dot{q}\}$ assume that there exists an indicator function $V(x)$ for the corresponding class room model for the existence of improving sequences. Thus, in the corresponding class room model improving sequences are non-circular. Assume the existence of a cardinal utility function $U(x; q)$ with the following properties: 1. $U(x; q) \leq V(x)$ for all q; 2. $U\big(x; \rho(x)\big) = V(x)$; 3. $\frac{\partial U}{\partial q}\dot{q} = \frac{\partial U}{\partial q} f(x; q) \geq 0$. Then we say that preferences are smoothly adaptive.

I explain the economic meaning of smoothly adaptive preferences: As before in section K consider U to be some kind of “happiness” index. Then, for a given basket x, the person´s well- being is highest with preferences which are induced by x, i.e. with preferences $\rho(x)$. This then leads to equation 2. and inequality 1. in the definition of smoothly adaptive preferences. Condition 3. then only adds that, what prevails globally (for constant x preferences converge to those which maximise utility), also prevails locally: the time derivative of utility for constant x is non-negative.

We then can show

Theorem 1D: For a “real world model” preference system $\{x; q; \dot{q}\}$ assume that in the corresponding class room model improvement sequences are non-circular and that there exists an indicator function $V(x)$ for improving sequences of the class room model. Assume for the “real world” model that preferences are smoothly adaptive. Then improving sequences are non-circular in the “real world” model.

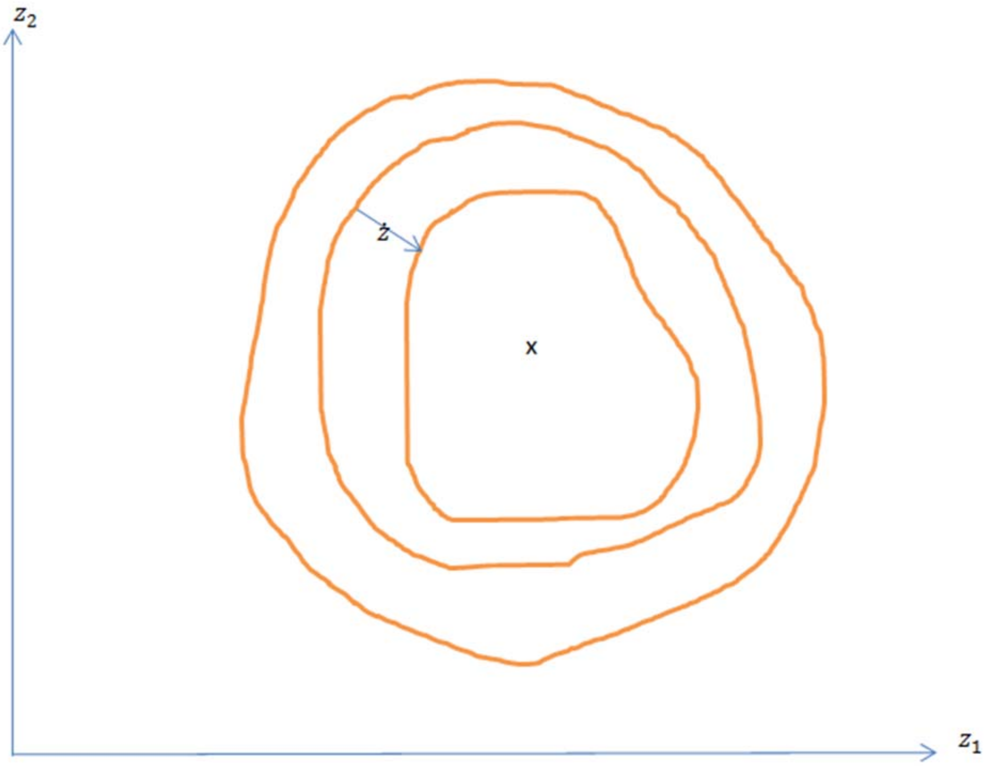
Proof: By the definition of an improving sequence we have $\frac{\partial U}{\partial x}\dot{x} \geq 0$ wherever $x(t)$ is differentiable. Where there is a jump point of $x(t)$ utility jumps upward. Because of smoothly adaptive preferences we thus have $\dot{U} = \frac{\partial U}{\partial x}\dot{x} + \frac{\partial U}{\partial q}\dot{q} \geq 0$ wherever there is differentiability and thus U is a non-decreasing function of time. Moreover, at time T utility makes an upward jump, because we look at an improving sequence. Thus $U\big(x(T); q(T)\big) > U(x(0); \rho\big(x(0)\big) = V(x(0))$. On the other hand $V(x(T)) \geq U(x(T); q(T))$ and thus $V\big(x(T)\big) > V(x(0))$ which implies $x(T) \neq x(0)$ and so proves non-circularity. QED

Theorem 1D is of particular interest, because there is great potential for transforming purely ordinal preferences into an “as if cardinal” expression. If we then also can derive smoothly adaptive preferences we can use Theorem 1D to show non-circularity of improving paths in the real world model.

As an example we introduce the following ordinal utility function. We are in world in which the corresponding class room model implies non-circularity of improving sequences. We then have from the class room model an indicator function $V(x)$. For any x and q consider the indifference hyper-surface $I(x;q)$ of baskets z which are indifferent to x, given preferences q. Thus, in a formula, $I(x;q) = \{z\colon z(=;q)x\}$. We then define $U(x;q) = \min_{z\in I(x;q)}\{V(z)\}$. In words: the "utility" of x, given preferences q, is the smallest value of $V(z)$ reachable within the indifference hyper-surface containing x. We assume that such minimum always exists. First we have to show that this is a utility function which represents the preferences for any given q. Let $y(>;q)x$. Then we know that $I(y;q)$ lies above $I(x;q)$. Therefore we also have $U(y;q) = \min_{z\in I(y;q)}\{V(z)\} > \min_{z\in I(x;q)}\{V(z)\} = U(x;q)$. This proves that $U(x;q)$ is a utility function representing preferences q.

Obviously, since $x \in I(x;q)$ we know that $U(x;q) \leq V(x)$. On the other hand, due to Theorem 2B and its Corollary we know that for $z \in I(x;\rho(x))$ we have $V(z) \geq V(x)$, and therefore $U\big(x;\rho(x)\big) = V(x)$. Thus, for given x, "utility" is maximised across preferences q at the point $\rho(x)$. So the conditions 1. and 2. of smooth adaptiveness are fulfilled. Concerning condition 3 we observe the following. We look at preferences which are induced by some basket z, i.e. $\rho(z)$. Note that in this case the defined minimum $U\big(x;\rho(z)\big) = V(z)$. Normally it will be the case that the defined minimum $U(x;q) = \min_{z\in I(x;q)}\{V(z)\}$ declines as the distance between z and x rises. For $n = 2$ we then have a map of "isoquants" for $U(x;\rho(z))$ which look like a map of a single peaked mountain with the peak at $z = x$. This "Mount Utility" may be connected with a vector differential equation for the movement of preferences, which is linear in commodity space. Since, for constant x, preferences converge towards $\rho(x)$ the time derivative of preferences points from z to x and thus points in the direction of rising utility. This then is condition 3 of smoothly adaptive preferences which reads $\frac{\partial U}{\partial q} f(x;q) \geq 0$.

Figure 4: Single peaked "Mount Utility" = Smoothly Adaptive Preferences



To generalise from $n = 2$ to $n \geq 2$ we may assume that also in the real world model the preferences system has the property of "two-dimensional mappings of improving sequences"(see Definition 5): for any given improving sequence (or weakly improving sequence) $x(t)$ beginning at $x(0)$ and ending at $x(T)$ there exists an improving sequence (or weakly improving sequence) $z(t)$ beginning at $x(0)$ and ending at $x(T)$ such that for $0 \leq t \leq T$ the basket $z(t)$ is contained in a two-dimensional subspace $R^2(x(0), x(T))$ containing the beginning and the end of the improving sequence (or weakly improving sequence). This property of "two-dimensional mappings of improving sequences" can be assumed, because we know from Theorem 2 that it is valid whenever all improving sequences are non-circular.

We then understand that smoothly adaptive preferences are the "canonical case" of adaptive preferences, like a single peaked mountain is the "canonical case" of a mountain. Moreover, I am convinced that further mathematical effort will enable me or somebody else to show that a regularity condition quite similar to the one in the class room model is sufficient to show that under adaptive preferences improvement sequences are non-circular.

Whatever the results for an “ordinal” preference theory are, the “cardinal” utility proof is a nice heuristic to intuitively understand why the theorems work. We have seen this for the class room model in section K above. And we see it in the quite simple and intuitive proof of Theorem 1D above.

Here I summarize the results of the model of adaptive preferences, which are the results of this Part II of the paper. If preferences generally have the property of continuity, non-satiation and (extended) regularity then adaptive preferences imply that improvement sequences are non-circular, i.e. are improvement paths (Theorem 1). Moreover, if in a preference system all improving sequences are non-circular then there exists an indicator function $V(x)$ which looks like an ordinal utility function and which indicates which basket can be reached from which other basket by means of an improvement path. (Theorem 2). In addition, as a corollary, it then also follows that preferences are adaptive. Since fixed preferences are a special case of adaptive preferences the present theory can be understood as a true generalisation of traditional, neoclassical preference theory. And, as will be seen in Part III of this paper, we thereby can develop the foundations of a welfare economics of market economies under the assumption that preferences are adaptive. Also it lays the foundation for the proposition that adaptive preferences are a necessary condition for a functioning system of decentralised decision making.

Q A Simple Example With Two Goods

As a kind of appendix to Part II of the paper I present a simple example of the theory. It may help the reader to understand what is going on in the formal theory of adaptive preferences. The example is a model with continuous time.

Assume the ordinal utility function of a person to be

$U = \frac{1}{1-\gamma} g {x_1}^{1-\gamma} + \frac{1}{1-\gamma}(1-g){x_2}^{1-\gamma}$. Here x_1 and x_2 are the quantities of the two goods consumed, $g \in (0,1)$ is a weight parameter of the two goods, and $\gamma > 1$ is a substitution parameter of the two goods. $1/\gamma$ is the elasticity of substitution. The latter then is smaller than unity. Given the prices of the two goods the ratio $z = \frac{x_1}{x_2}$ in which the goods are consumed can be computed to be

$z = \frac{g}{1-g} p^{-\frac{1}{\gamma}}$ with $p = \frac{p_1}{p_2}$ the price ratio of the two goods. Now I introduce the influence of past consumption on present tastes. In this simple model I can assume that the weight factor $\frac{g}{1-g}$ is influenced by an exponentially weighted average w of the past values of z. We may write $\frac{g}{1-g} = bw^{\mu}$, where $b > 0$ is a constant weight parameter of the two goods and μ is a parameter, which indicates the strength of the influence of past consumption on present tastes. We assume $0 \leq \mu < 1$. The case $\mu = 0$ is the case of fixed preferences. The assumption $\mu < 1$ is related to the property of adaptiveness of tastes. So the demand function now reads $z = bw^{\mu} p^{-\frac{1}{\gamma}}$.

The preference characteristic w is modeled as an exponentially weighted average of former levels of z. We then get the linear differential equation $\dot{w} = \alpha(z - w)$. Here the real number $\alpha > 0$ is a speed parameter for the adaptation of tastes to any given consumption basket proportion z. The solution of the differential equation then is

$$w(t) = e^{-\alpha t}(w(0) + \alpha \int_0^t e^{\alpha \tau} z(\tau) d\tau)$$

There is a long run demand function, if prices remain constant. We can compute it by solving the differential equation keeping p constant and by looking at the limit as time goes to infinity, or by observing that constant prices in the long run will lead to a situation of constant quantities, hence a constant level of z, which again implies that the weighted average of past consumption converges to the actual level of consumption. Thus a stationary level of z and w will be characterised by $w = z$. Using this equation for the computation of the long run value of z by means of the demand function yields the equation

$$z = bw^{\mu}p^{-\frac{1}{\gamma}} = bz^{\mu}p^{-\frac{1}{\gamma}} \text{ from which follows } z = (b^{\frac{1}{1-\mu}})(p^{\frac{-1}{\gamma(1-\mu)}})$$

The long run demand function thus is of a similar kind as the short run demand function; but the elasticity of substitution $\frac{1}{\gamma(1-\mu)}$ is higher than in the short run case. Thus, for example, if the short run elasticity of substitution is one half (corresponding to $\gamma = 2$) and the influence parameter μ of past consumption is also one half, then the long run elasticity of substitution is equal to 1, which corresponds to a logarithmic utility function. As is known from traditional utility theory the long run demand function of this specific form has the property that there exists a utility function which would generate the long run demand function. For $\gamma(1-\mu) \neq 1$ it can be written as

$$V(x) = \frac{1}{1-\gamma(1-\mu)}\left[\beta {x_1}^{1-\gamma(1-\mu)} + (1-\beta){x_2}^{1-\gamma(1-\mu)}\right]$$

where $\beta = \frac{b^{\frac{1}{1-\mu}}}{1+b^{\frac{1}{1-\mu}}}$

For $\gamma(1-\mu) = 1$ it can be written as $V(x) = {x_1}^{\beta}{x_1}^{1-\beta}$

It can be shown that there exists an improving path from x to y if $V(y) > V(x)$.

The preference system of this simple example can be described in terms of the parameters. The utility function $U = \frac{1}{1-\gamma} g{x_1}^{1-\gamma} + \frac{1}{1-\gamma}(1-g){x_2}^{1-\gamma}$ has the two parameters γ and g. Thus, in this case, the dimension N of the preference space is equal to 2. This presupposes that we already have specified the functional form of the ordinal utility function as being one of the constant elasticity of substitution type. The two parameters then specify the value of the elasticity of substitution $(1/\gamma)$ and the weights of the two goods (g and $1-g$). Note that for the restrictions $\gamma > 1$ and $0 < g < 1$ the utility function is continuous in the parameters γ and g. This continuity corresponds to our Assumption I in the general case.

The function $q = \rho(x)$ of induced preferences from commodity space to preference space in this case can be computed from the convergence point of the preference parameters if we keep the consumption basket x constant through time. First, we note that the elasticity of substitution for given preferences remains the same at $1/\gamma$. But the weights of the two goods are influenced by past consumption. From the equation $\frac{g}{1-g} = bw^{\mu}$ indicating the influence of past consumption and the convergence condition $w = z$ we then obtain $\frac{g}{1-g} = bz^{\mu}$ or $= \frac{bz^{\mu}}{1+bz^{\mu}}$. For $q = (\gamma, g)$ the mapping $q = \rho(x)$ is specified by γ, i.e. a constant; and $g = \frac{b(\frac{x_1}{x_2})^{\mu}}{1+b(\frac{x_1}{x_2})^{\mu}}$. Thus, although there are only two preference parameters for the characterization of the preferences themselves there are two additional truly exogenous parameters b and μ which characterise the "induced preference mapping" $\rho(x)$. Then there is the speed parameter α. Altogether we have four truly exogenous parameters of the preference system: γ, b, μ and α. One exogenous parameter enters the utility function U directly. Two parameters determine the "induced preference mapping" to fix the induced weights of the two goods in the utility function. And there is a speed parameter, which determines the convergence speed.

We also can show that this example exhibits smoothly adaptive preferences.

R Inter-Temporal Complementarity

In this section I mainly use verbal argument rather than mathematical tools. The aim is to enable the reader to get a better understanding of the meaning of the hypothesis of adaptive preferences. The concept of adaptive preferences is an inter-temporal concept. We define "induced preferences" in terms of a convergence in time of preferences towards a certain point in "preference space". This convergence process takes time – and thus the very concept of adaptive preferences which builds on "induced preferences" involves preference changes through time. In the class room model this convergence process is very fast: it takes just one unit period to be completed. The class room model predicts the following: assume adaptive preferences. Then, for a given budget constraint today, demand for good i today is a rising function of its consumption yesterday. We have discussed this result in section J. We may write this in a formula. In the class room model with the budget constraint $py = 1$ let $y = f(p; x)$ be the demand basket of today as a function of today´s price vector and of the basket x consumed in the preceding period. Demand then is determined by preferences

$\rho(x)$ because we are in the class room model. If the demand function is differentiable we obtain $\frac{\partial y_i}{\partial x_i} \geq 0$.

In traditional economics we know many reasons for inter-temporal complementarity of consumption. If we want to understand the connection between inter-temporal complementarity and adaptiveness of preferences we have to discuss well known processes which are elicited by economics to explain observed inter-temporal complementarity. We then find out to which extent they are consistent with the hypothesis of adaptive preferences.

There are processes which to a certain degree result in the opposite of inter-temporal complementarity. They also will be discussed. The first one is an example

1. The appetite-saturation cycle. Before we eat a meal we are hungry, after the meal we are saturated, as food is concerned. Then gradually we get hungry again. This cycle, which we share with almost all animals, comes about because our body uses energy continually, but opportunities for the intake of energy by nourishment are not available continually. For survival the body just needs storage possibilities of energy. Our tastes then are geared to this fact. The hunger instinct signals the need for replenishment of the energy stock in our body and lets us intensify our search for food and our urge to eat.

   We thus observe an inter-temporal substitutability in terms of food intake. A higher level of food consumption a short while ago induces lower demand for food now. But economists know that this observation does not contradict the traditional assumption of fixed preferences. We simply have to take the average of food consumption over a period, like a day, which is long enough to include a full cycle of appetite and saturation. Between two neighbouring periods of such length the demand for food is no longer a close substitute.

   Apart from purely physiological appetite-saturation cycles there are such food related cycles due to “taste” rather than simply hunger. A person who has one meal a day with meat or fish may want to alternate between the two. Thus, after he/she has consumed meat for a few days in a row, he/she will have a preference for fish today and vice versa. People have a preference for variety and thereby exhibit a certain degree of inter-temporal substitutability of any given kind of food: for given prices today a lower price of meat yesterday may induce a lower demand for meat today. Or to put it this way: meat yesterday and fish today are complements, whereas meat yesterday and meat today are substitutes.

But, as we know, a preference for variety is not a contradiction to the hypothesis of fixed preferences. One way to see this is to take consumption in unit periods which are sufficiently extended to encompass demand cycles due to this preference for variety.

If the taste for variety is not a contradiction to the assumption of fixed preferences it also cannot be seen as a contradiction to the hypothesis of adaptive preferences. For, as discussed above in section F, fixed preferences are a special case of adaptive preferences.

Concerning food, adaptive preferences then show up in the phenomenon that for unit periods long enough to accommodate the preference for variety we see an inter-temporal complementarity of demand for any given kind of food. People in Argentina get used to a food mix with a substantial share of meat. Vegetarians do not eat meat at all. Children don´t like to drink alcoholic beverages – and adults who never have consumed alcohol tend to dislike the taste of an alcoholic beverage. But a person who – for whatever reason – did drink alcohol as an adolescent tends to like alcoholic beverages as an adult: habit formation. It did take the Prussian kings quite some effort to induce or force their subjects to consume potatoes. But, once this was achieved, Prussian subjects, given their choice, preferred potatoes over other forms of caloric intake. Ever since Duesenberry´s path-breaking book (Duesenberry (1949) have economists been familiar with the empirically well-established phenomenon of habit formation.

The appetite-saturation cycles applies to many other goods beyond food. There is a universal taste for variety. Alfred Marshall already understood it very well that this was not in contradiction to what I call adaptive preferences. Concerning the “law of diminishing marginal utility” he writes in his Principles of Economics: “The marginal utility of a thing to anyone diminishes with every increase in the amount of it he already has. There is however an implicit condition in this law which should be made clear. It is that we do not suppose time to be allowed for any alteration in the character or tastes of the man himself. It is therefore no exception to the law that the more good music a man hears, the stronger is his taste for it likely to become; that avarice and ambition are often insatiable; or that the virtue of cleanliness and the vice of drunkenness alike grow on what they feed upon. For in such cases our observations range over some period of time; and the man is not the same at the beginning as at the end of it. If we take a man as he is, without allowing time for any change in his character, the marginal utility of a thing to him diminishes steadily with every increase in the supply of it." Marshall (1920).

As we can see, Marshall was interested in the law of diminishing marginal utility and wanted to show that, what I call adaptive preferences, do not interfere with this law. I am interested in the hypothesis of adaptive preferences and thus I show that the taste for variety (which corresponds in ordinal terms to the - cardinal - law of diminishing marginal utility) does not contradict the hypothesis of adaptive preferences.

2. <u>Random or foreseen changes in consumption constraints.</u> When it rains our consumption basket is different from the one we consume when there is sunshine. Our consumption basket in winter is different from the one we demand in summer. This is, of course, no contradiction to the hypothesis of fixed preferences. What changes through time is the set of baskets we can consume. For the case of fixed preferences all this is well understood. Given that fixed preferences are a special case of adaptive preferences weather or season or age dependent consumption baskets are also no contradiction to the general hypothesis of adaptive preferences.

   Moreover, it is interesting to observe the following: Assume there are two states of the world: rain (R) and sunshine (S). We assume the "class room model". We keep the price vector the same across the two states of nature R and S. We designate by the real number y the budget available in state R. We designate by the real number z the budget available in state S. For simplicity of presentation we call $[y; R]$ and $[z; S]$ a "basket", thereby ignoring the fact that with a given state R (or S) and a given budget y (or z) it takes time until the actual commodity basket converges to some basket corresponding to the preferences induced by that basket. For simplicity of presentation I further assume that for this given price vector preferences induced by $[y;R]$ are the same for different levels of y and, similarly, preferences induced by $[z;S]$ are the same for different levels of z. Thus, for induced preferences we can write $\rho(R)$ and $\rho(S)$. But keep in mind that induced preferences may depend on the price vector, which we keep constant for our little example.

Assume that in period Zero it rains, i.e. the state R prevails and the person has a consumption budget of y_0. We want to construct an improving path. Thus, if in period 1 R prevails the available budget must satisfy the inequality $y_1 > y_0$. If in period 1 S prevails income must be above $\hat{z}(y_0)$ where the function $\hat{z}(y)$ is defined by$[\hat{z};S](=;\rho(R))[y;R]$. Thus $z_1 > \hat{z}(y_0)$. Symmetrically let $\hat{y}(z)$ be defined by $[\hat{y};R](=;\rho(S))[z;S]$. Assume now that the state of period 2 is again R. For an improving path we then have the condition $y_2 > \hat{y}(z_1) > \hat{y}(\hat{z}(y_0))$.

Assume now that we have adaptive preferences. This implies that $[\hat{z}(y_0);S](\geq;\rho(S))[y_0;R]$. Since, on the other hand $[y_2;R](>;\rho(S))[\hat{z}(y_0);S]$ we see that $y_2 > y_0$. Let $y^*(y_0)$ be the infimum value for a budget in period 2 such that it is compatible with an improving sequence, provided that the state of nature is R in periods 0, 1 and 2. Obviously we have $y^*(y_0) = y_0$. Let $y^{**}(y_0)$ be the infimum value for a budget in period 2 such that it is compatible with an improving sequence, provided the states of nature are R in period 0, S in period 1, and R in period 2. Then, due to the inequality $y_2 > y_0$ derived above for this sequence of states we can infer $y^{**}(y_0) \geq y_0$ and thus $y^{**}(y_0) \geq y^*(y_0)$. The symmetric result can be derived, if we start with state of nature S.

The important point is that changing states of nature do not violate the proposition of Theorem 1B which says that adaptive preferences imply the non-circularity of improving sequences. On the contrary, if distinct states of nature really matter for the baskets which are being bought, and if in addition preferences are not fixed but adaptive in the narrower sense of the word which excludes fixed preferences then continuity and non-satiation and regularity assumptions imply that improving sequences are even “more non-circular” than in the case that states of nature remain the same or are irrelevant for the basket bought with a given budget. In our example, in that case we have $y^{**}(y_0) > y^*(y_0)$.

It is my conjecture that this property is a general one: in a wide class of circumstances variation in the feasibility of consumption baskets - other than variation in available budgets – maintains the conclusion of Theorem 1: adaptive preferences imply non-circularity of improving sequences.

3. <u>Inter-temporal allocation of consumption, i.e. saving and dissaving.</u> The standard model of saving and dissaving assumes the existence of a life utility function which is a weighted sum of period utilities. The problem then to be solved by the consumer is to maximize this life utility for a given inter-temporal budget constraint. In an economy in which consumers can rely on the existence of markets for all goods they can postpone the decision which particular goods to buy in the future. Then the relevant parameters for an optimal saving decision today are the inter-temporal prices (interest rates) and the income flows which jointly form the inter-temporal budget constraint together with an appropriate price index of the goods available in the future.

   In this model there exists no inter-temporal complementarity of demand for any given good. If the world were like this model and thus all consumption goods could be bought - without further transaction costs – at the time they are consumed then the computational effort to maximize the life utility would be insubstantial and thus one could realistically assume that this maximization exercise would be performed.

   In real life things are more complicated. For example, many purchases come in the form of consumer durables. Relative to buying the services of the durables every period again transaction costs are substantially lower, if one buys these durables. This then generates an inter-temporal complementarity of demand for the services of the consumer durables. If the person has consumed the services of a vacuum cleaner in the preceding period it is much more likely that she will consume these services again in the present period than if she had not consumed the vacuum cleaner services in the last period.

   This is well known in economics and does not contradict the hypothesis of fixed preferences. Here we can exemplify the difference between the traditional approach and our approach encompassing the hypothesis of adaptive preferences. Gary Becker, one of the authors of the Stigler-

Becker paper quoted above in section B, has pioneered the household production approach, which has been very fruitful for many theoretical and practical topics in economics; see, for example Becker (1993). In this household production approach one then can try to explain the inter-temporal complementarity of consumption in terms of transaction costs of market transactions. In my approach of adaptive preferences I simply state that consumer behavior is in line with the hypothesis of adaptive preferences, i.e. it exhibits inter-temporal complementarity of consumption. I do not necessarily investigate the causes of this inter-temporal complementarity.

We may consider this to be a waste of knowledge about consumer behaviour. But in normative individualism, we stick to the proposition that within a certain realm a decision or choice of an agent is legitimate simply due to the fact that it the person´s choice. It is on purpose that we look at the person with “a veil of ignorance”, as was discussed above in section C. We do not have to find out why the person makes this choice rather than any other choice within his/her choice set, because the choice taken by the person is legitimate irrespective of the causes for this particular choice.

For specific purposes of economic policy it may be useful to find out some of the causes of any particular behavior. But for a general theory on the basis of normative individualism it is sufficient to be able to corroborate the hypothesis of adaptive preferences.

Once we have accepted this point of view we then are also able to accept much more easily that – in their inter-temporal allocation decisions – people do not exactly maximize a life utility function which consists of a weighted sum of period utilities. One reason why they do not act in that way is the fact that in real life the corresponding optimization calculus is much too complex. Even with the enormous simplification of life by means of the institution of “money” and by means of the existence of a large array of reliably functioning markets there is a large gap between the real life situation and the above mentioned model of a maximisation of a life utility function. One reason for this gap is a kind of “self-destroying” tendency of the low transaction cost assumption behind this simple model: the easier it is to transact on goods markets in a money economy the more such goods markets come into being. They allow, as Adam Smith already told us, the social organisation of the highly productive division of labour, Smith (1776), Book I, Chapters 2 and 3. Transaction costs – in terms of human time expenditure – are characterised by a “rebound effect”: the lower the costs of transacting on any given market are, the more such markets arise. Thereby, in sum, transaction costs may not decline at all through historical time for the persons benefitting from these markets. The complexity of life generated by the wealth producing division of labour then makes it implausible that people could pursue their optimization in such a simple way as the additive period utility model of maximising a life utility function suggests.

Taking account of this link-up with Adam Smith´s most important proposition it is then also more productive to describe human behaviour in terms of endogenously changing preferences rather than in terms of fixed preferences or fixed meta-preferences. On the latter see the important work of Gary Becker; Becker (1996), including the Becker-Murphy “theory of rational addiction”.

Inter-temporal complementarity of demand for any given good then means that choice in the future is constrained by certain choices taken in the past. To the extent that these choice constraints are not imposed by society on the basis of “compossibility” considerations they may be seen as an expression of the preferences of the citizen. Due to the inter-temporal complementarity we then recognize them as an expression of adaptive preferences. But, apart from the “durables effect” discussed above, this inter-temporal complementarity may result from simplification strategies of the person: in order not to have to make consumption decisions anew every morning for the day the person decides to arrange his/her things in such a way that certain earlier consumption decisions are also binding for consumption baskets consumed later.

Thus, apart from hardware durables (or, indeed, software durables in the literal sense of that word – in an age of notebooks and tablets) we will also encounter many “decision durables” to reduce the amount of effort needed to make decisions. Thus, the hypothesis of adaptive preferences is supported also by the phenomenon of “decision durables” as a device to simplify one´s life.

This consideration also can be applied to the well-known fact of limited mobility of people. Generally, once a person has settled in a particular town, the probability is very high that he/she still lives in this town ten years hence. Immobility is a great device to simplify your life! And, seen from the perspective of normative individualism and adaptive preferences, it is not so important whether this resistance against changing your home town is for emotional or for purely rational reasons.

In economics the hypothesis of bounded rationality (Simon (1955), Gigerenzer and Selten (2002)) is of course well accepted by now. It ties up very well with this phenomenon of inter-temporal complementarity that I subsume under the hypothesis of adaptive preferences.

4. <u>Information Acquisition as a Byproduct of Consumption or by Search.</u>

Real life is characterized by incomplete information about the existence, the availability and the quality of goods and services. For decades the economics of incomplete information has been a thriving field of inquiry. It is obvious that under conditions of incomplete information markets do not show the same efficiency performance as under perfect information and perfect competition. The classic contributions by Stigler (1961), Arrow (1963), Akerlof (1970), Stiglitz (1976), Spence (1973) and others are known by every economist.

Economists also have thought about the consequences of the fact that consumers are aware of their imperfect knowledge concerning consumption goods. One particular point, the evolution of trademarks and reputation as an asset has been emphasized by Hayek (1946) long ago. He then argued that the build-up of a reputation for good quality was an answer to the problem of incomplete information and that this build-up was a productive part of the competitive process and thus trademarks and brands should not be seen as an obstacle to competition.

Here I do not go into the details of the welfare analysis of actual and potential markets with incomplete customer information. I am interested in the relation of incomplete information to the hypothesis of adaptive preferences. First I point to the simple fact that one way information about products is gathered is by using them. Of those products which the consumer considers to be satisfactory the likelihood of repeat buys is very high. The industrial organization literature talks of “experience goods”.

Some people will buy a new product introduced by a supplier into the market; others are not among the pioneer customers. If the product is satisfactory to those who have obtained it early on they will be repeat buyers; and this then provides a positive correlation between the distributions of purchases of that product among people yesterday and today. This then is again the phenomenology of adaptive preferences.

Moreover, psychologically, this observed inter-temporal complementarity is supported by an effect which is well established empirically: avoidance of cognitive dissonance, Festinger (1957). Once a person has decided that the product was a good buy he or she will raise his or her emotional attachment to the product. The marketing literature agrees on this point – and, of course, it is also being exploited by marketing practitioners in real life. Thus, even apart from the statistically observed inter-temporal complementarity, if you ask people about their subjective preference concerning a particular product, they will give answers which are proof of the hypothesis of adaptive preferences, here understood as an expression of customer emotions.

As I will discuss in more detail in separate work concerning inter-personal influences on preferences, the imitation of other people is a particular form of adaptive preferences. Imitation implies a similar positive feedback from actual consumption to preferences as we observe with adaptive preferences defined in this paper. But imitation of others is of course one of the main forces by which new products obtain rising sales. In this case we can speak of information acquisition as a byproduct of other people´s consumption.

We then see a strong support for inter-temporal complementarity of consumption from the information acquisition process going on as a by-product of consumption. This is in line with the hypothesis of adaptive preferences.

Incomplete information also stimulates search activities. Economics has investigated quite a few aspects of search. I only mention the work underlying the 2010 Nobel Prize for Peter Diamond (1984), Dale Mortensen and Christopher Pissarides (1994). Here I am interested in the relation of search activities to the hypothesis of adaptive preferences. Search is not without cost. And search costs limit the search activities. People may want to avoid search costs by putting a (subjective) premium on those goods they know by having consumed them. This then is exactly in line with the hypothesis of adaptive preferences.

5. Education and Schooling. Education and schooling are social activities organized by the grown-ups for their children. Children thereby acquire useful skills – one hopes – and, of course, thereby become –one hopes – better informed citizens than they otherwise would be. But parents also want to influence children´s attitudes and preferences. Without going into details I simply state that the belief of most parents in the fruitfulness of education rests on an implicit assumption that their children have adaptive preferences. Children imitate their parents. It is therefore generally accepted that parents´ own attitudes and behaviour are important for the success of education. But imitation is part of the hypothesis of adaptive preferences. Moreover, parents generally try to induce their child to perform activities of which they believe that they will make the child´s adult life a "better life", if they continue performing those activities. By inducing (forcing?) them to play the piano as children they expect thereby to influence children's tastes so they will like to play the piano when grown up. Obviously, this expectation rests on the implicit assumption of adaptive preferences. If preferences were "anti-adaptive" education, as our civilization knows it, would be inconceivable. If parents had to expect that inducing children to acquire the skill of playing the piano would induce them to dislike the piano when grown up, how could they expect to succeed in their wish that the children will play and like to play the piano when grown up? Those people who, as children did acquire the skill, don´t like to use it. Those people who, as children, did not acquire the skill, would like to use it, but can´t because they did not acquire it.

More generally: The human species is a species whose individuals live and even survive on acquired skills. That species would not exist with anti-adaptive preferences. The success of education and of training skills builds on adaptive preferences.

6. Switching Costs and the "Default Option" . For individual decisions economists and psychologists have established the quite robust fact that the "default option" has a much higher probability of being chosen as compared to a different scenario with the same choice menu but a different alternative being the default option. We can easily identify this quite general observation with our hypothesis of adaptive preferences. We only have to define the "default option" as the "basket" that is actually consumed. Moreover, as is usually the case, if the default option remains the same through time it is very likely that we observe a strong inter-temporal complementarity of choices.

   Another phenomenon frequently discussed in economics is "switching costs". If a consumer has the choice between different products for fulfilling a certain task, switching from one product to another may involve "switching costs". If you move from one flat to another one you incur moving costs. Obviously, to avoid switching costs, consumers will continue to consume the same item that they consumed before, unless a competing offer is so much superior that it is worth switching and thereby incurring the switching costs. Again we then observe strong inter-temporal complementarity of consumption.

   I put switching costs under the same heading as the "default option", because they quite naturally define a default option. It is the product consumed so far, which therefore can be further consumed without incurring switching costs. And the other way round: deviating from the default option in a decision situation implies "psychic switching costs". Again, for the result of substantial inter-temporal complementarity, it is immaterial whether switching costs are "objective" costs (whatever that may mean) or "subjective" costs which we also may call "psychic" costs or reasons for "serendipity". On switching costs see the survey article by Farrell and Klemperer (2007).

S Adaptive Preferences as a Result of Evolution

Theorems 1 and 2 tell us about the close relation between adaptive preferences and the non-circularity of improvement sequences. Under certain assumptions non-circularity of improvement sequences implies adaptive preferences; and adaptive preferences imply non-circularity of improvement sequences. I start this section with a thought experiment: what would happen, if preferences were "anti-adaptive"? For this purpose I first refer to one effect which is a salient confirmation of adaptive preferences: the "endowment effect". It has been shown in many experiments that valuation of a particular object, say, a coffee mug, is higher, if by accident the person owns that object than if – by accident – the person does not own that object. It is a striking refutation of the homo oeconomicus hypothesis that preferences always are exogenous. At the same time it is a good example of adaptive preferences: if the status quo is ownership of the object I have a higher preference for it than if the status quo is that I don't own the object.

Assume now – contrary to experimental evidence – that preferences are anti-adaptive. Take the following example. I own a piano. I am prepared to sell the piano for € 500.--. So I sell it for that price. Now, because my preferences are anti-adaptive, I value a piano of the same quality at more than € 700.--. So I go and buy a similar piano for € 700.--. I am now back at my original state – except that I am € 200.-- poorer than I was originally. Now somebody comes along and gives me € 200.--. Thus, I am now back to the point from where I started. Each transaction was an improvement. Otherwise I would not have agreed to it. So I have walked an improvement sequence and I came back to my original position. That improvement sequence was circular.

Not only does this sequence of events shed some light on my limited degree of rationality. It also implies that others have made a profit at my expense. Someone has pocketed the € 200.—which I lost in selling and then buying again my piano. If preferences generally were anti-adaptive we would expect that a class of arbitrageurs arises who make a living out of exploiting anti-adaptiveness of preferences of the general public.

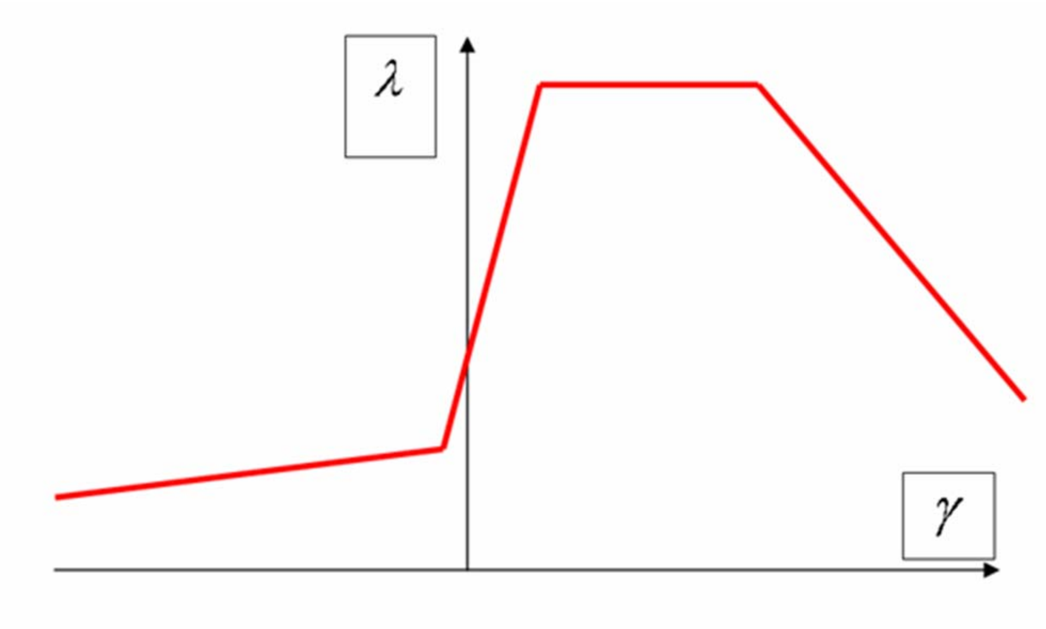
We would not expect this to be a stable state of affairs. Anti-adaptive preferences are unlikely to survive. We would expect at least two mechanisms by which anti-adaptive preferences will be extinguished. One is individual and social learning. A person experiencing downward spiraling "improvement sequences" again and again eventually understands that, in some sense, his/her behaviour is not rational. He/she would expect to be a happier person if he/she changed his/her behaviour. From the outside, from the point of view of normative economics this change in behaviour due to learning is considered a change in preferences. In our language, there is a tendency for a change in the "law of motion" of preferences in the direction of adaptive preferences.

The other, much slower mechanism that extinguishes anti-adaptive preferences is evolution in the biological sense of that word. Through the history of mankind up until, but excluding very modern times, there was a competition for survival similar to the Darwinian principle of the "survival of the fittest". High birth rates and high infant and adult mortality due to under-nourishment, due to infectious diseases, due to violence and civil war were the rule rather than the exception. The "laws of motion" of preferences must have been formed very much by this competition for survival. In this competition among different laws of motion of preferences, anti-adaptive preferences must have been rather unfit for promoting the survival of its human bearers. As such humans equipped with anti-adaptive preferences were potential prey of clever exploiters, their lot –other things equal – must have been much worse than that of people with adaptive preferences. Their and their offspring's chances of survival must have been much inferior to those people with adaptive preferences.

Fixed preferences are the borderline case between adaptive and anti-adaptive preferences. Consider some parameter γ which determines the degree to which preferences are adaptive ($\gamma > 0$) or anti-adaptive ($\gamma < 0$) or in between, i.e. fixed ($\gamma = 0$). Assume now that the basic unconstrained development of γ is a random walk with expected value of zero for the rate of change $\Delta\gamma$. But different values of γ have different survival values for its bearers. Let the survival value $\lambda(\gamma)$ be small for $\gamma < 0$, large for a range of positive values of γ and then again small for very large values of γ. We then could compute the ergodic frequency distribution of γ. Its main mass will be in the positive range of γ and its average will be positive.

Figure 5

$\lambda(\gamma)$ survival value of the "degree of adaptiveness" γ

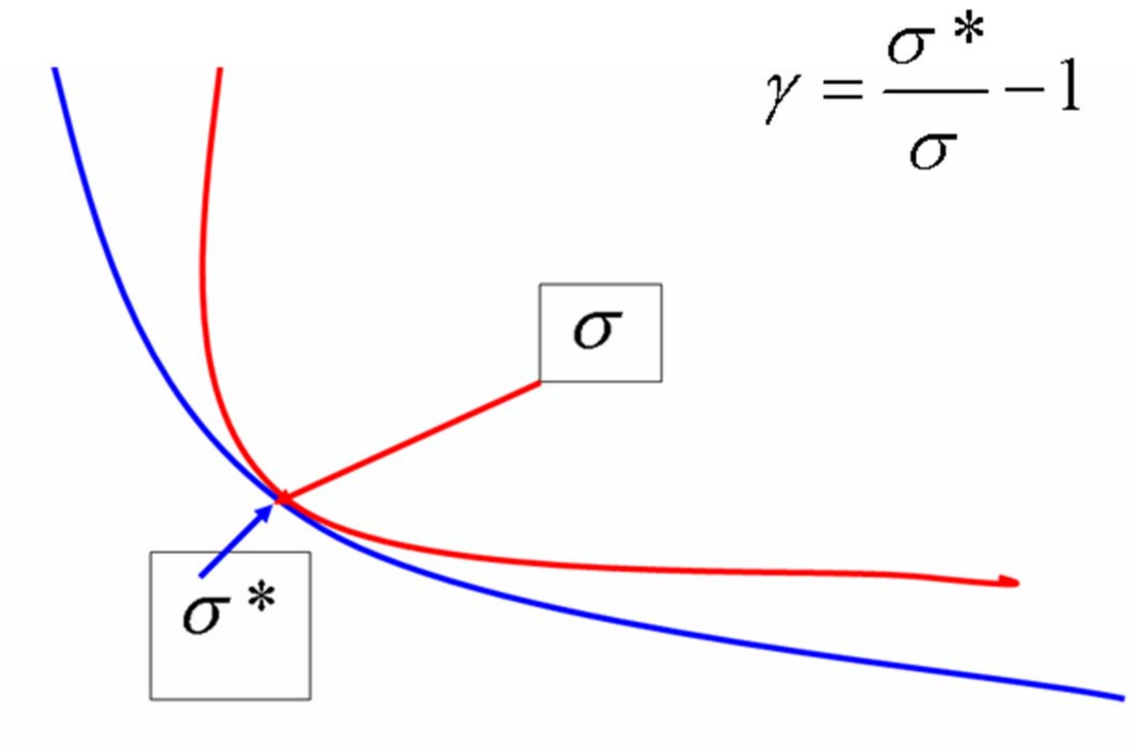


In the case of two commodities ($n = 2$) we can define γ in the following way: Let σ be some kind of appropriately weighted average of the elasticity of substitution of the indifference curves corresponding to preferences q and baskets x. Let $\sigma *$be some kind of appropriately weighted average of the elasticity of substitution of the quasi-indifference curves for given baskets x. These are the quasi-indifference curves derived in Theorem 2. They can also be constructed for anti-adaptive preferences. Here their economic meaning is "the opposite" of the meaning in the case of adaptive preferences: it indicates which basket can be reached from which other basket by means of a "deterioration path". We can show in the case of "smoothly anti-adaptive preferences" that deterioration paths are non-circular. The adaptation parameter γ then can be defined by the following formula

$$\gamma = \frac{\sigma^*}{\sigma} - 1$$

With adaptive preferences the indifference curve going through some point x with preferences $\rho(x)$ induced by x lies above the quasi-indifference curve going through x. Hence the long run demand function is more elastic than the short run demand function, which means that σ^* is greater than σ at this point. The adaptation parameter then is a kind of average of the coefficient between the long run and the short run demand elasticity, minus one.

Figure 6: Short run and long run elasticity of substitution



In the case of anti-adaptive preferences the long run demand function is less elastic than the short run demand function: if due a change in relative prices demand for one good goes up and demand for the other good goes down anti-adaptive preferences have the effect that the relative taste for the good now more consumed goes down, and hence there is a swing-back of demand due to the preference change. This then implies that $\sigma^* < \sigma$ and therefore $\gamma < 0$.

Part III Welfare Economics for a Free Society With Adaptive Preferences

T Understanding the Framework for Freedom

As I already discussed in section D, a free society needs constraints of individual behaviour so as to make rights of individuals compatible, or, as Steiner called it, “compossible”. There are, however, at least two different forms of “compossibility” of rights. One form we may call “strict compossibility”; the other form we may call “pragmatic compossibility”. The idea is that within the realm of the individual rights the agent is free to act as he/she pleases.

Strict compossibility, as I define it, means that the architecture of individual rights is such that, in whichever way each agent makes use of his/her freedom, these actions do not interfere negatively with the freedom of the other citizens.

Pragmatic compossibility is a weaker form of compossibility. Its definition is somewhat more complicated. But, as I shall argue, it is the form of compossibility which reasonably can be asked for. Here, even before defining it precisely, I want to point out the following: since pragmatic compossibility is a much weaker requirement than is strict compossibility the rights which can be granted to the different citizens under pragmatic compossibility can be much broader than the rights which can be granted under strict compossibility. Indeed, under strict compossibility people would only have very few rights.

Take the use of cars with a given road infrastructure. If people who have a car can use it as they like without interfering with other people´s rights, then very few people indeed could own the right to drive a car. This would be the case of strict compossibility. If the use of the roads for car drivers is subject to certain rules like obeying the commands of traffic lights, speed limits, prohibition to drive a car after having consumed alcohol etc. many more people can use a car. But even then there are certain negative externalities which one car driver imposes on other car drivers. If too many people drive at the same time there will be traffic jams. And experience tells us: traffic jams are a rather regular occurrence. There may be accidents, even fatal accidents affecting people who have obeyed all traffic rules etc. The actual driving rules, as experience shows, make it possible to grant driver licenses to a large number of people, thereby enhancing rights to act legitimately within one´s constraints defined by these rights. Provided we consider them to be satisfactory we then see the actual rules of the road as an example of “pragmatic compossibility”. And it is an example for the proposition that pragmatic compossibility generates much greater freedom of action for citizens than does strict compossibility. But it does so by accepting the fact that there *are* negative externalities suffered by any one driver from other drivers.

Traditionally economics has made the distinction between physical and pecuniary externalities. The latter were considered immaterial concerning the goal of an efficient allocation of resources. The former were considered to be detrimental for an efficient allocation of resources. That theory was “pre-Coasian”. Markets in that model operated competitively and did not generate any transaction costs. Following Coase (1960) and taking account of transaction costs we no longer can consider the existence of physical externalities to be necessarily an indicator of inefficiency. On the other hand pecuniary externalities in real life may cause inefficiencies (Greenwald and Stiglitz (1986). For many questions it is then no longer adequate to draw this sharp distinction between physical and pecuniary externalities.

Before defining pragmatic compossibility I refer to the well-known paradigm of the Walras-Arrow-Debreu General Equilibrium and its property of pareto-optimality. We note that “rights” allocated to the agents in this model do not satisfy “strict compossibility”. Each agent has the “right” to buy and sell as many goods as he/she wants, provided the budget constraint is satisfied. But of those different budget-wise feasible consumption baskets of any given agent only a small subset - generally only one basket of those exhausting the budget – is “compossible” with the consumption baskets of the fellow- citizens. The general compossibility of the actions of the agents in the Walras-Arrow-Debreu world is only provided for those actions of the agents which they actually choose, given their constraints and given their preferences. Thus, already in the basic paradigm of traditional welfare economics the strict compossibility criterion is rejected.

To come to the definition of pragmatic compossibility I further observe the following property of the Walras-Arrow-Debreu general equilibrium and its associated allocation. An easy way to show this general property is to assume a pure exchange economy. For ease of presentation I assume that for any given set of initial allocations and any given set of preferences there exists a unique Walras general equilibrium. For any given preferences the corresponding Walras general equilibrium is pareto-optimal. Assume now a set of preferences, called “preferences 1”. The corresponding Walras equilibrium may be called "equilibrium 1". Assume further for citizen A alternative preferences different from those he has in the "preferences 1" case. We then define a set of "preferences 2": here citizen A has those alternative preferences and all the other citizens have the same preferences as in "preferences 1". We then have a different Walras equilibrium, called "equilibrium 2". We compare the (ordinal) utilities in the two equilibria, i.e. we compare the "real incomes" of the citizens. Let p^1 be the price vector prevailing in equilibrium 1. Let p^2 be the price vector prevailing in equilibrium 2. Since in a Walras equilibrium equilibrium prices are only defined as relative prices we always can set the two equilibrium price vectors such that the equation $p^1 x = p^2 x$ is fulfilled, where x is the total consumption vector of the economy, which is the same in the two equilibria.

In terms of price vector p^2 let Δy_i be the change in real income of citizen i as the economy moves from equilibrium 1 to equilibrium 2. By this we mean the negative of the change in income citizen i would require to keep his utility constant. Let $x^i(1)$ be the demand basket of citizen i in equilibrium 1. It is then clear that $\Delta y_i \geq (p^1 - p^2)x^i(1)$. For, if Δy_i were equal to $(p^1 - p^2)x^i(1)$ then, if citizen i would receive $-\Delta y_i$ as compensation for the change in prices then he/she could buy the old consumption basket he/she has consumed in equilibrium 1. The inequality $\Delta y_i \geq (p^1 - p^2)x^i(1)$ also applies to citizen A, if we apply his new preferences. Let $\Delta y = \sum_{i=1}^{m} \Delta y_i$ be the sum of real income changes for all citizens. We then obtain the inequality $\Delta y \geq \sum_{i=1}^{m} (p^1 - p^2)x^i(1) = (p^1 - p^2)x$=0. Thus, applying "preferences 2" we see that the changeover from equilibrium 1 to equilibrium 2 raises real income of the economy in terms of prices prevailing in equilibrium 2.

But similarly we show that this result also obtains if we define real income changes in terms of prices prevailing in equilibrium 1. In deriving that result we simply have to replace the consumption basket consumed in equilibrium 1 used above by the consumption basket consumed in equilibrium 2. Obviously, it is then also possible to show that real income rises from equilibrium 1 to equilibrium 2 in terms of any price vector $p^\lambda = \lambda p^1 + (1-\lambda)p^2$, 0$\leq \lambda \leq 1$, which is a mixture of the price vectors of the two equilibria.

We then see that changes in demand of one agent due to his/her change in preferences raise real income in the economy. The potential loss in real income resulting for the other agents is smaller than the gain (in terms of the "new" preferences) in real income of the agent whose preferences have changed.

Within the Arrow-Debreu framework of general equilibrium this result can be generalised to the case of production. Indeed this can be easily seen by the fact that we can consider producing firms in this model as add-ons of consumers. We may see production as “negative consumption”. The shareholder of the producing firm who is an agent with an ordinal utility function then is an “extended” consumer with an “enriched” initial endowment where the “enrichment” consists of his proportional part of that firm. In a sense, we turn the idea of “household production” (of the positive economics approach developed by Becker) upside-down by looking at production as if it was (negative) consumption.

But the generalization can also be shown directly by working through the Arrow-Debreu calculus of consumption and production. A special case which is easily understood is the case of a single original factor of production which we may call labour. Moreover we assume absence of joint production of different goods. This then is the “labour theory of value” economy where final consumption goods bear prices in proportion to the direct and indirect labour content of their production. Here a change in tastes by any one consumer does not affect market prices of consumption goods. Only the quantities of the goods will change in accordance with the new preferences. People whose preferences have not changed are not affected by this change in demand. And the change in demand by the others raises their income relative to the equilibrium that prevailed before the change in tastes and demand took place.

For our aim to find a reasonable definition of “pragmatic compossibility” we now can conclude: in the paradigm of Walras equilibrium and pareto-optimality we find that changes in the behaviour of any given agent A within his/her realm of granted “rights” have an impact on other members of society that is more favourable than the negative of the gain for agent A from this change of behaviour. I then use this criterion as the general criterion of “pragmatic compossibility” of rights. But pragmatic compossibility has further to be construed to be compatible with the constitutionally granted “basic rights”. They are an additional barrier against interference of one citizen with another one. I then define

<u>Definition 11:</u> Granted basic rights of every citizen, a sufficient condition for the rights of the citizens of a society to be <u>pragmatically compossible</u> is satisfied if the following holds: a change of behaviour of any given citizen within the realm

of his/her rights provides at least as great an advantage to this citizen as the negative of the byproduct of this change to his/her fellow citizens.

Note that this is a *sufficient* condition for compossibility in the pragmatic sense. We would not expect that the concept of freedom (in terms of compossibility) can be completely captured by this income criterion. More on this below.

To put this sufficient condition of compossibility in different words: Mr. A changes his choice within the realm of his rights. He does so, because his preferences have changed – and the new choice suits his changed preferences. The sum of side effects he thereby imposes on others may either be positive (in monetary terms) or, if it is negative, it is so small in absolute value that his own benefit from the change is larger than the absolute value of the sum of side effects on others.

We thus do not require that any change in behaviour of a given person only has positive or at least non-negative effects on all other citizens. Negative effects on others of any change in behaviour remain compatible within a pragmatic regime of free people, and they are justified within the realm of compossible rights if the benefits of this change of behaviour outweigh the costs.

This idea of pragmatic compossibility of rights is of course related to earlier work by economists, in particular their critique of Hayek´s definition of liberty as the absence of coercion (Hayek (1960)). One example of this critique is Stigler (1978). See also Schmidtchen (2004), where a more detailed argument is developed.

Common sense tells us that pragmatic compossibility as just defined is more in line with the common meaning of freedom than would be the strict compossibility criterion. Any society, but in particular a free society, is characterized by lots of competitive situations. This holds not only in economic matters in the narrow sense of this word. It is a characteristic of everyday life. If John loves Mary and Robert loves Mary we would consider it Mary´s freedom to decide whether to live with John or with Robert or with neither. If she decides to live with Robert then John suffers a setback as compared to the situation where Mary had not yet made up her mind. This kind of “negative externality” in matters of personal live is unavoidable in a free society.

In economic matters economists and perhaps other people consider it a good thing that suppliers compete with each other. Indeed, anti-trust law is here to promote this competition. Typically, and in contradiction to the model of perfect competition, competing suppliers sell at prices which are above marginal cost. They make substantial efforts to sell their wares (advertising, marketing, hiring a sales force etc.). If customer C has to make up his mind whether to buy from supplier A or from supplier B then we are in a typical situation where the freedom of the customer to decide which supplier to prefer will end up in disappointment by that supplier who was not chosen.

Whenever the freedom of choice of an agent involves the choice between different persons eager to be chosen then any given decision of the agent causes harm to those persons who were not chosen.

The distinction between actions that are within the boundaries of pragmatically compossible rights and actions that are not within these boundaries then is generally provided by the criterion of gain or loss to society at large. Thus, in contrast to economic competition, robbery is not within those boundaries. The gain obtained by the robber is not only compensated by the loss of the person being robbed, but overcompensated by the incremental costs of preventing being robbed, if robbery were legal. Also, unregulated monopoly does not fit the criterion of pragmatic compossibility. I discuss this case in more detail below in section V.

It is obvious to the economist that this principle of pragmatic compossibility has a certain vicinity to the well-known efficiency criterion by Kaldor-Hicks-Scitovsky. They apply this criterion to government legislation or executive action. Here I apply the criterion of net gain in terms of real national income to derive a definition of pragmatic compossibility. As will be seen later this confluence of criteria helps us to develop a foundation of welfare economics within the framework of a market economy.

The important point concerning this concept of pragmatic compossibility is that society or its appointed agents do not own a calculating machine which allows them to compute gains and losses of any kind of actions and thereby allows it to define rights which are compossible. The reason I call this compossibility criterion “pragmatic” is that it is mainly by experience, as society evolves, that law-makers obtain some reasonable, but never perfect judgment about the kind of arrangements that are compossible according to this criterion of net social gain from any change in a person´s behaviour.

It is this “pragmatic” point of evolving experience that leads me back to the main topic of adaptive preferences.

But before we get there I want to emphasize that a free society is characterised by many unalienable rights, be they in the form of legally adopted human rights, be they in the form of constitutionally protected rights like the USA “Bill of Rights” of the first ten Amendments, or like the “Basic Rights” of the German Constitution. These rights mainly are meant as a protection of citizens against encroachments of their liberty by government. As such they are important constituents of a free society. Yet they may be seen as a limitation of the principle of pragmatic compossibility as defined here: a particular government action or law may violate one of these basic liberties and yet raise total real income in this State. Such conflict between these basic rights and the principle of pragmatic compossibility can be interpreted differently.

Either we say: pragmatic compossibility is one limit of rights of individuals, but there are others like the basic constitutional rights, which further limit one person´s right to interfere with the affairs of other persons. Or we say: given the complexity of social life and the inability to reach consensus about the probable effects of action by government, basic rights are a safeguard against erroneous majority beliefs about the benefits and costs of any change in law instituted by government. Thus, these basic constitutional individual rights can be seen as being consistent with the principle of pragmatic compossibility – taking account of the obvious difficulty of reaching consensus about the effects of any new legislation. Both interpretations have the effect that my theory definitely is not a plea to abolish constitutionally protected individual rights against encroachments by the government.

We may also consider constitutionally protected individual rights as a feature of a society which follows Karl Popper´s incrementalism, which he calls “piece-meal engineering” (Popper (1945), Chapter 9). We do not have a consensus about a total picture of an ideal society. According to Popper, belief in such consensus would be totalitarian and thus would be the opposite of an “open society” or a free society. The way a free society runs its common affairs is by incremental steps away from the status quo, by piecemeal engineering. Such steps may turn out to be in error and may turn out to be the opposite of improvement. Then society must have the opportunity to reverse such incremental steps. Open society is a society guided by the principle of reversibility. But then constitutionally protected individual rights are a safeguard against steps which in a profound sense violate the principle of reversibility.

Although “social justice” is not a topic of this paper I want to add the following thought concerning the principle of pragmatic compossibility. Distributional justice has been introduced into formal theory, among others, by Atkinson (1970). The Atkinson welfare function incorporates “society´s” idea of the trade-off between average wealth and a more equal distribution of wealth. For a society of m citizens it looks like this $W = \sum_{i=1}^{m} U(y_i)$ where y_i is real income of person i and the function U reflects the trade-off between a higher average real income and its more equal distribution. A linear function U would correspond to society´s goal of maximizing average real income irrespective of its distribution. A concave function U would represent society´s concern about distribution. The stronger the “degree of concavity” the more important are distributional concerns relative to the absolute level of real income. There is, it appears, nothing which prevents us from defining the principle of pragmatic compossibility in terms of $U(y_i)$ rather than y_i as I have suggested above. (In a different paper I want to show why – again for pragmatic reasons – we still need the conventional criterion of Kaldor-Hicks-Scitovsky-efficiency improvement, even if we basically agree to pursue a policy according to the Atkinson Welfare function, say, in the framework of an optimal income tax, as developed by Mirrlees (1971)).

Freedom includes the right “not to cooperate”. And this is a right which is fundamental. But it may be in conflict with the income criterion for compossibility which we discussed above. Because of this conflict I say that the income criterion is only a sufficient condition of compossibility, not a necessary one. Assume the paid work of a person -like, for example, a doctor- generates positive externalities. Then his/her decision to reduce or to end the supply of this work may reduce the economy`s real income. But our understanding of personal freedom obviously would consider it to be the right of the person to reduce his/her workload. Economists may argue that this inconsistency of freedom with the income criterion is due to a “false” wage system. The doctor is underpaid, they could say. But this counterargument only would be valid, if it were possible that everybody in the economy could obtain a monetary income which equals his/her marginal product. But this may not be the case. We may be in a world in which even at a macro-level economies of scale prevail, particularly due to the production of public goods like new knowledge. It is then impossible to internalize all positive externalities- even if we were able to use non-linear pricing at a large scale.

U The Framework for Freedom and Adaptive Preferences

Ours is not a world of Walras general equilibrium. It is quite complex and obviously difficult to analyse. We do not have a general equilibrium model of the world. We cannot in every detail predict what the results of certain private and public actions are. We cannot predict with certainty what the impact of some proposed legislation is. We cannot predict with precision the consequences of a product innovation.

But we do observe regularities in the social process. We do observe that the behaviour of people is characterised by a certain degree of constancy. In deciding politically what kind of laws to pass, what kind of public administration to organize we rely on our ability to extrapolate more or less stable patterns of behaviour which we have observed in the past.

As things change and as experience with the prevailing law becomes richer society or its politically elected majority will have a tendency to change the law so as to improve things. One of the drives to change the law is the hope that it is possible to enhance the freedom of people within the framework of the principle of compossibility. In this permanent attempt to improve the rights of people one is guided by the observed behaviour of the citizens under the already prevailing law. Thus, it is factually observed behaviour of people which guides the evaluation of proposed legislation. Behaviour which would have been legitimate under present or past law but which was never or only rarely observed is unimportant for the evaluation of proposed new law.

Economists see the link between observed behaviour and preferences. It is the principle of revealed preference. Thus, not only is observed behaviour important for the prediction of the effects of new legislation. Important is also the presumption that observed behaviour was preferred by citizens over other alternative behaviour which also would have been legitimate under prevailing law. Thus one can also use observed behaviour for answering the question: what is it that people want from the legislator?

I do not go into the details of the question: what do we really mean when we say we learn from observation and experience as regards human behaviour. Only a short remark: Extrapolating any observed behaviour into the future implicitly or explicitly requires the description of behaviour in terms of categories and requires a language which allow us to say which behaviour was “the same” as the one that was observed earlier under different circumstances. Thus, abstraction, “theory” are always involved in the extrapolation of observation. In an age of thriving research in the different behavioural sciences it is definitely the case that expertise in these fields has a strong influence on legislation.

Obviously, there are differences of opinion about what the experience of the past tells us. Political controversy about the effects of actual and proposed laws is the normal picture of public life. Basic rights like freedom of speech serve the function for the public to get a “full picture” of facts and opinions on any proposed legislation. Other general principles and basic rights like equality before the law or procedural fairness in conducting any trials and procedures before judicial courts and administrative bodies also belong to any institutional set-up of a free society. All this has of course been extensively discussed in the literature.

The special point I want to make is the one about adaptive preferences. If the principle of pragmatic compossibility is the guideline for legislation in a free society and if it is experience of the past which guides predictions about the effect of any legislation then one implicitly assumes that preferences are adaptive. Indeed, if preferences of people were anti-adaptive then it would be very difficult to extrapolate their behaviour. In the passing of time preferences then would turn against whatever the agent had preferred to do in the past. Behaviour then would change all the time – and thus could not be well predicted. Also past preferences then would not be a good indicator of future preferences.

Like in the case of schooling and education the principle of pragmatic compossibility would not work with anti-adaptive preferences; and social life as well as legislation would be very difficult indeed. The historical fact that free, democratic societies have prospered and have shown superior performance over other kinds of societies is proof for me that preferences of people are adaptive and that thus their behaviour is reasonably well predictable.

Theorems 1 and 2, which we discussed in detail above, are an additional support for the hypothesis that pragmatic compossibility only can work if preferences are adaptive. Without adaptive preferences, Theorem 2 tells us, we might encounter improving sequences which are circular. We could not rely on our basic democratic belief that progress can be expected through time. Without such belief democratic politics would become quite difficult. On the other hand Theorem 1 tells us that the prevailing mode of incrementalism is on the right track. Small, consecutive improvements in science, the economy and legislation add up to improving sequences which are true improvements and not spurious. All these implicit assumptions of our democratic system then can be seen as part and parcel of a world characterised by the prevalence of adaptive preferences.

V Avoiding Stagnation When Preferences Are Adaptive: Partial Equilibrium Analysis Remains Valid

1. Introduction

A free society is characterised by decentralised decision making. One of the main tasks of welfare economics is to show the superiority of a system of decentralised decision making over a system in which a government takes all the important decisions in the interest of the common good. How does one show and to which extent can one show this superiority of decentralised decision making? One of the most important parts of this task is the analysis within a partial equilibrium framework. Frequently this partial equilibrium modeling takes the form of cost-benefit analysis.

Cost-benefit analysis is not only a theoretical exercise. It is used all the time in policy making, but also in private decisions by individuals or firms or associations. It is a method, which intellectually isolates certain parts of the world from the rest of the world and then concentrates on these parts, which appear to be relevant for the issue at hand. Parliament has to decide whether to change a certain law. A firm has to decide whether to make a certain investment in order to enlarge its production capacity. A Schumpeterian entrepreneur has to decide whether to introduce an innovation in the market. An individual has to decide whether to accept a certain job offer or not.

The "rest of the world" generally is represented by the money involved in the particular decision. It is "money" and market prices which make sure that the wider context of the particular decision is taken account of (Hayek 1945). To the extent that this kind of representation of the interdependence of everything with everything is appropriate, the "*money form*" of this representation makes decision taking vastly simpler than it would otherwise be. This simplification is the prerequisite for a world in which a very large number of decisions can take place simultaneously. Without such simplification the number of feasible simultaneous decisions would have to be very much lower. Society could not have obtained its present degree of complexity and could not draw on its present high degree of the division of labour. Without the money form of representation of the wider world, the default option, i.e. the status quo bias in the form of "non-decision" would be absolutely dominant. As far as I can see, economics so far lacks a mathematical model that describes this liberation from the status quo: by the money form of decentralisation. I believe that such a model could be constructed by using ideas developed by Herbert Simon in his article "The architecture of complexity", i.e. by using his concept of "*near-decomposability*". On this see also Simon, Fisher, Ando (1963).

Economists have investigated the conditions under which it is appropriate to do this partial equilibrium exercise which is involved in any cost-benefit analysis. The general presumption here is the all-round existence of reasonably competitive markets. Without going into the details of these analyses it is so far clear that they all rely on the assumption that members of the economy are people who maximise an ordinal utility function which is exogenously given.

In this section I indicate that one can generalise cost-benefit analysis to the case of adaptive preferences. I do not present a full theory, which would require a voluminous book.

2. A Simple Example

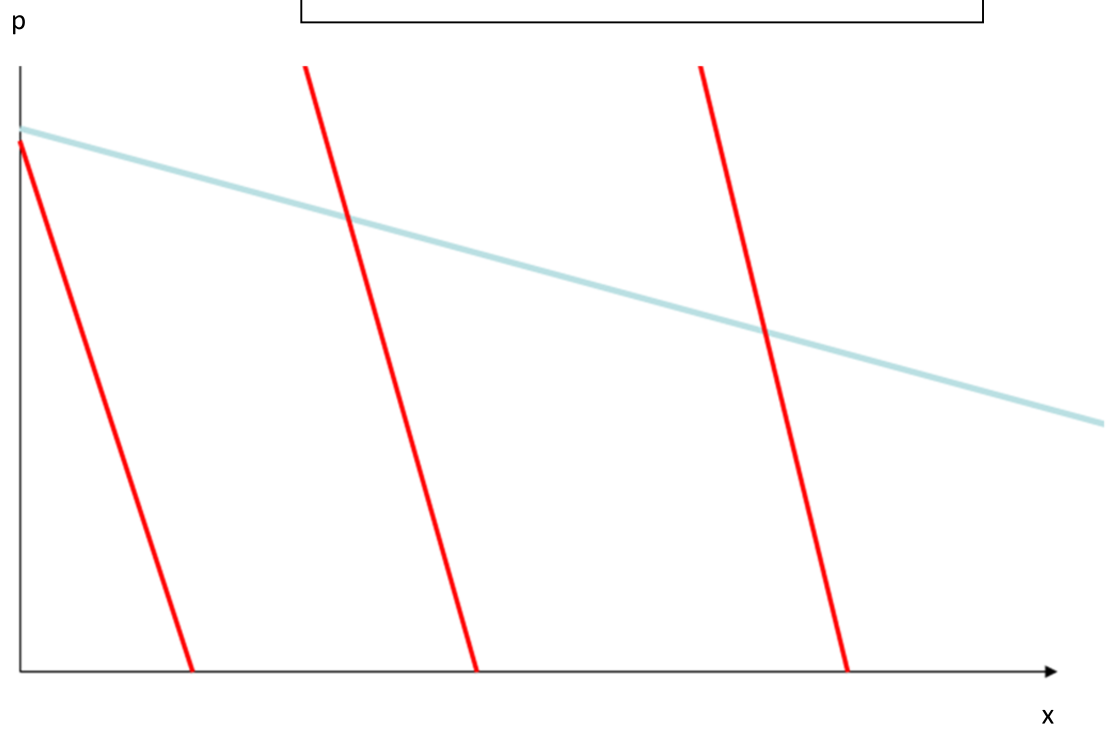
I begin with a simple example. Consider the case of a product innovation or the construction of a new bridge across a river. Traditionally cost benefit analysis proceeded by estimating the benefit from the new product by means of the integral under the demand curve for the new product. The cost then is the monetary cost of providing the new product. This procedure is correct under the assumption that there are no strong side effects on the relative prices of other goods. Can we carry over this cost benefit analysis to the case of adaptive preferences? For this simple example I make the same simplifying assumptions which are made in the traditional procedure. In particular I assume that relative prices of other goods approximately remain the same. The test of whether cost benefit analysis remains valid under adaptive preferences is the following.

The decision to go ahead with the project is taken with "ex-ante preferences", i.e. with preferences as they prevail before the decision to go ahead with the project. Can the project be justified afterwards with "ex-post preferences", i.e. with preferences that have changed due to the project? If this is the case then we say that cost benefit analysis remains valid with the feedback from the project to the preferences that provide the measuring rod for the value of the project.

Note that this test is "one-sided". If the project is accepted with ex-ante preferences we ask whether it is also justified with ex-post preferences. We do not ask the question: if the project is rejected with ex-ante preferences would its rejection also have been justified with ex-post preferences that would have prevailed, had the project been undertaken. The reason for this one-sidedness is clear: we have no way to find out precisely what the hypothetical ex-post preferences with the feedback of the project on preferences would have been, if the project is not undertaken. But we do know the ex-post preferences, in case the project is being undertaken. Thus a "preference controlling" of the project, if it has been undertaken, is possible. I return to this one-sidedness issue below.

For simplicity of presentation I concentrate on the "yes-or-no" question: should the project be implemented or should it not? I thus ignore the question: if there are different variants of the project, which one –if any – should be implemented?

Figure 7: Dupuit´s Bridge With Adaptive Preferences



This figure provides the argument that in this simplified setting cost-benefit analysis continues to work, if we go from fixed preferences to adaptive preferences. The most leftward demand curve applies for ex-ante preferences. If the project is implemented and the product generated by the product is sold at a particular reasonable price there is positive demand for the product. Due to their adaptiveness preferences change so that the demand curve for the new product shifts to the right. The blue curve is the "long run demand curve" which accounts for the preference changes induced by a certain price of the new product. The shift of the red demand curve to the right obviously means that the consumer benefit from the product rises relative to the one expected with ex-ante preferences. Thus ex-post preferences justify the project if ex-ante preferences did. In this sense our one-sided test for the validity of cost-benefit analysis is positive.

We note explicitly that the validity test for cost-benefit analysis would fail, if preferences were anti-adaptive. For, then the implementation of the project would induce a shift of the demand curve to the left. Thus the expected consumer benefit of the project would be larger with ex-ante preferences than with ex-post preferences and thus there is no guarantee that ex-post preferences justify the decision to offer the product taken under ex-ante preferences. (Without being relevant for the real world we can state the mirror image "one-sidedness" of the cost-benefit test, if preferences were anti-adaptive: if ex-ante preferences indicate a "no" to the project then the hypothetical ex-post preferences in case the decision had been "yes" would confirm that "no" was the right decision).

3. A Theorem for the General Case

In my thought experiment concerning the new project like a bridge I have made a simplifying assumption, namely that the initial preferences are those preferences which are induced by the pre-project consumption vector. This assumption enables us to predict that adaptive preferences will shift the demand curve to the right after the bridge has been built. In the real world this assumption does not always hold. The consumption path of the past was not always constant and preferences did not always have time to catch up fully with the changes in the consumption baskets of the citizens. Actual ex-ante preferences then are a kind of (exponentially) weighted average of those preferences which are induced by the different consumption baskets of the past. (This is a mathematically correct statement in the case that the "law of motion" of preferences $\dot{q} = f(x; q)$ is a linear vector differential equation in terms of commodity baskets).

As in the simple example discussed above I concentrate on the case that there is a "yes or no" issue. Let $x(t)$ be the development of the "default" consumption basket through time. It is consumption of the economy in the case the project is not undertaken. Let $y(t)$ be the consumption basket expected to occur if the project is undertaken. Then $y(t) - x(t)$ is the contribution of the project from an ex-ante view. It is this expected contribution which justifies the project. We then also speak of $y(t)$ as the "ex-ante basket". Let $z(t)$ be the basket as it really develops if the project is implemented. We then also speak of $z(t)$ as the "ex-post basket". Let $q(t)$ be the preferences of the citizens through time in the "default case", which is $x(t)$. Let $r(t)$ be the preferences of citizens through time, which come about, if $y(t)$ were the consumption basket. Let $s(t)$ be the preferences of the citizens through time which actually develop, if the project is undertaken.

The vectors $x(t)$, $y(t)$, and $z(t)$ are of dimension $n \, times \, m$, where n is the number of distinct commodities and m is the number of citizens in the economy. We assume that the decision about the project is made in time $t = 0$. We then describe the development of preferences by the initial condition $q(0) = r(0) = s(0)$ and by the differential equations $\dot{q} = f(x; q)$, $\dot{r} = f(y; r)$ and $\dot{s} = f(z; s)$. Moreover we have $z(0) = y(0) = x(0)$.

By traditional analysis the project should be undertaken, if $y(t)[>; q(t)]x(t)$. Here the preference relation $[.\,;.]$ refers to the "social preferences" to be explained below. Frequently, the decision maker is a firm which tries to make a profit out of the project – and it is the big "invisible hand" topic of traditional welfare economics under which conditions the profit orientation and the welfare orientation of the decision maker lead to the same result. To the extent that there are discrepancies in this respect in the traditional approach these discrepancies may carry over to the case of adaptive preferences. These discrepancies are not the topic of this paper. Rather I concentrate on the question: assume that under ex-ante preferences $q(t)$ the right decision has been taken to implement the project, is it also the right decision under ex-post preferences?

Before I continue I have to discuss the concept of "social preferences". Under normative individualism such "social preferences" have to be derived from individual preferences. But in addition some aggregation device is needed. The theory which I try to develop here is distinct from the traditional Bergson-Samuelson concept of a social welfare function. There, as discussed in detail by Samuelson (1956), the social welfare function makes different consumption baskets of the economy at large fully comparable. Bergson and later (in a generalised form) Samuelson show how one can derive such a social welfare function from the given preferences of the citizens. In the case of the Samuelson welfare function an additional "collectivist" aggregation device is needed.

Economic policy pragmatism did not make very much use of the Bergson-Samuelson concept. What has become important in the context of practical applications like cost-benefit analysis is the Kaldor-Hicks-Scitovsky criterion of incremental real income for the population at large. My approach shares this incrementalism with Kaldor-Hicks-Scitovsky. This is also in line with Popper´s philosophy of "piece-meal-engineering" that he proposes for an open society, which I interpret to be closely related to the concept of a free society. The latter concept I pursue in this paper.

This means that "social preferences" are not a concept apart from and in addition to individual preferences. Rather they are a mirror of these preferences within the framework of compossible individual rights.

As I use the concept in this analysis "social preferences" refer to paths of consumption baskets $x(t)$ and $y(t)$. They then are of the form $y(t)[>;q(t)]x(t)$. By this we mean: given the path of preferences $q(t)$, $t \geq 0$ society prefers the consumption path $y(t)$ over the consumption path $x(t)$.

In particular, therefore, "social preferences" need to satisfy the

<u>Axiom: Freedom Consistency of Social Preferences:</u> Let $x(t)$ and $y(t)$ be two paths through time of consumption baskets. Assume that individual rights are (pragmatically) compossible. Initial conditions and initial property distributions are given. Let the prevailing preferences be $q(t)$. Let $\hat{q}(t)$ be alternative preferences. Assume that under preferences $\hat{q}(t)$ and the prevailing institutions with free decisions and trading possibilities $x(t)$ would have been implemented. Assume that under the prevailing preferences $q(t)$ and the same institutional set-up and free decisions and trading possibilities the path $y(t)$ is implemented. Then $y(t)[>;q(t)]x(t)$.

The meaning of this axiom can be expressed in the following way: With the prevailing set-up of individual rights (which are pragmatically compossible) a change in preferences from $\hat{q}(t)$ to $q(t)$ generates individual behaviour of citizens such that a changeover from path $x(t)$ to $y(t)$ occurs. The axiom then tells us that society honours the change from path $x(t)$ to $y(t)$, because it occurs due to the activities of the citizens within their compossible rights.

I now introduce the concept of "quasi-induced preferences". They refer to the economy at large. Induced preferences for the individual were defined as the convergence point of preferences, if the consumption basket remains constant through time. They were assumed to be independent of the initial preferences. Induced preferences are a particular single point in preference space. Quasi-induced preferences are a mapping from the non-negative part of the time axis (in continuous time) into the preference space, like $q(t)$. As we work on the individual level in the "real world model" with the differential equation $\dot{q} = f(x; q)$ the development of preferences $q(t)$ depends on the development of the consumption basket $x(t)$. Together with the initial value of $q(0)$ it is then $x(t)$ which determines $q(t)$. We then designate $q(t)$ as "quasi-induced" by $q(0)$ and $x(t)$. This is then the following

<u>Definition 12:</u> For any given path of consumption baskets $x(t)$ and any given initial value $q(0)$ let $q(t)$ be the single solution to the differential equation $\dot{q} = f(x; q)$ which describes the dynamics of preference formation. We then call the preference path $q(t)$ <u>quasi induced</u> by $q(0)$ and $x(t)$

The concept of "quasi-induced" then is a mapping from the space of initial preferences times the space of consumption paths into the space of preference paths.

The concept of adaptive preferences builds on the concept of induced preferences. I now introduce the concept of "quasi-adaptiveness" of preferences which builds on the concept of quasi-induced preferences. I apply it to social preferences.

<u>Definition 13:</u> For given initial social preferences $q(0) = r(0)$ let $q(t)$ be the preference path quasi-induced by the basket path $x(t)$ and let $r(t)$ be the preference path quasi-induced by the basket path $y(t)$. Social preferences are <u>quasi-adaptive</u> if the following holds: whenever $y(t)[>; q(t)]x(t)$ then $y(t)[>; r(t)]x(t)$.

This means: assume society has the choice between the "default" $x(t)$ and the "project" $y(t)$ and thus decides on the basis of the preferences $q(t)$, quasi-induced by the default $x(t)$; assume further that society decides to implement the project. Then quasi-adaptive preferences imply that the project is also ex-post justified by the preferences $r(t)$ which are quasi-induced by the "project".

I now come back to the original question: Assume $y(t)[>; q(t)]x(t)$. Can we then infer $z(t)[>; s(t)]x(t)$? As we have seen in the simple example, the answer is "yes" if preferences are adaptive and if $q(0)$ is induced by $x(0)$. We now generalise this proposition.

First I introduce another definition. For this we observe the following. We have assumed that $q(t)$ is quasi-induced by the default $x(t)$. If the project is implemented we expect $y(t)$. This basket path "quasi-induces" preferences $r(t)$. But $r(t)$ typically do not reproduce $y(t)$. Thus, $y(t)$ is not "self-reproducing" by means of the preferences it "quasi-induces". Eventually, by an interplay of changed preferences and changed basket paths the economy settles down on the basket path $z(t)$ and the preference path $s(t)$. Here this convergence is due to the fact that the actions of the citizens under preference path $s(t)$ generate $z(t)$ and the basket path $z(t)$ "quasi-induces" $s(t)$. We then see the pair $z(t)$ and $s(t)$ as a kind of dynamic equilibrium. We then introduce the following

Definition 14: For a given set of individual rights and a given initial set of preferences $q(0) = s(0)$, let the preference path $s(t)$ and the basket path $z(t)$ be such that by the actions of citizens within their rights the preferences $s(t)$ generate the basket path $z(t)$ and such that $s(t)$ is quasi-induced by $z(t)$. Then the pair $z(t)$ and $s(t)$ is called an equilibrium pair of preferences and baskets. We also call $z(t)$ a self-reproducing path of baskets; and we also call $s(t)$ a self reproducting path of preferences.

Applied to our three basket paths $x(t)$, $y(t)$, and $z(t)$ and the corresponding quasi-induced preference paths $q(t)$, $r(t)$, and $s(t)$ we know by construction that $z(t)$ and $s(t)$ are an equilibrium pair of preferences and baskets. We can assume that the "default" pair $x(t)$ and $q(t)$ are an equilibrium pair of preferences and baskets, whereas $y(t)$ and $r(t)$ are not an equilibrium pair: $r(t)$ is quasi-induced by $y(t)$, but $r(t)$ generally does not generate $y(t)$. If it were otherwise then the transition from $y(t)$ to $z(t)$ would not take place- or, to put it differently, $z(t)$ and $y(t)$ would coincide.

It is the very idea of adaptive preferences and of quasi-adaptive preferences that decisions today are taken with a view of the future in mind which corresponds to the actual preferences. Thus $y(t)$ is what the decision maker expects to occur, if the project is implemented; and it is therefore the hypothetical result of the project subject to preferences $q(t)$. But then $y(t)$ induces different preferences $r(t)$, so that therefore the result of the project is distinct from $y(t)$. Only in the very unlikely case that the newly induced preferences have the same effect on baskets as the original preferences would it be the case that $y(t)$ and $r(t)$ are an equilibrium pair.

We may put this logic also in the following terms. The path $y(t)$ corresponds to the *intended consequences* of the “project”. The difference $z(t) - y(t)$ then are the *unintended consequences* of the “project”. But, in a free society with compossible rights, these unintended consequences are legitimate, because they are the result of the free interplay of the activities and of the preferences of the citizens.

Further I introduce what I call the

<u>Quasi-Improvement Axiom:</u> Assume, society has the choice between 1. remaining in the “default” $x(t)$ with initial preferences $q(0)$ and preferences $q(t)$ quasi-induced by $x(t)$ – and 2. a “project” $y(t)$ such that $y(t)[>; q(t)]x(t)$ and $y(t)[>; r(t)]x(t)$. Let the pair $z(t)$ and $s(t)$ be the equilibrium pair of preferences and baskets which arises out of the implementation of “project” $y(t)$ by means of the interaction of citizens in a system of rights that corresponds to the principle of pragmatic compossibility. Then society choses to implement the first “project” $y(t)$ irrespective of whether a direct move from the default $x(t)$ to $z(t)$ would have been accepted or rejected. That is: society acts in such a way that $z(t)$ is “revealed preferred” over $x(t)$. We then can write $z(t)[>, q(t)]x(t)$.

I call this the “quasi-improvement axiom” because it is of course similar to the improvement axiom introduced above in section H. Below, after having derived Theorem 3, I discuss this quasi-improvement axiom. Here I only state that it basically follows from normative individualism.

We can derive

<u>Theorem 3:</u> Assumption 1: The society is characterised by (pragmatically) compossible rights. Assumption 2: The axiom of freedom consistency of social preferences prevails. Assumption 3: The quasi-improvement axiom holds. Assumption 4: Social preferences are quasi-adaptive. Consider a project leading from allocation $x(t)$ to expected allocation $y(t)$ and for the preferences $q(t)$ which are quasi-induced by $x(t)$ we have $y(t)[>; q(t)]x(t)$. Let $z(t)$ and $s(t)$ be the equilibrium pair of baskets and preferences resulting from implementation of the project. Then we have $z(t)[>; s(t)]x(t)$.

<u>Proof:</u> Assumption 4 of quasi- adaptiveness tautologically leads to an ex-post justification of an ex-ante “yes” – decision for $y(t)$ by the preferences $r(t)$, quasi-induced by $y(t)$. The change from $y(t)$ and $r(t)$ to $z(t)$ and $s(t)$ is

simply due to actions of citizens within the realm of their rights and ensuing changes in preferences. Thus, by the axiom of freedom consistency of social preferences we obtain $z(t)[>; r(t)]y(t)$. Then, by the quasi-improvement axiom we also obtain $z(t)[>; q(t)]x(t)$. Moreover, then again by quasi-adaptiveness, we also obtain $z(t)[>; s(t)]x(t)$. QED.

The proof of the theorem is really quite straightforward. The “difficult” part of the theory then is not the math; it is a true understanding of the concepts introduced above. Therefore I need to explain a little more what I am doing. I discuss the four assumptions of Theorem 3. Assumptions 1, 2 and 3 derive from the idea of a society of free citizens. In addition there is Assumption 4: quasi-adaptiveness. I discuss it below in section 4. There I provide a plausibility argument that it can be derived from individually adaptive preferences. Here I discuss the other three assumptions.

As I have discussed at length in sections T and U, freedom in a society rests on the prevalence of pragmatically compossible rights of citizens. But this freedom implies that the consumption basket of society changes according to changes in the preferences of the citizens. And this implies the axiom that the basket-result of this change in preferences is socially preferred to the earlier basket. This then is what Assumptions 1 and 2 of Theorem mean. If social preferences are a mirror of individual preferences within the framework of a free society then social preferences cannot deny that the result of the free interaction of its citizens is preferred over the initial allocation together with the initial preferences. But then the quasi-improvement axiom (Assumption 3) is also implied. For, if society adheres to the principles of freedom within the framework of compossible rights then social preference for a change away from the “default” must imply social preference for any further changes in the basket which are a consequence of the free reaction of people upon the initial change implemented by the government. Thus, any social preference for a specific change by means of a “project” implies the general social preference for any further changes implemented by the citizens within their compossible rights.

This consideration cuts both ways. On the one hand it enables society to liberate itself from the strong adherence to the status quo which itself is a consequence of what I earlier have called “preference conservatism” and which is the same as adaptivity of preferences. This liberation takes the form of small deviations from the default, which may be considered all-right even with strong preference conservatism. The ensuing changes in preferences may then lead to further changes and thus to an improvement sequence of considerable length. – On the other hand, decision makers in society may anticipate further changes as a consequence of the initial change; and they may anticipate that these changes are not of the kind they consider a good thing for society. Thus, they may resist the primary change, not because they dislike it as such, but because they fear consecutive further changes which they dislike. But this latter effect of a “backward dislike of a project due to its further consequences” of course would contradict the freedom consistency of social preferences in a society with fully compossible rights of citizens. Nevertheless it is an important consideration for the “real world societies” of imperfectly compossible rights. More on this below.

In whichever way the quasi-improvement axiom works in practice it is basically unavoidable within a society that adheres to the principles of freedom. We may put it another way. Social preferences consistent with individual freedom within the range of compossibility do not only refer to eventual material outcomes of government decisions, but also to the *form* any change takes place. The decision to implement some project A may be motivated by the expected material outcome. But further changes as a consequence of the reaction of free citizens on the implementation of project A then are “preferred” by society over the non-implementation of project A, simply because they take the form of the interaction of free citizens – independent of the material outcome. It means that my theory of freedom and wealth generation is not a purely consequentialist theory like, for example, utilitarianism. In my theory, we have a consequentialist component in that the primary results of any “project” away from the default are evaluated by their benefit to the citizens. But, the secondary and further results of the project implementation - which are due to the interaction of free citizens and their preferences - are “socially preferred” over the default irrespective of their material content. This is in contradiction to consequentialism.

This is in line with a “philosophy” that acknowledges that we cannot know the future. Thus, it would be futile, if “society”, i.e. politics were to try to globally “plan” the future of society. As a society we may have a certain picture of future developments basically by extrapolation of observed trends. The “default” may be anticipated to a certain extent and proposals for projects may have a chance to obtain majority support, if they react on unsatisfactory aspects of the anticipated “default” path. Not much more can be expected in terms of manipulating the future. Change, this is the message, then comes mainly from the actions of citizens themselves and the interaction between the actions (baskets) and preferences. The acknowledgement of this structure of change by "society" means "ratification" of unforeseen consequences of any government project and thus acceptance of the quasi-improvement axiom – within the framework of pragmatic compossibility.

We need to add that there exists the possibility that the new self-enforcing path $z(t)$ and $s(t)$ no longer fulfil the condition of pragmatic compossibility: preferences have changes from $q(t)$ via $r(t)$ to $s(t)$; and, as described with the example of car traffic in sub-section 6 below, this change of behaviour of citizens requires new laws to maintain pragmatic compossibility. But, such behaviour cannot be predicted, and thus the mere possibility that compossibility may be violated due to changed preferences is not a legitimate excuse to forestall the project which has the effect to change the basket path from $x(t)$ to $z(t)$. If, ex-post, it turns out that the path $z(t)$ violates compossibility then one can implement another project to rectify the situation and to try to return to compossibility.

Why is Theorem 3 important for welfare economics? In a nutshell: *only under the predictions of Theorem 3 can society successfully and sustainably escape from the status quo, i.e. from the default option.* I explain this now.

First it is important to understand that decisions which are taken on behalf of society always are formal decisions, typically involving more than one person. This means any such decision does not happen by default. It is an explicit decision. If the decision is not taken the default prevails. As we have seen, already in the case of individual decisions, the default option has a very large chance of being chosen. This is even more so in "collective decisions". For, here substantial "transaction costs" of decision making arise. If there is resistance against a project even from a minority of persons involved in the decision quite substantial delays are likely to arise. Negotiations about possible compromise solutions may become necessary. Negotiations to form a coalition may also become necessary. Issues of legality, conformity with laws or with the constitution of the country arise frequently. Feasibility studies may be required etc. All this is on top of the individual preference conservatism which is a characteristic of individual adaptive preferences.

As an example take law-making. Unless a new law is passed the present law on the books prevails. The politics of changing a law is a complicated, time consuming process. In a given year only a minute proportion of laws is changed. There is a tremendous "law inertia".

In this context it is also relevant to observe the following. Even if the prediction of Theorem 3 applies there is a strong conservative bias in social decision making. Those projects which are being implemented will be justified by ex-post preferences. But, on the other hand, there may exist many potential projects which, if implemented would be justified ex-post, but which will not be implemented with the ex-ante preferences. We have four categories: 1.“yes” ex-ante; “yes” ex-post; 2. “yes” ex-ante, “no” ex-post; 3.“no” ex-ante; “yes” ex-post; 4. “no” ex-ante, “no” ex-post. Category 1 is clear, the projects will be implemented. If Theorem 3 applies, category 2 is empty. Category 3 will not be implemented. Category 4 will not and should not be implemented. The conservative bias then is the fact that Category 3 will not be implemented, despite the fact that ex-post their implementation would be justified.

Assume now that the prediction of Theorem 3 is not valid. Category 2 would then not be empty. Take the extreme case of anti-adaptive preferences. It would then be very likely that an approved project later on would not be justified ex-post. People would frequently regret earlier decisions to deviate from the default option. We would expect that society would be very reluctant to deviate from the default if experience shows that in many cases ex-post evaluation makes society regret the “project”. In anticipation of regret society would become very conservative indeed. And this would make a progressive society impossible. In particular, the legitimacy of decentralised decision making would be undermined. And, as already remarked above, decentralised decision making is the most important institutional pre-requisite of frequent deviations from the status quo.

To be sure, even with Theorem 3 the real world experiences many cases of regret about “projects”. This is due to error in evaluation, i.e. due to uncertainty. The risk of error is anyway a large burden for potential projects which break away from the status quo. A person who is a decision maker must justify his/her decision. With few exceptions justification is not required for “non-decision”, i.e. for not taking on a “project” and thus, for the default decision. But the decision to undertake a project, in particular a project with initial investments, has to be justified before others. Thus, uncertainty and the risk of error in undertaking a project, generates a justification bias towards the default and against projects. If Theorem 3 would not be valid this bias would be re-enforced, decentralised decision making would lose legitimacy and society would be stagnant.

In a sense, the fact that society is not stagnant in the western world is a kind of "proof" of Theorem 3 and of adaptive preferences.

4. Why quasi-adaptive social preferences are likely when citizens have adaptive individual preferences

I still have to justify Assumption 4 of Theorem 3. Why can we be rather confident that social preferences are quasi-adaptive, if we can assume that individual preferences are adaptive?

For any given project we can divide the default consumption basket $x(t)$ and the project consumption basket $y(t)$ into three parts a, b, and c. Some components of the two baskets are in category a; some components are in category b, and the remaining components are in category c. Category a consists of those goods whose production and consumption is intended to rise by the project. Thus, for the vector which only includes goods from category a we may write $y_a(t) > x_a(t)$. Category b consists of those goods whose production and consumption is intended or expected to decline by the project. So here we can write $y_b(t) < x_b(t)$. An example of a project may be the introduction of a new product into the market. Demand for the new product and for products which are its complements is higher than it would be, if the product were not introduced. The new product and its complements then form group a . Then there are goods which are substitutes for the new product. Demand for them may go down due to the new competition. Thus, when the combustion engine driven car is introduced the demand for horse drawn carriages goes down. These horse drawn carriages then belong to group b, when we talk about the introduction of the automobile as "the project".

Group c is all other goods. They are only indirectly affected by the new project. In a partial equilibrium cost-benefit analysis they only enter indirectly by the costs which are incurred through the project. Thus, $y_c(t) - x_c(t)$ does not enter directly into the calculation of the decision maker; rather they are the outgrowth of the fact that due to some initial investment for the project, income disposable for consumption goes down and thus the market value of the vector $y_c(t)$ may be lower than the market value of the vector $x_c(t)$ for a time interval containing small (positive) t-values.

We may then interpret the vector $y_c(t)$ under preferences $q(t)$ not so much as being specified in goods quantities, but rather as the result of consumer utility maximizing under a budget constraint, where the "project" focused on $y_a(t)$ and

$y_b(t)$ only defines the remaining budget for the vector $y_c(t)$. Seen in this light the budget for the vector $y_c(t)$ remains the same after preferences have moved from $q(t)$ to $r(t)$. A change in the comparative valuation of $x(t)$ and $y(t)$ due to a change in preferences from $q(t)$ to $r(t)$ then only can come from $x_a(t)$, $x_b(t)$, $y_a(t)$ and $y_b(t)$.

Here I now introduce the assumption that individual preferences are adaptive. But then we know that those goods in group a gain in esteem, relative to the earlier preferences and those goods in group b loose in esteem, relative to the earlier preferences. But this means that the partial move from $x_a(t)$,$x_b(t)$ to $y_a(t), y_b(t)$ obtains even more approval with preferences $r(t)$ than with preferences $q(t)$, because the y −vector provides more of those goods which now are in higher esteem and provides less of those goods which now are in lower esteem. This then tells us that if $y(t)[>; q(t)]x(t)$ then $y(t)[>; r(t)]x(t)$. Thus, social preferences are quasi-adaptive.

Note that our “trick” to neutralise the goods in group c is precisely the same as the one applied in traditional cost benefit analysis. There group c also consists of those goods whose quantities change due to the costs incurred by the project. And, indeed, in our simple example of the bridge in subsection 2 above also operates with the same “trick”.

And again: if individual preferences were anti-adaptive then group a would obtain a lower esteem with preferences $r(t)$ than with preferences $q(t)$, whereas group b would obtain a higher esteem with preferences $r(t)$ than with preferences $q(t)$. And this would mean that the esteem of $y(t)$ relative to $x(t)$ would go down as preferences move from $q(t)$ to $r(t)$. There would then be no guarantee that with ex-post preferences the project would still be preferred over the default.

Moreover, with anti-adaptive preferences the circularity problem looms. As Theorem 1 tells us, circularity is impossible with adaptive preferences; and, as Theorem 2 tells us, circularity is a possibility whenever preferences are not adaptive. But observation of such circularity of improvement sequences further undermines the belief that deviations from the default are productive, even if proposed projects from the ex-ante point of view look favourable.

5. In a free society and under adaptive preferences applied welfare economics is valid

As we have seen, the Assumptions 1, 2, and 3 of Theorem 3 are justified by the assumption that we look at a free society with (pragmatically) compossible rights. Assumption 4 essentially is supported by the observation that citizens´ preferences are adaptive. So we can rely on Theorem 3. I have also given reasons why the predictions of Theorem 3 are important ingredients of a society that is able to steadily pull itself away from the "default", from stagnation. Theorem 3 justifies decentralised decision making on the basis of partial equilibrium analysis. Of course, as in traditional economics, the appropriate "design" of institutions remains a big task. We have to find the institutional details which implement the "invisible hand" of conformity between the private goals of the agents and the promotion of the welfare of the other citizens.

The important consequence of Theorem 3 for a theory of decentralised decision making is that it provides conformity between ex-ante benefits and ex-post benefits of any "project" that is designed to break away from the "default". The preference changes induced by the project are such that the project itself will be justified ex-post, if it was seen as beneficial ex-ante. If this were not the case welfare economics could not really "ratify" such a project.

As I remarked earlier there remains a conservative bias. There is no converse theorem to Theorem 3 which would say; if a project is justified ex-post it is also justified ex-ante. Such a converse theorem only would exist if preferences were anti-adaptive. But then Theorem 3 would be invalid. The beautiful world of fixed preferences is not ours. Only in that world would we have (error and uncertainty aside) a perfect coincidence between ex-ante and ex-post justification of projects.

But from the point of view of welfare economics it is of course much better that ex-ante justification implies ex-post justification than the converse. For, god has created a world in which we first decide to act before we act. Thus, ex-ante evaluation is the basis for decisions. Ex- post evaluations take place anyway, and they are important for the learning process how to organize our society. And as such the conformity between positive ex-ante evaluations and positive ex-post evaluations is an essential ingredient of a society which has the power to break away from the default option.

In the analysis of adaptive preferences of the individual I have shown the very close relation between adaptive preferences and the non-circularity of improvement sequences. So far I have not analysed in detail whether similar theorems can be provided for quasi-adaptive social preferences. Such theorems would require a much more specific model of the economy at large. But I believe reasonably realistic models of this kind can be developed.

In my analysis I have only looked at "yes-or-no" decisions. But this does not mean that the theory only applies to a very special case. Indeed, if there are different variants of a project then eventually, before the "yes-or-no" decision is taken one finds out the optimal variant of the project (as evaluated with ex-ante preferences) and then compares this optimal variant with the default to come to a "yes-or-no" decision. In this paper I do not go into the issues which arise out the politics of preparing a "yes-or-no" decision. Of course the "optimal" variant eventually proposed is the result of a complicated interplay of "strategic" behaviour of different players. With few exceptions, it is not the optimum from an ex-post point of view, even if we disregard induced preference changes.

It is of course very likely that the optimal "size" of the project from an ex-ante perspective is smaller than the optimal "size" from an ex-post point of view. If preferences induced by the project give a higher esteem for the goods coming out of the project then, with these ex-post preferences, the optimum size would have been larger than the actual size which optimised with respect to the ex-ante preferences. This "size" effect is an example for the one-sidedness of project decisions which we have discussed before, i.e. a remaining status-quo bias, even with Theorem 3.

In this section I have discussed a single "project" $y(t)$ which was compared with the "default" $x(t)$. This procedure is all-right for the general theory, despite the fact that many "projects" are being considered and implemented at the same time. Indeed, since any given project may have a very long life - like, for example, a bridge to be built and to be used – very many projects overlap. The procedure is all-right, if we understand that for the particular project under consideration the "default" $x(t)$ comprises all other "projects" under way or even to be expected to be underway in the future. Thus, $x(t)$ is not a path of baskets through time invariant against a change in the project that we investigate. Rather, $x(t)$ is project specific. Therefore it would be a misunderstanding if one considered $x(t)$ being the picture of a stagnant economy. This is definitely not the case, if we are in an economy of decentralised decision making justified by the ex-post justification of project which get the go-ahead due to the ex-ante evaluation.

Nevertheless, the position taken above that without the conditions of Theorem 3 we are likely to be in a stagnant economy, is correct. For, without the conditions of Theorem 3 not only the project under consideration is unlikely to be implemented. Rather any project deviating from the default is unlikely to be implemented. And then stagnation does prevail.

Provided we can rely on Theorem 3 we then have a large number of projects. Some of these projects may compete against each other. Other projects may build upon another. But all this is included in the comparison of $x(t)$ and $y(t)$ when we consider any particular proposed project.

6. Pragmatics of incomplete compossibility

This sketch of partial equilibrium welfare economics in a world of adaptive preferences has worked with the assumption that citizens´ rights are fully compossible - in the pragmatic form of compossibility. This assumption is never fully realistic. Individual rights in a State that adheres to the principles of individual freedom and democracy are slow in being modified according to new developments in society. Social networks based on the internet have exploded in size in recent times. They are a challenge for the privacy of the citizen. We may look with considerable doubt on the proposition that these social networks and the rights associated with them are compossible according to our criterion of pragmatic compossibility. Legislation may be required to bring social networks more in line with (pragmatic) compossibility.

The rules which regulate the car traffic can again serve as a good example of society´s attempt to obtain pragmatic compossibility of individual rights. We have discussed them before in section T. Through time car traffic changes. More people may own a car and may have a driver´s licence. Additional roads become available. There is technical progress in cars and in the regulating potential. Wages of police officers and other regulating personnel may rise. Driving habits may change.

The rules on the books are likely to change in reaction to these structural changes of the car traffic. At any given time they may not be optimal because there is a legislation lag in answering the changes going on in the real car traffic world. I take an example which is related to our main topic: changing - perhaps endogenously changing - preferences. Earlier, we may assume for the sake of the argument, the system of speed limits and sanctions against violations of speed limits have been optimally adjusted to the actual driving habits of car drivers. For reasons which may lie outside of our sub-system of car traffic, driving habits change. We now may see that some people, perhaps a minority, drive more aggressively than they did in the past. Thereby, given the still prevailing rules concerning speed limits, this change in driving habits reduces the average net benefits of car driving: even evaluated with the new preferences of the more aggressive drivers, average net benefits of car driving have been reduced, because the incremental risk for all drivers of getting involved in car accidents outweighs the gain obtained by the people who now drive more aggressively.

Earlier, with the then optimal rules, the rights concerning the subsystem car traffic were pragmatically compossible. The sanctions against speeding may be seen as a "price" for speeding. This "price" discouraged speeding in those cases in which the monetary equivalent of the benefit of speeding was below this "price". Speeding then took place in cases in which the benefit for the speeder was higher than the "price" to be paid - in a probabilistic sense of course – for speeding. And the "price" of speeding reflected the net loss to the other car drivers in terms of a higher risk of getting involved in a car accident. This means that, as long as the average frequency of speeding was not changed, a single instance of "preference change" from refraining from speeding to speeding raised total income of car drivers, because other car drivers do not incur a loss, because they obtain the "price" for speeding (assuming – to keep things simple – that the money fine paid for speeding was added to the expenditures for making a better car driving system), and the speeding car driver obtains a higher benefit from speeding than the "price" he pays.

And, of course, vice versa the same holds. If the car driver speeded yesterday and his preferences changed so that he does not speed today then this again raises total income, because today his benefit from speeding is below the "price" he pays for speeding, whereas the other car drivers are neutral, because they lose the "price" for speeding, but they gain slightly more safety on the road.

Now, that there is a permanent shift in the direction of more speeding, the marginal "price" for speeding may be too low. Car drivers may now consider the marginal risk from another speeder to be higher than the marginal "price" paid by the speeder. Rules may have to be changed so that the "price" for speeding now is higher than it was before. Before this rule change takes place the principle of pragmatic compossibility is violated, because cases now may arise in which a preference change towards more speeding could reduce the summed net benefit of car drivers.

Another case of a violation of pragmatic compossibility is a market with a supplier monopoly. To the extent that this monopoly simply is there, “fell from heaven”, so to speak, we know that a change in the monopolist´s “preferences” such that he raises his price causes more harm than benefit to the economy at large, including the benefit of the monopolist himself. The institutions of anti-trust have been introduced to promote competition and to challenge monopolistic behaviour for this very reason. But not every positive price-cost margin is a sign that monopoly, in this sense, prevails. The many markets characterised by “monopolistic competition” do exhibit positive price-marginal cost margins. But it would be futile for government to intervene here. Indeed, “transaction costs” of such government intervention into such a competitive market are likely to exceed the benefits of a change in allocation decisions thereby accomplished. Also, if monopoly profits are the result of a patent due to an invention, it is likely to be counterproductive, if the government tried to prevent monopoly pricing. The general conclusion is that an optimal form of competition law and its pragmatic implementation are part of a regime of freedom within the realm of compossibility. We thereby also get the result that there is no conflict between a freedom oriented and an efficiency oriented anti-trust law.

What does an incomplete implementation of the pragmatic compossibility imply for our welfare analysis, for the result contained in Theorem 3? Here we have to distinguish between a matter of principle and a more pragmatic view. The issue is: how to deal with the fact that a project in the first instance changes the economy from $x(t)$ to $y(t)$; but then, due to quasi-induced preference changes from $q(t)$ to $r(t)$, the basket changes - after intermediate steps - to self-reproducing $z(t)$ and preferences change – after intermediate steps – to self-reproducing $s(t)$. It could happen that “society” with preferences $q(t)$ prefers $y(t)$ over $x(t)$, but, with the same preferences $q(t)$ prefers $x(t)$ over $z(t)$.

In the case of full compossibility we referred to the freedom consistency of social preferences and the quasi-improvement axiom to say that social preferences rule it out that $z(t)$ is not preferred over $x(t)$, if $y(t)[>;q(t)]x(t)$ and $y(t)[>;r(t)]x(t)$. The rule of law implies that decision makers on behalf of society have to work on the <u>presumption</u> that the law on the books satisfies compossibility. Otherwise we undermine the legitimacy of the process of law-making. The law maker cannot say: “I have made this law, but it is bad law”. This implies that the social decision maker should adhere to the principle that from $y(t)[>; q(t)]x(t)$ follows $z(t)[>; q(t)]x(t)$.

But the politics of law-making is different. If not for other reasons (and there are many!) a decision to change or not to change the law today can be formed by another majority than the one which made the law in the first place. Therefore it is possible that in the view of the present majority neither the status quo (corresponding to $x(t)$), nor the proposed change (corresponding to expected $y(t)$) fulfill the requirements of compossibility. The present majority therefore may prefer $y(t)$ to $x(t)$, but nevertheless may prefer $x(t)$ to expected $z(t)$, which then motivates it not to change the law and to stay with $x(t)$. It is against the spirit of freedom in society, but it is likely that this attitude prevails. We may call it *implicit paternalism*.

In this paper I do not go into a further inquiry of the normative issues involved here. Of course, “implicit paternalism” would have to be discussed in much more detail.

Private decisions about “projects” will be discussed in the next section.

W Innovative Anticipation of Preference Changes

My theory builds on the observation that by and large people are poor forecasters not only of events, but also of attitudes and preferences. And, a fortiori, they are poor forecasters of the interaction between events and preferences. In making up their mind about their own decisions they have a strong tendency to work with an implicit forecast which is characterised by a maximum of extrapolation of the present status quo. Beyond that they mainly recognise the fact that one cannot predict very well what is going to happen in the future. This means, they are very much aware of the uncertainties of their future environment.

For our analysis in the preceding section this means that $q(t)$ in particular has to be seen in a rather conservative light. Basically, in most cases, $q(t)$ can be seen as an extrapolation of present preferences into the future. This accentuates the difference between ex-ante and ex-post evaluation of any given proposed project.

But it is of course possible that some people in the community dare to predict that preferences change. They may “know” or they may have the intuition that preferences are adaptive, i.e. that there is likely to be a strong positive feedback from a new project, for example a new product, to customers´ preferences. Steve Jobs´ strategy of product innovation at Apple is of course a prime example of anticipated changes of customer preferences, once a new product is on the market.

The assumption of adaptive preferences of citizens is not only empirically valid. It serves an important function for the individual citizen because it ensures that improvement sequences are non-circular and that therefore individuals can rely on a more global rationality of a series of small improvement steps. In addition adaptive preferences also serve to ensure the conditions of Theorem 3. This ex-post justification of ex-ante decisions to undertake a project is a precondition for a society with a decentralised system of decision making, where many “projects” take place at the same time. On the other hand, adaptive preferences are a structure which we also have described as “preference conservatism”. So it is - perhaps paradoxically - the case that preference conservatism is the condition for the stability of a system of decentralised decision making, which is “progressive” in the sense that it takes on many “projects” that deviate from the default option.

Here I now describe an additional function of decentralised decision making. The preference conservatism of citizens induces a very conservative decision structure on the level of the collective. Government and similar decision bodies which basically are run by consensus building or at least by majority voting cannot be more progressive than corresponds to the preference conservatism of society´s citizens. A society which simply relies on democratic majority voting of all citizens for its decisions therefore is of necessity a stagnant society with an overwhelming power of the default alternative, i.e. with an overwhelming power of the status quo.

On the other hand, a regime of decentralised decision making like the market economy, provides the opportunity for entrepreneurs in general, but “preference entrepreneurs” in particular to deviate from the conservative majority. These entrepreneurs may then start a project - for example a new product - in the expectation that after they have implemented it, ex-post preferences of the citizens are quite different from their ex-ante preferences and thus demand for the new product after it has been launched on the market is much higher than the average citizen would have expected beforehand with his/her ex-ante preferences. In other words: the Schumpeterian (1912) “preference entrepreneur” relies on the following: *ex-ante preferences of the majority of citizens would induce them to reject the project; but once it has been implemented against the majority preferences, citizen preferences change in such a way that now they agree (by “revealed preference”, i.e. by buying the new product in large quantities) that undertaking the project was a good idea.*

A system of decentralised decision making thus is able to cope with the welfare aspects of induced preferences, as long as these induced preferences of the citizens are adaptive. Progress in society and preference conservatism do not only go together; they support each other: preference conservatism provides -via Theorem 3 - the justification of a regime with many projects that break away from stagnation. And social progress by decentralisation supports the political views of the citizens who support the system of decentralised decision making, but also supports their general pragmatism to approve only of things which they have themselves experienced. And this pragmatism is of course one facet of the general structure of adaptive preferences.

IV Outlook

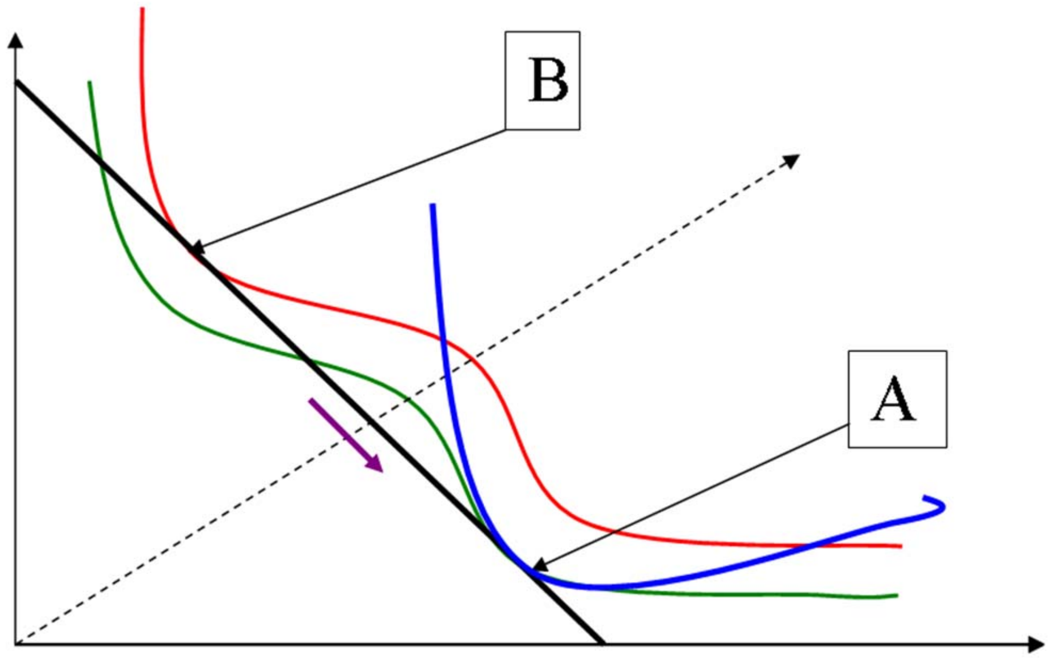
X Path Dependency of Preference Convergence.

In this paper I have presented basic elements of a theory which says that adaptive preferences are not only valid empirically, but that they enable citizens to live a consistent rational life of improvement and that they enable society to operate in a mode of decentralised decision making, thereby promoting freedom and wealth of the people. Such a theory has many ramifications, but faces also further challenges. In this fourth part of the paper I give some indications of a programme of further research within the general realm of this theory. I do hope thereby to stimulate the interest of other researchers to join me in developing this theory further.

In deriving Theorem 2 (non-circularity of improvement sequences implies a fixed quasi-preference structure and adaptive preferences) I assumed the existence of a long run demand function. This means that for a given budget, constant through time, the convergence point of demand is independent of the initial preferences. But this need not be the case. Long run demand may depend on initial preferences.

At least for the case of a two-dimensional commodity space I can derive a similar Theorem 2: if all improvement sequences are non-circular there exists an exogenous indicator function $V(x)$ so that for $V(y) > V(x)$ (and only then) there exists an improvement sequence from x to y. The proof is different from the proof above in this paper for the case of a unique long run demand function. We then may have a picture like this

Figure 8: Two different long run equilibria



There is a budget constraint: a black straight line from north-west to south-east. The function $V(x\ )$ is represented by two indifference curves, a red one and a green one. The green one is located below the red one and thus indicates a lower V –value. It touches the budget constraint at point A. The red indifference curve touches the budget constraint at point B. Except for point B the red indifference curve is above the budget constraint. The green indifference curve is "locally" above the budget constraint around point A, but it is partly below the budget constraint in the area of B. The blue indifference curve represents the preferences which are induced by point A. Because of the fact that we can derive that preferences are adaptive it must lie above the green indifference curve passing through A.

This means that A is a stable equilibrium. The person does not want to move away from A, once he/she has arrived there. Preferences settle down at those which are induced by A. Yet, theoretically there exists an improvement sequence starting at A and ending at B or even somewhat below B. But at least early on this improvement sequence must move above the budget constraint. If the person were aware of this he/she might borrow some money to spend beyond the budget along an improvement path which ends up somewhere below B, so that now the budget is not fully exhausted and the person can repay the debt. But, realistically, in most cases of such a situation the person may not be aware of this possibility. He/she will then behave as if A were the global optimum, although it is not.

I believe that in the real world, due to adaptive preferences and thus preference conservatism, there are many cases such that a move from a local optimum towards a "better" local optimum theoretically is available, but will not be undertaken, because most people want to avoid experimenting with "large" migrations, given that they see that small migrations do not lead to improvement. The same, it appears, is true for political bodies, like nations, states, cities etc. A case in point appears to me to be the financing of the health care system. There exist quite different financing schemes, say, in the United Kingdom, Germany and Switzerland. But in none of the three countries would a move from the own system to one of the two other systems be politically feasible. The British have strong preference for the UK system. The Germans have a strong preference for the German system; and the Swiss have a strong preference for the Swiss system. Here preferences are strongly adaptive! I venture the hypothesis that the three systems lie on different indifference curves of the indicator function $V(x)$. So, for two countries improvement would be possible. But such movement from one system to another is unlikely to occur in a democratic state. Moreover, due to the cognitive dissonance effect, it will be very unlikely that people can be convinced that one of the other systems - after preferences have adapted – is superior to one´s own system.

Beyond the possibility of getting stuck in a local, but not global optimum the figure also indicates the potential for profitable manipulation by others. In the following I take the example of advertising.

So far economics has had a hard time to have a clear view on advertising and certain other marketing devices. Traditionally economists distinguished between informative advertising and persuasive advertising. In the tradition of

Braithwaite's 1928 analysis persuasive advertising was considered an economic waste. Informative advertising was considered useful and welfare enhancing. The theory on the waste effect of persuasive advertising relied on the assumption that the "true" preference for the product was the one that existed before the product was advertised. This, in essence is in the tradition of economics which assumed that preferences are fixed and that therefore preference changes due to persuasive advertising are a "distortion" of "true" preferences. But, in a world of adaptive preferences, this procedure is unconvincing. Why should ex-ante preferences be the right preferences and ex-post preferences be distorted? If the general hypothesis of adaptive preferences is correct, why should the preference change due to the introduction of a new product be legitimate, but the preference change due to "persuasive" advertising not be legitimate?

There are of course great difficulties in practice anyway to separate persuasive advertising from informative advertising. I will not discuss these difficulties here. I simply point to the problem of information overload which may make "unpersuasive" advertising also effectively "uninformative" because nobody takes note of that advertising. Thus, if the supplier of the product has some useful information to provide, he may need "persuasive" advertising to get across his informative message.

There *are* government imposed limitations to advertising. For example, cigarette advertising is not allowed in certain media. There are certain rules concerning "truth in advertising". I do not go into details. My suggestion for a distinction between legitimate and non-legitimate forms of advertising is the following hypothetical test: does any particular advertising activity stabilise a sub-optimal local equilibrium like point A in the figure which would not be the equilibrium without this advertising activity, so that then B would be the equilibrium? In that case such advertising might be considered illegitimate.

In the diagram the dotted line is the "watershed" for convergence on the budget line to the right or to the left. Thus the point where the "watershed" crosses the actual budget line is the point so that an initial point to the right will converge to A, whereas an initial point to the left will converge to B. If a supplier by some advertising efforts manages to shift the starting preferences from the left of the watershed to the right of the watershed (the arrow in violet) then he may profit from having "nudged" the customer from a better convergence point B to an inferior point A. This may then be a reason for government intervention.

It is unlikely that advertising for "harmless" products will cause such suboptimal equilibrium. But we do know the phenomenon of addiction. Take the case of cigarettes. A regular cigarette smoker may be in a point like A. By some procedure he or she may be induced to stop smoking. This may be an improvement path that leads him/her to point B. But such an improvement path may be beyond his/her willpower. To walk the improvement path he/she may need external help of one kind or another. If it is the case that cigarette advertising was responsible for the smoker to be in point A in the first place then this would be one form of advertising lacking legitimacy.

Y Inter-Personal Influences on Preferences.

This, of course, is a vast field. At several points in my paper I already stated that imitation of others works in a similar way as the interaction of demand and preferences does in the case of adaptive preferences. Adaptive preferences imply that “long run demand” is more price-elastic than is “short run demand”. Interpersonal effects on preferences in the form of imitation have the same elasticity increasing effect. Assume that a good becomes more attractive to the consumer, once he/she has observed that their neighbours buy it. This influence on preferences then means that a price reduction for any given good will generate greater demand in the long run than it does for given preferences in the short run. Again we then can develop a long run demand function which satisfies the strong axiom of revealed preference – and thus we get an exogenous quasi-utility function $V(x)$ and non-circularity of improvement sequences, i.e. theorems similar to Theorems 1 and 2 above. But the welfare economics of imitation is more complex. This is due to the fact that the mechanics of interpersonal influences on preferences is itself endogenous. For example, it depends on the available information technology. I believe it is worthwhile to investigate these aspects further.

Happiness research and related research has emphasised that well-being is very much influenced by the relative position a person has in terms of income and consumption levels. This leads, as for example Stiglitz (2008) has emphasised, to imitation effects. Due to such imitation effects it is possible that leisure time does not rise with rising wages – despite the expectation that income effects are stronger than substitution effects. Also this can imply that the equilibrium of the economy depends on initial conditions. Stiglitz tries to explain differences between the USA and Europe by means of this “relative income effect”.

Experimental research also has shown that human interaction is strongly influenced by the principle of reciprocity. This, of course, is also a case for preference interdependence. See Bolton and Ockenfels (2000).

Inter-personal influences on preferences are, of course, at the very core of social life, for example of education. It is also advisable to rethink the concept of “rationality” in terms of inter-personal learning processes.

What we are so far lacking is a coherent theory by which we can provide a comprehensive welfare economics framework concerning these issues. I suggest that the hypothesis of adaptive preferences and its fruitfulness for the welfare economics of decentralised decision making might also be useful for the welfare economics of the inter-personal interdependence of preferences.

Z The psychology of adaptive preferences.

In recent decades a confluence of economic and psychological research has been going on. Daniel Kahneman, the psychologist, has received the Nobel Prize in economics. His recent book (Kahneman (2011)) summarises his research. Many stable observations have been generated which contradict the homo oeconomicus model. It is my hypothesis that most of these deviations of behaviour from the textbook model of economic man are consistent with the hypothesis of adaptive preferences. But this, obviously, remains to be shown in detail. Some such observations I have mentioned in the paper, for example the very strong influence of the default option in a decision situation, or the endowment effect. Also bounded rationality according to Herbert Simon and Reinhard Selten are consistent with the hypothesis of adaptive preferences. Furthermore, the Festinger theory of cognitive dissonance supports the hypothesis of adaptive preferences. “Identity economics”, as developed by George Akerlof and Rachel Kranton, is, I believe, also consistent with the hypothesis of adaptive preferences, cf. Akerlof and Kranton (2000). In the bestseller “Nudge” Thaler and Sunstein (2011) discuss quite a few phenomena which seem to contradict the homo oeconomicus hypothesis. As far as I can see, all of these effects are consistent with the hypothesis of adaptive preferences.

I believe that a general consistency hypothesis can be shown: human decision making generally is consistent with the adaptiveness of preferences. One reason that I adhere to this consistency hypothesis is that in matters of physiology the corresponding hypothesis is quite evident. The body adapts to the prevalent activities of the person: eating volume and stomach volume go together. Not only is a person with a large stomach able to eat much; more importantly: the volume of the stomach adapts to the eating habits of its bearers. Not least because of this effect is obesity such a problem. Obesity, I think, is one of these examples of a local “optimum” which is not a global one. On this see section X above. People who work hard physically or who do a lot of exercises or who run every day of course develop muscles which are fit for such activities. It is then easier for these people to continue such activities and therefore their preference for them rises: adaptive preferences.

Generalising from these physiological examples we thus hypothesise that human nature is “adaptive”. Moreover there are survival reasons for this adaptivity. It is an advantage for any member of the human race to be able to adapt to current circumstances. Thereby he or she can cope more easily with changed circumstances. In terms of a normative theory that encompasses freedom and compossibility of rights of free people such general adaptiveness then obtains the form of adaptive preferences.

For a rigorous comparison of results in psychology with the hypothesis of adaptive preferences we do of course need models which take account of risk and uncertainty. So, obviously, the extension of my theory to decisions under uncertainty is needed.

As a model of what I have in mind for further research I refer to the interesting paper by Munro and Sugden (2003). They start from the model with reference dependent preferences as published by the two psychologists Tversky and Kahneman (1991), which itself is an outgrowth or their pioneering experimental and theoretical work in prospect theory. Munro and Sugden then introduce an axiomatic theory of preferences which, according to their interpretation, is consistent with the experimental results obtained by Tversky and Kahnenman and others. From these axioms they then derive results about stable trading equilibria. Such trading equilibrium is a concept which is similar to my concept of a long run demand function, as used in my Theorem 2A. But it should be remarked that Munro and Sugden add the assumption that their parallel concept to my concept of improving sequences are non-circular. They justify this assumption by reference to a certain “rationality” postulate, because circularity of improvement sequences would enable others to exploit the person as a “money pump”. They refer to Samuelson (1950) who considered using this argument as a justification of the strong axiom of revealed preference. My theory presented above shows that one can derive non-circularity of improving sequences from the assumption of adaptive preferences (Theorem 1). The “money pump argument” then can be used as an additional support for the hypothesis of adaptive preferences. This is what I have done above in section S.

Also there is the axiomatic research related to the concept of “libertarian paternalism”. See for example: Bernheim and Rangel (2009), Köszegi and Rabin (2008).

AA Wrap-Up: A New Theory of the Good Economic Order?

Normative economics is a field of research which tries to develop advice for economic policy. Such advice may be very much concerned with the day to day decisions in politics, indeed with the advisability or otherwise of specific “projects” as we discussed in the preceding sections. But there is the more “philosophical” approach on the fundamental questions of social life. I mention “philosophers” or “economists” like Karl Popper, Hayek, Eucken, Rawls, Röpcke, Buchanan, Amartya Sen. After the war, in Germany the work of Walter Eucken had a particularly strong influence on actual economic policy. This line of research and economic policy got the name “Ordnungspolitik”. The turn to the “social market economy” in West Germany under Ludwig Erhard from 1948 onwards was strongly influenced by the idea of “Ordnungspolitik”. As I went back to Eucken´s (1939) and (1951) writings I observed, among other things, two characteristics, which show his close neighbourhood to the neoclassical tradition: First, Eucken explicitly defends the assumption of fixed preferences; second, Eucken explicitly defends his methodological approach to exclude endogenously caused changes in technology. This then brings him into the neighbourhood of the neoclassical general equilibrium approach which is highlighted by the two main theorems of welfare economics: the Pareto-optimality of a competitive general equilibrium and the possibility to find a Walras equilibrium for any given Pareto-optimal allocation. In this sense, Eucken´s important theoretical contribution is “static”.

In the meantime “new growth theory” has tried to make technology endogenous. A theory of a good economic order can build on these developments. Modern micro-economic theory has developed a large set of “market failure” phenomena, in particular built around the problem of incomplete information of market participants. Today, even under the assumption of fixed preferences nobody in economics believes that a “static ideal economic order” is the goal to be achieved. There is then no way back to Eucken. In a recent paper (in

German) I have indicated some points where a new theory of the good economic order will have to go beyond Eucken (von Weizsäcker (2013)).

Another reason is the development of “public choice”. Starting with Schumpeter´s “Capitalism, Socialism and Democracy” (1942) a fully-fledged discipline of the “positive (rather than normative) theory of government” has arisen. Thus, on the other hand, nobody in economics today seriously believes that there exists a “socialism of the 21st century” to be achieved. Historical developments like the breakdown of the centrally planned economy of the Soviet Empire have contributed to this overwhelming view among economists.

I believe that we then have to look for a theory of an economic order which adopts the philosophy of *incrementalism*. We may think of it as inspired by Poppers idea of “*piecemeal engineering*” – as opposed to the design of a Platonic “ideal state”. The *empirical* foundation of any policy design then is historical experience of that same society and of other societies in the real world. But experience filtered through theory and empirical research in the social sciences, in particular economics. The *normative* foundation should be normative individualism, as explained in the first part of this paper. This then is a theory of freedom. The theory of a good economic order is at the same time a theory of a society of free people.

As I have explained in Part III of this paper, the hypothesis of adaptive preferences enables us to develop a theory of the advantages of decentralised decision making. It is worth emphasising that these arguments in favour of decentralised decision making are different from the traditional ones. The arguments traditionally used to plead for a market economy are “static” in their core. This is the case for Hayek´s “use of knowledge in society”, for Eucken´s theory of the market economy (in German: “Verkehrswirtschaft”), for the Walras-Arrow-Debreu theory of general equilibrium and for other earlier approaches. Explicitly or implicitly the reference point is the hypothetical benevolent, omniscient dictator. This reference point defines optimality. It has - with the full acknowledgement of its purely hypothetical character – a positive connotation: it is “better” than what can be achieved in real life.

In my approach, following Popper´s incrementalism, I forego the search for a global optimum. This, of course, is also in line with Hayek´s later work, in particular his book on “The Constitution of Liberty” (1960) and his important critique of a philosophy which he calls “constructivism”. But thereby I also can forego the reference point of the benevolent, omniscient dictator. My reference point is the stagnant economy which comes about, if the vast majority of deviations from “the default” would be rejected. Relative to this reference point productive deviations by undertaking a large set of “projects” are better. The important point is that we no longer need an orientation from a utopian and thus always potentially totalitarian “ideal world”. We are satisfied with gradual improvement, with “local” deviations from the status quo. And, of course, we thereby can accommodate induced preferences, as long as these preferences are adaptive.

Welfare economics of this kind then allows us to develop a theory of the economic system which is no longer static, but dynamic, or, if you wish, “evolutionary”. The idea of the optimised system at large is replaced by the idea of “improvement”, by the idea of “progress” as it was developed in the age of enlightenment, as it inspired Adam Smith, the economists´ founding father.

But, of course, my approach, as described in this paper, is, as yet, an almost empty box. The only content of the box - but I believe, an important one - are the two propositions that decentralisation is required to escape stagnation (section W above) and that, with adaptive preferences, decentralisation is not self-destroying (section V above: Theorem 3). The institutional details of such decentralisations have not been specified, except for the emphasis on competition. Nevertheless, I am quite optimistic that much of received doctrine concerning institutional design can be incorporated into this theory of a good economic order.

A new theory of a good economic order has to include a theory of social justice. Hayek (1976) suggested that we should ignore the criterion of social justice. But even if, fundamentally, we were on his side in this respect there are good reasons for including social justice into a theory of a good economic order. The functioning State rests on its monopoly for the legitimate use of physical force → Hobbes, Leviathan. The fact that property can be redistributed creates an incentive for part of the electorate to demand such redistribution. The Festinger cognitive dissonance effect then induces ideas of social justice which justify such redistribution. And cognitive dissonance effects are consistent with adaptive preferences. Thus, if not for other reasons (my own value judgements would give me such other reasons), then at least from a public choice perspective, a theory of a good economic order has to include a theory of social justice.

A theory of a good economic order must of course take account of the diverse philosophical discourses which touch on this topic. I only mention a few names in alphabetical order: Arrow, Gary Becker, Berlin, Buchanan, Durkheim, Dworkin, Eucken, Habermas, Hayek, Marx, Menger, Mises, Müller-Armack, Nell-Breuning, Nozick, Ostrom, Popper, Rawls, Röpke, Sen, Simmel, Herbert Simon, Max Weber.

AB Conclusion

Is welfare economics, is normative individualism still possible, when preferences are endogenously determined? The answer is yes, if and only if the hypothesis of adaptive preferences is correct. If preferences satisfy the conditions of continuity, non-satiation and regularity, then adaptive preferences imply that improvement sequences are non-circular (acyclic): Theorem 1. And non-circularity of improvement sequences implies that there exists an exogenous quasi-utility function $V(x)$, such that $V(y) > V(x)$ indicates that y can be reached from x via an improvement sequence: Theorem 2. As a corollary preferences then are adaptive.

I define "pragmatic compossibility" of rights as a condition for a free society. Their specific form can only be obtained by experience, i.e. "piecemeal engineering" à la Karl Popper. For this concept of the "Open Society" to be feasible preferences have to be adaptive. Partial equilibrium cost-benefit analysis remains valid if and only if preferences are adaptive: Theorem 3. This is a requirement for a society which can escape stagnation by means of the "money form" of decentralised decision making. The success of western society through the last several centuries is "proof" that preferences are adaptive.

Mathematical Appendix

1.Introduction

Definition 1: A preference system $\{x; q; \dot{q}\}$ is a system consisting of a commodity space containing commodity baskets x, consisting of a preference space containing preferences q, and of a rule $\dot{q}(x; q)$ describing the change through time of preferences as a function of the actually prevailing commodity basket x and the actually prevailing preferences q.

Any particular person is characterised by a preference system.

For concreteness we may think of baskets x to be elements in a subset of n −dimensional Euclidean Space, for example the set of non-negative vectors, designated by R^n+. But the theory is in all likelihood applicable to more general spaces. As we define continuous preferences we assume the normal topology of Euclidean spaces.

The preference space may be a rather abstract space, as long as preferences as elements of this space fulfil certain properties defined below. For concreteness we may assume that preference space is also a Euclidean space of some dimension N, where N is a positive integer, which may be smaller or larger than n which is the dimension of the commodity space. For example, we may consider a subset of all continuous preferences over baskets x. By well-known theorems (Debreu (1959)) such preferences may be represented by continuous ordinal utility functions defined over a subset of R^n. We may then, for example, concentrate on such continuous utility functions which can be written as a polynomial of some order L, where we are free to choose any positive integer L. If we concentrate our attention on a compact subset of basket space R^n we can obtain very close approximations of all continuous utility functions by means of such polynomials. The preference q as a vector in R^N may then represent the N coefficients of the polynomial of order L which corresponds to the particular preferences under investigation. Continuity of preferences in preference space may then simply mean continuity of the utility function with respect to its N different parameters, using the normal Euclidean topology.

Concerning preference changes I investigate two different models, the "class-room model" and the continuous time model.

Definition 2: Induced Preferences. Preferences $\rho(x)$ are induced by basket x, if , for x constant through time, preferences q converge towards $\rho(x)$.

The function ρ is a mapping from commodity space into preference space indicating the inducement of preferences by actual consumption.

3. The class room model. Here I denote a preference system by $[x; q; \dot{q}]$. The class room model is a discrete time model such that $q(t) = \rho(x(t-1))$. In words: preferences lag behind the basket by one period in the sense that they are the preferences induced by the basket of last period.
4. The real world model. Here I denote a preference system by $\{x; q; \dot{q}\}$. But I use this notation also when I talk of a preference system without specifying whether it is of the class-room model type or the real world model type. The real world model works in continuous time. The preference dynamics then may be given by the vector differential equation
$$\frac{dq}{dt} \equiv \dot{q} = f(x; q)$$
I assume the function $f(x; q)$ to have the necessary properties so that for any given initial preferences $q(0)$ any given path $x(t)$ the differential equation has a unique solution. Moreover, I assume that for x constant through time preferences q converge to some definite value $\rho(x)$.

I now introduce the concept of adaptive preferences. I use the following notation. If basket y is preferred over basket x under preferences q we write $y(>; q)x$. If basket y is indifferent to basket x under preferences q we write

$y(=;q)x$. If basket x is not preferred over y under preferences q we write $y(\geq;q)x$.

Definition 3: The preference system$\{x;q;\dot{q}\}$ is characterised by adaptive preferences if the following holds: 1. For any two baskets x and y, if $y\big(>;\rho(x)\big)x$ then $y\big(>;\rho(y)\big)x$. 2. For any two baskets x and y, if $y\big(\geq;\rho(x)\big)x$ then $y\big(\geq;\rho(y)\big)x$. In words: Preferences are adaptive, if a basket y, which is preferred to x with preferences induced by x, is, a fortiori, preferred to x with preferences induced by y.

Assumptions about preferences. We assume that preferences are defined over non-negative commodity baskets in n-dimensional Euclidean space R^n, which we denote by R^n+. Specific assumptions are the following:

1. Continuity: Preferences are continuous, i.e. If $y(>;q)x$ then there exist neighbourhoods $N_1(x)$, $N_2(y), N_3(\mathrm{q})$ such that for $w \in N_1(x)$, $z \in N_2(y)$, $r \in N_3(q)$ we have $z(>;r)w$. Here "neighbourhood" is understood to mean a set containing an open set in the relative topology of $\bar{R}^n$ of those dimensions of R^n for which $x_i > 0$.

2. Non-Satiation. Let x and y be two baskets in R^n+. For each component i such that $x_i > 0$ we have $y_i > x_i$. Then for all preferences q we have $y(>;q)x$.

3. Basic Regularity I:
   3A. This assumption refers to any pair of two different preferences q^1 and q^2. For any basket$\bar{x}$, let $I(\bar{x};q^1)\complement R^2+$ be the indifference curve containing $\bar{x}$ with preferences $q^1$and let $I(\bar{x};q^2)\complement R^2+$ be the indifference curve containing $\bar{x}$ with preferencesq^2. Then for the intersection of the two indifference curves $\hat{I}(\bar{x};q^1;q^2) \equiv I(\bar{x};q^1) \cap I(\bar{x};q^2)$ we either have $\hat{I}(\bar{x};q^1;q^2) = I(\bar{x};q^1) = I(\bar{x};q^2)$ or $\widehat{I}(\bar{x};q^1;q^2) \equiv I(\bar{x};q^1) \cap I(\bar{x};q^2) = \{\bar{x}\}$.

3B. Moreover, I assume: if $y > x$ then $I(y; \rho(y))$ does not intersect with $I(x; \rho(x)$. Because of non-satiation this means, of course, that $I(y; \rho(y)$ lies "above" $I(x; \rho(x)$.

3C. Preferences $\rho(x)$ change continuously with the inducing basket x: If $y\big(>; \rho(x)\big)x$ then there exists a neighbourhood $N(x)$ of x s. t. for $z \in N(x)$ we have $y\big(>; \rho(z)\big)z$.

I call this "basic regularity", because later on, for $n > 2$, I introduce an additional assumption which then together with “basic regularity” is called “regularity” or “full regularity”.

2. Class-Room Model I: $n = 2$; preference systems with basic regularity

For the class-room model I now introduce the concepts of improvement stream, improvement sequence and improvement path.

Definition 4: Let A, B, C,… K be a finite set of consumption baskets which have the following properties. For preferences induced by A the basket B is preferred over A; for preferences induced by B the basket C is preferred over B; and so on. Each basket is preferred over the preceding one with preferences induced by the preceding one. Such a sequence I call an improving sequence. If, in addition, all other baskets in the sequence are different from the starting basket then the improving sequence of baskets is called an improvement path or an improving path.

In analogous way I define weakly improving sequences: Let A, B, C,… K be a finite set of consumption baskets which have the following properties. For preferences induced by A the basket B is weakly preferred over A; for preferences induced by B the basket C is weakly preferred over B; and so on. Each basket is weakly preferred over the preceding one with preferences induced by the preceding one. Such a sequence I call a weakly improving sequence.

I introduce the following notation: $yNEx$ if both components of y are greater than the corresponding components of x; in a formula: $yNEx$ iff $y_1 > x_1$ and $y_2 > x_2$. Similarly $yNWx$ iff $y_1 \leq x_1$ and $y_2 \geq x_2$ and $y \neq x$; Similarly $ySEx$

iff $y_1 \geq x_1$ and $y_2 \leq x_2$ and $y \neq x$. Similarly $ySWx$ iff $y_1 \leq x_1$ and $y_2 \leq x_2$ and $y \neq x$. Note that, obviously, the relations " NE" , "NW" "SE" and "SW" are transitive.

Because of non-satiation $yNEx$ implies $y\big(>; \rho(q)\big)x$ for any q.

Observe the following: Because of basic regularity if $y \in I(x; \rho(x))$ then the indifference curves $I(x; \rho(x))$ and $I(y; \rho(y))$ cross each other only at y. We then can identify a south-eastern wing of $I(x; \rho(x))$, denoted $SEI(x; \rho(x))$, and of $I(y; \rho(y))$, denoted $SEI(y; \rho(y))$, to the "south-east" of$y$; and a north-western wing of $I(x; \rho(x))$ and $I(y; \rho(y))$ to the "north-west" of y and denoted $NW(x; \rho(x))$ and $NW(y; \rho(y)$.

Concerning these four "wings" of the two indifference curves I now prove the following

<u>Lemma:</u> A) Assume $y \in I(x; \rho(x))$ and $x \in SEI(x; \rho(x))$. If preferences are adaptive then for any z$\in$ $SEI(x; \rho(x))$ we can find $\hat{z} \in SEI(y; \rho(y))$ with $\hat{z} > z$. If preferences are adaptive then for any z$\in$ $NWI(x; \rho(x))$ we can find $\hat{z} \in NWI(y; \rho(y))$ with $\hat{z} < z$. In other words: $SEI(y; \rho(y)$ lies above $SEI(x; \rho(x)$ and $NWI(y; \rho(y))$ lies below $NWI(x; \rho(x))$.

B) Assume $y \in I(x; \rho(x))$ and $x \in NWI(x; \rho(x))$. If preferences are adaptive then for any z$\in$ $SEI(x; \rho(x))$ we can find $\hat{z} \in SEI(y; \rho(y))$ with $\hat{z} < z$. If preferences are adaptive then for any z$\in$ $NWI(x; \rho(x))$ we can find $\hat{z} \in NWI(y; \rho(y))$ with $\hat{z} > z$. In other words: $SEI(y; \rho(y)$ lies below $SEI(x; \rho(x)$ and $NWI(y; \rho(y))$ lies above $NWI(x; \rho(x))$.

<u>Proof of A):</u> Then $x \in SEI(x; \rho(x))$. Proof by contradiction: Assume the contrary. Then $SEI(y; \rho(y))$ does not lie above $SEI(x; \rho(x))$. Because of basic regularity this means that $SEI(y; \rho(y))$ lies below $SEI(x; \rho(x))$. Because of $x \in SEI(x; \rho(x))$ and because of non-satiation and continuity we then have $x(>; \rho(y)y$. On the other hand, because of $y\big(=; \rho(x)\big)x$ adaptive preferences imply $y\big(\geq; \rho(y)\big)x$ which is a contradiction. Thus the Lemma is shown for its Part A. Proof of Part B is analogous. QED.

Corollary: A) Assume $yNWx$ and $y\big(>;\rho(x)\big)x$. Then $SEI(y;\rho(y))$ lies above $I(x;\rho(x))$. B) Assume $ySEx$ and $y\big(>;\rho(x)\big)x$. Then NW$I(y;\rho(y))$ lies above $I(x;\rho(x))$. Proof of A): Let $\hat{x} = x + \lambda e$ where $e = (1,1)$ is the unit vector and $\lambda > 0$ is chosen so that $y \in I(\hat{x};\rho(\hat{x}))$. Because of Condition 3C of basic regularity such $\lambda > 0$ exists. Because of the Lemma we then know that $SEI(y;\rho(y))$ lies above $I(\hat{x};\rho(\hat{x}))$. On the other hand, because of basic regularity assumption 3B, $I(\hat{x};\rho(\hat{x}))$ lies above $I(x;\rho(x))$, so that $SEI(y;\rho(y))$ lies above $I(x;\rho(x))$. Proof of B) is analogous. QED

Theorem 1A: If in a preference system $[x;q;\dot{q}]$ in a two-commodity world preferences are adaptive then improvement sequences are improvement paths, i.e. they are non-circular.

Proof:

First I show the Theorem to be true for $T = 2$. Due to the definition of an improvement sequence we have $x^1(>;\rho(x^0))x^0$ and $x^2(>;\rho(x^1))x^1$. Obviously $x^1 \neq x^0$. If we had $x^2 = x^0$ then $x^0(>;\rho(x^1))x^1$ which, together with $x^1(>;\rho(x^0))x^0$, would violate the assumption of adaptive preferences.

Next I show: If x^1NWx^0 and x^2SEx^1 then $x^2(>;\rho(x^0))x^0$. Proof: Due to the definition of an improvement sequence we have $x^1(>;\rho(x^0))x^0$ and $x^2(>;\rho(x^1))x^1$. Then by the Corollary $SEI(x^1;\rho(x^1))$ lies above $I(x^0;\rho(x^0))$. Because of x^2SEx^1 we can find $\hat{x}^1 \in SEI(x^1;\rho(x^1))$ with $x^2 > \hat{x}^1$, and thus x^2 lies above $SEI(x^1;\rho(x^1))$ and thus also above $I(x^0;\rho(x^0))$ which shows $x^2(>;\rho(x^0))x^0$.

Similarly I show: If x^1SEx^0 and x^2NWx^1 then $x^2(>;\rho(x^0))x^0$.

Now Proof of the Theorem by induction. Thus, I assume the proposition of the theorem to be true for some given T. Consider now the improvement sequence $\{x^0, x^1, \dots x^T, x^{T+1}\}$. Proof by contradiction: Assume $x^{T+1} = x^0$. First assume that there exists k such that $x^{k+1} > x^k$. Then, due to non-satiation and due to $x^k(>;\rho(x^{k-1})x^{k-1}$, we have $x^{k+1}(>;\rho(x^{k-1})x^{k-1}$. Thus we can construct the improvement sequence $\{x^0, x^1, \dots x^{k-1}, x^{k+1}, \dots x^T, x^{T+1}\}$ which is of length T and thus by induction assumption $x^{T+1} \neq x^0$, a contradiction to the assumption $x^{T+1} = x^0$.

Thus, we are restricted to the case that for all $k = 0,1, \dots .T$ we have $x^{k+1}NWx^k$or $x^{k+1}SEx^k$ $x^{k+1}SEx^k$. Obviously it cannot be the case that for all $k = 0,1, \dots .T$ we have $x^{k+1}NWx^k$, because the relation "NW"is transitive and thus this would mean$x^{T+1}NWx^0$, contrary to the assumption $x^{T+1} = x^0$. Obviously it cannot be the case that for all $k = 0,1, \dots .T$ we have $x^{k+1}SEx^k$, because the relation "SE"is transitive and thus this would mean $x^{T+1}SEx^0$, contrary to the assumption $x^{T+1} = x^0$. Assume x^1NWx^0. Then we can find $k \in \{1,2, \dots T\}$ such that x^kNWx^{k-1} and $x^{k+1}SEx^k$. But then, as shown, $x^{k+1}(>; \rho(x^{k-1})x^{k-1}$. Thus we can construct the improvement sequence$\{x^0, x^1, \dots x^{k-1}, x^{k+1}, \dots x^T, x^{T+1}\}$ which is of length T and and thus by induction assumption$x^{T+1} \neq x^0$, a contradiction to the assumption $x^{T+1} = x^0$.

Similarly for the case x^1SEx^0. Thus, we have shown that the assumption $x^{T+1} = x^0$ leads to a contradiction, which shows the Theorem. QED.

3.Class Room Model: Full Regularity and $n \geq 2$

For the generalisation of Theorem 1 to n larger than 2 I introduce the following additional regularity assumption which only makes sense, if we assume adaptive preferences. I call it the "triangle inequality assumption of adaptive preferences". Let $x^1(>; \rho(x^0))x^0$ and $x^2(>; \rho(x^1)x^1$. Then there exists a nonempty connected set M of real numbers $\mu \in M$ with $0 < \mu < 1$ such that for $x(\mu) = (1-\mu)x^0 + \mu x^2$ we have $x(\mu)(>; \rho(x^0)x^0$ and $x^2(>; \rho\big(x(\mu)\big))x(\mu)$. Moreover, let $x^1(\geq; \rho(x^0))x^0$ and $x^2(\geq; \rho(x^1))x^1$. Then there exists a nonempty connected set M of real numbers $\mu \in M$ with $0 \leq \mu \leq 1$ such that for $x(\mu) = (1-\mu)x^0 + \mu x^2$ we have $x(\mu)(\geq; \rho(x^0))x^0$ and $x^2(\geq; \rho(x(\mu)))x(\mu)$. Moreover we assume that $M(x^0; x^2)$ changes continuously with x^0 and x^2; i.e.: Assume for some $\bar{\mu}$ such that $0 < \bar{\mu} \leq 1$ we have $x(\bar{\mu})(\geq; \rho(\bar{x}^0))\bar{x}^0$ and $\bar{x}^2(\geq; \rho(x(\bar{\mu})))x(\bar{\mu})$. Then for any sequence of vector pairs $x^0(1), x^2(1); x^0(2), x^2(2); \dots \dots \dots$ converging to $\bar{x}^0$ resp. $\bar{x}^2$ such that there exists a two step weakly improving sequence from $x^0(i)$ to $x^2(i)$ we can find a sequence $\mu(1); \mu(2); \dots$ such that $x(\mu(i))(\geq; \rho(x^0(i)))x^0(i)$ and $x^2(i)(\geq; \rho(x(\mu(i))))x(\mu(i))$ and such that the sequence $\mu(1); \mu(2); \dots$ converges to $\bar{\mu}$.

Using this full regularity assumption we can show the following

Basic Lemma: Assume non-satiation and continuity of preferences; assume further full regularity and adaptive preferences. Let $\{x^0, x^1, x^2, \ldots . x^T\}$ be a weakly improving sequence. Let $R^2(x^0, x^T)$ be the two-dimensional Euclidean subspace spanned by the three vectors $0, x^0, x^T$. Then there exists a weakly improving sequence $x^0, z^1, z^2, \ldots . . z^{T-1}, x^T$ such that $z^k \in R^2(x^0, x^T)$ for k= $1,2, \ldots . T-1$.

Proof: Proof is by induction on T. For $T = 2$ the proposition follows directly from the "triangle inequality assumption of adaptive preferences". Assume now the proposition to be true for improvement sequences of length T or less. Consider now an improvement sequence $x^0, x^1, \ldots . . x^T, x^{T+1}$ of length $T + 1$. I now proceed to construct a sequence with the required properties. For this I define the Euclidean distance of any basket y from the subspace $R^2(x^0, x^{T+1})$ by the following (well-known) formula $d(y) = Min\,\{d(y,x): x\epsilon R^2(x^0, x^{T+1})\}$ with $d(y,x) = \sqrt{(\sum_{i=1}^{n}(y_i - x_i)^2}$. For any sequence of baskets $Y = (y^0, y^1, y^2, \ldots . y^T, y^{T+1})$ of length $T + 2$ define a distance vector $D = (d(y^0), d(y^1), d(y^2), \ldots \ldots d(y^T), d(y^{T+1}))$ of length $T + 2$ .Consider now the following sequence of basket sequences $Y(1), Y(2), \ldots \ldots Y(s), \ldots \ldots \ldots$ We define $Y(1) = (x^0, x^1, x^2, \ldots . x^T, x^{T+1})$. By assumption $Y(1)$ is weakly improving. Then consecutively $Y(s+1)$ is derived from $Y(s)$ in the following way. Let $t\epsilon(0,1,2, \ldots . T, T+1)$ be chosen so that $d(y^t(s)) \geq d(y^\tau(s))$ for all $\tau \in (0,1,2, \ldots T, T+1)$. If there is more than one such t choose the largest one. Either $t = T + 1$; but then the sequence $Y(s)$ is already contained in $R^2(x^0, x^{T+1})$ and provided $Y(s)$is weakly improving we have found what we are looking for. Thus, we only have to consider the case $t < T + 1$ and $d(y^t) > 0$. By induction assumption on s we can consider $Y(s)$ to be weakly improving. We then set $y^\tau(s+1) = y^\tau(s)$ for $\tau \neq t$. We now replace $y^t(s)$ by $y^t(s+1) = (1-\mu)y^{t-1}(s) + \mu y^{t+1}(s)$ where μ is chosen in such a way that $y^t(s+1)(\geq, \rho(y^{t-1}(s))y^{t-1}(s)$ and $y^{t+1}(s)(\geq; \rho(y^t(s+1))y^t(s+1)$. That such μ exists is granted by the "triangle inequality of adaptive preferences assumption". Thus $Y(s+1)$ is different from $Y(s)$only in one component. And this different component is chosen in such a way that, if $Y(s)$ is weakly improving so is $Y(s+1)$. Then, by construction, every $Y(s)$ is a weakly improving sequence.

We then look at the $T+2$ – dimensional distance vectors $D(s)=(d(y^0(s)),d(y^1(s)),\ldots\ldots d(y^T(s)),d(y^{T+1}(s)))$. By construction we observe that $D(s+1)\leq D(s)$: the largest component of $D(s)$ has been replaced by a weighted average of the two neighbouring components, one of which is definitely smaller than the replaced component. Only if the chosen $\mu=0$ and $d(y^{t-1}(s))=d(y^t(s))$ is this not the case. But then $y^t(s)=y^{t-1}(s)$ and hence the weakly improving sequence is really of length T, so that by induction assumption we know the proposition of the Lemma to be true. Thus, we only have to deal with the case that $D(s+1)\leq D(s)$ and $D(s+1)\neq D(s)$.

By construction the series of difference vectors is weakly declining, but remains non-negative. Thus each of the $T+2$ components has a convergence point. For any $t\in(0,1,\ldots.T,T+1)$ let $d^*(t)$ be that convergence point. Moreover, for each good i with $i\in(1,2,\ldots\ldots n)$ we know that $y_i^\tau(s+1)\leq\max(y_i^{\tau-1}(s),y_i^\tau(s),y_i^{\tau+1}(s))$, from which follows that $y_i^\tau(s)\leq\max(x_i^\theta:\theta\in(0,1,2,\ldots.T,T+1)$. Thus $y_i^\tau(s);s=0,1,\ldots\ldots$ moves in a compact set. Thus, also $y^\tau(s);s=0,1,\ldots..$ moves in a compact subset of R^n. Therefore the sequence $y^\tau(s);s=0,1,\ldots..$ has an accumulation point $\hat{y}^\tau$. Consider now the sequence of these accumulation points $\hat{y}^0,\hat{y}^1,\ldots\ldots\hat{y}^T,\hat{y}^{T+1}$.

We can show: the sequence $\hat{y}^0,\hat{y}^1,\ldots\ldots\hat{y}^T,\hat{y}^{T+1}$ is a weakly improving sequence. Assume the contrary. We then can find $t\in(1,2,\ldots\ldots T+1)$ such that $\hat{y}^{t-1}(>;\rho(\hat{y}^{t-1}))\hat{y}^t$. Because preferences are continuous we then find a neighbourhood $U(\hat{y}^t)$ and a neighbourhood $V(\hat{y}^{t-1})$ such that for $z\in U(\hat{y}^t)$ and $w\in V(\hat{y}^{t-1})$ we have $\mathrm{w}(>;\rho(w))z$. But every pair of neighbourhoods $U(\hat{y}^t)$ and $V(\hat{y}^{t-1})$ contains baskets which are part of a sequence $Y(s)$, which is a weakly improving sequence, as shown above. Therefore $U(\hat{y}^t)$ and $V(\hat{y}^{t-1})$ contains baskets $z\in U(\hat{y}^t)$ and $w\in V(\hat{y}^{t-1})$ with $z(\geq,\rho(w))w$ which, due to continuity, disproves $\hat{y}^{t-1}(>;\rho(\hat{y}^{t-1}))\hat{y}^t$. Therefore we know that the sequence $\hat{y}^0,\hat{y}^1,\ldots\ldots\hat{y}^T,\hat{y}^{T+1}$ is a weakly improving sequence. Obviously we have $d(\hat{y}^t)=d^*(t),t=0,1,\ldots.T,T+1$.

Assume now that there exists $t^* \in (1,2,\ldots T)$ such that $d^*(t^*) > 0$ and $d^*(t^*) \geq d^*(t); t = (0,1,\ldots T, T+1)$ and $d^*(t^*) > d^*(t); t = (t^*+1, t^*+2, \ldots . T, T+1)$. Let $\varepsilon = d^*(t^*) - d^*(t^*+1)$. By construction we have $\varepsilon > 0$. Let μ^*be defined such that $(1-\mu^*)\hat{y}^{t^*-1} + \mu^*\hat{y}^{t^*+1}(\geq; \rho(\hat{y}^{t^*-1}))\hat{y}^{t^*-1}$ and $\hat{y}^{t^*+1}(\geq; \rho\left((1-\mu^*)\hat{y}^{t^*-1} + \mu^*\hat{y}^{t^*+1}\right))$ $(1-\mu^*)\hat{y}^{t^*-1} + \mu^*\hat{y}^{t^*+1}$. Such μ^* exists with $0 \leq \mu^* \leq 1$ due to the triangle inequality assumption of adaptive preferences. If $\mu^* = 0$ then we have found a weakly improving sequence of length T and thus know from the induction assumption that the proposition of the lemma is fulfilled. We thus can assume $0 < \mu^* \leq 1$.

Because $\hat{y}^{t^*-1}$, $\hat{y}^{t^*}$ and $\hat{y}^{t^*+1}$ are accumulation points of the sequences $y^{t^*-1}(0), y^{t^*-1}(1), \ldots \ldots y^{t^*-1}(s), \ldots .$ and $y^{t^*}(0), y^{t^*}(1), \ldots \ldots y^{t^*}(s), \ldots .$ and $y^{t^*+1}(0), y^{t^*+1}(1), \ldots \ldots y^{t^*+1}(s), \ldots .$ respectively, we can find s such that $d(y^{t^*-1}(s)) - d^*(t^*-1) < \mu^* \frac{\varepsilon}{2}$ and $d\left(y^{t^*}(s)\right) - d^*(t^*) < \mu^* \frac{\epsilon}{2}$ and $d\left(y^{t^*+1}(s)\right) - d^*(t^*+1) < \mu^* \frac{\epsilon}{2}$ and such that there exists μ with $\mu > \frac{\mu^*}{2}$ and $(1-\mu)y^{t^*-1}(s) + \mu y^{t^*+1}(s)(\geq; \rho(y^{t^*-1}(s)))y^{t^*-1}(s)$ and $y^{t^*+1}(\geq; \rho\left((1-\mu)y^{t^*-1}(s) + \mu y^{t^*+1}(s)\right))(1-\mu)y^{t^*-1}(s) + \mu y^{t^*+1}(s)$. We then compute $d(y^{t^*}(s+1)) = d\left((1-\mu)y^{t^*-1}(s) + \mu y^{t^*+1}(s)\right) = (1-\mu)d\left(y^{t^*-1}(s)\right) + \mu d(y^{t^*+1}(s)) \leq (1-\mu)d^*(t^*-1) + \mu^* \frac{(1-\mu)\varepsilon}{2} + \mu d^*(t^*+1) + \mu^* \frac{\mu\varepsilon}{2} \leq (1-\mu)d^*(t^*) + \mu^* \frac{(1-\mu)\varepsilon}{2} + \mu d^*(t^*+1) + \mu^* \frac{\mu\varepsilon}{2} = d^*(t^*) - \mu\varepsilon + \mu^* \frac{\varepsilon}{2} < d^*(t^*) - \mu^* \frac{\varepsilon}{2} + \mu^* \frac{\varepsilon}{2} = d^*(t^*)$, or, in short, $d(y^{t^*}(s+1)) < d^*(t^*)$. But this is in contradiction to the fact that $d^*(t^*)$ is a lower bound to $d(y^{t^*}(s))$ for all s. We thus have shown that $d^*(t^*) = 0$. This means that the weakly improving sequence $\hat{y}^0, \hat{y}^1, \ldots \ldots \hat{y}^T, \hat{y}^{T+1}$ is contained in $R^2(x^0, x^{T+1})$. This proves the Basic Lemma. QED.

Let $\bar{A}(x^0)$ be the set of baskets in R^n+ which can be reached from $x^0$by way of a weakly improving sequence. Let $A(x^0)$ be the set of baskets in R^n+ which can be reached from x^0 by means of an improving sequence. Obviously

$A(x^0) \complement \bar{A}(x^0)$, since an improving sequence is also a weakly improving sequence.

We now show:

Interior Lemma: $A(x^0) = Int(\bar{A}(x^0))$. Proof by induction on the length of improving paths: For $T = 1$ it is the case that any basket that is above the indifference surface going through $x^0$is preferred to x^0, due to non-satiation. Thus, the proposition is correct for improving paths of length $T = 1$. Let the proposition then be true for all improving sequences and weakly improving sequences of length T or shorter. This means: any basket in the interior of the set of baskets that can be reached by means of a weakly improving sequence of maximum length of T can be reached by an improving sequence of maximum length of $T.$ Consider now $\bar{x}$ in the interior of the set of baskets that can be reached from x^0 by means of weakly improving sequences of maximum length $T + 1$. There exists then $\bar{\bar{x}} < \bar{x}$ such that $\bar{\bar{x}}$ can be reached from x^0 by means of a weakly improving sequence of length $T + 1$. But then there exists $\tilde{x}$ such that it can be reached from x^0 by means of weakly improving sequence of length T and such that $\bar{\bar{x}}(\geq; \rho(\tilde{x}))\tilde{x}$. Then, due to non-satiation, $\bar{x}(>; \rho(\bar{\bar{x}}))\bar{\bar{x}}$. Due to continuity we can find a neighbourhood $N(\tilde{x})$ of $\tilde{x}$ such that for $z \epsilon N(\tilde{x})$ we have $\bar{x}\big(>; \rho(z)\big)z$. But this neighbourhood intersects with the interior of the set that can be reached from $x^0$by means of weakly improving paths of maximum length T. Therefore, by the induction assumption, we can find $z \epsilon N(\tilde{x})$ that can be reached from x^0 by an improving sequence of length T. Thus, because of $\bar{x}\big(>; \rho(z)\big)z$ we have shown that $\bar{x}$ can be reached from x^0 by means of an improving path of length $T + 1$. Thus, we have shown $Int(\bar{A}(x^0) \complement A(x^0)$. The converse is obvious, because $A(x^0)$by continuity is an open set and of course $A(x^0) \complement \bar{A}(x^0)$. QED.

Corollary to the Basic Lemma and the Interior Lemma: Assume non-satiation and continuity of preferences; assume further full regularity and adaptive preferences. Let $\{x^0, x^1, x^2, \ldots . x^T\}$ be an improving sequence. Let $R^2(x^0, x^T)$ be the two-dimensional Euclidean subspace spanned by the three vectors $0, x^0, x^T$. Then there exists an improving sequence $x^0, z^1, z^2, \ldots . . z^{T-1}, x^T$ such that $z^k \in R^2(x^0, x^T)$ for k= $1, 2, \ldots . T - 1$.

Proof: Let $\bar{x}\epsilon\bar{A}(x^0)$. Let $R^2(x^0,\bar{x})$ be the two dimensional sub-space spanned by x^0 and $\bar{x}$. Let $\bar{A}^2(x^0;\overline{x})$ be the set of baskets in $R^2(x^0,\bar{x})$ which can be reached from x^0 by means of a weakly improving sequence fully contained $R^2(x^0,\bar{x})$. Then, by the Basic Lemma, we have $\bar{A}^2(x^0;\bar{x}) = \bar{A}(x^0) \cap R^2(x^0,\bar{x})$: any $\bar{x}$ that can be reached by a weakly improving sequence from x^0 can also be reached by a weakly improving sequence of the same length that is fully contained in $R^2(x^0,\bar{x})$. Consider $A^2(x^0;x^T)$ = the set of baskets that can be reached from x^0 by means of an improving sequence fully contained in $R^2(x^0,x^T)$. Applying the Interior Lemma to the two-dimensional space $R^2(x^0,x^T)$ tells us that $A^2(x^0;x^T) = Int(\bar{A}^2(x^0;x^T)) = Int(\bar{A}(x^0) \cap R^2(x^0,x^T) = A(x^0) \cap R^2(x^0,x^T)$. This proves the Corollary. QED.

We then can prove the following

Theorem 1B: Assume non-satiation, continuity and full regularity and adaptive preferences as defined above. Then improvement sequences are non-circular.

Proof: Consider an improvement sequence $x^0, x^1, \dots \dots x^T$. Then by the Corollary to the Basic Lemma and the Interior Lemma we find an improvement sequence $x^0, z^1, z^2, \dots \dots x^T$ fully contained in $R^2(x^0,x^T)$. Thus, we can apply Theorem 1A, which tells us that $x^0, z^1, z^2, \dots \dots x^T$is non-circular. Then obviously $x^0, x^1, \dots \dots x^T$is non-circular, which proves the Theorem. QED.

4. Class Room Model: Theorem 2

I now proceed to show a converse theorem: non-circularity of improving sequences implies adaptive preferences. Indeed, it implies more than that.

Revealed Preference Lemma of Induced Preferences: Assume the class room model. Assumptions I (continuity) and II (non-satiation) hold. Assume further that there exists a well-defined “long run” demand function $x = H(p) = h(p;\rho(x))$. Let $\{x^0 = H(p^0), x^1 = H(p^1), \dots . . x^T = H(p^T)\}$ be a sequence of baskets such that each x^i is revealed preferred to x^{i-1} for $i = 1,2, \dots . T$. This means $p^i(x^i - x^{i-1}) \geq 0$ for $i = 1,2, \ldots . T$. Then there exists an improving sequence beginning at x^0 and ending at x^T.

Proof: The sequence starts at x^0. For $t = 1,2, \ldots$ we set $z^t = h(p^1; \rho(x^{t-1}))$. Because, by assumption, $p^1 x^0 \leq 1$ we see that $z^1$is revealed preferred to x^0 under preferences $\rho(x^0)$ and thus the move from x^0 to z^1 is an improvement. Generally, by the same reasoning z^t is revealed preferred to z^{t-1} under preferences $\rho(z^{t-1})$ and thus the move from z^{t-1} to z^t is an improvement. We continue this procedure until we come close enough to $x^1 = H(p^1)$ so that a jump from z^t to x^1 is an improvement. Such finite t always exists, because for $\rho(x^1)$ the basket x^1 is revealed preferred to any basket with $p^1 z \leq 1$ which applies to all z^t. Thus, because $\rho(z^t)$ converges to $\rho(x^1)$ and because of continuity of preferences there exists t such that $x^1$is revealed preferred to z^t und preferences $\rho(z^t)$.

Thus, we have constructed an improving sequence from x^0 to x^1. In an analogous way we can construct an improving sequence from x^1 to x^2, from x^2 to x^3; ……from x^{T-1} to x^T. Combining these T improving sequences into one large improving sequence then gives us the improving sequence from x^0 to x^T. QED.

We then can prove

Theorem 2A: In the class room model under Assumption I (continuity) and Assumption II (non-satiation) assume further that all improving sequences are non-circular and that there exists a long run demand function $x = h\big(p; \rho(x)\big) = H(p)$ which is independent of initial preferences $q(0)$. Then the long run demand function satisfies the strong axiom of revealed preference. Thus there exists a quasi-utility function $V(x)$ underlying the long run demand function. $V(x)$ is continuous. Moreover, this underlying quasi-utility function has the following property: If and only if $V(y) > V(x)$ there exists an improving sequence starting at x and ending at y.

Proof: By the Revealed Preference Lemma of Induced Preferences the assumption of non-circularity of improving sequences implies that any sequence of revealed preferred baskets is non-circular. Thus the Strong Axiom of Revealed Preference is fulfilled. Thus, by the Samuelson-Houthakker Theorem of Revealed Preference there exists a preference ordering underlying the long run demand function. Moreover, because of the Revealed Preference Lemma of Induced Preferences this underlying preference ordering has the property that a basket y that is preferred over a basket x can be reached from x by an improving sequence.

For any x let $\hat{A}(x)$ be the set of baskets which can be reached from x by means of an improving sequence. Then, the set $\hat{A}(x)$ is open: obviously, because of Assumption I any target point x^T of an improving sequence is contained in a neighbourhood $N(x^T)$ such that for $z \in N(x^T)$ we have $z(>; x^{T-1})x^{T-1}$. Thus $N(x^T) \complement \hat{A}(x)$ which proves that $\hat{A}(x)$ is open. But then the preference underlying the long run demand function which, due to Revealed Preference Lemma of Induced Preferences is the preference ordering defined by the reachability by means of improving paths is a continuous preference ordering. Thus it can be represented by a continuous utility function $V(x)$. QED.

<u>Corollary to Theorem 2A:</u> Under the assumptions of Theorem 2A preferences are adaptive.

<u>Proof:</u> Assume $y(>; x)x$. Then, obviously $y \in \hat{A}(x)$. Thus, $V(y) > V(x)$. Since, by the Samuelson-Houthakker Theorem the underlying preference ordering is complete we either have $y(>; y)x$ or $y(=; y)x$. But indifference can be excluded, because of the continuity of $V(x)$ and because of non-satiation. Thus, $y(> y)x$. QED.

5. <u>Class Room Model: Equivalence Theorem</u>

For $n > 2$ we have shown non-circularity of improvement sequences by first constructing a “mapping” of the improvement sequences in the two-dimensional space defined by the starting point and the end point of the improvement sequence. We now show that the “two-dimensional mapping property” is equivalent to the property of non-circularity of improvement sequences.

Theorem 1C (Equivalence Theorem): Assume the Class-Room Model. Part A: Assume that every improvement sequence of a given preference system $[x; q; \dot{q}]$ has a "two-dimensional mapping" with the same starting point and the same end point which is also an improvement sequence. Then every improvement sequence is non-circular. Part B: Assume that every improvement sequence of a given preference system $[x; q; \dot{q}]$ is non-circular. Then every improvement sequence of that preference system has a "two-dimensional mapping" with the same starting point and end point which is also an improvement sequence.

Proof: The proof of Part A actually is the last part of the proof of Theorem 1B. It basically uses Theorem 1A which applies for $n = 2$. Proof of Part B: The assumption of Part B is also used in Theorem 2A. Thus, it follows from Theorem 2A that there exists a continuous quasi-utility function $V(x)$ which indicates the existence of improvement paths with $V(x^0) < V(\bar{x})$ for starting point x^0 and endpoint $\bar{x}$. Consider now the two-dimensional subspace defined by 0, x^0 and $\bar{x}$. Because in this subspace it is also the case that improvement sequences are non-circular by Theorem 2A we can find a continuous quasi-utility function $W(x)$ defined in the two-dimensional subspace which is an indicator for the location of improvement paths within this subspace. We then can show that $V(x^0) < V(\bar{x})$ implies $W(x^0) < W(\bar{x})$. Assume the contrary; thus $W(x^0) \geq W(\bar{x})$. If $W(x^0) > W(\bar{x})$ then there exists an improvement path in the subspace and thus in R^n from $\bar{x}$ to x^0. But then there exists an improvement sequence from x^0 to x^0 in contradiction to the assumption that all improvement sequences in R^n are non-circular. Because of non-satiation any neighbourhood of $\bar{x}$ in the subspace contains vectors z with $W(z) < W(x^0)$. We then can find z with $W(z) < W(x^0)$ and $V(z) > V(x^0)$ which again contradicts the assumption that all improvement sequences are non-circular. Thus we have shown that $V(x^0) < V(\bar{x})$ implies $W(x^0) < W(\bar{x})$ and hence the existence of an improvement sequence within the two-dimensional subspace from x^0 to $\bar{x}$. QED.

6. "Real World Model"

I now define and discuss improvement sequences in a model of continuous time. I call it the "real world model", because it mirrors the real world much more closely than does the class room model. The preference dynamics then may be given by the vector differential equation

$$\dot{q} \equiv \frac{dq}{dt} = f(x;q)$$

We assume that $f(x;q)$ has all the properties required to make the differential equation integrable.

If x remains constant through time preferences q converge towards $\rho(x)$.

For the following it is useful to introduce an ordinal utility function representing the preferences involved in the analysis. Thus $U(x;q)$ is a function continuous in x which represents the preferences q. Because preferences are continuous we know that such $U(x;q)$ exists. Moreover, as before, we assume that preferences are also continuous in preference space. We then also can assume $U(x;q)$ to be continuous with respect to q in the topology assumed to exist in preference space.

We now look at a path through time of the consumption basket: $x(t)$. According to the differential equation above, for any given initial preferences $q(0)$ we have a movement of preferences $q(t)$ which of course depends on $x(t)$. We introduce the following definition:

<u>Definition:</u> A point in time t is an <u>improvement point</u>, if for $q(t)$ there exists $\varepsilon > 0$ such that for $t - \Delta t > t - \varepsilon$ and $\Delta t > 0$ we have $U\big(x(t-\Delta t);q(t)\big) < U(x(\mathrm{t});q(t))$. A point in time t is a weakly improving point, if for $q(t)$ there exists $\varepsilon > 0$ such that for $t - \Delta t > t - \varepsilon$ and $\Delta t > 0$ we have $U\big(x(t-\Delta t);q(t)\big) \leq U(x(\mathrm{t});q(t))$.

Consider now a movement of x through time from time zero to some time T. We restrict ourselves to movements $x(t), 0 \leq t \leq T$ such that $x(t)$ is piecewise continuous with K "jump points" with K≥ 0 a finite integer. Let $J = \{t_1, t_2, \dots . t_K\}$ be the set of jump points. We then assume that $x(t_i)$ is the limit point of $x(t)$ as $t > t_i$ approaches t_i from above. With this restriction we consider any path $x(t)$. Due to this restriction of piecewise continuity and for a given $q(0)$ preferences $q(t)$ are well defined by means of the integrable differential equation $\dot{q} = f(x; q)$.

We then can describe the path by $\{x(t); q(0); T\}$.

Definition: A path $\{x(t); q(0); T\}$ is a weakly improving sequence, if $q(0) = \rho(x(0))$ and every $t \in (0, T]$ is a weakly improving point for $0 \leq t \leq T$.

Definition: A path $\{x(t); q(0); T\}$ is an improving sequence, if it is a weakly improving sequence and if $T = t_K$ is a jump point with_$U\big(x(T); q(T)\big) > \lim_{t \to T} U(x(t); q(T))$

Note that all utility comparisons are made with the same preferences.

We now use the results from the class room model for deriving results for the continuous time model. We first introduce the following

Definition: For a given preference system $\{x; q; \dot{q}\}$ in continuous time we define the corresponding class room preference system $[x; q; \dot{q}]$ as that class room model which exhibits the same induced preferences mapping $\rho(x)$.

We then show the following

Correspondence Lemma: Assume all improvement sequences of a real world (continuous time) preference system_$\{x; q; \dot{q}\}$ are non-circular. Assume that there is a long run demand function $x = h\big(p; \rho(x)\big) = H(p)$ for the corresponding class room model. For any basket x^0 let $A(x^0)$ be the set of baskets which can be reached from x^0 by means of an improvement sequence. For any basket x^0 let $\hat{A}(x^0)$ be the set of baskets which can be reached from x^0

by means of an improvement sequence in the corresponding class room model. Then $A(x^0) = \hat{A}(x^0)$.

<u>Proof:</u> First observe that both, $A(x^0)$ and $\hat{A}(x^0)$ are open sets.

Next I show $\hat{A}(x^0) \complement A(x^0)$. For any given improvement sequence $\{x^0, x^1, \dots\dots x^T\}$ in the class room model I construct an improvement sequence in the continuous time model starting at x^0 and ending in finite time at x^T. The path $x(t) = x^0$ for $t \leq \varepsilon$ for some small positive ε. We then set $x(\varepsilon) = x^1$. Because $q(\varepsilon) = \rho(x^0)$ the jump to x^1 is an improvement jump. We then keep $x(t) = x^1$for $t \geq \varepsilon$ until $q(t)$ is sufficiently close to $\rho(x^1)$ so that a further jump to x^2 is an improvement. This is always possible in finite time, because preferences are continuous in preference space and because $q(t)$ converges to $\rho(x^1)$. We then jump to x^2 which is an improvement jump. We then keep $x(t) = x^2$ until – in finite time – a jump to x^3 is an improvement jump, and so on until – in finite time – we have an improvement jump from x^{T-1} to x^T. This shows $\hat{A}(x^0) \complement A(x^0)$.

Now I show $A(x^0) \complement \hat{A}(x^0)$. Because we assume that improvement sequences in the continuous time model are non-circular and because of $\hat{A}(x^0) \complement A(x^0)$ we then know that improvement sequences in the class room model are also non-circular. Because of Theorem 2A we then have a continuous quasi utility function $V(x)$ such that for any pair of baskets x and y there exists an improvement path in the class room model from x to y, if and only if $V(y) > V(x)$. Assume now, to the contrary, that there exists y such that it can be reached from x^0 in the continuous time model, but not in the class room model. We then have $V(y) \leq V(x^0)$. In the case $V(y) < V(x^0)$ we then know that $x^0 \in \hat{A}(y)$ and thus $x^0 \in A(y)$. But then we have found an improving sequence from x^0 to x^0 for the continuous time model, contrary to the assumption that improving sequences are non-circular. This excludes $V(y) < V(x^0)$. If we had $V(y) = V(x^0)$ then y would not be in the interior of $A(x^0)$ and thus $A(x^0)$ would not be an open set, which contradicts the fact that $A(x^0)$ <u>is</u> an open set. Thus we have shown that for $y \in A(x^0)$ it follows $V(y) > V(x^0)$ and thus, by Theorem 2A, we have $y \in \hat{A}(x^0)$. This proves the Correspondence Lemma. QED.

Theorem 2B: Assume the continuous time model with a given preference system $\{x, q, \dot{q}\}$. We then assume further: 1.Preferences are continuous. 2. There exists a long run demand function $x = h(p; \rho(x)) = H(p)$ 3. Improvement sequences are non-circular. Proposition: Then there exists a continuous quasi-utility function $V(x)$ with the following properties: If and only if $V(x^1) > V(x^0)$ there exists an improving sequence beginning at x^0 and ending in finite time at x^1.

Proof: Note first that the long run demand function is the same as the one for the corresponding class room model, since it only depends on the mapping $\rho(x)$. Then, by the Correspondence Lemma, the quasi-utility function $V(x)$ derived for the class room model from Theorem 2A is also an indicator function for the sets $A(x^0)$. QED.

Corollary: In the continuous time model, if there exists a long run demand function $x = h(p; \rho(x)) = H(p)$ and if all improvement sequences are non-circular then preferences are adaptive. Proof: Due to the Correspondence Lemma, we can apply the corresponding Corollary of the class room model. QED.

References

Akerlof, George and Rachel Kranton, Economics and Identity, QJE (2000), p. 715-753

Akerlof, The Market for Lemons: Quality Uncertainty and the Market Mechanism, QJE 1970, p 488-500

Arrow, Kenneth, Uncertainty and the Economics of Medical Care, AER 1963, p 941-973

Atkinson, Anthony B., On the Measurement of Inequality, JET 1970, p. 244-263

Becker, Gary S., A Treatise on the Family, Enlarged Edition, Cambridge, Mass, 1993

Becker, Gary S., Accounting for Tastes, Cambridge, Mass, 1996

Bergson, Abram, A Reformulation of Certain Aspects of Welfare Econmics, QJE 1938, p 310-334

Bernheim, Douglas and Antonio Rangel, Beyond Revealed Preference: Choice-Theoretic Foundations for Behavioral Welfare Economics, QJE 2009, p 51-104

Bolton, Gary E. and Axel Ockenfels, ERC: A Theory of Equity, Reciprocity and Competition, AER 2000, 166-193

Braithwaite, D, The Economic Effects of Advertisement, EJ 1928, p 16-37

Buchanan, James M., The Limits of Liberty: Between Anarchy and Leviathan, Chicago 1975

Coase, Ronald, The Problem of Social Cost, Journal of Law and Economics, 1960, p 1-44

Debreu, Gerard, Theory of Value – An Axiomatic Analysis of Economic Equilibrium, New York 1959

Diamond, Peter, A Search-Equilibrium Approach to the Micro-Foundations of Macroeconomics, Cambridge, Mass, 1984

Duesenberry, James, Income, Saving and the Theory of Consumer Behavior, Cambridge, Mass, 1949

Eucken, Walter, Die Grundlagen der Nationalökonomie, 1st edition 1939, 9th edition, Heidelberg 1989

Eucken, Walter, Grundsätze der Wirtschaftspolitik, 1st edition 1951, 6th edition, Tübingen 1990

Farrell, Joseph and Paul Klemperer, Coordination and Lock-In: Competition with Switching Costs and Network Effects, in: Armstrong, Mark and Robert Porter (ed.), Handbook of Industrial Organisation, Vol 3, Amsterdam 2007, p 1967-2072

Festinger, Leon, A Theory of Cognitive Dissonance, Stanford, CA, 1957

Gigerenzer, Gerd; Selten, Reinhard, Bounded Rationality: The Adaptive Toolbox, Cambridge, Mass 2002

Greenwald, Bruce and Joseph Stiglitz, Externalities in Economies with Imperfect Information and Incomplete Markets, QJE, 1986, p 229-264

Hayek, Friedrich A., The Use of Knowledge in Society, AER 1945, p 519-530

Hayek, Friedrich A., The Meaning of Competition, Lecture 1946 in Princeton, published in Hayek, Friedrich A., Individualism and Economic Order, Chicago 1948, p 92-106

Hayek, Friedrich A., The Constitution of Liberty, Chicago 1960

Hayek, Friedrich A., The Mirage of Social Justice, London 1976

Houthakker, Hendrik S. and Lester D. Taylor, Consumer Demand in the United States: Analysis and Projections, Cambridge, Mass, 1966

Kahneman, Daniel, Thinking Fast and Slow, New York 2011

Köszegi, Botond and Matthew Rabin, Choices, Situations, and Happiness, Journal of Public Economics, 2008, 1821-1832

Marshall, Alfred, Principles of Economics, London 1920

Mirrlees, James A., An Exploration in the Theory of Optimal Income Taxation, RES 1971

Mortensen, Dale and Christopher Pissarides, Job Creation and Job Destruction in the Theory of Unemployment, RES 1994 p 397-415

Munro, Alistair and Robert Sugden, On the Theory of Reference Dependent Preferences, Journal of Economic Behavior and Organisation, 2003, p 407-428

Popper, Karl, The Open Society and its Enemies, London 1945, fifth edition 1966

Rawls, John, A Theory of Justice, Cambridge, Mass, 1971

Rothschild, Michael and Josef Stiglitz, Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information, QJE 1976, p 629-649

Samuelson, Paul A., The Problem of Integrability in Economic Theory, Economica 1950, 355-385

Samuelson, Paul A., Social Indifference Curves, QJE 1956, p 1-22

Schmidtchen, Dieter, Recht, Eigentum und Effizienz – Zu F.A. von Hayeks Verfassung der Freiheit, Ordo, 2004, p 3-29

Schumpeter, Joseph A., Theorie der wirtschaftlichen Entwicklung, Leipzig 1911

Schumpeter, Joseph A., Capitalism, Socialism, and Democracy, New York 1942

Sen, Amartya, Choice, Welfare and Measurement, Cambridge, Mass 1982

Simon, Herbert, A Behavioral Model of Rational Choice, QJE 1955, p 99-188

Simon, Herbert, The Architecture of Complexity, Proceedings of the American Philosophical Society, 1962, p 467-482

Simon, Herbert, Franklin Fisher, Albert Ando, Essays on the Structure of Social Science Models, Cambridge, Mass, 1963

Smith, Adam, Wealth of Nations, London 1776

Sondermann, Dieter, Revealed Preference: An Elementary Treatment, Econometrica, 1982, p. 777-779

Spence, Michael, Job Market Signalling, QJE, 1973, p 355-374

Steiner, Hillel, The Structure of a Set of Compossible Rights, The Journal of Philosophy, 1977, p 767-775

Stigler, George J., The Economics of Information, JPE, 1961 p. 213.225

Stigler, Gorge J. and Gary S. Becker, De Gustibus Non Est Disputandum, AER 1977, p 76-90

Stigler, George J., Wealth, and Possibly Liberty; Journal of Legal Studies, 1978, p 213- 217

Stiglitz, Joseph E., Toward a General Theory of Consumerism: Reflections on Keynes´ Economic Possibilities for our Grandchildren, in: Pecchi, Lorenzo and Gustvo Piga (ed.) Revisiting Keynes, Cambridge, Mass 2008, p 41-85

Thaler, Richard H. and Cass Sunstein, Nudge, (Revised and Expanded Edition), New York, 2011

Tversky, Amos and Daniel Kahmeman, Loss Aversion in a Riskless Choice: a Reference Dependent Model, QJE, 1991, 1039-1061

Vanberg, Victor, Individual Choice and Institutional Constraints: the normative Element in Classical and Contractarian Liberalism, Analyse und Kritik Vol 8, 1986, p 113-149

von Weizsäcker, Carl Christian, Notes on Endogenous Change of Tastes, JET 1971, p. 345-372

von Weizsäcker, Carl Christian, Welfare Economics bei endogenen Präferenzen: Thünen-Vorlesung 2001, Perspectiven der Wirtschaftspolitik, 2002, p 425-446

von Weizsäcker, Carl Christian, Akzeptanzdynamik der Marktwirtschaft: Die Frage nach der guten Wirtschaftsordnung, in: Theurl, Theresia (ed.), Akzeptanzprobleme der Marktwirtschaft: Ursachen und wirtschaftspolitische Konsequenzen, Berlin 2013, p.33-47