Utility Theory, Subjective Well-Being and Social Comparison

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Contents

An Overview of the Work

Chapter 1 contains a collection of reflections about the foundations of utility theory (UT). Two main issues are discussed. In the first place, it is argued that the postulates of Revealed Preference Theory (RPT) are sufficient but not necessary to give empirical content to UT. In particular, we can replace the assumption that only objects of choice belong to the preference domain with alternative postulates about how these non-choice objects affect utility, and still give empirical content to UT. So, UT may have empirically testable implications also under assumptions about individuals' preferences which allow for social determinants. This means that, from a methodological standpoint, assuming "interdependent preferences" is not inferior to assuming "independent preferences" (Duesenberry (1949)). Therefore, a theory based on the idea of *homo sociologicus* has, in principle, an epistemological status which is as respectable as that of a theory based on the traditional idea of *homo oeconomicus*. This is relevant because one of the main argument in favor of the postulates of RPT is that otherwise it is not possible to give empirical content to UT (Samuelson (1948)). Furthermore, this clarifies that, whenever we want to allow for social determinants of individuals' behaviour, we are required to specify how such determinants affect utility.

The second issue which is discussed in Chapter 1 is about the relevance of interview-based data for utility theory and welfare analysis. Economists are often skeptical about the use of survey data. I argue that if welfare analysis has to have some empirical content, then there are cases where the use of survey data is the only feasible way to gather the required information about people's preferences. More precisely, there are cases where externalities do not have behavioral implications with the result that we cannot rely on preference revelation to get information about people's utility. In such cases, given the not yet sufficient development of neuroscience and experimental economics, refusing the use of survey data may lead to the impossibility to carry out an empirically founded welfare analysis.

The first chapter opens with a brief historical account of the passage from utilitarianism to modern utility theory. Historical evidence suggests that both the assumption of "independent preferences" and the skepticism about survey data have been brought about by the advent of the behavioristic approach in utility theory. More important, methodological arguments seem to have been used to support both theoretical positions.

Chapter 2 contains a rigorous analysis of some aspects of the first issue discussed in Chapter 1. Firstly, it is shown that admitting that the preference domain is as large as to contain anything that individuals may consider relevant leads to the impossibility of deriving testable implications: any set of data can be rationalized by opportune utility functions. Secondly, it is shown that empirically testable implications can be obtained by either introducing the hypothesis of RPT (circumstances of choices are irrelevant) or by making suitable assumptions about *how* individuals care about the circumstances of choice (e.g. the behaviour of others).

Chapter 3 presents a general framework for investigating the implications of social comparison. In the first sections the literature on social comparison is briefly reviewed with reference to the stylized facts about happiness, life satisfaction and work trends, which constitute the main motivation of this study. Thereafter, a model of consumption choice under social comparison is proposed and discussed in detail. The main novelty lies in that, instead of making specific assumptions about utility functions (or preferences) with the purpose of studying particular forms of concern for social status, the phenomenon is investigated in very general terms. The core characteristics of status seeking are substantiated by two very basic postulates: i) by consuming each individual produces negative externalities on her peers and ii) consumption is a strategic choice and shows complementarity among peers. It turns out that postulates i) and ii) are sufficient to define a strategic environment which can be fruitfully studied with the tools of game theory. Building on the recent results about supermodular games (Milgrom and Roberts (1990), Vives (1990, 2005)), it is shown that even the Pareto-best equilibrium may be Pareto inefficient: the Pareto optimum is obtained in a non-equilibrium point where everybody consumes and works not more, and someone strictly less, than in any equilibrium. Furthermore, applying the dynamical results of Milgrom and Roberts (1991), convergence to the set of equilibria is obtained under a vast class of dynamic laws, suggesting that such an inefficiency can actually arise. Finally, a generalized increase in wages (that in this simplified framework can be interpreted as a generalized increase in productivity) is shown to be potentially detrimental to welfare under social comparison. In fact, since a higher wage increases the status gain of an extra unit of labour, a generalized increase in wages may increase competition for status so much that the benefits of a greater consumption are more than offset by the reduction of leisure time. Another objective of the present analysis is to begin the exploration of the impact of interpersonal interactions on the concern for status. The motivation is that, since people tend to compare themselves with the individuals they interact with most, the structure of social interactions is likely to affect how social comparison is actually carried out. As a simple example of this, it is shown that in a well connected society where few individuals care not only about their relative position but also about how frequently they compare themselves with others – and, therefore, their concern for status is positively affected by the frequency of social interactions – a higher frequency of interactions is sufficient to increase everyone's effort in the competition for status.

In Chapter 4 the model developed in Chapter 3 is applied to investigate some specific issues. Firstly, a specification of utility similar to those already applied in the literature (Clark and Oswald (1998)) is proposed and discussed. Furthermore, economically meaningful conditions which are sufficient for equilibrium uniqueness are found. Secondly, an attempt to generalize the concept of social comparison is illustrated. The idea is that people differently perceive their status – or, equivalently, obtain satisfaction from it – on the basis of how much concern they have about either being identified with high status people – upward-looking – or being differentiated from low status people – downward-looking. Finally, the impact of inequality in the distribution of income is investigated. It turns out that much depends on the degree of upward-looking. If people are upward-lookers, then it is likely that more inequality increases both consumption and work time but reduces welfare while, if people are downward lookers, then exactly the opposite is likely to happen.

Chapter 1

Preference Revelation, Social Determinants of Utility and the Relevance of Survey Data

> "In connection with slavery, Thomas Jefferson has said that, when he considered that there is a just God in the Heaven, he trembled for his country. Well, in connection with the exaggerated claims that used to be made in economics for the power of deduction and a priori reasoning [...] I tremble for the reputation of my subject."
>
> *Paul Samuelson, 1972, Collected Papers*

> "Explaining behaviour without reference to anything other than behaviour is pure rhetoric"
>
> *Amartya Sen, 1997, Econometrica.*

1.1 Introduction

This introductory chapter is a collection of reflections about the foundations of Utility Theory (UT) and has two main purposes. The first is to emphasize that the postulates of Revealed Preference Theory (RPT) are sufficient but not necessary to give empirical content to UT. In particular, we can replace the assumption that only objects of choice belong to the preference domain – which is used, together with the assumption of constant preferences, to get a constant order of desirability of alternatives across observed choices – with alternative postulates about how these non-choice objects affect utility – hence allowing for a non-constant order of desirability of alternatives across observed choices – and still obtain a UT which has empirical content. More precisely, I argue that UT has empirically testable implications also under assumptions about individuals' preferences which allow for social determinants. This point has been firstly raised by Duesenberry (1949) during the early years of RPT, with specific reference to people's concern about relative consumption.[1] Here, I make the more general claim that a theory based on the idea of *homo sociologicus* – i.e. individuals' utility also depend on others' choices – has an epistemological status which is as respectable as that of a theory based on the traditional idea of *homo oeconomicus* – i.e. individuals' utility only depends on what they choose. The basic argument is that both require, in order to provide testable implications, assumptions about people's preferences and there is no straightforward reason to believe that those required by the latter are methodologically superior. This is important for two reasons. First, because one of the main arguments in favor of the postulates of RPT is that otherwise it is not possible to give empirical content to UT (Samuelson (1948)). Second, because it clarifies that, whenever we want to allow for social determinants of individuals' behaviour, we are required to specify *how* such determinants affect utility.

My second purpose is to point out that that when we are concerned with people's welfare then we may have the necessity to integrate information on preferences obtained by observing individuals' behaviour with information obtained from survey data. Of course, the idea of using survey data is not a novel thing in the debate about preferences' recoverability. Recently, the usefulness of survey data has been put forward by Manski (2000) who contends that standard preference revelation

[1] In the introduction of his book Duesenberry argues that the hypothesis of "interdependent preferences" – or, better, the hypothesis of externalities in consumption choices – may be tested against data. Actually, the book is a brilliant attempt to explain consumption and savings trends in the US by assuming that people is concerned with relative consumption.

techniques are often unapplicable. In previous years, Sen (1971, 1973, 1993) came to support the use of survey data because, he argued, observed behaviour cannot be correctly interpreted without any hint about individuals' intentions. McCloskey (1983, 1985) reflects about the scarce use of survey data in economics and argues that economists are excessively critical toward them. In fact, despite the number of economists who accept the use of survey data has significantly grown in the last decade, there are still many who argue the uselessness of survey for preference recovery. For example, Broussolle (2005) criticizes the use of surveys arguing that conclusions drawn on them are definitely unreliable and contends – explicitly supporting Samuelson's approach – that preference revelation is the only reliable source of information. Actually, there is no consensus about this issue.

In this chapter I do not discuss whether or not (or to what extent) survey data are a reliable source of information about people's preferences. Instead, I focus on the importance of survey data for welfare analysis. More precisely, I argue that there are cases where the use of survey data may be the *only* way, if any exists, to obtain the information which is required to make meaningful welfare statements. In fact, in the presence of externalities which i) fail to have implications on people's observed behaviour and ii) cannot be reproduced in a controlled setting, if direct measurement of welfare-related brain activity is impossible, then either we renounce welfare analysis or we rely on survey data.

Before discussing these issues I provide a brief historical account about how UT moved away from some of the initial utilitarian ideas. In particular, I focus on the modifications and novelties that have followed the *behaviouristic* turn which culminated with Samuelson (1938a,b).[2] Historical evidence suggests that with the advent of the behaviouristic approach the pre-analytical beliefs commonly held by economists turned against the utilitarian conception of utility as a psychophysical quantity, leading to the idea that utility is an unmeasurable quantity and, therefore,

[2] See Varian (2006) for a recent survey on RPT's developments and contributors.

to conclude that information about preferences can be recovered only from observed behaviour. Certainly, this turn is one of the keys of the academic success of RPT and, possibly, it may explain the use of methodological arguments in favour of the latter. Furthermore, it seems to be intimately related to the economists' skepticism about the use of interview-based data.

1.2 From Utilitarianism to Utility Theory

Modern UT models people's choice by presuming that each individual has a subjective evaluation of the possible *descriptions* of the world – i.e. lists containing the subjectively relevant characteristics of the world – and that descriptions can be ranked according to such evaluations. The subjective ranking so obtained naturally induces a relation on the set of descriptions. This relation is assumed to satisfy basic properties of orderings and is referred to as a *preference* relation. In this framework utility is just a numerical representation of preferences. Individuals choose what they prefer the most or, equivalently, what gives them the maximal utility.

Such an understanding of utility is rather different from that of Bentham (1789) and the followers of *Utilitarianism*. Actually, utilitarians believed in utility as a psychophysical quantity and, hence, believed in its measurability. Things changed during the first part of the Twentieth Century with the *behaviouristic* turn brought about by Pareto (1906), Slutsky (1915), Allen (1934) and Hicks (1934) which aimed, besides the objective of giving more rigor to the theory, at getting rid of any trace of utilitarianism from UT.[3] This turn culminated with Samuelson (1938a,b, 1948), Houttaker (1950) and Uzawa (1960) who provided a full axiomatization of UT and worked to give empirical content to the theory by showing that, at least under ideal

[3]The second paragraph of Allen (1934) reads: "[...] Of all Pareto's contributions there is probably none that exceeds in importance his demonstration of the immeasurability of utility. To most early writers, to Marshall, to Walras, to Edgeworth, utility had been a quantity theoretically measurable; that is, a quantity which would be measurable if we had enough facts. Pareto definitely abandoned this and replaced the concept of utility by the concept of a scale of preference [...]".

condition, i) UT can have empirically testable implications and ii) information about actual preferences can be recovered by observing individuals' behaviour (see Richter (1966), Afriat (1967), Varian (1982) for subsequent contributions).

1.2.1 The Old View: Utility as Psychophysical Magnitude

The explanation of individual behavior as well as the identification of the determinants of well-being motivate a long array of researches and investigations in the field of economics. Indeed, economic performance is not interesting by itself. It is relevant because it is a means to an end, namely mankind's well-being. Not surprisingly then, since early economic theorizing individuals' motivations have been a central issue. Systematic study of the topic began during the Enlightenment with the work of Bentham (1789). In his *Principles of Morals and Legislation* he suggests that human beings are animated by self-interest in the sense that they try to reduce pain and increase pleasure. So, explaining and predicting human behaviour requires the identification of what produces pleasure and pain.

Although Bentham and the followers of *Utilitarianism* were concerned with "utility", they were not much involved in its measurement. The reason is not that they considered utility unmeasurable. On the contrary, according to them utility was a concrete thing whose measurement was a matter of psychometrics. In a way not much dissimilar to what modern neuroscientists argue, utilitarians considered pleasure and pain not as subjective states of mind but as objective stimuli generated by human actions. The lack of attempts to measure utility might be explained with the lack of suitable metric instruments or with the scarce scientific relevance given in that period to the provision of testable implications. In any case, utilitarians firmly believed in the measurability of pleasure and pain, claiming that individuals' behaviour is the observable consequence of the pursuit of the former and the avoidance of latter.

At the end of the Nineteenth Century, when the neoclassical paradigm was moving its first steps, economists were still convinced that utility could be measured in physical terms. Notably, Edgeworth (1879) – somehow mixing the utilitarian and neoclassical approach – described utility as something measurable by psychometricians, though it would be better left out of economic inquiry. The following passage about a hypothetic *hedonimeter* gives the flavour of his understanding of utility which resemble a research program in modern neuroscience

> "[...] Let there be granted to the science of pleasure what is granted to the science of energy, to imagine an ideally perfect instrument, a psychophysical machine, continually registering the height of pleasure experienced by an individual, exactly according to the verdict of consciousness, or rather diverging therefrom according to a law of errors. From moment to moment the hedonimeter varies; the delicate index now flickering with the flutter of the passions, now steadied by intellectual activity, low sunk whole hours in the neighbourhood of zero, or momentarily springing up toward infinity [...]"

Eventually, most economists abandoned such an idea, rejecting psychophysical explanations of utility.

1.2.2 The Behavioristic Turn: Unmeasurable Utility and Reduced the Preference Domain

Between the end of the Nineteenth Century and the beginning of the Twentieth Century, the idea that utility should not be defined as a psychophysical quantity began to spread among economists (Jevons (1888), Fisher (1892), Pareto (1906)) and quickly gained support (e.g. in Wicksteed (1910), Slutsky (1915)).[4] The utilitarian

[4] In Wicksteed (1910) the last paragraph of the introduction reads: [...] By a man's "scale of preferences" or "relative scale," then, we must henceforth understand the whole register of the terms on which (wisely or foolishly, consistently or inconsistently, deliberately, impulsively or by inertia, to his future satisfaction or to his future regret) he will, if he gets the chance, accept or reject this or that alternative. And by saying, for example, that a bunch of radishes stands higher

view progressively lost consensus and utility functions began to be considered as "rules" underlying actual behavior rather than functions representing the level of pleasure and pain. Hicks (1934) and Allen (1934) showed how to derive utility from preferences (taken as a primitive concept) and further developed Pareto's argument showing that there exists an infinite number of utility representations of preferences – i.e. utility functions are unique up to a monotone positive transformation.

Samuelson started from these results to investigate if the behavioristic approach can provide restrictions on observed choice, emphasizing that this is a necessary condition to avoid circular reasoning in a theory of utility which does not rely on utilitarian conceptions. To this aim, he proposed to gain information about preferences directly from observed behaviour, arguing that this has the further advantage of eliminating the last vestiges of utilitarianism. This line of research is well expressed in the introduction of his famous 1938 article:

> [...] The discrediting of *utility* as a psychological concept robbed it of its only possible virtue as an *explanation* of human behavior in other than a circular sense, revealing its emptiness as even a construction. As a result the most modern theory confines itself to an analysis of indifference elements [...] Consistently applied, however, the modern criticism turns back on itself and cuts deeply. For just as we do not claim to know by introspection the behavior of utility, many will argue we cannot know the behavior of ratios of marginal utilities or of indifference directions.
>
> Why should one believe in the *increasing rate of marginal substitution*, except in so far as it leads to the type of demand functions in the market which seem plausible? Even on the advanced front we are confronted

than a red herring on his scale of preferences, or that an honorary degree stands lower than a baronetcy, we shall simply mean that he would at this moment, if he had the choice, take the radishes in preference to the herring, and receive the title rather than the degree. This conception of a "scale of preferences" will underlie all our future investigations. It is quite fundamental, and the whole purpose of this introductory chapter has been to explain and to illustrate it[...]"

> with this dilemma – either the argument with respect to indifference varieties is circular or to many people inadmissible [...] I propose, therefore, that we start anew in direct attack upon the problem, dropping off the last vestiges of the utility analysis.[...]"

Few paragraphs later, Samuelson (1938a) sets out the basic postulates of his theory

> [...] I assume in the beginning as known, i.e., empirically determinable under ideal conditions, the amounts of n economic goods which will be purchased per unit of time by an individual faced with the prices of these goods and with a given total expenditure. [...] Thus confronted with a given set of prices and with a given income, our idealised consumer will always choose the same set of goods [...] [However] Merely knowing that there will be a unique reaction to a given price and income situation puts no restrictions on that reaction. Fortunately [...] it is possible to develop suitable restrictions so that our theory is more than formal [...] [i.e.] if an individual selects batch one over batch two, he does not at the same time select batch two over batch one [...]

During the following decade, Samuelson refined his arguments which led him to the development of RPT (Samuelson (1948)). Subsequently, Houttaker (1950) and Uzawa (1960) completed his research program providing a fully axiomatized version of the theory. At this stage two objectives were finally obtained. The first is purging utility theory of any psychophysical element in favour of a behaviouristic conception. The second is demonstrating that this does not imply a circular reasoning, that is, that restrictions on observed choices my be provided if (revealed) preferences are taken as a primitive concept and utility is interpreted as a mere numerical representant of preferences. Few years after the publication of Samuelson's *Foundations*, the new conception had definitely replaced the original utilitarian ideas.

However, the behavioural interpretation of utility is not the only novelty introduced with the advent of the new approach. Another relevant change took place on a different level: the domain of preferences (or, from a utilitarian perspective, the determinants of utility). Until then, the preference domain was thought to be, in principle, as large as to contain any characteristic of the world that individuals might consider relevant. In the fifth chapter of Bentham (1789) we find an almost all-comprehensive list of sources of pleasure and pains

> "[...] II. The several simple pleasures of which human nature is susceptible, seem to be as follows: 1. The pleasures of sense. 2. The pleasures of wealth. 3. The pleasures of skill. 4. The pleasures of amity. 5. The pleasures of a good name. 6. The pleasures of power. 7. The pleasures of piety. 8. The pleasures of benevolence. 9. The pleasures of malevolence. 10. The pleasures of memory. 11. The pleasures of imagination. 12. The pleasures of expectation. 13. The pleasures dependent on association. 14. The pleasures of relief.
>
> III. The several simple pains seem to be as follows: 1. The pains of privation. 2. The pains of the senses. 3. The pains of awkwardness. 4. The pains of enmity. 5. The pains of an ill name. 6. The pains of piety. 7. The pains of benevolence. 8. The pains of malevolence. 9. The pains of the memory. 10. The pains of the imagination. 11. The pains of expectation. 12. The pains dependent on association.[...]"

In the same chapter Bentham goes into the very details of each category cited above. They cannot be reported here but, just to give an example, I include the following one which clearly shows that utility was supposed to depend on things which do not belong to the set of alternatives available to individuals (which in this case are others' actions)

> "[...] VII. 5. The pleasures of a good name are the pleasures that

> accompany the persuasion of a man's being in the acquisition or the possession of the good-will of the world about him; that is, of such members of society as he is likely to have concerns with; and as a means of it, either their love or their esteem, or both: and as a fruit of it, of his being in the way to have the benefit of their spontaneous and gratuitous services. These may likewise be called the pleasures of good repute, the pleasures of honour, or the pleasures of the moral sanction.[...]".

Such ideas are not limited to Bentham's thought. Also in Marshall (1890) trace of this conception may be recognized. In book 3.6 of his *Principles* he writes

> "[...] 5. There remains another class of considerations which are apt to be overlooked in estimating the dependence of wellbeing upon material wealth. Not only does a person's happiness often depend more on his own physical, mental and moral health than on his external conditions: but even among these conditions many that are of chief importance for his real happiness are apt to be omitted from an inventory of his wealth.[...]"

Few years later Pigou (1903) states with great clarity that individuals' utility depends on others' choices

> "[...] The utility of [commodity] A to [individual] I is a function not only of the quantity of different commodities that he possesses but also pf the quantity that other people possess [...] It is difficult properly to express this dependance of [utility function] U upon the way in which A is distributed [among other individuals] in mathematical form. To be accurate therefore we should have to make U a function of many variables, representing the quantity of A in the hands of each other person and also of the proximity of each in place or station to I. [...]"

The fact that, according to Pigou, such determinants of utility are very important and cannot be neglected is confirmed by the following passage where Pigou is extremely precise in remarking that they may not explicitly appear in utility functions only because of the *ceteris paribus* condition

> "[...] U would therefore finally emerge as a function of innumerable variables, and the employment of a common expression $U = F(Q_1)$ demands justification, or rather an explicit statement of the assumption made using it.
>
> Now this expression $U = F(Q_1)$ is not used by authoritative writes absolutely, but always with the condition "other things being equal." In other words the remaining variables upon which U depends are temporarily treated as constants. This is. of course, a perfectly legitimate proceeding, but it is important to distinguish between those influences which are thus provisionally impounded, and those which may be ruled out of court altogether as of negligible importance. [...] The notion that our position requires us to live in such and such style, and to do such and such a thing, is widely prevalent one, and what our "position requires" is, of course, simply what other people in like position as to class, place or time are accustomed to do. Therefore it should be clearly understood that [...] [these] are merely impounded and not dismissed as negligible when we write $U = F(Q_1)$. [...]"

Contrary to what was argued by these prominent authors, within the new approach the relevant preference domain was identified with the set of alternatives among which an individual can choose. In the case of consumer behaviour this translates in assuming that the preference domain is constituted by commodities for which a market exists, so that consumers only care about bundles among which they can potentially choose. If we abstract from the issue of giving empirical content to UT, then assuming such a narrow preference domain seems totally unjustified. Taking into account the epistemological position held by Samuelson in his *Foundations* (which deeply influenced the contemporary methodological debate among economists), why such an assumption was supported by the developers of RPT becomes much more clear.

Samuelson explicitly challenged the traditional support of *a priori* reasoning, advocating the switch to what he called the *operational* approach. In his own definition, operationalism is a methodology characterized by the commitment to the development of theories which produce implications that can be empirically tested by applying a clear sequence of operations. In other words, it is the commitment to developing theories with empirical implications and to state unambiguously what actions should be carried out to test them.[5,6] In particular, Samuelson's affirmed that, in order for UT to produce testable conclusions, there must be a way to obtain information about preferences from measurable variables only, like prices and quantities.

This objective was obtained with RPT. However, RPT required the identification of the relevant preference domain with the set of alternatives among which an individual can potentially choose. Let me clarify this point. Denote the set of alternatives among which an individual can choose with X. Since information about preferences is obtained from observed purchases (elements of X) and prices only, then the order of desirability of elements of X has to be independent of anything which is outside X, otherwise from observed choice we cannot deduce that the chosen bundle is preferred to those that have not been chosen. Hence, we must assume that the order of desirability of elements of X do not change across observations

[5] Samuelson's operationalism differs from other definition of operationalism while it is very similar to Popperian falsificationism (see Machlup (1963) and Blaug (1980) for more about terminological issues).

[6] In Samuelson (1948) we read "[...] By a *meaningful* theorem I mean simply a hypothesis about empirical data which could conceivably be refuted if only under ideal conditions" (p. 4, italics original) and "[...] our theory is meaningless in an operational sense unless it does imply some restrictions upon observable quantities, by which it could conceivably be refuted [...]" (p. 7).

otherwise we cannot deduce information from choice. In other words, RPT must postulate that if an individual prefers bundle $x \in X$ to bundle $y \in X$ in some circumstance then she *always* prefers bundle x to bundle y, no matter what the circumstances are (see for instance postulate III in Samuelson (1938a)). Given the logic of preference revelation this requirement is certainly not surprising. However, it has important implications for the theory of utility which should not be neglected.

1.3 A Broader Preference Domain

Although in a few years Samuelson's ideas became widely accepted by the academic community, the new approach was not introduced without criticisms. For instance, in the late Forties, Duesenberry (1949) noted that

> "[...] preference systems have been used in a way which assumes much more than the existence of preferences at every moment [...] [that is] the parameters of preferences systems are substantially independent of the other economic variables. In particular it usually implies that preferences of each individual are independent of the actual purchases of others [...] There is little observational warrant for the independence of different individuals' preferences yet it is implicit in most economic theory. The assumption has slipped in during the course of the historical development of consumer behavior theory [...]"

As mentioned in the previous section, the basic argument in favor of the assumption that the preference domain coincides with the set of alternatives – what Duesenberry calls the assumption of "independent preferences" – is that it allows UT to have empirical implications and to recover information about preferences from the observation of choices and prices. In the following I illustrate that assuming a broader preference domain *may* make it impossible to derive empirical implication from UT or to recover preferences from the observation of choices and prices. Although with some differences in notation, the illustration of this point is a refinement of that found in Holländer (2001). However, it differentiates from it in some important respects. Holländer (2001) contends that "[...] the behavioristic concept of utility is not operationally meaningful in the sense of Samuelson since [...] even under ideal observational conditions it is not ordinally measurable [...]". Strictly speaking, this is not true. I will argue that preferences are not fully recoverable *only if* utility does not only pertain to objects of choice but also pertains to the circumstances of choice. Moreover, in the latter case some empirical testable implications may still be obtained. Empirical testability is impossible *if* some circumstances of choice are endogenous to the process of preference measurement *and* no further suitable assumptions are made in order to deal with such endogeneity.

Actually, Hollander's results seems to rest on the presumption that the preference domain contains, besides objects of choices, the choices of other – which are endogenous to the process of preference revelation because they depend on prices. However, Holländer (2001) is not very clear in its argument failing to distinguish between what he assumes and what it is assumed in RPT, hence not clarifying what can or cannot be done under his assumptions and what under Samuelson's. For instance, he asserts that "[...] the strong axiom of revealed preference theory is not a rationality or consistency axiom as is usually claimed, but, rather, a not particularly interesting axiom of preference separability [...]". He does not seem to recognize that if this is the case then the WARP is an empirical testable implication of the theory – namely, that observed choice must show separability – and, hence, that under Samuelson's assumptions UT has an empirically testable implication.

My contribution to this discussion is threefold. First, I separate the issue of preference recoverability from that of empirical testability, illustrating that the second may be possible even when the first is not fully obtainable. Second, I show that prices and all variables which depend on prices form a class of characteristics of the world that, if allowed into the preference domain without any additional assumption, prevent UT from producing empirical restrictions on observable behaviour. Third, I clarify that excluding such characteristics from the preference domain – e.g. assuming "independent preferences" – succeeds to produce restrictions on observable behaviour, but also that this is not the only way to obtain such a result. Alternatively, we can assume *how* the order of desirability of alternatives depends on these characteristics. Therefore, from a methodological point of view assuming "dependent preferences" is not inferior to assuming "independent preferences".

Denote by S the set of descriptions of the world which are considered relevant by the individuals, that is, which affects the individuals' utility. In other words, the individuals' preferences are defined over the set S. For each individual, say i, every $s \in S$ can be naturally thought as composed of two parts: one denoting her own choices, say x^i, and the other containing information about everything else which affects her utility, say z^i. Denote by X and Z the sets containing, respectively, all possible x and z. In order to separate in a neat way what an individual can chose from what she cannot, we write a description of the world as $s^i = (x^i, z^i)$, where $x^i \in X$ is referred to as i's choice and z^i as the circumstances of i's choice. For instance, if individuals cares only about what they consumes and in which season they are then X contains just commodity bundles while Z contains the four seasons. The only difference between this formulation and one which assumes "independent preferences" is that $Z \neq \emptyset$. Denote with H_{RPT} the hypothesis that $Z = \emptyset$ and any other assumption which implies that (x^i, z^i) is indifferent to $(x^i, \tilde{z}^i)$ for any $z^i, \tilde{z}^i \in Z$ and $x^i \in X$.

Since no ambiguities can arise, the superscript identifying the individual is dropped. Consider individual i and suppose that $s_0 = (x_0, z_0)$ is observed, that is, i chooses $x_0 \in X$ under circumstances $z_0 \in Z$. What can we deduce from the observation of this outcome? Take $s_1 = (x_1, z_1)$ such that $x_1 \in X$ is available under the budget constraint in s_0. RPT would tell us that x_1 is directly revealed to be preferred to x_0. If, in addition, under the prices in s_0 the alternative x_1 costs strictly less than x_0, then – because of non-satiation – RPT would imply that x_0 is directly revealed strictly preferred to x_1.

On the basis of RPT, one could conclude that $u(s_0) \geq u(s_1)$ (or $u(s_0) > u(s_1)$ if strict preference is revealed) where $u(\cdot)$ denotes i's utility function. However, any such conclusion requires restrictive assumptions such as H_{RPT}. Under the current assumptions which allow for $Z \neq \emptyset$ specifying neither what Z contains nor how its elements affect utility, the observation of s_0 only tells us that $s_0 = (x_0, z_0)$ grants to i a utility not lower (greater) than that granted by (x_1, z_0), and not that s_0 a utility not lower (greater) than $s_1 = (x_1, z_1)$. In this case observations cannot establish the preference relation between any two elements of S which differ in the component z. Since any two different observations of the choice of an individual must differ for some characteristic of the world which is not under her choice – e.g. prices – then they can never contradict each other and UT has no empirical implication.

Now, the occurrence of any $z \in Z$ is a collection of contingencies; it is then natural to ask whether the existence of contingent markets for the characteristics of the world which are not under the choice of individuals would be sufficient to provide some restrictions on observed choices. Holländer (2001) does not discuss this point but I think that it is worth doing because it may help clarifying important issues. On the one hand, it illustrates a typical argument used to claim that the postulates of RPT do not necessarily imply a narrow preference domain (since contingent markets allow to greatly expand the choice set); on the other, it clarifies why prices and variables which depend on them have a special role in the process of preference revelation and why the effects of their inclusion in the domain of preferences cannot be sterilized by contingent markets.

When an individual purchases bundles which are conditioned on elements of Z, she provides information about how elements of Z affect her order of desirability of elements of X. Indeed notice that, if individuals can choose elements of X conditionally on Z, then the set of alternatives is $\hat{S} \equiv X^{|Z|}$ where the generic element is of the form $s = (x_{1,z_1}, \dots, x_{1,|Z|}, \dots, x_{|X|,|Z|})$. In such a case individuals' choices reveal individuals' preferences over $\hat{S}$ for *given* beliefs about the relative likelihood of elements of Z. If beliefs are assumed to be constant across observations then, we can reinterpret preference revelation as a revelation about $\hat{S}$ instead of S. Therefore, if contingent markets exist such that any element of $\hat{S}$ can be purchased then, at least in principle, restrictions on observed behaviour can be obtained.[7]

A simple example will clarify this point. Consider a consumer who has a consumption set $X \equiv \Re^2_+$ with $x = (h, m) \in X$ where h is the amount of heating services and m is income. Let $Z \equiv \{c, w\}$, where c represents the case of "cold weather" and w represents the case of "warm weather". Hence, in this oversimplified situation we can observe the consumer in two different circumstances only, either under c or under w. Suppose that we observe $s = ((h, m - ph), c)$ and $s' = ((0, m), w)$ with p the price of heating service (the same in s and s'). This reveals that $((h, m - ph), c)$ is preferred to $((v, m - hv), c)$ for any $pv \leq m$ and that $((0, m), w)$ is preferred to $((v, m - pv), w)$ for any $pv \leq m$, but it tells us nothing about the preference relation between s and s'. The assumptions made in this example give us no restriction on any pair of observations in which one is obtained under c and the other under w. Suppose, instead, that there exist contingent markets and that the consumer can buy commodities conditionally upon the occurrence of c or w. In this case the consumption set is $X \equiv R^4_+$ and consumption bundles are 4-tuples of the form (h_c, h_w, m_c, m_w) where pedices indicate whether the consumption of the commodity is conditioned to the occurrence of either c or w. Let p_c be the price paid for heating services whenever c occurs and p_w be the price for heating services whenever w occurs. Let m_c and m_w be perfect substitutes. If the consumers choose (h'_c, h'_w, m'_c, m'_w), then bundle (h'_c, h'_w, m'_c, m'_w) is directly revealed to be preferred

[7] A further difficulty arise if such a situation is thought as one intertemporal equilibrium. In fact, in an intertemporal equilibrium each individual chooses just once and hence it is physically impossible to have more than one observation per individual. Preference revelation only works if individuals experience multiple choices under different price systems. Therefore it requires choices to be taken either in disequilibrium or in a sequence of equilibria.

to all bundles (h_c, h_w, m_c, m_w) satisfying $p_c h_c + p_w h_w \leq m_c + m_w$ (and strictly preferred in the case inequality strictly holds). From this it is straightforward to obtain restrictions on consumer behaviour.

There are cases in which of people care about characteristic of the world that are not object of choice but, nevertheless, by means of contingent markets we can obtain the information which is required to produce testable implications. Is this true in *all* cases? Notice that, since a full set of contingent markets hardly exists, the real issue here is whether the existence of a full set of contingent markets provides the *logical* possibility to put restrictions on future behaviour.[8] In any case, the answer is negative. As anticipated, the reason is that there exists a class of characteristics of the world, namely prices and variables that depend on prices, for which the reasoning made in the previous example cannot be applied.

In order to make my argument more concrete, let me refer to the Generalized Axiom of Revealed Preference (GARP) and check under which conditions it is a testable implication of UT. The GARP states that for any sequence of $k > 1$ observations which implies that x_j is directly revealed preferred to x_{j+1}, $j = 1, \ldots, k-1$, x_k cannot be directly revealed to be strictly preferred to x_1. Under hypothesis H_{RPT} the GARP is a testable implication of UT or, if one prefers, data must satisfy the GARP in order to be consistent with UT (Afriat (1967), Varian (1982)). I will show that, without additional hypothesis, the GARP can be a testable implication of UT *only if* prices and any variable which depends on prices are excluded from the preference domain.

Suppose that prices are represented in Z as a relevant characteristic of the world. Consider again the generic individual i and suppose that her preferences are represented by the utility function $u(s) = v(x) + h(x, z)$. For the sake of concreteness, one can think that $v(x)$ represents the material utility of commodities while $h(x, z)$ represents the utility accruing from social or psychological factors, but other inter-

[8] Of course under the hypothesis – which I do not discuss here – that preferences which are defined on the set S are constant over time.

pretations are equally plausible.

Suppose you observe individual i purchasing x_1 under z_1, x_2 under z_2 and x_3 under z_3, where prices differ in each case. Suppose also that x_2 costs not more than x_1 at the prices in z_1 and that x_3 costs not more than x_2 at the prices in z_2. Applying RPT, we would obtain that x_1 is directly revealed preferred to x_2 which is directly revealed preferred to x_3. Hence, x_1 is revealed preferred to x_3. In particular, the GARP imposes that if individual i purchases x_3, then x_1 evaluated at the prices in z_3 does not cost strictly less than x_3. However, if individual i has utility function u such an implication does not logically follow. Since prices differ in the three observations then $z_1 \neq z_2$, $z_2 \neq z_3$ and $z_1 \neq z_3$, implying that the component $h(\cdot)$ can take different values in the three cases and possibly give rise to situations which are instead ruled out by the GARP. If, for example, $v(x_1) = 3$, $v(x_2) = 2$, $v(x_3) = 1$ and $h(x_1, z_1) = 1$, $h(x_2, z_2) = 2$, $h(x_3, z_3) = 4$ then $u(x_1, z_1) = u(x_2, z_2) = 4 < 5 = u(x_3, z_3)$. Therefore, $s_3 = (x_3, z_3)$ is strictly preferred to both $s_1 = (x_1, z_1)$ and $s_2 = (x_2, z_2)$, implying that x_3 can be chosen under the prices in z_3 even when x_1 costs strictly less than x_3.

In such a case not even a full set of contingent markets would provide a solution. The reason is that in order to have a pair of observations which reveals contradictory preferences we must observe i's choice under two different price systems. Since prices must change from one observation to the other, contingent markets cannot be used for prices – i.e. commodities cannot be conditioned on prices.[9] This should not be a surprise because the mechanism of preference revelation is built on the assumption that prices are "preference-irrelevant". If we admit that they belong to the preference domain then we implicitly require them to be at the same time part

[9]Notice that there is another issue regarding markets for commodities contingent on prices. In fact, the prices of contingent markets introduced in the first place require additional contingent markets which introduce further prices, hence requiring further contingent markets, and so on and so forth. This line of reasoning can lead to problems of inconsistencies possibly preventing the introduction of such contingent markets. This issue is not further investigated here because it is not central to my argument.

of the circumstances of choice (because they define the budget set) and an object of choice (because they directly affect utility), but this is impossible to obtain in any single observation.

The same argument applies for any variable which depends on prices. This explains why they create the same type of difficulty. Consider the example above but assume that utility is directly unaffected by prices – i.e. prices are do not appear as characteristics of the world in the elements of Z. In this case, the fact that prices differ in the three observations (x_1, z_1),(x_2, z_2) and (x_3, z_3) does not *imply* that z_1, z_2 and z_3 must differ among themselves. However, the condition $z_1 = z_2 = z_3$ can be satisfied only if the elements of Z do not represent characteristics of the world which depend on prices. Since preference revelation requires prices to differ across observations, variables which depend on prices must differ across observations too. As a result, contingent markets are not a solution for variables which non-trivially depend on prices. This is the case of, for instance, the choice of individuals other than i because because different prices imply different budget sets.

Summing up, under the presumption that preferences are constant across observations if H_{RPT} is satisfied – i.e. if the preference domain is restricted to the set X – then: i) UT has an empirically testable implication and ii) subjects' preferences can be in principle recovered by a sufficient number of observations, that is, by a sufficient number of measurements of objective variables. More precisely, under H_{RPT} we have that i$'$) UT implies the GARP and ii$'$) preferences can be recovered by the measurement of prices and quantities purchased. Furthermore, if H_{RPT} is not satisfied – i.e. if the preference domain includes also $Z \neq \emptyset$ – and either prices or any variable which non-trivially depends on prices are characteristic of the world which are represented in the elements of Z, then neither i$'$) nor ii$'$) survives.

1.3.1 More On Method

I wish now to claim that H_{RPT} is not a necessary condition for i) and ii) but only a sufficient one.[10] This is important because if i) and ii) can be obtained under assumptions which do not rule out Z from the preference domain, then a UT developed on them would not be inferior, from a methodological point of view, to a UT based on H_{RPT}. Moreover, since the existence of non-choice objects which depend on prices (e.g. the choices of others) and which have a substantial impact on people's utility is quite reasonable, a UT which tries to incorporate such elements would be preferable to a UT which is equally worth from a methodological point of view but rules them out.

Consider the previous example where the utility function is composed of two parts, namely $u(s) = v(x) + h(x, z)$. Notice, for instance, that if $h(\cdot)$ satisfies the property of being additive in some transformations of x and z, i.e. $h(x, z) = h_1(x) + h_2(z)$, then the order of desirability of the elements of X is independent of Z. Therefore, if choosing x_0 gives more utility than x_1 under some $z \in Z$, then choosing x_0 gives more utility than x_1 under any $z \in Z$. As a consequence, data must satisfy the GARP to be consistent with the theory. Point i) is recovered.[11]

However, the assumption of additivity is not sufficient to recover point ii) because it does not allow to assess the welfare of individuals. Although under additivity each observation provides information about the order of desirability of elements of X which can be extended to any $z \in Z$, we cannot say if individual i is better in a situation, say $s_0 = (x_0, z_0)$, or in another, say $s_1 = (s_1, z_1)$, when circumstances are different, namely $z_0 \neq z_1$. Even if it is revealed that $v(x_0) + h_1(x_0) > v(x_1) + h_1(x_1)$

[10]Notice that H_{RPT} is also necessary for i$'$) and ii$'$) sinche they are a particular case of i) and ii).

[11]Samuelson would argue that only point i) is relevant in this discussion leaving point ii) to welfare economics (Samuelson (1938a)). In other terms, he would contend that H_{RPT} can be weakened to the following: if $(x^i, z^{i'})$ is preferred to $(y^i, z^{i'})$ for some $z^{i'} \in Z$, then (x^i, z^i) is preferred to (y^i, z^i) for any $z^i \in Z$. The case of additivity just described satisfies such a weaker version of H_{RPT}. I have decided to formulate H_{RPT} in the stronger sense because I am interested in both i) and ii). This footnote is intended to make clear that, once one has the correct interpretation in mind, the choice between the weak and strong formulation is only an innocuous matter of definition.

we still ignore whether the value of $h_2(z_0)$ is greater, equal or smaller than the value of $h_2(z_1)$.

Point ii) can be recovered by introducing opportune assumptions about *how* elements of Z affect utility. With reference to the previous example, this means to put opportune restrictions on $h_2(\cdot)$ as to make the observation of objective variables sufficient to establish if s_1 grants a greater, equal or smaller utility than s_0. If the elements of Z represent objective characteristics of the world, then $h_2(\cdot)$ can be always specified such that ii) obtains. Actually, H_{RPT} imposes that the preference domain coincides with X – which amounts to say that $Z = \emptyset$ – or, in simple words, that circumstances of choices have the particular role of having no role (in terms of the example, $h_2(\cdot)$ is constant in z). Obviously, different specifications of $h_2(\cdot)$ – how elements of Z affect utility – lead to different results in terms of welfare assessment, but as far as only objective characteristics of the world are represented by the elements of z, all specifications of $h_2(\cdot)$ succeed in recovering point ii). Therefore, from a methodological point view they are all equally legitimate.

This discussion, besides emphasizing the methodological legitimacy of assuming a broader preference domain, puts in evidence a point which motivates a reflection on a different but strictly related issue. While we can obtain implications of UT which are empirically testable against observed behaviour even when $Z \neq \emptyset$, independently of whether $Z = \emptyset$ or not the information about the individuals' utility that we get from the observation of the behaviour of individuals and that is required to construct welfare statements rely on the validity of assumptions whose implications cannot be tested against observed behaviour. In the previous example where $h(x, z) = h_1(x) + h_2(z)$ we could put a lot of restrictions on $h_2(\cdot)$ which grant us to obtain the needed information from observed behaviour, but we would nevertheless be unable to use observed behaviour to either confirm or refute any welfare claim obtained in such a way. This suggests that data obtained from the observation of actual choices may not be sufficient and that we should turn our attention to other sources of information about individuals' preferences and utility.

1.4 Beyond Prices and Quantity Purchased

The old utilitarian idea that utility is a measurable quantity seems to be regaining strength among economists. On the one side, there is the neuro-based approach where much effort is put in the attempt to measure utility from the map of cerebral activity. Under the recently coined label of Neuroeconomics several studies have been produced whose aim is to apply the findings of neurosciences as microfoundations of the modelling of economic behaviour. Neuroeconomics scholars have gone so far as to apply utility theory to monkeys and monitor their cerebral activity to check if their behaviour is consistent with rational decision making (Glimcher et al. (2005)). While only a few years ago the neuro-metric approach would have been regarded as impossible, now Neuroeconomics is considered an established branch of economics. Unfortunately, despite their academic success (which attests the fact that, at least in principle, utility measurement are considered admissible), neuroeconomists are still far from providing direct evidence of the utility experienced by individuals in real economic situation.

On the other side, the renewed interest in people's happiness and life satisfaction and the necessity to evaluate the impact of environmental goods on welfare, have pushed some economists to rely on surveys to gain information about people's preferences and utility. People are asked how satisfied they are in general or with respect to hypothetical alternatives. In the former case, we speak of *subjective* well-being – a terminology which is common in psychology and sociology – instead of *objective* well-being while in the latter case we speak of *stated* preferences – a terminology which is common in contingent evaluation studies – instead of *revealed* preferences.

Thirty years ago the survey-based approach was regarded, by the majority of economists, as methodologically wrong because of the intrinsic subjectivity of survey data. Nowadays, the use of surveys is better considered but still many economists are skeptical about the reliability of interview data. While in psychology and sociology surveys are applied as a standard measurement tool, in economics their use is highly debated. As Easterlin (2004) reminds us, economists' aversion to survey data has deep roots in the historical development of the profession. It stems from the more general aversion to subjective data which, in turn, is the result of the behavioristic turn which has taken place in early Twentieth century. The words of Fuchs (1983), president of the American Economic Association in 1995 and Nobel prize laureate, well illustrate the behaviourist view

> "[...] Economists, as a rule, are not concerned with the internal thought process of the decision maker or in the rationalization that the decision maker offers to explain his or her behavior. Economists believe that what people *do* is more relevant that what people say [...]"

McCloskey (1983, 1985) finds that, unlike other social scientists, economists are extremely hostile to the use of questionnaires and other self-descriptions. She argues that such a diffused attitude is the result of a debate, which took place in the late '30, concerning the usefulness of interviewing businessmen in order to ask whether they equalize marginal cost to marginal revenue. McCloskey (1983) claims that the failure of such a study seems to have convinced most economists to abandon self-testimony. In accordance with Fuchs (1983), she maintains that economists "[...] are unthinkingly committed to the notion that only the externally observable behavior of economic actors is admissible evidence concerning economics [...]". Boulier and Goldfarb (1998) suggest that the anti-survey conviction has spread later on, with the debate between Lester (1946) and Machlup (1946). Lester (1946) interviewed employers and found that their responses were at odds with the hypothesis of profit-maximization. Machlup (1946) criticized the use of interviews arguing that answers do not need to represent actual behaviour and, in any case, successful employers must be profit-maximizers although they may not recognize it. Shiller (1991) attributes economists' hostility toward the use of surveys to the impact of the famous methodological article by Friedman (1953). Shiller (1991) argues that many economists seem to be convinced that "[...] Friedman's 'billiard player' analogy justifies omitting ever asking people about what they do[...]".[12] In defending his own application of survey data, Blinder (1991) illustrates a typical argument that economists use to criticize the use of interviews

> "[...] We are trained to study behavior by watching what people *do* (usually in markets), not by listening to what they *say*. For example, critics will point out that subjects of interviews have no incentive to respond truthfully or thoughtfully, so *homo economicus* might refuse to cooperate or even give misleading answers [...]"

A recent example of aversion to subjective data is Broussolle (2005). In his defense of preference revelation as the most reliable method to obtain information about individuals' preferences, he argues that surveys suffer of three main problems: i) interviewed agents may consciously be insincere for strategic reasons, ii) they may unconsciously make false reports because they misperceive reality and iii) they may be sincerely hesitating. So Broussolle (2005) concludes that, although it would be useful to know the *true* agent's opinion, "[...] what credit would he be granted by us, even if he were sincere? Agents may well deceive themselves or hesitate [...]" and, hence, "[...] It seems preferable to keep an external approach of behaviour [...]".

Evidently, the debate about the usefulness of surveys is far from being over. On the one side economists use surveys at an increasing rate. On the other side, many criticisms are well founded. Seemingly, further investigation about the reliability of surveys as means to recover information on people's preferences and welfare is necessary. A straightforward suggestion is to look at the work of those who have

[12] The "billiard player" analogy is used by Friedman (1953) to exemplify the fact that optimizing behaviour need not result from the conscious application of optimal conditions. In fact, even the best billiard player hardly knows the laws of physics and certainly does not apply optimality conditions to win the game.

been applying survey-based methods for many years. The actual use of surveys in social sciences like psychology and sociology may provide useful information about the surveys' potential.

The purpose of this chapter is, however, a different one. My objective is to convince the reader that there are cases where surveys constitute the only possibility to get the information we need to make welfare statements. More precisely, I will argue that there are cases where, given the actual development of neuroscience and experimental economics, either we renounce to recover information about people's utility or we accept to rely on survey data.

It is worth emphasizing that my claim is purely theoretical. Preference revelation as a means to get information about individuals' preferences has been already criticized from a practical point of view by Manski (2000). In particular, he stigmatizes economists' overconfidence about the likelihood that conditions are met which allow a useful application of preference revelation techniques. He argues that in many cases preference revelation is feasible in theory but not in practice because choice data are not available in a sufficient number

> "[...] Having devoted much of my own research to revealed preference analysis of discrete choice behavior, I have become keenly aware that observation of the action that an agent chooses places only mild restrictions on the agent's preferences and expectations. To be sure, the theory of revealed preference as pioneered by Samuelson and extended by Savage to the theory of subjective expected utility shows that a researcher observing many choices of a person can infer the person's preferences and expectations. However, empirical revealed preference analysis does not have the extensive data presumed available in the Samuelson and Savage thought experiments. The empirical researcher usually observes a sample of heterogeneous agents each of whom makes a single choice from a single choice set. Observation of a single choice from a single choice

set reveals something, but not much, about an agent's preferences and expectations [...]"

Manski's point – with which I agree – is that in all cases where choice data are not available in the necessary number, preference revelation is useless from a practical point of view and, hence, we should look for feasible alternatives. My point is that there are cases where preference revelation does not work even if an ideal data set is available.

Consider the last example of the previous section where preferences of individual i are represented by the utility function $u(s) = v(x) + h_1(x) + h_2(z)$. In such a case, choice determines a certain amount of utility and the circumstances of choice just add or subtract something to this amount. As previously shown, under this specification of utility, we can obtain only partial information from observed choices – i.e. the order of desirability of elements in X – while we are unable to compare i's utility under different circumstances – i.e. we cannot obtain the order of desirability of elements in S. Notice that from the point of view of recovering information about preferences this is the most favourable case under the assumption that $Z \neq \emptyset$ and its elements non-trivially affect utility. Indeed, optimal choice is independent of circumstances, although the latter still affect the level of welfare.

In this example, if we rely on nothing else than observed choices to get information about people's preferences, then we will find ourself in trouble whenever we have to assess welfare. For instance, we cannot establish whether i considers the consumption of other people a bad, a good or neither of them – i.e. if $h_2(\cdot)$ reduces, increases or is constant in the consumption of others. Let me briefly discuss what this implies. Consider $z_0, z_1 \in Z$ and suppose that the only relevant difference between them is that in z_1 everyone consumes twice as much as in z_0. Suppose also to have observed i purchasing x_0 under z_0 and x_1 under z_1. Because of non-satiation, we get that $v(x_0) + h_1(x_0) < v(x_1) + h_1(x_1)$. Moreover, if we assume that the consumption of others is a good for i we get that $h_2(z_0) < h_1(z_1)$, if we assume that it is a bad we get that $h_2(z_0) > h_1(z_1)$, and if we assume that it is a neither a good nor a bad we get that $h_2(z_0) = h_1(z_1)$. Which is the best assumption among these three? From the observation of prices and quantities, there is no way to rank the goodness of such assumptions because we cannot establish whether $u(x_0, z_0) < u(x_1, z_1)$ is true or false. In other words, we have no reason to prefer any of the assumptions because all are equally consistent with the data. According to Occam's razor we should conclude that every statement whose truth depends on any of the three assumptions is illegitimate.[13]

As economists, we cannot be very much satisfied with this conclusion. It is evident that the impossibility to rank this type of assumptions amounts to giving up welfare analysis. In order to assess i's welfare we have to find some other source of information about how i considers the others' consumption (and, more in general, about i's order of desirability of elements of S). Three alternatives exist in this regard. The first is to construct an artificial situation where i can choose between $s_0 = (x_0, z_0)$ and $s_1 = (x_1, z_1)$. In a controlled environment we might be able to put a relevant part of the component z under i's control and, hence, to obtain the revelation of i's preferences. If we presuppose that individuals behave in the artificial setting as they behave in real economic situations, then the information gathered in such a way may help us to rank the three assumptions. In particular, *ad hoc* settings may be created to test assumptions which produce sharp behavioral implications for i – e.g. the irrelevance of elements of Z. Unfortunately, not every characteristic of the world can be recreated in the lab and therefore there are cases where experiments do not work. We cannot recreate the two alternatives s_0 and s_1 of the example because we can neither halve nor duplicate the consumption of a group of subjects. What can be done is to run experiments where i can affect the others' income by modifying her own income. In this way we can gather information about i's preferences and

[13] Occam's razor states that the explanation of any phenomenon should make as few assumptions as possible, eliminating, or "shaving off", those that make no difference in the observable predictions of the explanatory hypothesis or theory.

have a clue about which of the three assumptions may be nearest to reality. In many cases, however, such an "artificial revelation" technique is impossible because of the nature of the characteristic of world involved – e.g. pollution, criminality, marriage, etc.

The second solution is the measurement of utility – or one of its correlates – in psychophysical terms. The measurement of brain activities which are correlated with well-being may give us the necessary information for ranking assumptions about preferences. For instance, if we could measure i's utility under s_0 and s_1, then we could directly check whether $u(x_0, z_0) < u(x_1, z_1)$ is true or false and, hence, establish if some of the three competing assumptions performs better than the others. If available, such a measurement of utility is obviously the best solution. However, despite the recent progress in neuroscience, in most cases it is impossible to do such a measurement.

The last solution is the survey method where preferences and utility are elicited. By recording people's subjective assessment of what they actually prefer or how satisfied they are, surveys hopefully give us a correlate of utility or a ranking of alternatives which may allow a justified choice between competing assumptions. Obviously, a subjective assessment is not as reliable as an objective one. As pointed out by Broussolle (2005), there are many reasons that can induce an individual to not answer truthfully and many situations where an individual is not completely conscious of her actual utility or preferences. However, surveys are feasible. In many cases experiments and psychophysical measurements are not. This is why we should explore the possibility to use subjective data. I do not mean that they are *certainly* reliable, and certainly there are cases where they are not. However, since for the time being we have little else choice a part from arbitrarily assuming what people prefer, we should try to use surveys and check which kind of information we can really gather from them. It seems to me that there is no advancement for economics in the *a priori* assertion that surveys are useless if, in addition, no feasible alternative to measure people's preferences is provided. An anti-survey conviction which is not supported by a feasible alternative to measure preferences has the unpleasant consequence of confronting us with the choice of renouncing welfare analysis or accepting welfare statements without empirical content.

1.5 Concluding Remarks

In this chapter I have pointed out several things. The first is that allowing for social determinants of utility – and, in particular, allowing for Duesenberry's hypothesis of "interdependent preferences" – does not prevent the possibility to test UT on individuals' behaviour. My argument is the following. Denote with P the set of characteristics of the world containing prices and any other characteristic which depends, either directly or indirectly, on prices (e.g. the consumption choices of others). Since preference revelation by means of observed choices requires to observe individual behaviour under different price systems, the elements of P are necessarily outside the observable choice set of individuals. Therefore, very little can be revealed unless we specify *how* elements of P affect utility. The traditional argument in favor of the postulates of RPT is that, by assuming that P has no influence, we obtain the possibility to empirically test the theory. However, neglecting P is just one possible specification of *how* elements of P affect utility which gives the possibility to test the theory on observed behaviour. Other specifications may be equally plausible and legitimate. In other words, although neglecting P is sufficient to give empirical content to UT, it is not necessary for such a result. By introducing assumptions about how (observable) elements of P affect utility we can allow social factors to affect individuals' utility – e.g. others' choices – and still get testability on observed behaviour. Therefore, the traditional position in favor of the postulates of RPT – namely that otherwise it is not possible to give empirical content to UT (Samuelson (1948)) – it is not true. This is important because the superiority of the postulates of RPT may be convincingly argued on a methodological basis only. In fact, quite reasonably there exist non-choice objects which depend on prices and which have a substantial impact on people's utility. Hence, a UT which tries to incorporate such elements would be preferable to a UT which is equally worth from a methodological point of view but rules them out. Furthermore, this discussion has evidenced another important point. If we want to retain the empirical content that UT has under H_{RPT} and, at the same time, we want to allow for the social determinants of individuals' behaviour, then we are forced to specify *how* such determinants affects utility. In other words, we have to make an arbitrary choice about how people's preference are which is on the same level of H_{RPT} (but, hopefully, more reasonable).

The second point in that, whenever we are concerned with people's welfare, then we may have the necessity to integrate information on preferences obtained by observing individuals' behaviour with information obtained from survey data. While I have not discussed whether or not survey data are a reliable source of information about people's preferences, I have argued that there are cases where either we use survey data or we renounce making welfare statements with an empirical content. My argument is the following. There might be externalities which fail to have implications on the observed behaviour of individuals and which cannot be reproduced in a controlled setting. This may be the case, for instance, when individuals are concerned with the environment or their social status. In any case, this general possibility cannot be ruled out by data but only an opportune assumption. In the presence of this type of externality, preference revelation techniques cannot go beyond the measurement of the order of desirability of alternatives because we have no means to infer in which direction and how much the externality affects welfare. Therefore, in order to make a welfare statement in such a situation which is based on the evaluations of individuals (and not just on ours), we have to find a way to measure the utility actually experienced by them. In the case that direct measurement of welfare-related brain activity is impossible, then either we renounce welfare analysis or we are forced to rely on survey data.

This pragmatic approach seems to be gaining support among economists. As previously noted, an increasing number of scholars is relying on survey data both to evaluate people's welfare (Easterlin (1974, 1995), Blanchflower and Oswald (2004), Layard (2005)) and to model people's preferences (Stutzer (2004), Luttmer (2005), Clark and Oswald (1998)). Furthermore, there is a discussion about the appropriate statistical techniques to better handle this type of data (Clark et al. (2005), Ferrer-i-Carbonell and Frijters (2004)) as well as studies in favor of the reliability of subjective declarations (Kahneman and Krueger (2006)). Despite the traditional aversion to subjective data, many scholars seem to be looking for a way to obtain welfare statements not from purely arbitrary assumption but from individual evaluations which have an empirical basis. Although economists are still very skeptical about subjective statements, they may have become even more skeptical about an economic theory whose welfare statements lack empirical content.

Chapter 2

A Note on the Testable Implications of Utility Theory

2.1 Introduction

In this short chapter I study what information about preferences can be recovered from an ideal but finite set of data, that is, what can be deduced about people's preferences from a finite number of exhaustive descriptions of the world. This is done by means of a thought experiment where, in the spirit of Afriat (1967) (see also Varian (1982), Matzkin (1991)), it is assumed that observations satisfy certain properties and it is checked whether the hypothesis of utility maximization can be tested on them.

The novelty of the present contribution lies in that both preferences and data are defined over a space which is broader than that considered in Afriat (1967) (and subsequently Richter (1966), Varian (1982), Matzkin (1991)), comprising in principle any characteristic of the world which agents may consider relevant. It is shown that, in general, assuming that preferences satisfy the properties of reflexivity, transitivity, and completeness is not sufficient to obtain testable implications about utility maximization. In particular, without further restrictions on preferences any set of data satisfying the non-satiation hypothesis can be rationalized by utility functions which are monotonic in commodity bundles. Furthermore, it is argued that the restrictions usually assumed in revealed preference theory (RPT) are not the only ones which allow to obtain empirical implications. As an example, it is shown that assumptions which incorporate the idea of social comparison can provide implications which have an empirical content.

2.2 Revelation and Rationalization

2.2.1 Preliminaries

Let S be a set and R be a binary relation on S, where sRs' means that $(s, s') \in R$. The case of sRs' and not sRs' is indicated by sP_Rs'. The existence of a sequence $\{s_k\}_{k=1}^{K+1}$ in S such that $K > 0$, $s_1 = s$, $s_{K+1} = s'$ and s_kRs_{k+1}, for $k = 1, \ldots, K$, is indicated by sR^Ks'.

A binary relation R on S is *complete* if and only for any $s, s' \in S$ either sRs' or $s'Rs$. A binary relation R on S is *reflexive* if and only, for any $s \in S$, sRs. A binary relation R on S is *transitive* if and only for any $s, s', s'' \in S$, sRs' and $s'Rs''$ implies sRs''. The binary relation $\bar{R}$ is said to be the *transitive closure* of R and is defined as $\bar{R} \equiv \{(s, s') : sR^Ks', K > 0$.

A *representation* of R is a function $u : S \to R$ such that i) if sRs', then $u(s) \geq u(s')$, and ii) if sP_Rs', then $u(s) > u(s')$.

Let $X \subseteq \Re^m$. The set $\partial X = \{x \in X : y \not\geq x, y \in X \setminus \{x\}\}$ is said to be the *upper frontier* of X.

2.2.2 Preferences

Suppose there are n individuals which are assumed to be "pure consumers", that is, they can only choose what to purchase. Denote with $X \subset R_+^m$ the set of commodity bundles for which there exists a market. Notice that any of the m markets might actually be a future market. Denote with Z the set whose elements contain a description of the characteristics of the world that individuals may consider relevant but cannot purchase in any market. Notice that, although individuals care about both Z and X, they can choose only in X.

Denote by $S \equiv X^n \times Z$ the set of all descriptions of the world. The elements of S are written as ordered $(n+1)$-tuples, namely $s = (x^1, \ldots, x^n, z)$ where $x^i \in X$ for $i = 1, \ldots, n$ and $z \in Z$. In order to handle separately what characteristics of the world can be affected by i's choice from those that cannot be, we introduce the further n-tuples $s^{-i} \equiv (x^1, \ldots, x^{i-1}, x^{i+1}, \ldots, x^n, z)$ which is interpreted as i's *circumstances of choice*, and $x^i(s^{-i})$ which is interpreted as i's choice under circumstance s^{-i}.

By *preferences* of individual i it is meant her subjective ordering of the elements of S. Preferences are represented by a binary relation on S which is assumed to be *complete* and *transitive*.

2.2.3 Revelation

Let $D \subset S$ be a finite set containing $q \equiv ||D||$ observations of the world which are referred to as data. Each piece of evidence $d \in D$ is a $(n+1)$-tuple of the type $(x^1, \ldots, x^n, z)$ where $x^i \in X$ is the commodity bundle chosen by individual i and $z \in Z$ are the characteristics of the world other than commodities purchased. In particular z comprises, among other things, the budget set of each individual which is denoted by $B^i(d) \subset X$. Budget sets are assumed to be closed sets. Moreover, if x belongs to some B then any $y \neq x$ such that $0 \leq y \leq x$ also belongs to B. Finally, it is assumed that $x^i(d) \in \partial B^i(d)$, namely data satisfy *non-satiation*.[1]

The basic idea of "direct revelation" is that when an individual is given the possibility to choose among different alternatives, by the very act of choosing one of them, say x, she directly reveals that x is at least as preferred as all remaining possibly chosen alternatives. Coherently with this understanding of direct revelation, we say that $s_1 \in S$ is directly revealed preferred to $s_2 \in S$ for individual i, indicated with $s_1 R(D)^i s_2$, if and only if

[1]Notice that, as in Matzkin (1991) which generalized the model of Afriat (1967), budget sets are allowed to be non-linear and therefore prices do not explicitly appear.

i) $s_1 \in D$

ii) $s_1^{-i} = s_2^{-i}$

iii) $x^i(s_2^{-i}) \in B^i(s_1)$

Moreover, s_1 is strictly directly revealed preferred to s_2 if $s_1 R(D)^i s_2$ and $s_2 \notin \partial B^i(s_1)$, and it is indicated with $s_1 P_R(D)^i s_2$. Condition i) means that s_1 must be observed; condition ii) requires i's circumstances of choices to be the same in s_1 and s_2, otherwise the two choices cannot be be compared; condition iii) requires that the the budget set in s_1 allows i to buy $x^i(s_2^{-i})$ so that individual i could have effectively obtained s_2 when s_1 is observed.

Revelation here differs from that of traditional revealed preference theory (RPT) because the latter is not conditional on the circumstances of choice. According to traditional RPT if $s_1 \in S$ is observed where individual i buys $x^i(s_1) \in X$, then x^i is directly revealed preferred to all $x \in B^i(s_1)$ under any s^{-i}. If people care just about the elements of X then this is fine. Since this is not the case and we have no prior about the composition of Z or i's preferences, revelation can only tell us something which is conditioned to s_1^{-i}, that is, s_1 is directly revealed preferred to all s such that $s_1^{-i} = s^{-i}$ and $x^i(s^{-i}) \in B^i(s_1)$.

Since preferences are assumed to be transitive, direct revelation provides further information. More precisely, we say that s_1 is *revealed preferred* to s_2 if and only if $(s_1, s_2) \in \bar{R}(D)^i$, where $\bar{R}(D)^i$ is the transitive closure of $R(D)^i$.

2.2.4 Rationalization

We now turn to showing that any possible set of observations D is consistent with the hypothesis of utility maximization. A set of data D is *rationalizable* if there exists a representation u^i of $\bar{R}(D)^i$ for any $i = 1, \ldots, n$. The following is a key result which states the necessary and sufficient conditions for a binary relation to have a representation. It is well known and therefore given without proof (see e.g. Richter (1966)).

Theorem 1 *A binary relation R on S has a representation if and only if, for any $s, s' \in S$, $s\bar{R}s'$ implies that $s'P_R s$ is false.*

The condition which guarantees representability is the absence of cycles involving strong preference. The rationalizability of any set of data D is proved by showing that cycles of this kind are impossible to be obtained in any $\bar{R}(D)^i$.

Proposition 1 *Any set of data D is rationalizable.*

Proof. Consider individual i. Suppose there exist $d, d' \in D$ such that $d\bar{R}(D)^i d'$. Then, there exists a sequence $\{d_k\}_{k=1}^{K+1}$ in D such that $K > 0$, $d_1 = d$, $d_{K+1} = d'$ and $d_k R(D)^i d_{k+1}$, for $k = 1, \ldots, K$. By the definition of direct revelation follows that, for any d_k, d_{k+1}, $d_k^{-i} = d_{k+1}^{-i}$ which, in turn, implies that $d^{-i} = d_2^{-i} = \ldots = d_k^{-i} = d'^{-i}$. In particular, $B^i(d) = B^i(d')$. Therefore, $x^i(d) \in \partial B^i(d')$ implying that $d'P_R(D)^i d$ is false. Result follows then by Theorem 1.■

Proposition 2 *Any set of data D can be rationalized by a family of utility functions $\{u^i\}_{i=1}^n$ where each u^i is monotonic in $x^i \in X$, i.e. $s_1^{-i} = s_2^{-i}$ and $x^i(s_1) \geq x^i(s_2)$ imply $u^i(s_1) \geq u^i(s_1)$ and if, in addition, $x^i(s_1) > x^i(s_2)$ then $u^i(s_1) > u^i(s_2)$.*

Proof. Let $\succeq^i$ be a binary relation such that $s_1 \succeq^i s_2$ if and only if either $s_1\bar{R}(D)^i s_2$ or $s_1^{-i} = s_2^{-i}$ and $x^i(s_1) \geq x^i(s_2)$; let also $s_1 \succ^i s_2$ if and only if either $s_1 P_R(D)^i s_2$ or $s_1^{-i} = s_2^{-i}$ and $x^i(s_1) > x^i(s_2)$. By Theorem 1 it is sufficient to show that, for any $s_1, s_2 \in S$, $s_1 \succeq^i s_2$ implies $s_2 \succ^i s_1$ is false.

Suppose $d_1 \succeq^i d_2$. Because of non-satiation and the shape of budget sets, if $x^i(d_1) < x^i(d_2)$ then $x^i(d_1) \in B^i(d_2) \setminus \partial B^i(d_2)$ implying that $B^i(d_1) \neq B^i(d_2)$. Therefore, $d_1^{-i} \neq d_2^{-i}$ which implies $d_2 \succ^i d_1$ is false. If $x^i(d_1) \geq x^i(d_2)$ and $d_1^{-i} = d_2^{-i}$

then $B^i(d_1) = B^i(d_2)$ which implies $x^i(d_1), x^i(d_2) \in \partial B^i(d_1) = \partial B^i(d_2)$. Hence, $d_2 \succ^i d_1$ is false.■

From the proofs of Proposition 1 and 2 it is evident that, whenever budget sets are relevant characteristics of the world – i.e. they may affects the order of desirability of elements of X – then $d\bar{R}(D)^i d'$ always implies that $d' P_R d$ is false. The reason is that, if budget sets are relevant, then $d, d' \in D$ and $dR(D)^i d'$ implies – because of condition ii) – that $B^i(d) = B^i(d')$ and, therefore, that $d, d' \in \partial B^i(d) = \partial B^i(d')$, resulting in $d' R(D)^i d$.

If budget sets are irrelevant then not any D is rationalizable, at least in principle. Let $x^{-i}(d) \equiv (x_1(d), \ldots, x_{i-1}(d), x_{i+1}(d), \ldots, x_n(d))$ represent the choices of individuals other than i in observation d. Let also $\hat{z}(d)$ be the characteristics of the world other than purchases and budget sets which are observed in d. If $\hat{z}(d) = z(d)$ for any $d \in D$ – i.e. budget sets are assumed to be irrelevant – we can write i's circumstances of choices in d as $d^{-i} \equiv (x^{-i}(d), \hat{z}(d))$.

Proposition 3 *Let D be a set of data such that $\hat{z}(d) = z(d)$ for any $d \in D$. Any such D is rationalizable if and only if for any individual i and any sequence $\{d_j\}_{j=1}^r$ such that $x^i(d_j) \in B^i(d_{j+1})$, $d_{r+1} \equiv d_1$, and $(x^{-i}(d_1), \hat{z}(d_1)) = \ldots = (x^{-i}(d_r), \hat{z}(d_r))$ we have that $x^i(d_1), \ldots, x^i(d_r) \in \partial \bigcup_{j=1}^r B^i(d_j)$.*

Proof. Consider D and suppose that, for some i, there exists a sequence $\{d_j\}_{j=1}^r$ in D such that $x^i(d_j) \in B^i(d_{j+1})$ and $(x^{-i}(d_j), \hat{z}(d_j)) = (x^{-i}(d_{j+1}), \hat{z}(d_{j+1}))$. From direct revelation follows that $d_j R(D)^i d_{j+1}$ and, hence, that $d_j \bar{R}(D)^i d_l$, $l = 1, \ldots, r$. Suppose that $x^i(d_k) \notin \partial \bigcup_{j=1}^r B^i(d_j)$ for some $k \in \{1, \ldots, r\}$. Recall that any budget set B is such that if $x \in B$ then any $y \neq x$ such that $0 \leq y \leq x$ belongs to B too. Hence, since $x^i(d_k) \in \partial B^i(d_k)$, $x^i(d_k) \in B^i(d_t) \setminus \partial B^i(d_t)$ for some $t \in \{1, \ldots, r\}$, $t \neq k$. Therefore, $d_t P_R(D)^i d_j$ which, by Theorem 1, implies that D is not rationalizable.

On the other hand, suppose that D is not rationalizable. Then, by Theorem 1 there exists, for some i, a sequence $\{d_j\}_{j=1}^r$ in D such that $d_j R(D)^i d_{j+1}$, $j =$

$1, \ldots, j-1$, and $d_r P_R(D)^i d_1$. The latter implies that $x^i(d_1) \notin B^i(d_r)$ and, in particular, that $x^i(d_1) \notin \bigcap_{j=1}^r \partial B^i(d_j)$.■

We can make make stronger assumptions about subjects' preferences and obtain tighter implications. We can assume, for instance, that $Z = \emptyset$ – namely that any characteristic of the world other than others' choices is irrelevant to individuals . In this case point ii) of revelation becomes $x^{-i}(s_1) = x^{-i}(s_2)$ and we obtain

Corollary 1 *If $Z = \emptyset$ then a set of data D is rationalizable if and only if for any individual i and any sequence $\{d_j\}_{j=1}^r$ such that $x^i(d_j) \in B^i(d_{j+1})$, $d_{r+1} \equiv d_1$, and $x^{-i}(d_1) = \ldots = x^{-i}(d_r)$ we have that $x^i(d_1), \ldots, x^i(d_r) \in \partial \bigcup_{j=1}^r B^i(d_j)$.*

Proof. Analogous to the proof of Proposition 3 but, since Z is irrelevant, there is $x^{-i}(d)$ in the place of $(x^{-i}(d), \hat{z}(d))$.■

Proposition 3 and Corollary 1 illustrate examples of how restrictions on preferences can produce implications which are, in principle, empirically testable. However, practical testability remains extremely difficult in both cases because the condition $x^{-i}(d_1) = \ldots = x^{-i}(d_r)$ is enormously demanding. It is hardly the case that every individual but one chooses the same bundle under distinct budget constraints. From this we see that allowing whatever depends on budget sets (e.g. others' choices) as a relevant characteristic of the world results in the (practical) impossibility to have empirically testable implications.

In order to obtain practical testability we must impose further restrictions on subjects' preferences. In particular, we must further specify *how* individuals care about others' choices (and anything which depends on budget sets). One example of this is the assumption of traditional RPT that individuals' preferences are restricted to the set X – i.e. circumstances of choice are irrelevant. In this case condition ii) of direct revelation disappears and we get

PROPOSITION 4 *If circumstances of choice are irrelevant then a set of data D is rationalizable if and only if for any individual i and any sequence $\{d_j\}_{j=1}^r$ such that $x^i(d_j) \in B^i(d_{j+1})$, $d_{r+1} \equiv d_1$, we have that $x^i(d_1), x^i(d_2), \ldots, x^i(d_r) \in \partial \bigcup_{j=1}^r B^i(d_j)$.*

Proof. Analogous to the proof of Proposition 3 but, since circumstances of choice are irrelevant, condition $x^{-i}(d_j) = x^{-i}(d_{j+1})$, $j = 1, \ldots, r$, is not considered.■

In the special case of linear budget sets, the condition illustrated in Proposition 4 is equivalent to the well known *cyclical consistency* (Afriat (1967), Varian (1982)).

Another example of such further restrictions is assuming that $Z = \emptyset$ is irrelevant and that individuals care about others' choices in the following way: given any choice in X, individuals prefer to have as many people as possible consuming not more than what they consume. Let $V^i(s) \equiv \{j \neq i : x_j \leq x_i\}$ and $v^i(s) \equiv ||V(s)||$. Each individual i is assumed to care about x^i and v^i only. In other words, actual identity of individuals is irrelevant and only ordinal differences in consumption matter. We define individuals whose preferences satisfy these conditions as *ordinal comparers*.

According to the hypothesis of ordinal comparison, condition ii) of the definition of direct revelation is substituted with $v^i(\tilde{s}(x^i(s_2), x^{-i}(s_1))) \geq v^i(s_2)$, where $\tilde{s}(x^i(s_2), x^{-i}(s_1))$ is the element of S where i chooses what she chooses in s_2 and the other individuals choose what they choose in s_1. In addition, if $s_1 R(S)^i s_2$ and either $v^i(\tilde{s}(x^i(s_2), x^{-i}(s_1))) > v^i(s_2)$ or $s_2 \notin \partial B^i(s_1)$, then $s_1 P_R(D)^i s_2$. These conditions capture the idea that combining the fact that 1) if i purchases $x^i(s_1)$ when $x^i(s_2) \in B^i(s_1)$ then s_1 is preferred to $\tilde{s}(x^i(s_2), x^{-i}(s_1))$ and 2) if $v^i(\tilde{s}(x^i(s_2), x^{-i}(s_1))) \geq v^i(s_2)$ then $\tilde{s}(x^i(s_2), x^{-i}(s_1))$ is preferred to s_2, we can conclude that s_1 is preferred to s_2. Therefore, we obtain

PROPOSITION 5 *If $Z = \emptyset$ and individuals are ordinal comparers then a set of data D is rationalizable if and only if for any individual i and any sequence $\{d_j\}_{j=1}^r$ such that $x^i(d_j) \in B^i(d_{j+1})$ and $v^i(\tilde{s}(x^i(d_{j+1}), x^{-i}(d_j))) \geq v^i(d_{j+1})$, $d_{r+1} \equiv d_1$, the following conditions are satisfied for any $j, k \in \{1, \ldots, r\}$*

i) $x^i(d_j) \in B^i(d_k) \Rightarrow v^i(d_j) \geq v^i(\tilde{s}(x^i(d_j), x^{-i}(d_k)))$,

ii) $x^i(d_j) \in B^i(d_k) \setminus \partial B^i(d_k) \Rightarrow v^i(d_j) > v^i(\tilde{s}(x^i(d_j), x^{-i}(d_k)))$.

Proof. Consider D and suppose that, for some i, there exists a sequence $\{d_j\}_{j=1}^r$ in D such that $x^i(d_j) \in B^i(d_{j+1})$ and $v^i(\tilde{s}(x^i(d_{j+1}), x^{-i}(d_j))) \geq v^i(d_{j+1})$. From direct revelation follows that $d_j R(D)^i d_{j+1}$ and, hence, that $d_j \bar{R}(D)^i d_l$, $l = 1, \ldots, r$. Consider condition i). If $x^i(d_j) \in B^i(d_k)$ and $v^i(d_j) < v^i(\tilde{s}(x^i(d_j), x^{-i}(d_k)))$ for some j, k, then $d_k P_R(D)^i d_j$. Since $d_j \bar{R}(D)^i d_k$, from Theorem 1 follows that D is not rationalizable. Consider condition ii). If $x^i(d_j) \in B^i(d_k) \setminus \partial B^i(d_k)$ and $v^i(d_j) \leq v^i(\tilde{s}(x^i(d_j), x^{-i}(d_k)))$ for some j, k, then $d_k P_R(D)^i d_j$. Again, from Theorem 1 follows that D is not rationalizable.

On the other hand suppose that D is not rationalizable. By Theorem 1 there exists, for some i, a sequence $\{d_j\}_{j=1}^r$ in D such that $d_j R(D)^i d_{j+1}$, $j = 1, \ldots, j-1$, and $d_r P_R(D)^i d_1$. The latter implies that either $x^i(d_1) \in B^i(d_r)$ and $v^i(d_1) < v^i(\tilde{s}(x^i(d_1), x^{-i}(d_r)))$, which violates i), or $x^i(d_1) \in B^i(d_r) \setminus B^i(d_r)$ and $v^i(d_1) \geq v^i(\tilde{s}(x^i(d_1), x^{-i}(d_r)))$, which violates ii).■

Proposition 5 states that, under the hypothesis that Z is irrelevant and people are ordinal comparers, a set of data is rationalizable if and only if for any individual i and any pair of observations d, d' such that $d\bar{R}(D)^i d'$, either data reveals nothing about i's preferences between d and d' – i.e. either $x^i(d)$ cannot be purchased under $B^i(d')$ or $x^i(d)$ grants an ordinal position under $x^{-i}(d)$ which is strictly better than under $x^{-i}(d')$ – or data reveals that d' is directly preferred to d but not strictly preferred – i.e. $x^i(d)$ belongs to the upper frontier of $B^i(d')$ and $x^i(d)$ grants the same ordinal position under $x^{-i}(d)$ and $x^{-i}(d')$.

2.3 Comment

It has been shown that standard regularity conditions on preferences are insufficient to provide testable implications of utility theory. In other terms, it is not possible to give utility theory empirical content with a "pure" behavioristic approach. In particular, whenever budget sets or characteristics of the world which depend on them are relevant to individuals, testability is compromised. Further restrictions on preferences must be introduced. The traditional assumptions of RPT are an example of how the imposition of additional hypothesis on preferences can produce testable implications (Samuelson (1948)). However, as shown by Proposition 3, Corollary 1 and Proposition 5, this is not the only way to obtain such a result. By better specifying how these characteristics of the world influence the order of desirability of alternatives in the choice set, testable implication can be obtained.

Chapter 3

Status as a Game: Equilibrium, Dynamics and Welfare

3.1 Introduction

Social status is a good in any society but there is no general rule which determines the social status of person. In fact, actual determinants of social status depend on the characteristics of the society a person lives in. However, as far as contemporary capitalist societies are concerned, we recognize that consumption has a very important role: social status is either obtained or signalled by means of comparison between what one consumes and what is consumed by other people. This phenomenon goes under the label of *social comparison*.

Delaying to next sections the discussion of the relevance of social comparison for real economic situations, one serious problem with its modeling is that it can take a variety of forms and it is not clear which, if any, best fits reality. Among the several contributions appeared so far on the subject, there are many common points but also substantial differences. This sometimes makes unclear what results depends on the particular kind of concern for status which is assumed – how consumption determines status and, hence, how social comparison takes place – and which are independent of it. A step ahead would be identifying a small set of characteristics which is common to all – or at least to most – type of concern for status which have been studied so far. If this could be done, then a general framework for investigating the implications of social comparison could be developed.

The first objective of this chapter is exactly the one just described. Instead of making specific assumptions about utility functions (or preferences) in order to analyze the implications of particular forms of concern for social status, the investigation starts from two basic postulates which are believed to constitute the core characteristics of status seeking. In brief, these postulates are: i) by consuming, every individuals produces negative externalities on the people she interacts with and ii) consumption is a strategic choice and shows complementarity among peers. It turns out that postulates i) and ii) define a strategic environment which can be usefully studied with the tools of game theory. More precisely, by exploiting recent developments in the theory of supermodular games (Milgrom and Roberts (1990, 1991), Vives (1990, 2005)), some important properties of the solution of the game are obtained. First, in the presence of multiple equilibria, a Pareto best equilibrium obtains when everybody consumes and works the least possible. Second, in most cases the best equilibrium is Pareto inefficient and the Pareto optimum is obtained in a non-equilibrium point where everybody consume and work not more, and someone strictly less, than in any equilibrium. This suggests that regulations aimed at either reducing everybody's consumption or work time can be welfare improving. Third, convergence to the set of equilibria is assured under a vast class of dynamic laws (Milgrom and Roberts (1991)) suggesting that such an inefficiency can actually arise. Finally, it is shown that under social comparison a generalized increase in wages (which can be also seen as a generalized increase in productivity) can be detrimental to welfare because it increases the competition for status and, hence, makes people work so much that the benefits of a greater consumption are more than offset by the reduction of leisure time.

The second objective is to move the first step in a direction that the literature on social comparison has not explored yet, namely the role of the structure of interpersonal interactions. Intuitively, since people tend to compare themselves with the individuals they mostly interact with, the structure of social interactions – that is, with whom individuals have direct contacts and consequently make direct comparisons – plays an important role. The structure of interactions is modelled by supposing that individuals compare themselves with a subset of the population which is referred to as neighbours. Some preliminary results of interest are obtained. First, if society is well connected – that is, if for any two individuals there exists a chain made of neighbours, neighbours of neighbours, etc. connecting them – then individual choices have an impact on everybody's status even if each individual interacts with few people only. Second, if people also care about how frequently they compare themselves with others, then the concern for status is positively affected by the frequency of social interactions which, in turn, can increase the competition for status and possibly have negative effects on welfare. Moreover, it is shown that such a result does not require that many people have such preferences. If society is well connected, then few individuals with such preferences who experience a higher frequency of interactions are sufficient to increase everyone's effort in the competition for status.

3.1.1 An Overview of the Literature on Social Comparison

Intuitive recognition of consumption complementarities and externalities due to the concern for status is probably antecedent to economic science. However, Veblen (1899) has been the first to extensively analyze them as a well defined social phenomenon. For this reason, his seminal contribution is widely acknowledged as a milestone of both social and economic investigation. The term "conspicuous consumption" – which he used to indicate the act of consuming for the purpose of bettering one's own social status – is still applied to indicate that part of consumption which is motivated by social comparison.

For several decades afterwards scarce attention has been paid to this issue. Then, starting from the '70, an increasingly large stream of literature on the subject appeared. The precursor of the modern literature on social comparison is Duesenberry (1949) who first attempted to translate Veblen's main insights into modern economic language. His basic intuition is that people care about their relative consumption and not, as assumed in standard economics, about absolute consumption. This type of modeling of social comparison is often referred to as the interdependent preferences approach and is attracting an increasing number of scholars (Pollack (1976), Hayakawa and Venieris (1977), Corneo and Jeanne (1997, 1998), Clark and Oswald (1996, 1998), Holländer (2001), Hayakawa (2000)).[1] More precisely, the core of this approach consists of assuming that (or appropriately postulating preference relations so that) utility functions depend not only on the absolute level of consumption, but also on a weighted average of the consumption of the whole population (which is interpreted as a sort of representative consumer with whom one must compare).

It must be noted that such formulation implicitly assumes that social status is cardinal, meaning that what matters for an individual is the distance between her and others' consumption. On the contrary, under ordinal status people only care about the number of individuals consuming more or less than them. The latter concept has been advocated by Frank (1985b) who has applied the interdependent preferences approach with ordinal status in a study about the demand for positional and non-positional goods (ordinal rank is also assumed in Robson (1992), Direr (2001), Cooper et al. (2001), where different implications of social comparison are investigated).

A further source of heterogeneity in this research field is that economists do not agree about the reasons why people possess a concern for status. One explanation is that concern for status is *intrinsic* to human beings. Therefore, if at the very begin-

[1] Actually this label is misleading because people's preferences do not really depend on each other. In fact, preferences are fixed but are defined not only over the commodity space but also over others' actions space, resulting in the concern about relative consumption.

ning of human history social comparison probably concerned the ability to gather food and hunt, in an impersonal market economy it mainly concerns consumption. This view is often supported by evolutionary theorists and to a large extent by Veblen himself.[2]

A different explanation of status seeking behaviour is that social status is *instrumental*, namely it is a means to an end. People do not value status itself but seek it because a high status grants better consumption opportunities. This less pessimistic view about the current nature of human beings has the attracting feature of making one further step in giving account of the social comparison phenomenon. However, since usually there are several benefits associated with a high social status, it may be very difficult to establish whether social comparison depends on the preferences for such benefits or on preferences for the status itself. This approach has been recently advocated by Postlewaite (1998). Consumption and saving decisions where status is instrumental were studied extensively by Cole et al. (1992, 1995, 1998).

Besides, there is the issue of why consumption is important for status. A very simple explanation is that it determines status. A more elaborated motivation is that status is determined by something else and consumption is a good signal for status, particularly when it is wasteful. For instance, if wealth is unobservable but determines status, then consumption may be a way to signal one's wealth to others. This idea has been explored using either the intrinsic approach (Ireland (1994, 2001), Bagwell and Bernheim (1996)) or the instrumental approach (Cole et al. (1995), Corneo and Jeanne (1998),) to the concern for status.

As anticipated, in most of these models one's consumption – or its conspicuous part – produces negative externalities on others and induces strategic complementarity. Therefore, equilibria are typically Pareto inefficient showing overconsumption.

[2]Rayo and Becker (2005) have shown that the concern for status may have emerged through evolutionary selection. They argue that, ten thousands years ago, a higher social status on average granted a higher fitness – especially in times of resource scarcity – and that the individuals with more concern for social status were more likely to obtained it.

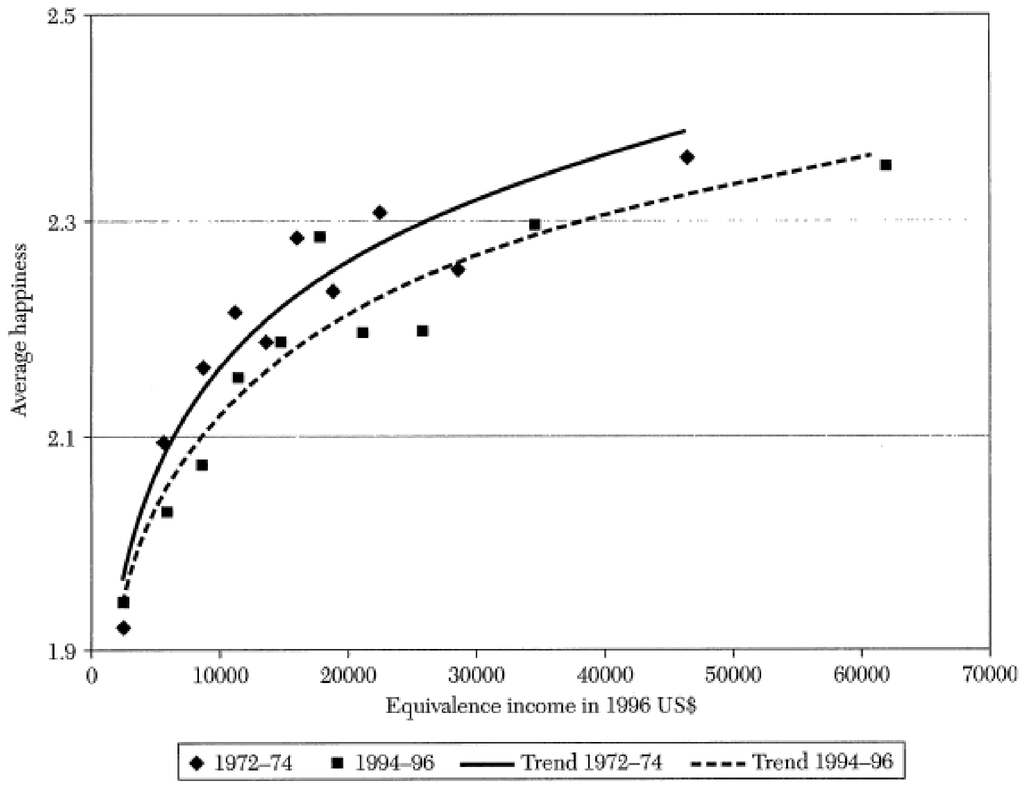

Figure 3.1. Happiness and income in the US (from Frey and Stutzer (2002b)), source: General Social Survey and National Opinion Research Center.

3.1.2 The Happiness "Paradox" and Work Time Choices

So far, I have motivated the interest in the phenomenon of social comparison by arguing that it is quite common in contemporary societies. Although this alone could be sufficient to justify research about the economic implications of the quest for status, actually there is a further important motivation. Taking into account the social comparison phenomenon can help to explain the puzzling data provided by the literature on happiness and work trends.

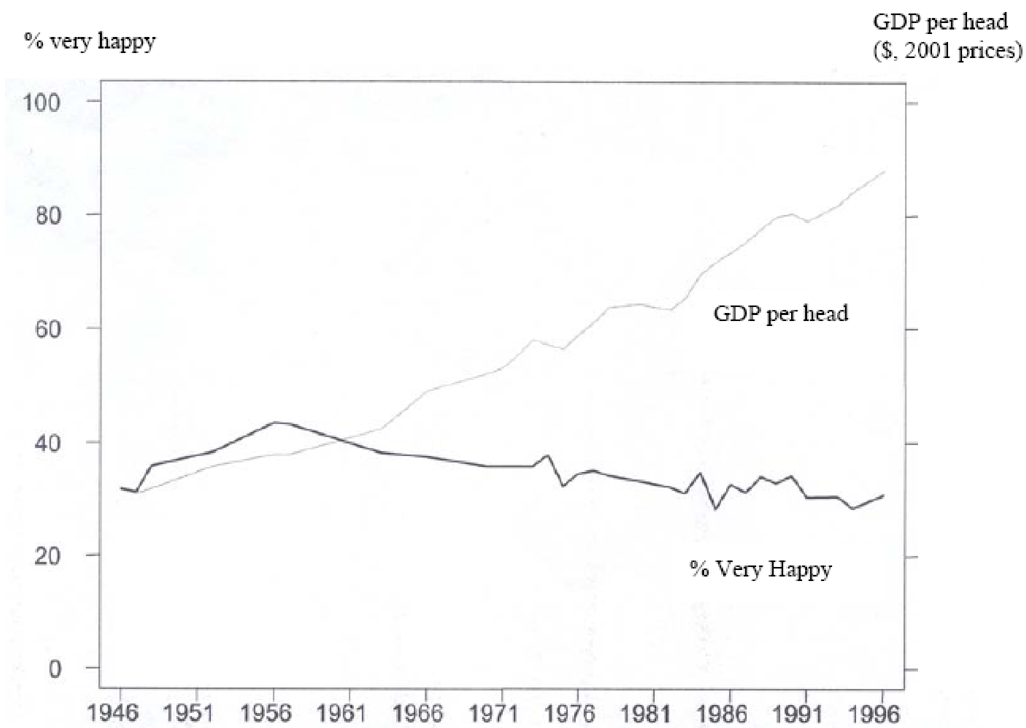

Figure 3.2. Per capita real income and percentage of very happy people in the U.S. 1945-1996 (source: Layard (2005))

Since the pioneering work of Easterlin (1974), a large amount of evidence has been produced about the so called "happiness paradox". Unexpectedly, although at any point in time happiness results positively correlated with income, in developed countries this relationship almost vanishes when one looks at the impact of income over time (Oswald (1997), Blanchflower and Oswald (2004), Diener and Biwas-Diener (2002), Diener and Oishi (2000), Easterlin (1995, 2001), Kenny (1999, 2006), Veenhoven (1991, 1996), Frey and Stutzer (2002b, 2004), Layard (2005), see figures 3.1, 3.2, 3.3 and 3.4). In fact, a greater absolute income seems to have persistent positive effects on people's happiness only when current income is low

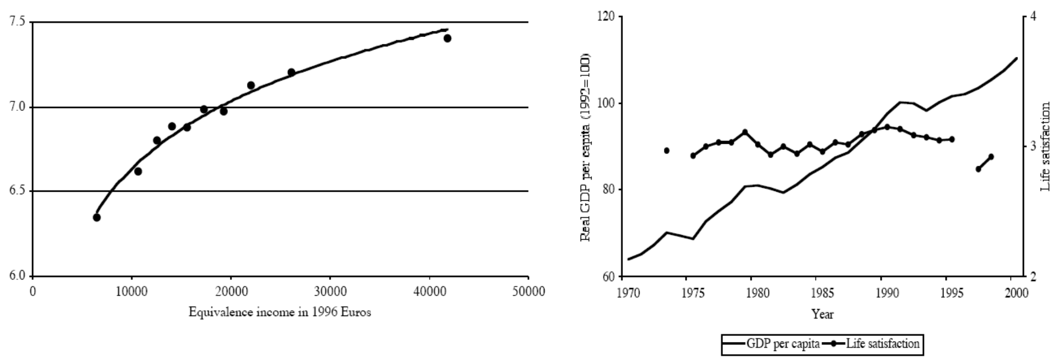

Figure 3.3. Satisfaction with life and income in Germany (from Frey and Stutzer (2004)), source: German Socio-Economic Panels, Eurobarometer, Penn World Table and OECD.

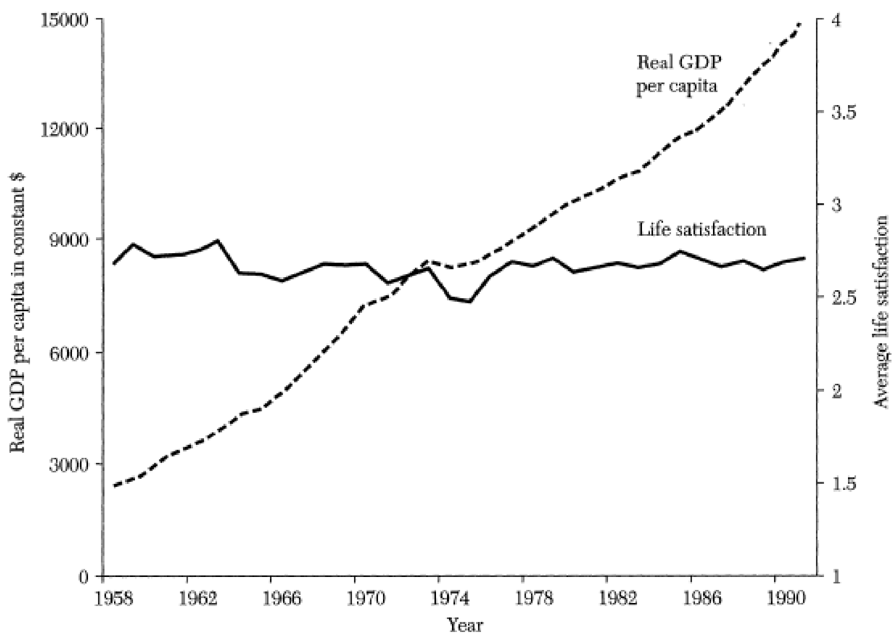

Figure 3.4. Satisfaction with Life in Japan in the period 1958-1991 (source: Easterlin (2001))

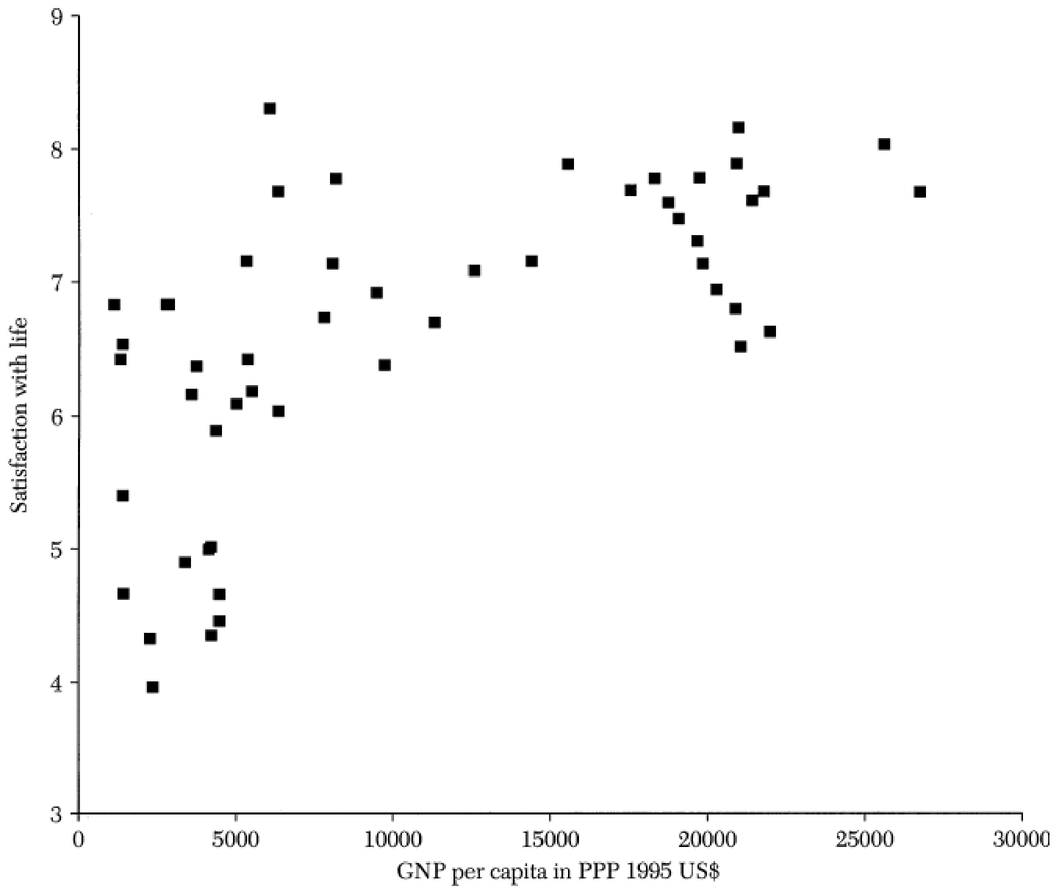

Figure 3.5. Life satisfaction and income levels across the world in the 1990s. (from Frey and Stutzer (2002b)), source: World Values Survey 1990-1993/1995-1997 and World Development Report 1997.

and, hence, it coincides with a better access to very basic goods like food, clothing, etc. Furthermore, cross-country analysis suggests that factors other than absolute income become more and more important beyond a certain income threshold (figure 3.5).

On the other hand, the existing literature on work trends and well-being suggests

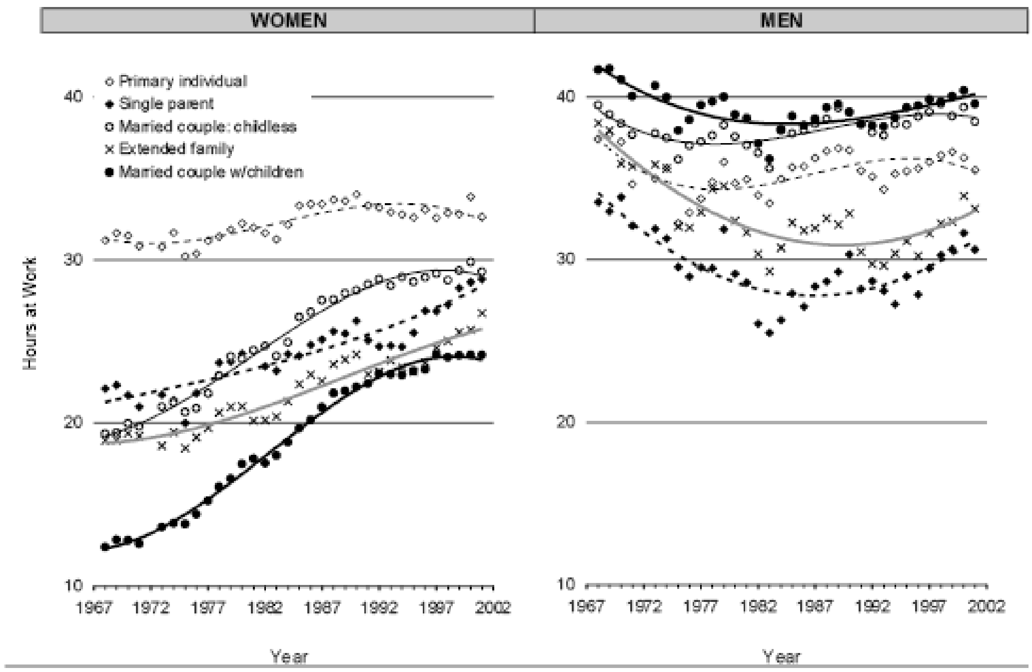

Figure 3.6. Hours at work in the U.S. by year, gender and family type; persons 25-54 years old in the period 1967-2002 (source: Hout and Hanley (2005)).

that people are experiencing more and more stress at work as well as during free time (Hochschild (1997), Schor (1998, 2004)). It has been even argued that in contemporary market societies people work more hours than in the pre-industrial era and that, at least for the US, the secular trend in work time reduction has stopped and people actually work more than in the 1960s (Schor (1992)). The latter claim is particularly controversial and has been criticized on a statistical basis (Coleman and Pencavel (1993a,b), Robinson and Godbey (1997), Jerry and Garson (2001)), though both counter-critic and further evidence have been provided (Rones et al. (1997), Schor (2000), Gabriel and Schmitz (2004), Hout and Hanley (2005), see figure 3.6). Unless we take as a reference the first stage of the industrial era, it

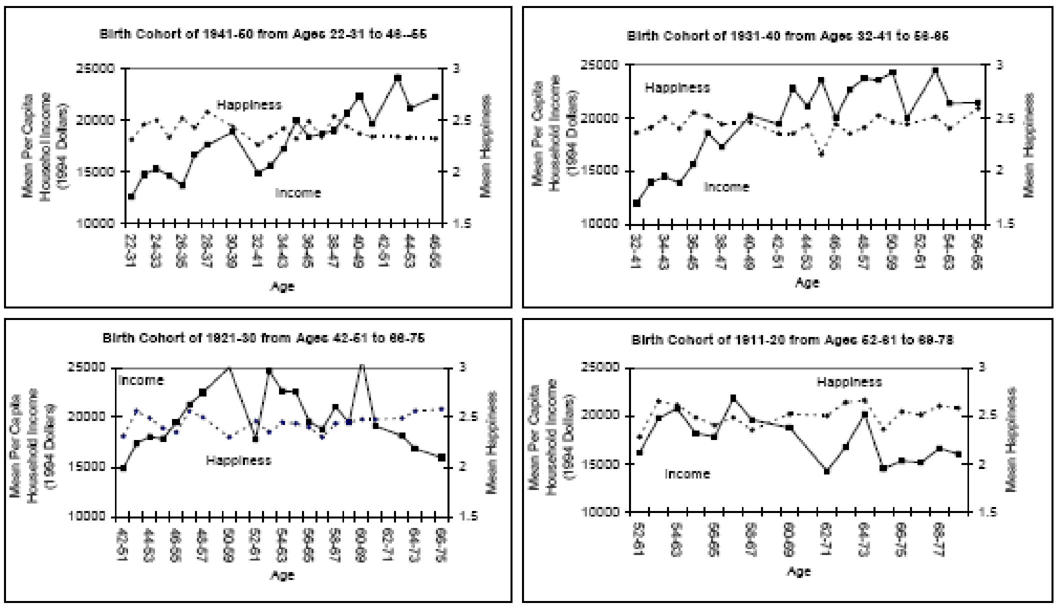

Figure 3.7. Happiness and income over the life cycle (source: Easterlin (2001))

is fair to say that the dramatic productivity growth of industrialized countries has not produced so far a parallel dramatic growth of leisure time. Quite surprisingly, Hout and Hanley (2005) find that, although people assert that they would like to spend more time with their family and friends and less at work, they are not ready to give up some of their income for this and some – especially men – would accept longer work time for more money (see figure 3.8).

From these facts one could be tempted to conclude that people act against their own interest. Income fails to increase satisfaction with life, but people nevertheless put a lot of effort in attempting to get more and more of it. Actually, it might be the case that many would be better off by struggling less to increase their income and, instead, taking more leisure or having less stressing jobs.

The concern for status offers an explanation of this seemingly sub-optimal be-

Preferences and Attitudes about Time and Work: Married Persons, 25-54 Years Old, 1997

Item	A. Which of the things on the following list would you like to spend more time on…. Much more time	A bit more time	Same time as now	A bit less time	Much less time	Total
A paid job	8	14	36	26	15	100
Doing household work*						
Wives	3	22	21	27	27	100
Husbands	5	20	37	25	13	100
With family	54	36	9	1	1	100
With friends	20	52	26	2	1	100
Doing leisure activities	31	52	15	1	1	100

Time-Money Trade-off by Gender: Married Persons, 25-54 Years Old, 1997

Partner	Which of the following choices would you prefer? Work longer hours & earn more money	Work the same hours & earn the same money	Work fewer hours & earn less money	Can't choose	Total
Wife	13	58	18	11	100
Husband	31	53	8	8	100

Note: Gender difference is statistically significant (p < .05).

Figure 3.8. Attitudes about time and money-time tradeoff (source: Hout and Hanley (2005))

haviour. Even if people *individually* act in an optimal way, the interplay of externalities and complementarities due to social comparison makes people's choices *globally* sub-optimal. In fact, the quest for status may create a coordination failure inducing people to engage in a wasteful competition which results in everybody being worse off. In the happiness literature this explanation is often referred to as the "positional treadmill". However, its implications are still far from being fully recognized by policy-makers (Frank (2005)). Moreover, if it is admitted that social comparison is something about which individuals are not completely conscious, then it is even more likely that the "positional treadmill" has a substantial impact on people's welfare. In fact, if people do not fully recognize externalities and complementarities arising from social comparison then they overestimate the benefits of a higher relative income. Being overconfident about outperforming their peers, people desire to increase their consumption too much and end up being stressed by the lack of leisure and by the pressure to advance their career.

An alternative explanation – which is closely related to and compatible with the "positional treadmill" – is the so called "hedonic treadmill". The basic idea is that people's satisfaction depends on the gap between their aspirations and their actual consumption. However, aspirations tend to rise with income and, therefore, additional income can only temporarily increase happiness. As people adapt to a higher standard of goods and services, the gap between aspirations and actual consumption eventually reappears and happiness goes back to the level it had before the income increase (Scitovsky (1976)). Consequently, as long as the gap between aspirations and actual consumption remains relatively constant, happiness stagnates even if income rises considerably. Several economists have applied the "hedonic treadmill" to explain the stagnation of happiness in high-income countries. Easterlin (2001) finds that the average happiness of a ten-years cohort does not vary much during the life cycle, although distinct cohorts experience different income trends (figure 3.7). His explanation of this remarkable finding is that happiness varies directly with income and inversely with material aspirations but the latter increases proportionately to income and, hence, happiness results fairly constant over time. Also Frey and Stutzer (2004, 2002a) use the rising aspiration argument in order to explain the happiness paradox. However, they explicitly put forward the idea that aspirations rise not only because of habit but also because of social comparison. Indeed, this seems a reasonable point since aspirations are the result of experience and experience can be about either one's own or others' consumption. This is even more clear when one looks at the issue from a more abstract point of view. Indeed, by expanding the definition of social comparison so as to include self-comparison, habituation can be represented as a form of comparison with oneself of the recent past.

Finally, it has been stressed that people do not correctly take into account how their aspirations vary over time. Loewenstein and Schkade (1999) suggests that, although it is common knowledge that aspirations eventually rise with income, people seem to neglect it when evaluating the happiness derived from additional income. Similarly, Easterlin (2001) claims that people tend to evaluate past and future happiness mostly on the basis of actual aspirations and hence they underestimate past happiness and overestimate future one.

3.1.3 The Empirical Evidence About Social Comparison

In recent years several empirical studies have confirmed that social comparison has an important role in determining people's welfare.[3] Solnick and Hemenway (1998) conduct a survey study where approximately fifty percent of the respondents declare that they would be happy to give up half of their real purchasing power in order to have a higher relative income position. McBride (2001) uses the 1994 General Social Survey data to study the concern for relative income. He finds that absolute income positively affects reported well-being, while reference income – whose measure is constructed with information about parents – negatively affects well-being. Moreover, the strength of these effects reduces in the respondent's income: at low income levels, the relative-income effect appear to be smaller and absolute income becomes more important.

In their study about the determinants of happiness in Britain and US, Blanchflower and Oswald (2004) find that both absolute and relative income matter. Using experimental-survey methods, Alpizar et al. (2005) obtain similar results. Interestingly, they also show that, although the positional concern varies across different types of goods, it is significantly present also in the choice of goods which are tra-

[3]See Senik (2005) for a recent survey on this issue.

ditionally believed to be non-positional like vacations and insurances.

Ferrer-i-Carbonell (2005) investigates the role of social comparison applying German panel data. She finds that i) even if income has a small effect on individual well-being, the effect is not insignificant, ii) absolute income is more important for the poor (East Germans) than for the rich (West Germans), iii) an identical increase of family's and reference group's income has no significant effect on well-being, iv) the larger one's own income is in comparison with the income of her reference group, the happier she is, and iv) comparisons are mostly upward, that is, the (negative) impact of a relatively low income on poor individuals' well-being is greater than the (positive) impact of a relatively high income on rich individuals' well-being (such effect is particularly marked for West Germans).

Besides, there is evidence suggesting that the structure of interactions among individuals affects how social comparison takes place. Using a data set of 6000 interviews to Switzerland citizens, Stutzer (2004) finds that the richer one's neighbours are, the higher the aspiration level is and, as a consequence, the lower reported well-being is. Moreover, the aspiration level of community members who interact within the community reacts much more to changes in average income than the one of members who do not interact. Similar results are found in Luttmer (2005) where US micro data are used. Firstly, self-reported happiness is negatively affected by the earnings of others in the neighbourhood. Secondly, using alternative and more objective measures of welfare – e.g. the frequency of marital disagreements – it is shown that the finding is not only a consequence of how people report happiness. Thirdly, the strongest negative effects on happiness are obtained for those who socialize more in their neighborhood and the size of the effect is economically meaningful. Finally, an increase in neighbours' earnings and in own income have roughly about the same effect (in absolute terms) on well-being, indicating that the negative externality due to social comparison is likely to be of the same order of magnitude of the benefits of a greater income.

A different approach is used by Carlssona et al. (2005). They apply a survey-based choice-experiment where Indian students are asked to make repeated choices between imagined societies, in order to investigate the importance of relative income both within and between Indian castes. They find that, on average, half of people's marginal utility of income comes from relative income effects ad interpret this result as providing no support for the idea that large concerns for relative income primarily reflect a western and/or rich country phenomenon. Furthermore, an individual's welfare reduces if the mean income of her caste increases while the individual's income doesn't. This implies that the relative position within a caste is more important that the relative position of the caste in the society.

These findings suggests that the structure of interactions affects social comparison in two ways. The first is by influencing the composition of the reference group. The second is by modifying the weight given to relative income with respect to absolute income, that is, the subjective value of a high position in the community. The latter seems to be as relevant as the former but has not received much attention yet.

Finally, Bowles and Park (2005) provide evidence that work time is increasing in the degree of income inequality. They explain this fact on a social comparison basis and show that, theoretically, if people's reference group is composed of individuals of a higher social status – implying that individuals compare themselves only with richer people – then a greater degree of inequality induces longer work hours. Bowles and Park (2005) use work hours data of the manufacturing employees of ten countries over the period 1963-1998 and apply three different measures of income inequality. They suggest that, although also incentive motives may account for such positive correlation, they are not sufficient to explain it completely.

3.2 The Model

In this section I illustrate the economic implications of social comparison by analyzing a simple game of consumption and work time decisions in the presence of negative consumption externalities and strategic consumption complementarities. The main objective is to characterize the equilibrium behaviour under the most general conditions.

It must be remarked, however, that the model is slightly less general that it could be. Some non-crucial assumptions are introduced in order to save on those technicalities that would have made the paper much less accessible without adding that much to intuition. In order to allow the reader to identify such assumptions, in the text there is explicit reference to those postulates whose absence would not affect the substance of results.

3.2.1 General Framework

Consider a society made of individuals who have to choose how much to work and consume and who can interact with each other. Interaction means that agents observe the choices of others. Let $N \neq \emptyset$ be set of agents with $n \equiv ||N||$ finite. Denote by $N(i) \subset N$ the set of individuals interacting with agent $i \in N$, where $n_i \equiv ||N(i)||$. Notice that $i \notin N(i)$. Suppose for simplicity that there is only one commodity which is also the numeraire. Consumption is indicated by the vector $\mathbf{c} \equiv (c_1, \ldots, c_n) \in \Re^n$ where c_i is i's consumption. Similarly, leisure is denoted by the vector $\mathbf{l} \equiv (l_1, \ldots, l_n) \in \Re^n$ where l_i is i's leisure time. Production is not explicitly considered. The only source of income is work and it is entirely spent in consumption. Equivalently, one can think this society as producing commodities by means of labour only.

Every agent has the same endowment which is constituted of $\bar{h}$ units of time. This is also the maximum amount of time that can be spent working. The vector $\mathbf{w} \equiv (w_1, \ldots, w_n) \in \Re^n$ indicates real wages per labour unit supplied where w_i is the real wage of agent i. Real wages are supposed to be exogenous to the model, e.g. determined by productivity. Therefore, the supply of labour can be expressed as the vector $\mathbf{h} \equiv (h_1, \ldots, h_n) \in \Re^n$ where $h_i \equiv (\bar{h} - l_i)$ is the labour supply of agent

i. Finally, i's preferences are represented by the following utility function

$$U^i : \Re^n \times [0, \bar{h}]^n \times 2^N \to \Re, \;\; (\mathbf{c}, \mathbf{l}, N(i)) \to U^i(\mathbf{c}, \mathbf{l}, N(i)) \qquad (3.1)$$

which is twice continuously differentiable in $(\mathbf{c}, \mathbf{l})$.[4] Notice that no concavity assumption is made. Moreover, it is assumed that $U^i_{c_i} \equiv \partial U^i / \partial c_i \geq 0$, $U^i_{l_i} \equiv \partial U^i / \partial l_i \geq 0$, i.e. both consumption and leisure are goods.

The choice to have the arguments $\mathbf{c}$ and $\mathbf{l}$, instead of the usual c_i and l_i, is meant to allow for external effects. The further argument $N(i)$ is meant to make external effects depend on whether individuals interact or not. There are two general kinds of externalities – consumption externalities and leisure externalities – whose positiveness or negativeness is established by the sign of the following derivatives, for $i \neq j$

$$U^i_{c_j} \equiv \frac{\partial U^i}{\partial c_j} \; , \quad U^i_{l_j} \equiv \frac{\partial U^i}{\partial l_j}$$

Furthermore, one's consumption and leisure can be either strategic complements or substitutes to others' consumption and leisure.[5] There are four general kinds of strategic complementarities/substitutabilities in this framework: own consumption with others' consumption, own consumption with others' leisure, own leisure with others' consumption and own leisure with others' leisure. Whether these are actually complementarities or substitutabilities is established by the sign of the following second derivatives, for $i \neq j$

$$U^i_{c_i c_j} \equiv \frac{\partial^2 U^i}{\partial c_i \partial c_j} \; , \quad U^i_{c_i l_j} \equiv \frac{\partial^2 U^i}{\partial c_i \partial l_j} \; , \quad U^i_{l_i c_j} \equiv \frac{\partial^2 U^i}{\partial l_i \partial c_j} \; , \quad U^i_{l_i l_j} \equiv \frac{\partial^2 U^i}{\partial l_i \partial l_j}.$$

[4]Differentiability is not required for the main results which rest on other properties of U^i. Actually, as far as continuity and differentiability are concerned, it is sufficient that U^i – which could even be a correspondence – is order upper semi-continuous in (c_i, l_i) (for any fixed value of $(\mathbf{c}_{-i}, \mathbf{l}_{-i})$) and order continuous in $(\mathbf{c}_{-i}, \mathbf{l}_{-i})$ (for any fixed (c_i, l_i)) and has a finite upper bound (Milgrom and Roberts (1990)).

[5]Strategic complementarity (substitutability) means that there is an incentive to increase (reduce) one's consumption or leisure when others increase their consumption or leisure.

Notice that the existence of complementarities or substitutabilities is completely independent of the sign of $U^i_{c_j}$ and $U^i_{l_j}$, i.e. it is independent of the kind of externalities. Moreover, there may be further complementarities or substitutabilities between own consumption and own leisure and viceversa. These, however, are not strategic and no particular assumption is made about them.

3.2.2 Social Comparison

Our first assumption specifies in which way the actual pattern of interactions is taken into account.

A1. *For any* $i, j \in N$, $j \notin N(i)$, $U^i_{c_i c_j} = U^i_{c_i l_j} = U^i_{l_i c_j} = U^i_{l_i l_j} = U^i_{c_j} = U^i_{l_j} = 0$.

Assumption A1 states that strategic complementarities/substitutabilities and externalities may exist only between individuals that interact with each other. More precisely, it states that i's utility and marginal utility of both consumption and leisure may be affected by j's choices only if i interacts with j.

Furthermore, social comparison is modelled with the following two assumptions.

A2. *For any* $i, j \in N$, $j \in N(i)$, $U^i_{c_j} \leq 0$.

A3. *For any* $i, j \in N$, $j \in N(i)$, $U^i_{c_i c_j} \geq 0$.

Assumption A2 introduces negative externalities of consumption and it is meant to capture the competitive character of social comparison. Notice that A2 does not impose the presence of a strictly negative externality but just excludes that, whenever agent i interacts with agent j, i's utility increases in j's consumption. Other kinds of externalities are allowed.

Assumption A3 introduces consumption complementarities. It imposes that, whenever i interacts with j, i's marginal utility of consumption is non-decreasing in j's absolute consumption. As for the case of externalities, a weak form of consumption complementarity is preferred which is equivalent to excluding consumption substitutability.[6]

Assumption A3 is a crucial assumption. Since its trueness is not self-evident, it needs some further remarks. The basic idea behind A3 is that one's incentive to consume increases when others increase their consumption. Since the work of Veblen (1899) the explanation of why the quest for status fosters consumption – often in a wasteful way – is that one's desire to consume depends positively on others' consumption.[7] A further argument in favor of A3 may be found by looking at the implications of the opposite case. If social comparison induces consumption substitutability then we obtain the intuitively odd situation where a greater difference between social statuses of individuals induces a greater incentive to further increase such difference.

Let me provide a more formal analysis to put in highlight which kind of preferences about social status induce consumption complementarities or substitutabilities. Suppose that the consumption of individuals in $N(i)$ affects i's utility function because it affects i's social status. Suppose also that social status is determined according to the twice differentiable function $r^i(\mathbf{c}, N(i))$, where $r^i_{c_i} \geq 0$ and $r^i_{c_j} \leq 0$ for any $j \in N(i)$ and $r^i_{c_i} = 0$ and $r^i_{c_j} = 0$ for any $j \notin N(i)$. Therefore, i's utility function can be written as $U^i(c_i, \mathbf{l}, r^i(\mathbf{c}, N(i)))$ where c_i enters directly into U^i for standard reasons and indirectly through the function r^i for status reasons.[8] Then, for any $j \in N(i)$, we have

$$U^i_{c_i c_j} = U^i_{13} r^i_{c_j} + U^i_{33} r^i_{c_i} r^i_{c_j} + U^i_3 r^i_{c_i c_j}$$

[6] This is done in order to clarify that A3 holding with strict inequality for every $j \in N(i)$ is not required. Obviously, the trivial case $U^i_{c_i c_j} = 0$ for any $j \neq i$ is of little interest.

[7] Actually, not every model about social comparison assumes consumption complementarity (e.g. Duesenberry (1949)).

[8] See Section 4.1 for an instance of this class of utility functions.

where, in U_3^i, U_{13}^i, and U_{33}^i, the number 1 and 3 indicate partial derivation with respect to the first and third argument of U^i. Since a higher status is assumed to be beneficial to i, i.e. $U_3^i > 0$, if marginal utility of consumption for standard reasons is reasonably independent of status, i.e. $U_{13}^i = 0$, then

$$U_{c_i c_j}^i \geq 0 \quad \Leftrightarrow \quad \frac{U_{33}^i}{U_3^i} \leq -\frac{r_{c_i c_j}^i}{r_{c_i}^i r_{c_j}^i} \tag{3.2}$$

From (3.2) follows that a sufficient condition for A3 to hold is that $U_{33} \leq 0$ and $r_{c_i c_j}^i \geq 0$. In other words, if marginal utility of status is non-increasing and the marginal improvement in status obtained with a greater consumption is non-decreasing in others' consumption, then we have consumption complementarity. On the contrary, if $U_{33} \geq 0$ and $r_{c_i c_j}^i \leq 0$ then we have consumption substitutability.[9]

Besides, some additional assumptions are made.

A4. *For any* $i, j \in N$, $U_{l_j}^i = 0$.

A5. *For any* $i, j \in N$, $U_{c_i l_j}^i = 0$.

A6. *For any* $i, j \in N$, $U_{l_i c_j}^i = 0$.

A7. *For any* $i, j \in N$, $i \neq j$, $U_{l_i l_j}^i = 0$.

Assumption A4 rules out leisure externalities while assumptions A5-A7 rule out any kind of strategic complementarity/substitutability other than consumption complementarity. Actually, A4-A7 are not strictly required for the results described in

[9] In particular, consumption substitutability implies that one more unit of j's consumption increases i's marginal costs of improving her status more than it increases i's marginal benefit of status as a consequence of i's status reduction. Clark and Oswald (1998) show that if social status is given by $r^i(c_i, c_j) = (c_i/c_j)$ and the utility function is not sufficiently concave in r^i, then consumption substitutability may arise.

this section, but they help in isolating and making clear the implications of social comparison.

3.2.3 A Consumer Game of Status

Any individual $i \in N$ maximizes her utility function with respect to (c_i, l_i) under the budget constraint $c_i \leq w_i l_i$ and the feasibility constraints $c_i \geq 0$ and $0 \leq h_i \leq \bar{h}$. Denote by $\mathbf{h}_{-i} \in \Re^{n-1}$ the choices of labour supply of all individuals but i. Conveniently, any choice of consumption and leisure, (c_i, l_i), can be expressed in terms of labour supply, h_i. Since the set $[0, \bar{h}]$ is compact and U^i is continuous in h_i, for any $\mathbf{h}_{-i} \in H^{n-1} \equiv [0, \bar{h}]^{n-1}$ there exists at least one choice of h that maximizes U^i. In general, we have a set of the form

$$H_i^*(\mathbf{h}_{-i}) \equiv \{h_i \in [0, \bar{h}] : h_i \in \arg\max(U^i(h_i, \mathbf{h_{-i}}))\}$$

Notice that, since H_i^* depends on $\mathbf{h}_{-i}$, consumer choice is strategic. Therefore, we can define a game where payoff functions are the utility functions and the strategy space is $H^n \equiv [0, \bar{h}]^n \subset \Re^n$, with the usual partial order of $\Re^n$. Let me indicate such a game by $\Sigma \equiv (N, (U^i, N(i), H)_{i \in N}, \geq)$. The best response correspondence of a generic individual i is defined as follows

$$\Phi_i : H^{n-1} \to [0, \bar{h}] \; , \;\; \mathbf{h_{-i}} \to H_i^*(\mathbf{h}_{-i})$$

Since each Φ_i takes values in $2^{[0,\bar{h}]}$, both $\inf \Phi_i(\mathbf{h}_{-i})$ and $\sup \Phi_i(\mathbf{h}_{-i})$ exist and belong to $[0, \bar{h}]$. Furthermore, since U^i is continuous in h_i which takes values in the compact $[0, \bar{h}]$, the elements of $H_i^*(\mathbf{h}_{-i})$ are either isolated points or belong to a closed interval which is itself in $H_i^*(\mathbf{h}_{-i})$, implying that $\inf \Phi_i(\mathbf{h}_{-i}) \in \Phi_i(\mathbf{h}_{-i})$ and $\sup \Phi_i(\mathbf{h}_{-i}) \in \Phi_i(\mathbf{h}_{-i})$. Moreover, we have the following result

LEMMA 1 *Let* $\{\Phi_i\}_{i \in N}$ *be the collection of best reply correspondences of the game* Σ*. Suppose that* U^i *is a function of* $\delta \in \Re^k$*. If* $\delta' \geq \delta$ *implies that* $U^i_{c_i}(\delta') \geq$

$U^i_{c_i}(\delta')$ *and* $U^i_{l_i}(\delta) = U^i_{l_i}(\delta')$, *then* $\inf \Phi_i(\delta') \geq \inf \Phi_i(\delta)$ *and* $\sup \Phi_i(\delta') \geq \sup \Phi_i(\delta)$. *Moreover, if* $\inf \Phi_i(\delta), \sup \Phi_i(\delta) \in (0, \bar{h})$ *and if* $\delta' \geq \delta$, $\delta' \neq \delta$, *implies that* $U^i_{c_i}(\delta') > U^i_{c_i}(\delta')$ *and* $U^i_{l_i}(\delta) = U^i_{l_i}(\delta')$, *then* $\inf \Phi_i(\delta') > \inf \Phi_i(\delta)$ *and* $\sup \Phi_i(\delta') > \sup \Phi_i(\delta)$.

Proof. Suppose that $\delta' \geq \delta$ implies $U^i_{c_i}(\delta) \leq U^i_{c_i}(\delta')$ and $U^i_{l_i}(\delta) = U^i_{l_i}(\delta')$. Then, for $c_i' > c_i$ we have that $U^i(c_i', \delta) - U^i(c_i, \delta) \leq U^i(c_i', \delta') - U^i(c_i, \delta')$. Therefore, $h_i' > h_i$ implies that $U^i(h_i', \delta) - U^i(h_i, \delta) \leq U^i(h_i', \delta') - U^i(h_i, \delta')$.[10] Furthermore, since $\inf \Phi_i(\delta) \in \Phi_i(\delta)$, for any $h_i \in [0, \bar{h}]$ and $\delta \in \Re^k$ we have

$$U^i(\inf \Phi_i(\delta), \delta) - U^i(h_i, \delta) \geq 0 \tag{3.3}$$

In particular, $h_i < \inf \Phi_i(\delta)$ implies that (3.3) holds with strict inequality. Therefore, for $\delta' \geq \delta$ and $h_i < \inf \Phi_i(\delta)$ we have that

$$U^i(\inf \Phi_i(\delta), \delta') - U^i(h_i, \delta') \geq U^i(\inf \Phi_i(\delta), \delta) - U^i(h_i, \delta) > 0 \tag{3.4}$$

Inequality (3.4) implies that $h_i \notin \Phi_i(\delta')$ and, hence, that $\inf \Phi_i(\delta') \geq \inf \Phi_i(\delta)$.

Moreover, if $\inf \Phi_i(\delta) \in (0, \bar{h})$ then $w_i U^i_{c_i}(\inf \Phi_i(\delta)) = U^i_{l_i}(\inf \Phi_i(\delta))$ since $\inf \Phi_i(\delta)$ is an optimal choice away from the boundaries of i's strategy set. Hence, if $\delta' \geq \delta$, $\delta' \neq \delta$, implies that $U^i_{c_i}(\delta') > U^i_{c_i}(\delta')$ and $U^i_{l_i}(\delta) = U^i_{l_i}(\delta')$, then it also implies that $\inf \Phi_i(\delta') \neq \inf \Phi_i(\delta)$ which, by what we have shown above, implies that $\inf \Phi_i(\delta') > \inf \Phi_i(\delta)$.

Analogous proofs apply for the supremum.■

COROLLARY 2 *Let* $\{\Phi_i\}_{i \in N}$ *be the collection of best reply correspondences of a game* Σ. *Then, for every* $\mathbf{h}_{-i}, \mathbf{h'}_{-i} \in H^{n-1}$, $\mathbf{h}_{-i} \leq \mathbf{h'}_{-i}$ *implies* $\inf \Phi_i(\mathbf{h}_{-i}) \leq \inf \Phi_i(\mathbf{h'}_{-i})$ *and* $\sup \Phi_i(\mathbf{h_{-i}}) \leq \sup \Phi_i(\mathbf{h'_{-i}})$.

[10]This property is often referred to as *increasing differences* in the pairs (h_i, δ) and (c_i, δ) (see Tarski (1955), Topkins (1978)).

Proof. From assumption A3 and A5-A7 follows that, for any $i \in N$ and $h_i \in [0, \bar{h}]$, $U^i_{c_i}(h_i, \mathbf{h}_{-i})$ is non-decreasing in $\mathbf{h}_{-i}$. Then, the result follows by Lemma 1.■

Corollary 2 states that strategic consumption complementarity implies that the boundaries of the set of best reply choices are non-decreasing in the consumption choices of others.

3.3 Equilibrium Analysis

Standard Nash equilibrium is applied as the solution concept of the game Σ. Following the usual definition, a vector of labour supplies $\mathbf{h}^*$ is said to be an equilibrium if and only if

$$\forall i \in N, \Phi_i(\mathbf{h}^*{}_{-i}) = h^*_i \tag{3.5}$$

In order to identify the equilibria of Σ and study their properties, I shall apply some recent results about games with strategic complementarities or *supermodular games*. The relevant definitions and theorems are found in Appendix 3.5.

3.3.1 Consumer Choice as a Supermodular Game: General Results

It is easy to check that the game Σ described in Section 3.2 is a smooth supermodular game (see Appendix 3.5). Therefore, by Theorem 2 we know that Σ has at least one equilibrium, that is, there exists at least a vector of labour supplies $\mathbf{h}^* \in H^n$ satisfying (3.5). In addition, there exists a smallest and a largest equilibrium of Σ, respectively $\underline{\mathbf{h}}^*$ and $\overline{\mathbf{h}}^*$, such that any equilibrium $\underline{h}^*$ belongs to the interval $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$. It must be noticed that in general there will be inner points of the interval $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ which are not equilibria.

Since there may be a multiplicity of equilibria, it is natural to try to rank them according to individuals' utility. Since welfare measures which allow for utility aggregation would be arbitrary and would require a more detailed specifications of utility functions, Pareto efficiency is applied. It turns out that it is sufficient to establish the worse and best equilibrium of Σ.

Proposition 6 *Let* $\mathbf{h}^*$ *and* $\mathbf{h}^{*\prime}$ *be two equilibria of the game* Σ*. Then,* $\mathbf{h}^* \geq \mathbf{h}^{*\prime}$ *implies that* $U^i(\mathbf{h}^{*\prime}) \geq U^i(\mathbf{h}^*)$ *for each* $i \in N$*. Moreover, if* $\partial U^i/\partial c_j < 0$ *and* $h_j^* > h^{*\prime}_j$ *for some* $j \in N(i)$*, then* $\mathbf{h}^{*\prime}$ *Pareto dominates* $\mathbf{h}^*$*; if* $\mathbf{h}_j^* > \mathbf{h}^{*\prime}_j$ *and, for each* $i \in N$*, there exists some* $j \in N(i)$ *such that* $\partial U^i/\partial c_j < 0$ *then* $\mathbf{h}^{*\prime}$ *strictly Pareto dominates* $\mathbf{h}^*$*.*

Proof. Proposition follows from Theorem 4.■

Since any equilibrium lies in $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$, Proposition 6 implies that $\underline{\mathbf{h}}^*$ is a Pareto-best equilibrium. Therefore, whenever we have multiple equilibria, the one characterized by the smallest supply of labour for each individual, and hence the smallest consumption, grants the highest welfare.

Notice that this result holds under very general conditions. Indeed, neither concavity nor convexity requirements are needed. Consumption and leisure can be ordinary, inferior or Giffen goods. As noted in the previous section, even the twice continuously differentiability of U^i is not strictly necessary. The crucial assumptions are A2 and A3, namely negative consumption externalities and strategic consumption complementarities. Together they give rise to a coordination failure which may trap society in a Pareto inferior outcome: all individuals prefer a situation where all consume less and have more leisure time but they are unable to coordinate on the superior outcome because individual deviations from the inferior one result in lower individual welfare. This does not mean, however, that a greater consumption for everybody is always a bad. The benefits accruing from a greater consumption may well offset the negative externalities and the disutility of labour due to a greater labour supply. In fact, there can be regions of the strategy space H^n where an increase in everybody's supply of labour implies a Pareto improvement.

Obviously, different forms of the "box" $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*] \subseteq H^n$ result in different interpretations of such a ranking of equilibria. The actual shape of the "box" depends on those characteristics of $\{U^i\}_{i \in N}$ that have been left unspecified. Hence, in this framework $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ lacks substantial constraints. Therefore, the statements contained in Proposition 6 have no direct implication for policy. For instance, if equilibrium is unique – or the distance between $\underline{\mathbf{h}}^*$ and $\overline{\mathbf{h}}^*$ is very small – then we expect that society is close to a Pareto-best equilibrium. In this case, moving society to a better equilibrium would scarcely improve welfare. On the other hand, if $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is close to H^n – or the distance between $\underline{\mathbf{h}}^*$ and $\overline{\mathbf{h}}^*$ is quite large – then it can easily happen that society is in a quite bad equilibrium. In such a case, moving society to a new equilibrium characterized by lower labour supplies would result in a substantial welfare improvement.

Welfare and policy implications can be obtained by looking at the location of Pareto-optima. More precisely, they can be obtained by establishing whether society is capable of self-positioning in an optimal outcome, i.e. by checking whether Pareto-optima belongs to $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$. The following statements provides results in this regard.

PROPOSITION 7 *Let $\underline{\mathbf{h}}^*$ and $\overline{\mathbf{h}}^*$ be respectively the smallest and the greatest equilibrium of a game Σ. Then,*

i) If there exists $i, j \in N$ such that $\underline{h}_i^* \in (0, \overline{h})$, $\underline{h}_j^* \in (0, \overline{h})$ and $\partial U^i / \partial c_j < 0$, $\partial U^j / \partial c_i < 0$, then there exists $\hat{\mathbf{h}} \leq \underline{\mathbf{h}}^*$, with $\hat{h}_i < \underline{h}_i^*$ and $\hat{h}_j < \underline{h}_j^*$, such that $\hat{\mathbf{h}}$ Pareto dominates $\underline{\mathbf{h}}^*$,

ii) if, for any $i \in N$, $\underline{h}_i^* \in (0, \bar{h})$ and there exists some $j \in N(i)$ such that $\partial U^i / \partial c_j < 0$, then there exists $\hat{\mathbf{h}} < \underline{\mathbf{h}}^*$, such that $\hat{\mathbf{h}}$ strictly Pareto dominates $\underline{\mathbf{h}}^*$.

Proof. Consider the hypothesis of case i). By Theorem 4, $\underline{\mathbf{h}}^*$ Pareto dominates any $\mathbf{h} \in (\underline{\mathbf{h}}^*, \overline{\mathbf{h}}]$. Moreover, since $\underline{h}_i^*$ and $\underline{h}_i^*$ are non-boundary optima choices, we have that both $\partial U^i/\partial h_i$ and $\partial U^j/\partial h_j$ evaluated at $\underline{\mathbf{h}}^*$ are equal to zero. Notice also that $U^i_{c_j} < 0$ and $U^j_{c_i} < 0$ implies that $\partial U^i/\partial h_j < 0$ and $\partial U^j/\partial h_i < 0$. Therefore, by slightly reducing the choice of both i and j the sum of the utility loss due to a smaller consumption and the utility gain due to a greater leisure, is of an inferior order of magnitude compared to the positive effect due to the smaller negative externality that they exert on each other. Hence, there exists neighbourhoods of $\underline{h}^*_i$ and $\underline{h}^*_j$ containing, respectively, $\tilde{h}_i < \tilde{h}^*_i$ and $\hat{h}_j < \underline{h}^*_j$ such that the vector $\hat{\mathbf{h}}$, whose k-th element is $\hat{h}_k \equiv \underline{h}^*_k$ if $k \notin \{i, j\}$ or $\hat{h}_k = \tilde{h}_k$ otherwise, Pareto dominates $\underline{\mathbf{h}}^*$.

The proof of case ii) is obtained by applying the argument used for case i) to all players instead of players i and j only.■

Proposition 8 *Let $\underline{\mathbf{h}}^*$ be the smallest equilibrium of a game Σ. If, for every $i \in N$, there exists $j \in N(i)$ such that $U^i_{c_j} < 0$, then all Pareto optima lie in $[0, \underline{\mathbf{h}}^*]$.*

Proof. Let $\underline{\mathbf{h}}^*$ be the smallest equilibrium. Consider a strategy profile $\mathbf{h} \in H^n$ and define the collections of individuals $N^+(\mathbf{h}) \equiv \{i \in N : h_i > \underline{h}^*_i\}$ and $N^-(\mathbf{h}) \equiv \{i \in N : h_i < \underline{h}^*_i\}$. Denote with $\mathbf{h}_{N^+}$ the strategies of individuals in $N^+(\mathbf{h})$ and with $\mathbf{h}_{-N^+}$ the strategies of individuals in $N \setminus N^+(\mathbf{h})$. By A2 we have

$$U^i(\underline{\mathbf{h}}^*{}_{N^+}, \mathbf{h}_{-N^+}) \geq U^i(\mathbf{h}) \quad , \quad \forall i \in N \setminus N^+$$

Moreover, for any $i \in N^+$, we have

$$U^i(\mathbf{h}_{N^+}, \mathbf{h}_{-N^+}) - U^i(\underline{\mathbf{h}}^*{}_{N^+}, \mathbf{h}_{-N^+}) \leq U^i(\mathbf{h}_{N^+}, \underline{\mathbf{h}}^*{}_{-N^+}) - U^i(\underline{\mathbf{h}}^*{}_{N^+}, \underline{\mathbf{h}}^*{}_{-N^+}) \leq$$

$$\leq U^i(h_i, \underline{\mathbf{h}}^*{}_{-i}) - U^i(\underline{\mathbf{h}}^*_i, \underline{\mathbf{h}}^*{}_{-i}) \leq 0$$

where the first inequality is implied by the fact that $U^i_{c_i}$ is non-decreasing in $\mathbf{h}_{-N^+}$ (see the proof of Lemma 1), the second inequality is implied by A2 and the last one by optimality of $\underline{\mathbf{h}}^*$. Hence,

$$U^i(\underline{\mathbf{h}}^*{}_{N^+}, \mathbf{h}_{-N^+}) \geq U^i(\mathbf{h}) \quad , \quad \forall i \in N$$

Finally, Suppose that $||N^+(\mathbf{h})|| > 0$. Then, by hypothesis there exist some $i \in N^+$ and $j \in N$ such that $i \in N(j)$ and therefore $U^j(\underline{\mathbf{h}}^*_{N^+}, \mathbf{h}_{-N^+}) > U^j(\mathbf{h})$. Hence, a necessary condition for a strategy profile $\mathbf{h}$ to be a Pareto optimum is that $||N^+(\mathbf{h})|| = 0$. Since from the compactness of H^n and continuity of U^i we know that at least a Pareto optimum exists, all of them must be contained in $[0, \underline{\mathbf{h}}^*]$.■

COROLLARY 3 *Consider a game Σ where for every $i \in N$ there exists $j \in N(i)$ such that $U^i_{c_j} < 0$. Let $\underline{\mathbf{h}}^*$ be the smallest equilibrium. Then,*

i) $\underline{\mathbf{h}}^*$ is the only equilibrium which can be a Pareto optimum,

ii) if $\underline{\mathbf{h}}^* > 0$ then $\underline{\mathbf{h}}^*$ is not a Pareto optimum,

iii) if $\underline{\mathbf{h}}^* = 0$ then $\underline{\mathbf{h}}^*$ is the unique Pareto optimum.

Proof. Corollary follows from Proposition 7 and Proposition 8.■

Together, Proposition 7 and 8 tell us that, if everyone is comparing herself with someone in her neighbourhood, then all equilibria are Pareto inefficient unless part of the population is not working and consuming at all. The intuition is the following. As long as in equilibrium there are two individuals who interact with each other and have positive consumption (work time), the welfare of both – and possibly of others they interact with – can be improved by slightly reducing their consumption (work time). This is because, in equilibrium, the cost of consuming less and the benefit of a greater leisure offset each other, while the smaller negative externalities of consumptions provide additional benefits. Hence, this situation cannot be a Pareto optimum.

Notice that the assumption that zero is the least possible supply of labour plays a minor role. A qualitatively similar outcome would be obtained by replacing the lower bound of any individual's strategy space with a positive number. The major point

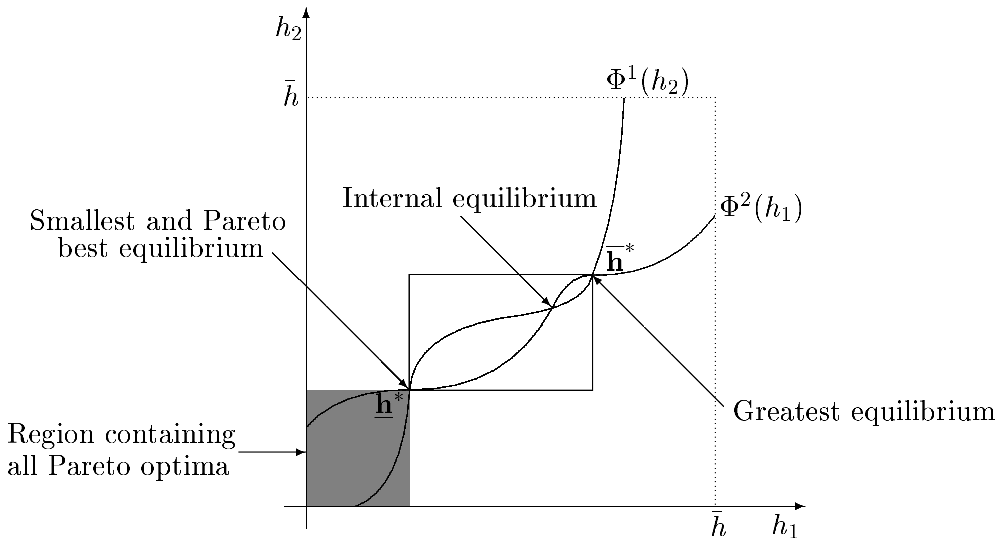

Figure 3.9. An example where population is made of two individuals, i.e. $N \equiv \{1, 2\}$, and there are three equilibria. The graphs of Φ^1 and Φ^2 represent, respectively, the best reply of individual 1 to individual 2's choice of labour supply and viceversa. Point $\underline{\mathbf{h}}^*$ is the smallest and Pareto best equilibrium while point $\overline{\mathbf{h}}^*$ is greatest equilibrium. The interval $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ clearly contains the inner equilibrium.

is, instead, about interpretation. If people cannot reduce their consumption below a certain level, say $\underline{c}$, then of course welfare improvements cannot be obtained by making people work less than $\underline{h}_i = \underline{c}/w_i$. For instance, if consuming below $\underline{c}$ makes people starve, then we can normalize the strategy space by assuming that $\underline{c} = 0$ (and, hence, that $\underline{h}_i = 0$). Below $\underline{c}$ there is nothing interesting to be said and, in particular, nothing interesting about the implications of the quest for status. On the contrary, if consuming below $\underline{c}$ does not make people starve, then the normalization $\underline{c} = 0$ is legitimate only if social comparison can reasonably be neglected for $c < \underline{c}$. What really matters about the lower bound $\underline{c}$ is its nature and not its value. For any lower bound that is greater than both the subsistence level and the level of consumption from which social comparison motives begins to work is clearly not suited for this model and leads to incorrect interpretations of results.

Summing up, the results suggest that the concern for social status may trap society in a Pareto inferior situation characterized by too much work and too much consumption. This may cast doubts about the policy target of GDP growth. In fact, a higher GDP does not imply a higher welfare even in the case everyone consumes strictly more than before. The negative externalities produced by social comparison may well erode the benefits of a greater consumption. Actually, it may turn out that an exogenous intervention capable of reducing everybody's consumption – and thereafter maintain it at a lower level – is welfare improving. This suggests a reconsideration of policies oriented to regulating consumption and working time as well as to helping the self-organization of consumers and workers in unions with a similar aim. It must be noted, however, that the model does not suggest that either consumption or labour supply should be as small as possible. In fact, if $\underline{\mathbf{h}}^* \neq 0$ then $\mathbf{h} = 0$ is not, in general, a Pareto optimum.

3.3.2 Some Further Comments on the Nature of Results

It has been shown that the quest for status produces a social behaviour that can jointly stimulate the supply of labour and offset the benefits of a greater consumption. On this basis, one could argue that the so called "positional treadmill" provides a good explanation of the stylized facts briefly illustrated in the introduction, i.e. the scarce increase of reported well-being and the scarce reduce of work time in spite of a huge income growth.

However, before any tentative conclusion is drawn in this regard, a further relevant aspect of the issue must be investigated. Both happiness and work time trends are about a period of human history during which industrialized countries experienced, on average, a substantial productivity and earnings growth. In order for the model described here to be compatible with such a situation, the results illustrated so far must be consistent with a generalized wage growth. More precisely, a generalized wage growth must not induce a work time reduction or a welfare growth. Let first go through the issue of work time trends. Define the wage of the generic individual i as $w_i \equiv \sigma_i \lambda$, where σ_i represents i's individual characteristics and λ represents the general level of productivity. To see how an increase of λ affects the set of equilibria we must look at how the marginal utility of work time varies with respect to λ. By Theorem 3, we know how the "box" $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ changes depending on the sign of the following

$$\frac{\partial^2 U^i}{\partial h_i \partial \lambda} = \sigma_i \left[U^i_{c_i} + \sigma_i h_i \left(\lambda U^i_{c_i c_i} - U^i_{l_i c_i} \right) \right] + \sum_{i \neq j} \sigma_j h_j U^i_{c_i c_j} \tag{3.6}$$

More precisely, if (3.6) is non-negative (positive) for any $i \in N$ then the smallest and the greatest equilibrium are non-decreasing (increasing) in λ; otherwise, if (3.6) is non-positive (negative) for any $i \in N$ the smallest and the greatest equilibrium are non-increasing (decreasing) in λ.

In principle, there are no reasons to expect that (3.6) is either positive or always negative for any $i \in N$. It may be positive for some individual while it may be negative for someone else. It might also be the case that, for the same individual, (3.6) is positive for certain values of $\mathbf{h}$ and λ and negative for other values. Hence, nothing conclusive can be said without more information about people's preferences. This implies that the hypothesis of social comparison by itself does not imply any specific prediction about work trends in the presence of a generalized wage growth. Consequently, the model is trivially compatible with the data.

Nonetheless, there is a minor explanatory advantage of the social comparison approach with respect to a theory which focuses on absolute consumption only. The presence of the extra term $\sum_{i \neq j} \sigma_j h_j U^i_{c_i c_j}$ allows for (3.6) to be persistently non-negative also under the assumption that $U^i_{c_i c_i} < 0$ and $U^i_{l_i c_i} > 0$. In other words, strategic complementarities in consumption can, in principle, indefinitely offset both the reduction of $U^i_{c_i}$ and the increase of $U^i_{l_i}$ due to a greater absolute consumption. This is is especially relevant because both $U^i_{c_i c_i} < 0$ and $U^i_{l_i c_i} > 0$ are quite reasonable assumptions.

Let now move our attention to the effects that a greater λ has on welfare. Other things being equal, the marginal impact on the generic individual i is given by

$$\frac{\partial U^i}{\partial \lambda} = \sigma_i h_i U^i_{c_i} + \sum_{i \neq j} \sigma_j h_j U^i_{c_j} \tag{3.7}$$

Recent estimations about the magnitude of welfare effects due to a greater income suggest that, on average, $U^i_{c_i} = -\sum_{i \neq j} U^i_{c_j}$ (Ferrer-i-Carbonell (2005), Stutzer (2004), Luttmer (2005)). If we accept this, then (3.7) becomes

$$\frac{\partial U^i}{\partial \lambda} = \sum_{i \neq j} U^i_{c_j} \left(\sigma_j h_j - \sigma_i h_i \right) \tag{3.8}$$

which suggests that, *ceteris paribus*, a generalized wage increase makes some people better off and some others worse off. In particular, high-skilled/hard-working people are more likely to benefit since they are more likely to increase their social status.[11] A further important aspect enlightened by expression (3.8) is that it can make a substantial difference whether people are upward-looker or downward-looker in comparing themselves with neighbours. For instance, if people are upward-looker then most weight (in terms of the $\{U^i_{c_j}\}_{j \in N(i)}$) is given to individuals showing a high value of $\sigma_j h_j$, with a depressing effect on the overall value of (3.8). The opposite is true if people are downward-looker.

However, the study of (3.8) can only tell us what happens under the *ceteris paribus* hypothesis. The ultimate welfare outcome of a generalized wage increase also depends on how people adjust their labour supply. Therefore, nothing conclusive can be said in this regard too and the model is, again, trivially consistent with the data. On the one hand, this is a good news because it shows that there are no logical incompatibilities between a theory based on social comparison and the

[11] Actually, any individual i who only interacts with individuals of the type j such that $h_j \sigma_j > h_j \sigma_j$ is certainly better off. On the contrary, any individual i who only interacts with individuals of the type j such that $h_j \sigma_j < h_j \sigma_j$ is certainly worse off.

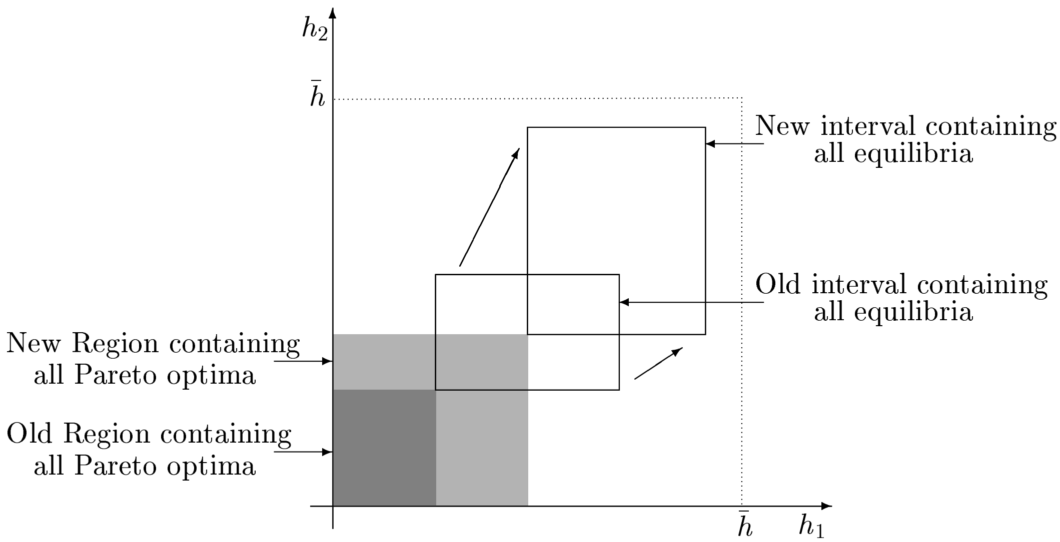

Figure 3.10. An example where population is made of two individuals and the minimum interval containing all equilibria moves upward. As a result the region where Pareto optima can fall enlarges.

empirical evidence. On the other hand, one could argue that it is also bad news because a theory which can accommodate many different empirical facts is rather uninformative.

Actually, this is not entirely disappointing from a theoretical perspective. In the first place, it must be recognized that in a theory where people care only about absolute income and leisure a generalized wage growth implies a welfare improvement for everybody. This puts the social comparison approach in a better position with respect to a theory which focuses on absolute consumption only. In the second place, a model which gives a sharp prediction about welfare or work time trends under the very general assumptions made here would be unsatisfactory. In fact although there is evidence that, in spite of the dramatic productivity and income growth of the last fifty years, reported well-being improved, if any, only slightly and work time reduced, if not increased, only slightly, it would be an exaggeration to claim that this is the unavoidable consequence of people's quest for status. We are still not sure about the evolution of people's well-being since two or more centuries ago while work time certainly rose during the the industrial revolution and then reduced until the mid of the last century (Kenny (2006), Huberman (2004), Voth (1998)). Most likely, the quest for status leads to different outcomes in different social and economical context (high/low social mobility, upward/doward looking, etc). In conclusion, the relevance of the social comparison approach lies in that it provides a theoretical framework where the traditional wisdom that more productivity implies more consumption, that in turn implies more welfare, is no longer true.

Finally, there are two relevant issues which are worth mentioning but that cannot be satisfactorily investigated at this level of generality. The first is the distance between equilibria and Pareto optimal profiles. This is important because it tells us how distant are equilibria from Pareto optima and, hence, it gives us an idea of how much consumption and labour supply should be reduced in order to move society to a Pareto optimum. The second is the size of the welfare gap between equilibria and Pareto optima. This probably is even more relevant because it gives a measure of the welfare loss due to social comparison. Unfortunately, in both cases much depends on the specification of $\{U^i\}_{i \in N}$ which determines the actual position of $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$, the number and position of Pareto optima in $[0, \underline{\mathbf{h}}^*]$ and the welfare gaps between the former and the latter. Again, little can be said without more information about people's preferences that, I believe, can only come from empirical research.

3.3.3 The Structure of Interactions

A society's interaction structure is a shorthand to indicate the actual pattern of interactions among individuals. Interest about the interaction structure stems from the fact that it may take a variety of forms and it is not always evident how – and to what extent – different interaction structures affect the outcome of social comparison. For instance, people living in the city meet other people more frequently and more randomly with respect to those living in the countryside. Therefore, it may be important to know whether frequency and randomness of interactions have some effect on the consequences of social comparison. Since the interaction structure may also depend on the type of job one has, the labour market may be relevant too. More precisely, if the interaction structure affects comparisons, then we may expect the distribution of employees among jobs to have an impact on the concern for status. Technology is not less important. In recent times technical progress has been responsible – at least in countries with a high GDP per capita – for a drastic change in the way individuals interact with each other. With the advent of telecommunications, a new variety of ways to gather information about others becomes available and, potentially, new ways of comparing social statuses.

A full analysis of the role played by the interaction structure requires the development of a model which can account for the richness of the topological characteristics of social interactions. This goes beyond the scope of the present paper and it is left for further research. As a first step in this direction, however, I illustrate a few basic results about a single aspect of the issue. Although there is not yet much empirical research in this field, some recent studies suggest that the way people compare themselves with other individuals is affected by the structure of their interactions in at least two ways (Stutzer (2004), Luttmer (2005), Carlssona et al. (2005)). First, if people interact more frequently with a particular group of individuals, it is likely that such group have a larger influence on reference income. Second, the frequency of interactions seems to positively affect the marginal utility of relative income. Reasonably, interacting with more people – or more frequently with the same people – makes status matter more because there are more circumstances in which one's relative position comes into play. In the remaining part of this subsection, I focus on the latter aspect.

The idea that the number of interactions may affect how much people care about their social status can be rationalized as follows. Suppose that an individual interacts with other individuals for some reason (socializing, exchanging information, etc.) but, whenever she interacts with someone, she also compares her social status by looking at how much the other consumes with respect to her. Two extreme and opposite cases exists. First, individuals may benefit or lose from each comparison independently of the number of comparisons they do. This implies that more interactions make the status matter more because status is an "asset" whose services grant benefits in a greater number of situations. This is refered to as *one-to-one-comparison*. Second, people may compare their consumption with an average of the consumption of individuals they interact with. This instead implies that the concern for status does not vary – as long as such average remains the same – with the number of interactions because, in practice, there is just one comparison to be done. This is referred to as *group-comparison*. Besides, there is a continuum of situations which are inbetween these two extremes. Individuals may benefit or lose from each comparison but not independently of the number of comparisons they do. Thus, on the one hand a greater number of comparisons reduces the benefits and losses that people sustain for each of comparison because the consumption of each peer matters less but, on the other, more interactions still imply a greater total amount of benefits and losses accruing from comparisons and, therefore, a greater concern for status. This case is referred to as *peer-comparison*.

Let me characterize more precisely the cases just described. In order to do this, however, the model must be first enriched by allowing individuals to interact with other individuals at different levels of intensity. This is done by giving the possibility to an individual to interact with another individual more than once. Then, the number of interactions is naturally interpreted as the intensity of interaction. Let $q^i(j)$ be the number of times i interacts with j. Denote by N^∞ the set containing the infinitely and countably many replicas of each element of N, where every infinite series of replicas of each $i \in N$ is sub-indexed according to natural numbers. Define

$N^{\infty}(i)$ as the set containing all $j_k \in N^{\infty}$ such that $j \in N(i)$ and $0 < k \leq q^i(j)$. Therefore, $N^{\infty}(i)$ contains as many elements as i's total number of interactions and as many replicas of each $j \in N(i)$ as the number of times i interacts with j. Furthermore, since people cannot sustain an infinite number of interactions, $N^{\infty}(i)$ is assumed to be finite for any $i \in N$, with n_i^{∞} denoting its cardinality. For the sake of exposition, it is also assumed that A3 holds with strict inequality. Therefore, by a neighbour of i it is now meant someone with whom i effectively compares herself (instead of someone with whom i potentially compares herself).[12] Finally, denote with Σ^{∞} the version of a game Σ which allows for multiple interactions with the same individual.

Utility function U^i is said to satisfy *peer-comparison* if and only if

$$N'^{\infty}(i) \subset N^{\infty}(i) \Rightarrow \sum_{j_k \in N^{\infty}(i)} U^i_{c_i c_{j_k}}(\mathbf{c}, \mathbf{l}, N^{\infty}(i)) > \sum_{j_k \in N'^{\infty}(i)} U^i_{c_i c_{j_k}}(\mathbf{c}, \mathbf{l}, N'^{\infty}(i)) \quad (3.9)$$

The property of one-to-one-comparison is a special case of peer-comparison. It is obtained when (3.9) holds and, in addition, $U^i_{c_i c_{j_k}}(\mathbf{c}, \mathbf{l}, N^{\infty}(i)) = U^i_{c_i c_{j_k}}(\mathbf{c}, \mathbf{l}, N'^{\infty}(i))$ whenever $j_k \in N^{\infty}(i) \cap N'^{\infty}(i)$. Moreover, individuals are said to be *group-comparer* when the relationship between the right-hand side and the left-hand side of the inequality in (3.9) only depends on the relationship between (some kind of) average consumption of people in $N(i)$ and $N'(i)$ and on the collections $\{q^j(i)\}_{j \in N(i)}$ and $\{q^j(i)\}_{j \in N'(i)}$.[13,14]

Let me refer to $G(N) \equiv \{N(i)\}_{i \in N}$ as the qualitative representation of the interaction structure and to $G^{\infty}(N) \equiv \{N^{\infty}(i)\}_{i \in N}$ as the quantitative one. An individual $i \in N$ is said to be a *global term of comparison* if and only if the qualitative

[12] Without this assumption it would be required to specify that the considered neighbours are those for which A3 holds with strict inequality, making notation unnecessarily heavy.

[13] I do not provide a more precise definition of *group-comparison* because it is not needed for the analysis and it would require to get involved in the issue of how group-comparers average over the consumption of their neighbours depending on $\{q^j(i)\}_{j \in N(i)}$ and $\{q^j(i)\}_{j \in N'(i)}$.

[14] Implicitly it is assumed that the number of interactions does not affect marginal utility of leisure.

interaction structure G is such that for any $j \in N \setminus \{i\}$ there is a finite sequence of individuals $\{k_l\}_{l=1}^m$ such that $k_1 = i$, $k_m = j$ and $k_l \in N(k_{l+1})$ for $1 \leq l < m$. Moreover, a population N is said to be *strongly connected* if and only if every $i \in N$ is a global term of comparison.

The following statements illustrate a case where the number of interactions has an effect on consumption and welfare.

PROPOSITION 9 *Consider a game Σ^∞ and suppose that there exists $P \subseteq N$, $P \neq \emptyset$, such that any $i \in P$ is a peer-comparer. Then, $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is non-decreasing and non-constant in n_j^∞, $j \in P$. Moreover, if some $j \in P$ is a global term of comparison, then $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is increasing in n_j^∞.*

Proof. By hypothesis, $U_{c_j}^j$ is increasing in n_j^∞ for any $j \in P$. Moreover, since $G^\infty(N) \setminus N^\infty(j)$ is independent of n_j^∞, $U_{c_i}^i$ is non-decreasing in n_j^∞ for any $i \neq j$. Therefore, by Lemma 1 follows that, for any $\mathbf{h} \in H^n$, i) $\inf \Phi_i(\mathbf{h}_{-i})$ and $\sup \Phi_i(\mathbf{h}_{-\mathbf{i}})$ are non-decreasing in n_j^∞ for any $i \neq j$ and ii) $\inf \Phi_j(\mathbf{h}_{-j})$ and $\sup \Phi_j(\mathbf{h}_{-j})$ are increasing in n_j^∞ for any $j \in P$. In addition, by Lemma 2 we have that $\underline{\mathbf{h}}^* = (\inf \Phi_1(\underline{\mathbf{h}}^*{}_{-1}), ..., \sup \Phi_n(\underline{\mathbf{h}}^*{}_{-n}))$ and $\overline{\mathbf{h}}^* = (\sup \Phi_1(\overline{\mathbf{h}}^*{}_{-1}), ..., \sup \Phi_n(\overline{\mathbf{h}}^*{}_{-n}))$. Therefore, the interval $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is non-decreasing and non-constant in n_j^∞.

Suppose that some $j \in P$ is a global term of comparison. Consider a generic individual $i \in N$. Since j is a global term of comparison, then there exists a finite sequence of individuals $\{k_l\}_{l=1}^m$ such that $k_1 = j$, $k_m = i$ and $k_l \in N(k_{l+1})$ for $1 \leq l < m$. Take the individual k_{l+1}. Since $k_l \in N(k_{l+1})$ by A3 (holding with strict inequality) and Lemma 1 follows that both $\inf \Phi_{k_{l+1}}$ and $\sup \Phi_{k_{l+1}}$ are increasing in h_{k_l}. As already shown, $\underline{h_j}^*$ and $\overline{h}_j^*$ are increasing in n_j^∞. Therefore, by Lemma 2 follows that $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is increasing in n_j^∞.■

COROLLARY 4 *If population N is strongly connected and $j \in N$ is a peer-comparer, then $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is increasing in n_j^∞.*

Proof. Corollary follows from Proposition 9 once it is noted that in a strongly connected population every agent is a global term of comparison.■

The intuition behind Proposition 9 is very simple. If a peer-comparer interacts more intensely – either more times with the same people or with more people – then her concern for status increases and therefore she finds it convenient to consume and work more. As an effect of this, people who compare themselves with such peer-comparer find their status reduced. Hence, they increase their consumption and work time independently of whether they are peer-comparers or not. This, in turn, pushes the people who interact with the latter individuals to increase their consumption and work time too, and so forth. If the peer-comparer considered at the beginning is a global term of comparison, then this type of cascade effect extends to the whole population.

For what concerns welfare, it must be noted that individuals who choose to increase their consumption – beside the peer-comparer – take this decision only because some of their peers have increased theirs. Therefore, they end up being worse off. Moreover, if some of the neighbours of the peer-comparer are affected too, then it is possible that the peer-comparer finds herself consuming and working more than she initially found convenient (this is certainly the case if, for instance, some of the individuals affected are a a global term of comparison). Hence, it may happen that the peer-comparer ends up being worse off too.

Therefore, whenever there are peer-comparers in the population, the number of interactions can have an impact on the concern for status and, as a consequence, on individuals' consumption, work time and welfare. It might be argued, however, that in reality only very few individuals are peer-comparers because the kind of preferences about relative social position that they have are rather extreme: peer-comparers are the kind of people who compete with more intensity when they interact with more people or with the same people but more often. In any case, Proposition 9 and Corollary 4 tell us that even very few of them may be sufficient to trigger a self-reinforcing mechanism which pushes most people to consume and work more, provided that population is well connected. In particular, when the number of interactions is greatly increased for everybody – as happened since the beginning of industrialization and urban life – we expect this cascade effect to be irrelevant only if peer-comparers are totally absent or completely disjoined from the rest of society.[15]

Furthermore, in the presence of peer-comparers the number of interactions affects the consequences of a generalized increase of wages. Indeed, from expression (3.6) it is evident that, if i is a peer-comparer, then i's marginal utility of work is increasing in the number of interactions. Therefore, the greater the number of i's interactions, the more likely that i reacts to a generalized wage increase by consuming and working more. This in turn increases the likelihood that the individuals who interact with i react by consuming and working more, because it is more likely that their statuses are reduced by i's choice. For the same reason, the people with whom the latter interact are more likely to react by consuming and working more, and so on. In this case too there is a sort of cascade effect, although this time it is in terms of the likelihood to increase consumption. The magnitude and dimension of the propagation depend on how people are connected among themselves or, more precisely, on how many people interact with the peer-comparer i, how many people interact with those who interact with i, etc.

In the extreme situation where everyone is a peer-comparer, we obtain that expression (3.6) is increasing in the number of interactions for everybody. Therefore, there always exists a number of per capita interactions which induces everybody to react to a generalized wage increase by consuming and working more. Such a diffusion of peer-comparers, however, is not necessary for this result. Actually, a weaker condition is sufficient: the extra marginal utility of consumption given

[15]Schor (1992, 1998, 2004, 2000) points out that the number of comparisons carried out by people may have been greatly increased by television watching.

by any additional interaction must be bounded away from zero for everybody. In fact, as long as such a condition is satisfied, by increasing everybody's number of interactions we must eventually obtain that (3.6) is positive for any $i \in N$. This idea is captured by the following property.

The utility function U^i satisfies *ϵ-peer-comparison* if and only if for any $N^\infty(i) \subset N^\infty$ there exists $\epsilon > 0$ such that, for any $j_k \in N^\infty(i)$, $U^i_{c_i c_{j_k}} > \epsilon$. The following proposition formalizes the result.

PROPOSITION 10 *Consider the family of games $\Sigma^\infty(\{N^\infty(i)\}_{i\in N})$ where the wage $w_i = \sigma_i \lambda$ for any $i \in N$. If U^i satisfies ϵ-peer-comparison for any $i \in N$, then there exists a number $\bar{n}^\infty(\lambda)$ such that any game in $\Sigma^\infty(\{N^\infty(i)\}_{i\in N})$ satisfying $n_i^\infty \geq \bar{n}^\infty(\lambda)$ for any $i \in N$, has the property that $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is marginally increasing in λ.*

Proof. Consider (3.6). Since the strategy set H^n is compact and U^i is twice continuously differentiable, the term $\sigma_i \left[U^i_{c_i} + \sigma_i h_i \left(\lambda U^i_{c_i c_i} - U^i_{l_i c_i}\right)\right]$ has a lower bound for any given λ. Let $\underline{b}_i(\lambda)$ be such a bound for individual i. Define $\underline{b}(\lambda) \equiv \min_{i\in N} \underline{b}_i(\lambda)$. Since every individual is an ϵ-peer-comparer, if $n_i^\infty > -\underline{b}(\lambda)/\epsilon$ then (3.6) is positive. Hence,

$$\bar{n}^\infty(\lambda) = \max_{i\in N} \left(-\frac{\underline{b}(\lambda)}{\epsilon}\right) + 1$$

which concludes the proof.■

If we look at society as a network of relationships then we understand that – if people's concern about peer-comparisons does not vanish for large numbers of interactions – when the network gets larger and denser it becomes more and more likely that individuals react to a generalized increase in real wages by increasing both consumption and the supply of labour.

Let me put in evidence some important things about this result. First, it holds even if we have that $w_i' > w_i$ implies $\inf \Phi^i(\underline{\mathbf{h}}^*{}_{-i}, w_i) > \inf \Phi^i(\underline{\mathbf{h}}^*{}_{-i}, w_i{}')$ and $\sup \Phi^i(\overline{\mathbf{h}}^*{}_{-i}, w_i) > \sup \Phi^i(\overline{\mathbf{h}}^*{}_{-i}, w_i{}')$ for any $i \in N$. In other terms, it holds even if people best respond to an individual increase of their real wage by lowering the boundaries of their set of optimal choices.

Second, although the requirement of ϵ-peer-comparison is not much restrictive in itself – because ϵ can be very small – the argument applied in Proposition 10 assumes that the number of per capita interactions is not bounded above. Actually, this may not be the case. When ϵ is very small $\bar{n}^{\infty}$ can be very large, possibly so large that nobody can sustain such a number of interactions. Hence, Proposition 10 can tell us something about reality only if it is implicitly presumed that either ϵ is not very small or individuals are able to sustain a quite large number of interactions. This suggests that technology might have a crucial but subtle role. Technical progress – and in particular the recent development of information technologies – may be increasing the potential of interactivity and, hence, allowing the number of interactions to be as many as $\bar{n}^{\infty}$ even for small a ϵ.

Finally, it is unclear what are the welfare implications of an increase in the number of interactions. The reason is that no assumption has been made about the welfare impact of comparing oneself with more people (one can either benefit, suffer or being indifferent to the number of interactions itself). So, even supposing that we know the welfare impact of the increased competition for status, cannot establish the total welfare consequences.

3.4 Dynamics

So far investigation has been carried out in a static framework with equilibrium analysis having no reference to dynamics. However, the focus on equilibrium – as well as the application of comparative statics – is justified only if we expect convergence to take place. In particular, since multiple equilibria are possible, even if convergence is assured the actual equilibrium outcome may depend on initial conditions and, therefore, the identification of basins of attraction is of particular interest.

In order to discuss the dynamics of consumption and leisure in the presence of social comparison, we have to enrich the model by allowing for a temporal structure and to specify how consumers take their decisions and which information are in their possession. For this purpose, it is assumed that the game Σ is repeatedly played over an infinite period of time and consumers are informed about some of the last choices of their neighbours.[16]

Furthermore, since individuals are supposed to try to get what they believe is the best outcome, we need a mechanism of beliefs formation – i.e. a mechanism which tells us what people learn from the information they have – plus an idea of how good people are at best replying to their current beliefs – i.e. a presumption about how people are good at exploiting what they have learned. This two aspects of decision-making are jointly referred to as the *learning process*.

By looking at the characteristics of the phenomenon under consideration, some desirable features of the learning process can be identified. Cognitive limitations and social factors are likely to be responsible for idiosyncrasies and inertia in individuals' consumption decisions. Consumers may act responding to some sudden desire, without evaluating the effects of their choices. They may follow some customary rule which turned out to be useful in the past, even if it is no longer such. They may also imitate the decisions of some individuals simply because they are best considered among their kin, although this does not necessarily improve their social position. In other terms, consumers may not only have wrong beliefs about others' intentions but they might also take decisions which sensibly differ from what is optimal on the basis of their actual beliefs.

However, wrong choices and wrong beliefs are not likely to last forever. Indeed, it

[16]The results illustrated in this section hold for Σ^{∞} too.

seems plausible that, sooner or later, consumption choices which are extremely disadvantageous must be discarded. The speed at which this takes place characterizes the relative importance of cognitive limitations and social factors with respect to the benchmark case of best responding and correct forecasting. Notice that such relative importance may range, in principle, from almost nothing to very high. Actually, there are consumers who spend a lot of their cognitive resources in deciding what to consume, carefully evaluating each piece of information they have. They always search for new information, accurately monitor the choices of people they interact with. These consumers are also likely to be forward looker, maybe anticipating next year's fashion or guessing future trends in consumption levels.

3.4.1 The Milgrom-Roberts Sophisticated Learning

In the light of what argued so far a suitable learning process should be rather general because it should be capable of accommodating different plausible specifications. More precisely, we look for a kind of best-reply process which satisfies the following desiderata

D1.) beliefs are formed taking into account information about past choices,

D2.) neither the exact way in which beliefs are formed nor how actual selection happens in the set of feasible replies are specified,

D3.) there is a finite adjustment time during which non-best replies may be chosen,

D4.) beliefs formed on the basis of observed choices can also be about others' beliefs – of any order – introducing the possibility of anticipating others' decisions.

Desideratum D1 establishes the source of information which individuals' use to form their beliefs, desideratum D2 requires the process to be little specified as to take into account a variety of beliefs formation mechanisms, desideratum D3 allows for temporary wrong replies and desideratum D4 introduces the possibility of forward looking behaviours.

Since desiderata D1-D4 allow for a huge variety of actual behaviours, one hardly expects that any learning process satisfying them guarantees convergence to equilibrium. Indeed, in general convergence is not assured. However, for the case of supermodular games, Milgrom and Roberts (1991) proved convergence to the "box" of equilibria for a class of learning processes which is consistent with D1-D4, namely MR-sophisticated-learning (see Definition 2 in Appendix 3.5).[17]

Hence, for the model described in Section 3.2 we obtain the following.

COROLLARY 5 *Consider a game Σ and suppose that $\{\mathbf{h}(t)\}$ is a process on Σ. If individuals are consistent with MR-sophisticated learning, then* $\liminf(\mathbf{h}(t)) \geq \underline{\mathbf{h}}^*$ *and* $\limsup(\mathbf{h}(t)) \leq \overline{\mathbf{h}}^*$ *where $\underline{\mathbf{h}}^*$ and $\overline{\mathbf{h}}^*$ are respectively the smallest and greatest equilibrium.*

Proof. Since Σ is a supermodular game, Corollary follows by direct application of Theorem 5.■

Corollary 5 tells us that, if individuals are consistent with MR-sophisticated learning, in the limit the system necessarily gets to $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ starting from any initial profile of labour supplies. Therefore, individuals' consumption and leisure converge to $[(\underline{\mathbf{c}}^*, \underline{\mathbf{l}}^*), (\overline{\mathbf{c}}^*, \overline{\mathbf{l}}^*)] \subseteq \Re^n_+ \times H^n$, where $\underline{c}_i^* = w_i \underline{h}_i$, $\underline{l}_i^* = \overline{h} - \underline{h}_i$ and similarly for $\overline{c}_i^*$, $\overline{l}_i^*$. This result is extremely relevant because MR-sophisticated-learning is a very general learning process, which gives much robustness to the findings of Section 3.3.

COROLLARY 6 *Consider a game Σ and suppose that $\{\mathbf{h}(t)\}$ is a process on Σ. Let $\overline{\mathbf{h}}^*$ and $\underline{\mathbf{h}}^*$ be respectively the smallest and the greatest equilibrium. If i) for every $i \in N$ there exists $j \in N(i)$ such that $U^i_{c_j} < 0$, ii) $\underline{\mathbf{h}}^* > 0$ and iii) $\{\mathbf{h}(t)\}$ is*

[17] More precisely, Milgrom and Roberts (1990) proved convergence for MR-adaptive learning and Milgrom and Roberts (1991) for MR-sophisticated learning (see Appendix 3.5).

consistent with MR-sophisticated learning, then as t *goes to infinity* $\mathbf{h}(t)$ *converges to an interval of Pareto inefficient strategy profiles. In particular, for every* $\mathbf{h} \in [\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ *every* $i \in N$ *can be made better off by some* $\mathbf{h}' < \mathbf{h}$.

Proof. Corollary follows by Corollary 5, Proposition 7 and Proposition 8.■

By Corollary 6 we see that, in a broad range of situations, we should expect consumers' decisions to gravitate in a Pareto inefficient region characterized by too much work and too much consumption.

3.4.2 Comparative Statics and the Problem of Indeterminacy

A remark about the dynamics inside the interval $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is necessary. Since MR-sophisticated learning eventually prevents individual only from selecting strongly dominated strategy profiles which are not in any interval whose extremes are undominated strategy profiles, it cannot be excluded that, inside $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$, the system cycles indefinitely without ever persisting in any equilibrium.

It is easy to see why a weak Nash equilibrium cannot be a rest point of the dynamics. If $\mathbf{h}^*$ is a weak Nash equilibrium then there exists some individual $i \in N$ who is indifferent between playing h_i^* and some other strategy $h_i \in [\underline{h}_i^*, \overline{h}_i^*]$. Therefore, since h_i is among i's undominated strategies with respect to $\mathbf{h}_{-i}^*$, then $\overline{D}(\mathbf{h}^*)$ contains other strategy profiles besides $\mathbf{h}^*$ and, hence, the system can move away from $\mathbf{h}^*$.

However, also a strict Nash equilibrium may not be a rest point as showed by the following example. Suppose there are only two consumers, 1 and 2, and two equilibria $\mathbf{h}^{*\prime}$ and $\mathbf{h}^{*\prime\prime}$ where $\mathbf{h}^{*\prime} < \mathbf{h}^{*\prime\prime}$. Suppose also that they are strict Nash equilibria, i.e. $\Phi^1(h^{*\prime}_2) = h^{*\prime}_1$, $\Phi^2(h^{*\prime}_1) = h^{*\prime}_2$ and $\Phi^1(h^{*\prime\prime}_2) = h^{*\prime\prime}_1$, $\Phi^2(h^{*\prime\prime}_1) = h^{*\prime\prime}_2$. By Corollary 5 we know that the system eventually gets to $[\mathbf{h}^{*\prime}, \mathbf{h}^{*\prime\prime}]$ and remains in such an interval. However, due to the presence of inertia and idiosyncrasies, we cannot exclude that – for some finite number of periods – either consumer "wrongly" plays any strategy which is a component of profiles in $[\mathbf{h}^{*\prime}, \mathbf{h}^{*\prime\prime}]$. In particular, consumer 1 can start playing $h^{*\prime}_1$ and then alternate between $h^{*\prime}_1$ and $h^{*\prime\prime}_1$ while consumer 2 can start playing $h^{*\prime}_2$ and alternate between $h^{*\prime}_2$ and $h^{*\prime\prime}_2$. Since $\{h^{*\prime}_1, h^{*\prime\prime}_1\} \subseteq D^1([h^{*\prime}_2, h^{*\prime\prime}_2])$ and $\{h^{*\prime}_2, h^{*\prime\prime}_2\} \subseteq D^2([h^{*\prime}_1, h^{*\prime\prime}_1])$, then "mistakes" last just one period and the cycle which goes from $\mathbf{h}^{*\prime}$ to $\mathbf{h}^{*\prime\prime}$ and back can go on forever. This also shows that he system does not necessarily reach any equilibrium. Indeed, if consumer 2 start playing $h^{*\prime\prime}_2$ instead of $h^{*\prime}_2$, then the cycle goes from $\{h^{*\prime}_1, h^{*\prime\prime}_2\}$ to $\{h^{*\prime\prime}_1, h^{*\prime}_2\}$ and back, never getting to any equilibrium.

Summing up, although the system certainly converges to the "box" identified by the smallest and greatest equilibrium, in its interior it can follow any dynamics ranging from resting in an equilibrium to cycling among non-equilibrium points. Therefore, the exact position of the system inside the "box" is hard to predict with the result that statical analysis about the strategy profiles comprised between the smallest and the greatest equilibrium is greatly impaired. I refer to this problem with the term *indeterminacy*. In the following, I discuss its consequences for the findings illustrated in Section 3.3.

Because of indeterminacy, the equilibrium ranking provided by Proposition 6 is not very informative from a welfare point of view. Although it is true that equilibria characterized by greater consumption and longer work time are less efficient, single equilibria in general do not constitute points towards which the system tends to gravitate. Only the "box" as a whole has such a property. Hence, the characteristics of single equilibria are not particularly important while those of the "box" as a whole are extremely relevant.

Exactly for this latter reason, indeterminacy does not constitute a problem for the results provided by Corollary 3 and, more in general, it does not modify the fact that Pareto optima are hardly attained (Corollary 6). In fact, whatever happens inside $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ we expect inefficiency to arise when all strategy profiles in $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ are inefficient. If anything, indeterminacy strengthens our expectations that Pareto optimality is not obtained because even in the case that the smallest Nash equilibrium $\underline{\mathbf{h}}^*$ is a Pareto optimum, there is no warranty that the system rests there unless it is the only equilibrium.

However, indeterminacy is rather problematic from a comparative statics point of view. Since we cannot establish toward which equilibrium the system gravitates, comparisons of single equilibria associated with different parameter values are meaningless. Suppose that we are interested in the impact of some parameter τ. Suppose also that, at instant t, the system is in equilibrium and labour supplies are equal to $\hat{\mathbf{h}}(\tau') \in [\underline{\mathbf{h}}^*(\tau'), \overline{\mathbf{h}}^*(\tau')]$. If the parameter changes from τ' to τ'', we cannot say where the system will move to because any dynamics in $[\underline{\mathbf{h}}^*(\tau''), \overline{\mathbf{h}}^*(\tau'')]$ is possible in principle. As a consequence, meaningful comparative statics is restricted to comparisons involving the position of the "box" as a whole, leaving aside any effect of parameters which goes beyond the shape of the "box".

In the light of this, Proposition 9, Corollary 4 and Proposition 10 require additional comments. All these statements have the common characteristic of being about the impact of some parameter τ. In particular, they seem to suggests that a different τ induces a greater or lower consumption, work time length and welfare. This interpretation is not correct. Suppose that the "box" increases in the paramenter τ and that there is a change from τ' to $\tau'' > \tau'$. Then, the "box" moves from $[\underline{\mathbf{h}}^*(\tau'), \overline{\mathbf{h}}^*(\tau')]$ to $[\underline{\mathbf{h}}^*(\tau''), \overline{\mathbf{h}}^*(\tau'')]$ where $\underline{\mathbf{h}}^*(\tau') < \underline{\mathbf{h}}^*(\tau'')$ and $\overline{\mathbf{h}}^*(\tau') < \overline{\mathbf{h}}^*(\tau'')$. Can we say that either consumption is greater or work time is longer? No. In order to do so, it must be that $\overline{\mathbf{h}}^*(\tau') < \underline{\mathbf{h}}^*(\tau'')$. For otherwise it is possible that before the increase in τ the system was is some $\mathbf{h}' \in [\underline{\mathbf{h}}^*(\tau'), \overline{\mathbf{h}}^*(\tau')]$ and after it gravitates toward some $\mathbf{h}'' \in [\underline{\mathbf{h}}^*(\tau''), \overline{\mathbf{h}}^*(\tau'')]$ such that $\mathbf{h}' \geq \mathbf{h}''$ (see Figure 3.4.2).[18]

Furthermore, if it is agreed that after the change from τ to τ' an entirely new process starts, then memory is reset and people can choose strategies which move

[18] A solution may be to give some probability distribution to the interval $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ and apply comparative statics in stochastic terms. Under appropriate distributions one can formulate statements of the type "the greater τ, the more likely that people consume and work more".

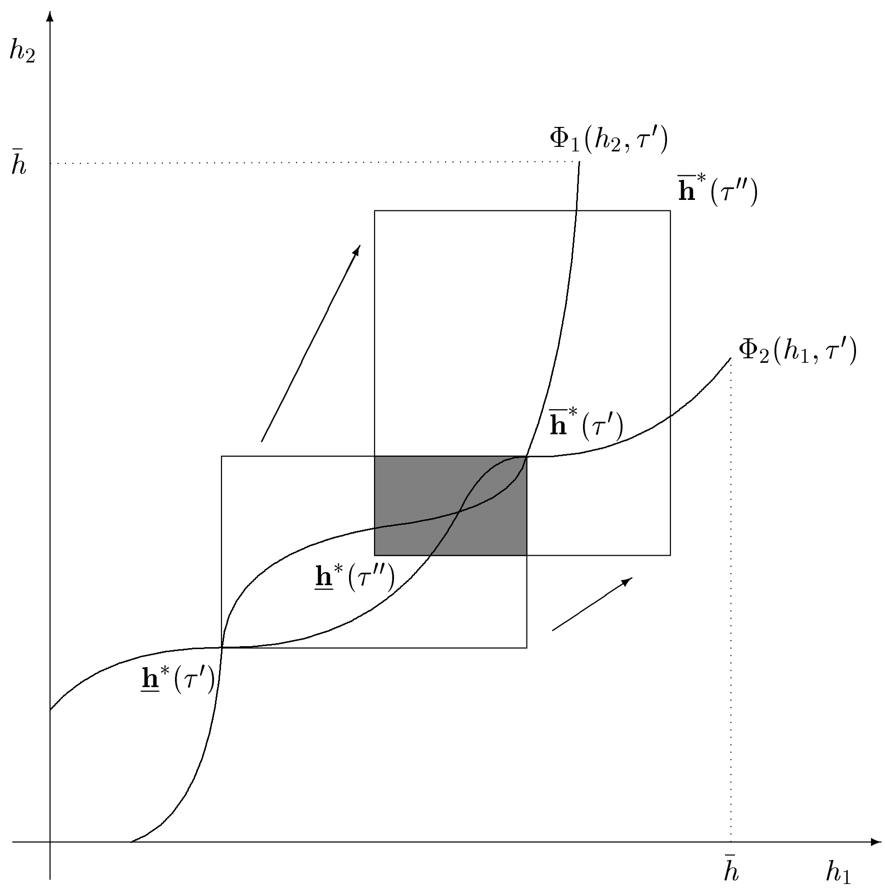

Figure 3.11. Population is made of two individuals, i.e. $N \equiv \{1,2\}$. The interval $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is increasing in τ. When τ' increases to τ'' the interval moves from $[\underline{\mathbf{h}}^*(\tau'), \overline{\mathbf{h}}^*(\tau')]$ to $[\underline{\mathbf{h}}^*(\tau''), \overline{\mathbf{h}}^*(\tau'')]$. Since the region $[\overline{\mathbf{h}}^*(\tau'), \underline{\mathbf{h}}^*(\tau'')]$ is common to both intervals of equilibria we cannot say whether the supply of labour of either 1 or 2 increases or reduces. It could turn out that $\overline{\mathbf{h}^*}(\tau')$ is persistently played under τ'' and $\underline{\mathbf{h}}^*(\tau'')$ under τ' or viceversa or neither case.

the system outside $[\underline{\mathbf{h}}^*(\tau), \overline{\mathbf{h}}^*(\tau)] \cup [\underline{\mathbf{h}}^*(\tau'), \overline{\mathbf{h}}^*(\tau')]$. Therefore, in the case that there exist more than one equilibrium we have no clue about where the system is likely to go. This problem can be overcome by assuming a learning process that, for what concerns out-of-equilibrium dynamics, gives sharper results than MR-sophisticated learning. More precisely, desideratum D3 should be rejected because it is the one responsible for such a difficulty. By allowing for the occurrence of any finite sequence of labour supplies before some "correct" strategy profile is selected, it allows for systematic deviations from any convergent path to $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ to any other convergent path. However, as already pointed out in this section, at least for what regards the choice of consumption and leisure it is not clear which specification should be assumed and, hence, conclusions obtained on the basis of particular presumption about learning mostly have a taxonomical interest.[19]

Finally, there is one case where the problem of indeterminacy can be neglected without relying on extra assumptions about individuals' learning process, namely when there is a unique equilibrium and hence $\underline{\mathbf{h}}^* = \overline{\mathbf{h}}^*$. In such a case we can easily apply the standard comparative statics approach since Corollary 5 assures global convergence to the unique equilibrium.[20]

COROLLARY 7 *Consider a game* $\Sigma \equiv (N, (U^i, N(i), H)_{i \in N}, \geq)$ *and the process* $\{\mathbf{h}(t)\}$ *acting on it. If* Σ *has a unique equilibrium* $\mathbf{h}^*$ *and* $\{\mathbf{h}(t)\}$ *is consistent with MR-sophisticated learning, then as* t *goes to infinity* $\mathbf{h}(t)$ *converges to* $\mathbf{h}^*$*.*

[19] Indeed what we can do, at most, is to investigate what happens under different dynamics in order to make clear which link exists between a given specification and comparative statics results. Along this line of research, for instance, Echenique (2002, 2004) and Echenique and Edlin (2004) have shown that, for a sub-class of MR-adaptive learning which does not satisfy D3 but nevertheless comprises, among others, fictitious play and best-reply dynamics, monotone comparative statics results can be obtained.

[20] In the next chapter an example where equilibrium uniqueness obtains is given.

3.5 Appendix

3.5.1 Supermodular Games: Static Results

With some oversimplification we can say that a supermodular game is a strategic situation where, besides some regularity conditions, there is complementarity among players' strategies. Several economic situation can be represented as a supermodular game as, for instance, Bertrand competition, some types of Counot oligopoly or the Arms Race. The results provided by the literature on supemodular functions on lattices (Tarski (1955), Topkins (1978), Granot and Veinott (1985)) and supermodular games (Topkins (1979), Vives (1990, 2005), Milgrom and Roberts (1990, 1991, 1994), Milgrom and Shannon (1994)) provide powerful analytical instruments which allow to derive strong conclusions from rather weak assumptions.

Actually, many of the results provided here hold under more general conditions. More precisely, the core results does not require convexity/concavity or differentiability assumptions. However, assessing social comparison in such a general framework would impose to introduce several lattice-theoretical results which do not add much to the basic intuition of the analysis. Hence, I will mostly refer to smooth supermodular games which are a particularization of supermodular games where payoff functions are twice continuously differentiable and strategy spaces are subsets of some product order of $\Re$.

Let $\Gamma = \{N, (S^i, \pi^i, i \in N)\}$ be a game in normal form where N is the set of agents and π^i and S^i are respectively agents' payoff functions and strategy spaces. If the strategy spaces S^i come with the partial orders $\geq_i$ which induce a product order $\geq$ on $S \equiv S^1 \times \ldots \times S^n$ such that for every $\mathbf{s}, \mathbf{s}' \in S$ the relation $\mathbf{s} \geq \mathbf{s}'$ holds if and only if we have $\mathbf{s}_i \geq_i \mathbf{s}'_i$ for every $i \in N$, then we say that Γ is a game in *ordered normal form*. If Γ is an ordered normal form game with finitely many players, then it is a *smooth supermodular game* if it satisfies the following

i) $\forall i \in N$, $S^i = [\underline{\mathbf{x}}_i, \overline{\mathbf{x}}_i] \equiv \{\mathbf{x} \in \Re^{k_i} : \underline{\mathbf{x}}_i \leq_i \mathbf{x} \leq_i \overline{\mathbf{x}}_i, k_i \geq 1\}$

ii) $\forall i \in N$, π^i is twice continuously differentiable on S

iii) $\forall i \in N$, $\dfrac{\partial^2 \pi^i}{\partial x_{il} \partial x_{im}} \geq 0$, $1 \leq l < m \leq n$

iv) $\forall i, j \in N$, $j \neq i$, $\dfrac{\partial^2 \pi^i}{\partial x_{il} \partial x_{jm}} \geq 0$, $1 \leq l \leq k_i$ and $1 \leq m \leq k_j$

Conditions i) and ii) impose regularity, namely compactness of the strategy space and smoothness of the payoff function. Conditions iii) and iv) impose strategic complementarity respectively between any pair of strategic variables of each player and between any pair of strategic variables of each pair of players.

The following results apply to smooth supermodular games and will be mostly given without proofs.[21]

THEOREM 2 *Let Γ be a supermodular game. Then, there exists at least one Nash equilibrium. Moreover, all Nash equilibria lie in the interval $[\underline{\mathbf{x}}, \overline{\mathbf{x}}]$ where $\underline{\mathbf{x}}$ and $\overline{\mathbf{x}}$ are respectively the smallest and the largest Nash equilibrium.*

LEMMA 2 *Let Γ be a supermodular where $\underline{\mathbf{x}}$ and $\overline{\mathbf{x}}$ are respectively the smallest and the largest Nash equilibrium. Then, for every $i \in N$, $\underline{x}_i$ is the infimum of the set containing all best replies to $\underline{\mathbf{x}}_{-i}$ and $\overline{x}_i$ is the supremum of the set containing all best replies to $\overline{\mathbf{x}}_{-i}$.*

Theorem 2 assures the existence of at least one Nash equilibrium and, whenever there are more than one, that they are all contained in a compact interval of $\Re^{\sum_{i=1}^n k_i}$ whose extrema are also Nash equlibria. This implies that we can always distinguish a smallest and largest Nash equilibrium in terms of the partial order of the strategy

[21]Milgrom and Roberts (1990) for detailed proofs which exploits Tarsky's fixed point theorem for supermodular functions (Tarski (1955)), Topkin's monotonicity theorem and, for what concerns the smooth version of supermodular games, Topkins sufficient conditions for supermodularity (Topkins (1978, 1979)).

space S. Therefore, every pair of Nash equilibria has both an infimum and a supremum in the set of Nash Equilibria. This allows a certain degree of comparability among Nash equilibria even though the order of S is partial.

A version of Lemma 2 is used by Milgrom and Roberts (1990) to prove Theorem 2. It is reported here because it is applied in a several proofs in text.

THEOREM 3 *Let $\Gamma = \{N, (S^i, \pi^i, i \in N), \tau\}$ be a family of smooth supermodular games parameterized by τ in some partially ordered set T. If $\partial^2 \pi^i / \partial x_{il} \partial \tau \geq 0$ ($\partial^2 \pi^i / \partial x_{il} \partial \tau > 0$) for all $i = 1, \ldots, n$ and $l = 1, \ldots, k_i$, then both the smallest and largest Nash equilibrium are non-decreasing (increasing) function of τ.*

Basically, Theorem 3 states that whenever the payoffs functions of a smooth supermodular game are all increasing in a parameter, then the "box" containing all equilibria moves upward with the parameter.

THEOREM 4 *Let $\Gamma = \{N, (S^i, \pi^i, i \in N)\}$ be a smooth supermodular game. Suppose $\mathbf{y}^*$ is a Nash equilibrium. Then,*

i) if $\dfrac{\partial \pi^i(\mathbf{x}_i, \mathbf{x}_{-i})}{\partial x_{jl}} \geq 0$ for each $\mathbf{x} \in S$, $j \neq i$, $1 \leq l \leq k_j$, then $\pi^i(\mathbf{y}^*) \geq \pi^i(\mathbf{x})$ for all $\mathbf{x} \leq \mathbf{y}^*$,

ii) if $\dfrac{\partial \pi^i(\mathbf{x}_i, \mathbf{x}_{-i})}{\partial x_{jl}} > 0$ for each $\mathbf{x} \in S$, $j \neq i$, $1 \leq l \leq k_j$, then $\pi^i(\mathbf{y}^*) > \pi^i(\mathbf{x}^*)$ for all $\mathbf{x} < \mathbf{y}^*$,

iii) if $\dfrac{\partial \pi^i(\underline{\mathbf{x}}_i, \mathbf{x}_{-i})}{\partial x_{jl}} \leq 0$ for each $\mathbf{x} \in S$, $j \neq i$, $1 \leq l \leq k_j$, then $\pi^i(\mathbf{y}^*) \geq \pi^i(\mathbf{x})$ for all $\mathbf{x} \geq \mathbf{y}^*$,

iv) if $\dfrac{\partial \pi^i(\underline{\mathbf{x}}_i, \mathbf{x}_{-i})}{\partial x_{jl}} < 0$ for each $\mathbf{x} \in S$, $j \neq i$, $1 \leq l \leq k_j$, then $\pi^i(\mathbf{y}^*) > \pi^i(\mathbf{x}^*)$ for all $\mathbf{x} > \mathbf{y}^*$.

Moreover, suppose $\mathbf{y}^*$ and $\mathbf{z}^*$ are two equilibria such that $\mathbf{y}^* \geq \mathbf{z}^*$ ($\mathbf{y}^* > \mathbf{z}^*$). If i) (ii) holds for some subset $N_1 \subseteq N$ and iii) (iv) holds for the remaining $N \setminus N_1$, *then* $\mathbf{y}^*$ *is the most (strictly) preferred equilibrium by individuals in* N_1 *and the least (strictly) preferred by the remaining ones while* $\mathbf{z}^*$ *is least (strictly) preferred by individuals in* N_1 *and most (strictly) preferred by the remaining one.*

Proof. Suppose $\mathbf{y}^* \geq \mathbf{x}$ ($\mathbf{y}^* > \mathbf{x}$) for some $\mathbf{x} \in S$. Statement i) (ii) follows by observing that optimality of $\mathbf{y}^*$ implies $\pi^i(\mathbf{y}^*{}_i, \mathbf{y}^*{}_{-i}) \geq \pi^i(\mathbf{x}_i, \mathbf{y}^*{}_{-i})$ and π^i non-decreasing (increasing) in $\mathbf{x}_{-i}$ implies $\pi^i(\mathbf{x}_i, \mathbf{y}^*{}_{-i}) \geq \pi^i(\mathbf{x}_i, \mathbf{x}_{-i})$ ($\pi^i(\mathbf{x}_i, \mathbf{y}^*{}_{-i}) \geq \pi^i(\mathbf{x}_i, \mathbf{x}_{-i})$). Statement iii) (iv) is proved similarly. Finally, since each statement independently holds for each $i \in N$, the remaining part of the Theorem easily follows.■

Theorem 4 gives a straightforward way to rank equilibria according to agents' preferences. Both Theorem 3 and Theorem 4 are particularly useful in comparative statics exercises.

3.5.2 Supermodular Games: Dynamical Results

The following adaptive process introduced by Milgrom and Roberts (1990) satisfies desiderata D1-D3. Denote by $S^{-i} \subseteq H^{n-1}$ a set of strategies of individuals in $N\backslash\{i\}$. For every individual i, indicate with $D^i(S^{-i}) \subseteq H$ the set of undominated responses of individual i to S^{-i}, that is all i's strategies which are not strictly dominated for $\mathbf{h}_{-i} \in S^{-i}$. Denote by $D(S) \equiv \{h_i \in H : h_i \in D^i(S^{-i})\} \subseteq H^n$ the collection of strategy profiles made of undominated responses. Indicate with $\overline{D}$ the closure of D in $\Re^n$, namely $\overline{D} \equiv [\inf(D(S)), \sup(D(S))]$. Indicate by $\{\mathbf{h}(t)\}$ the process representing how individuals update their behaviour on the basis of past observed choices, where t is time and $T(\bar{t}, \hat{t}) \equiv \{\mathbf{h}(t) : \bar{t} \leq t < \hat{t}\}$ is the collection of choices made between $\bar{t}$ and $\hat{t}$.

Definition 1 (MR-Adaptive Learning)
A process $\{\mathbf{h}(t)\}$ *is consistent with MR-adaptive learning if and only if for every* $\bar{t}$ *there exists* $\hat{t}$ *such that for every* $t \geq \hat{t}$ *we have that* $\mathbf{h}(t) \in \overline{D}([\inf(T(\bar{t}, t)), \sup(T(\bar{t}, t))])$.

Definition 1 embraces a broad class of processes which comprises, among others, both best and better reply dynamics, fictitious play and Cournot *tattonnement*. The type of time is voluntarily unspecified in order to consider both discrete and continuous time processes. Moreover, since the idea is that beliefs are formed on the basis of observed choices but there is little clue about the length of individuals' memory, the latter is left unspecified though assumed not nil.

The fundamental requirement in order to be a MR-adaptive process is that, however beliefs are formed, expectations about others' future choices are contained between the greatest and the smallest choices which are currently in memory. Trial and errors, idiosyncrasies and inertia are taken into account by the fact that the formation of such "correct" beliefs does not need to take place immediately but just in a finite period of time. On the contrary, perpetual and random mistakes are excluded by the fact that, from a certain period onwards, individuals best reply to their "correct" beliefs with certainty. Finally, notice that type of dominance concept applied here is less strong than it may appear. An individual is not forced to pick a response which is undominated according to strategies in her memory but according to the convex combination of them. Therefore, a smaller set of strategies results dominated. This accounts for the possibility that one expects others to choose a strategy which is in-between their past choices.

Although very general, Definition 1 does not take into account the possibility that consumers forward look. In order to account also for D4 we refer the following extension of MR-adaptive learning provided again by Milgrom and Roberts (1991). Let $F^0(\bar{t},\hat{t}) \equiv \overline{D}([\inf(T(\bar{t},\hat{t})), \sup(T(\bar{t},\hat{t}))])$ and, for $k > 0$, let $F^k(\bar{t},\hat{t}) \equiv \overline{D}(F^{k-1}(\bar{t},\hat{t}) \cup [\inf(T(\bar{t},\hat{t})), \sup(T(\bar{t},\hat{t}))])$. Given the history $T(\bar{t},\hat{t})$, individuals may adaptively think that others' choice will be in $[\inf(T(\bar{t},\hat{t})), \sup(T(\bar{t},\hat{t}))]$. However, they may also forward look and think that others can expect them to play in $\overline{D}([\inf(T(\bar{t},\hat{t})), \sup(T(\bar{t},\hat{t}))])$ and, hence, they can conclude that is better to choose a strategy in $F^1 = \overline{D}(F^0 \cup [\inf(T(\bar{t},\hat{t})), \sup(T(\bar{t},\hat{t}))])$. Strategy profiles in F^k are consistent with such a reasoning iterated k times.

Definition 2 (MR-Sophisticated Learning)
A process $\{\mathbf{h}(t)\}$ is consistent with MR-sophisticated learning if and only if for every $\bar{t}$ there exists $\hat{t}$ such that for every $t \geq \hat{t}$ we have that $\mathbf{h}(t) \in F^{\infty} \equiv \cup_{k=1}^{\infty} F^k(\bar{t}, t)$.

Since $F^0(\bar{t}, \hat{t}) = \overline{D}(T(\bar{t}, \hat{t}))$, Definition 1 satisfies Definition 2, i.e. any adaptive individual is a trivial sophisticated individual. In addition, Definition 2 is consistent with a large variety of belief formation mechanisms based on forward looking reasoning. It "justifies" any strategy which is not dominated in the set including not only the history of past play $T(\bar{t}, \hat{t})$ but also the strategy profiles obtained by any order of forward looking reasoning starting from $T[\bar{t}, \hat{t}]$ and assuming other individuals are sophisticated learners.

Milgrom and Roberts (1991) proved convergence to the "box" of equilibria for the whole class of processes satisfying Definition 2.

Theorem 5 *Let $\Gamma \equiv \{N, (S^i, \pi^i, i \in N)\}$ be a supermodular game, $\underline{\mathbf{x}} \equiv \inf(S)$, $\overline{\mathbf{x}} \equiv \sup(S)$ and $\Phi(\mathbf{x}) \equiv (\Phi_1(\mathbf{x}_{-1}), \ldots, \Phi_n(\mathbf{x}_{-n}))$ where $\Phi_i(\mathbf{x}_{-i})$ is the best reply correspondence of player i. Suppose $\{\mathbf{x}(t)\}$ is a process on Γ which is consistent with MR-sophisticated learning. Then, for every $k > 0$, there exists t_k such that for every $t \geq t_k$ we have $\mathbf{x}(t) \in [\underline{\Phi}^k(\underline{\mathbf{x}}), \overline{\Phi}^k(\overline{\mathbf{x}})]$, where $\underline{\Phi}^k(\underline{\mathbf{x}}) = \inf(\Phi(\underline{\Phi}^{k-1}(\mathbf{x}))$ and $\overline{\Phi}^k(\overline{\mathbf{x}}) = \sup(\Phi(\Phi^{k-1}(\mathbf{x}))$.*

The following is a rough intuition of the result. Consider the following sequences obtained by iteratively applying the operator D to the extremes of the strategy space. Let $\underline{\mathbf{x}}^0 \equiv 0$, $\overline{\mathbf{x}}^0 = \overline{\mathbf{x}}$ and $\underline{\mathbf{x}}^1 \equiv \inf(\overline{D}(0))$, $\overline{\mathbf{x}}^1 \equiv \sup(\overline{D}(0))$. In general, $\underline{\mathbf{x}}^{k+1} = \inf(\overline{D}(\underline{\mathbf{x}}^k))$ and $\overline{\mathbf{x}}^{k+1} = \inf(\overline{D}(\overline{\mathbf{x}}^k))$. Notice that $\overline{D}$ is a monotone non-decreasing function, i.e. $S \subseteq S'$ implies $\overline{D}(S) \subseteq \overline{D}(S')$. In fact, if some $\mathbf{x}$ is not a best reply to any strategy profile in S' then it is not a best reply to any strategy strategy profile in S. Therefore $\underline{\mathbf{x}}^{k+1} \geq \underline{\mathbf{x}}^k$ and $\overline{\mathbf{x}}^{k+1} \geq \overline{\mathbf{x}}^k$.

The key point is that in supermodular games for any $\mathbf{x}, \mathbf{x}'$ such that $\mathbf{x} \leq \mathbf{x}'$, $\overline{D}([\mathbf{x}, \mathbf{x}']) = [\underline{\Phi}(\mathbf{x}), \overline{\Phi}(\mathbf{x}')]$. In other terms, if $\mathbf{x} \leq \underline{\Phi}(\mathbf{x})$, $\mathbf{x} \neq \underline{\Phi}(\mathbf{x})$, then $\mathbf{x}$ is not a best reply to any strategy in $[\mathbf{x}, \mathbf{x}']$ and similarly if $\mathbf{x} \geq \overline{\Phi}(\mathbf{x})$, $\mathbf{x} \neq \overline{\Phi}(\mathbf{x})$. Then, by inductive reasoning one can see why Theorem 5 holds. For $k = 0$ it trivially holds. Suppose it holds for $k = j$, that is, there exists t_j such that $\mathbf{x}(t) \in [\underline{\Phi}^j(\underline{\mathbf{x}}), \overline{\Phi}^j(\overline{\mathbf{x}})]$ for any $t \geq t_j$. Now, applying the definition of MR-adaptive learning and setting $\bar{t} \equiv t_j$, $t_{j+1} \equiv \hat{t}$ we obtain that $\mathbf{x}(t) \in \overline{D}(\inf T(t_j, t), \sup T(t_j, t)) \subseteq \overline{D}([\underline{\Phi}^j(\underline{\mathbf{x}}), \overline{\Phi}^j(\overline{\mathbf{x}})]) = [\underline{\Phi}^{j+1}(\underline{\mathbf{x}}), \overline{\Phi}^{j+1}(\overline{\mathbf{x}})]$ for any $t \geq t_{j+1}$. The argument for MR-sophisticated learning is very similar and exploits the fact that $F^l(\bar{t}, t) \subseteq [\underline{\mathbf{x}}^k, \overline{\mathbf{x}}^k]$ for some k implies $F^{l+1}(\bar{t}, t) \subseteq [\underline{\mathbf{x}}^k, \overline{\mathbf{x}}^k]$.

Chapter 4

Some Applications

In this chapter I apply the theory developed so far to investigate some specific issues. For this purpose consumers' preferences are further specified to provide more familiar and tractable utility functionals.

Firstly, an example of additive concave-comparison specification of utility which satisfies A1-A7 is provided. The implications of such specification are analyzed and compared with the result of Clark and Oswald (1998) which apply a slightly different utility function. Besides, economically meaningful conditions which are sufficient for equilibrium uniqueness are found.

Secondly, an attempt to generalize the idea of social comparison is illustrated, introducing the possibility to care more about either richer or poorer people. The idea is that people differently perceive their status – or, equivalently, obtain satisfaction from it – on the basis of how much concern they have about either being identified with high status people or being differentiated from low status people. For the sake of intuition, the former if referred to as *upward-looking* behaviour while the second as *downward-looking* behaviour. However, in order to be have a model which is as general as possible, this relative concern for rich/poor people is modelled as a continuum variable which identifies the *degree* of upward-looking (or, equivalently, the inverse of the degree of downward-looking). It is shown that, *ceteris paribus*, the higher the degree of upward-looking is, the higher equilibrium consumption and the lower welfare and leisure are.

Finally, the impact of inequality in the distribution of income is investigated. It turns out that much depends on the degree of upward-looking: if people are upward-lookers, then it is likely that more inequality increases both consumption and work time but reduces welfare while, if people are downward-lookers, then exactly the opposite is likely to happen. Such results are then compared with the recent findings of Bowles and Park (2005) and Hopkins and Kornienko (2004, 2006).

4.1 Additive Concave-Comparison Utility Functions

The main idea underlying the present study is that individuals have both economic and social motivations. They care about absolute consumption and leisure – as is usually supposed – but, in addition, they also care about relative consumption because it affects social status. A simple specification of the utility function which captures such an idea is that of Clark and Oswald (1998). Actually, their specification is a special case of 3.1 where A1-A7 hold and the interaction structure is fixed.

In Clark and Oswald (1998) every individual is a convex combination of *homo oeconomicus* and *homo sociologicus* and is supposed to have decreasing marginal utility of social status (for this reason the utility function is referred to as concave-comparison). The following function follows a similar idea and, in addition, it takes into account the interaction structure.

$$V^i(c_i, l_i, r_i) = s_i \mu^i(c_i, l_i) + (1 - s_i)\rho(r_i) \tag{4.1}$$

$$r_i(\mathbf{c}, N(i)) = c_i - \theta(N(i)) \sum_{j \in N(i)} \alpha_j(N(i)) c_j \tag{4.2}$$

where $\mu^i_{c_i} > 0$, $\mu^i_{l_i} > 0$, $\rho' > 0$, $\rho'' < 0$ and $0 < s_i < 1$. Moreover, $\alpha_j(N(i)) > 0$, $\sum_{i \in N(i)} \alpha_j = 1$ and $\theta(N(i)) > 0$.

Function μ measures utility accruing from absolute consumption and leisure while ρ measures utility accruing from social status. The latter is determined according to function r_i.[1] The parameter s_i represents the weight that individual i gives to μ with respect to ρ. In other words, it represents the inclination of individual i toward *homo oeconomicus*. Coefficients $\{\alpha_j(N(i))\}_{j\in N(i)}$ represent the relative weights that i gives to the consumption of people she is interacting with. They are assumed be functions of $N(i)$ to take into account the fact that the relative importance given to an individual depends on who the others are. For the sake of simplicity, it is imposed that $N^{\infty}(i) = N(i)$ for any $i \in N$, i.e. individuals interact with each other at most once as assumed in Section 3.3. Finally, function $\theta(N(i))$ accounts for the impact of the number of interactions.[2]

In is easy to check that, under (4.1) and (4.2), V^i satisfies A1-A7. Moreover, A2 and A3 hold with strict inequality. For any $j \in N(i)$, we have

$$V^i_{c_j} = -(1-s_i)\rho'\theta\alpha_j < 0 \tag{4.3}$$

$$V^i_{c_ic_j} = -(1-s_i)\rho''\theta\alpha_j > 0 \tag{4.4}$$

It must be emphasized that the impact of parameter s_i on utility and marginal utility of consumption is ambiguous. Indeed, we have

$$\begin{aligned} V^i_{s_i} &= \mu^i - \rho \\ V^i_{c_is_i} &= \mu^i_{c_i} - \rho' \end{aligned}$$

[1] Notice that this formulation implicitly assumes that the status variable is cardinal. This assumption is not an innocuous one. Other researchers assume that status is an ordinal variable (Frank (1985a, 1999), Hopkins and Kornienko (2004)). Some of the consequences of this assumption are discussed at the end of the chapter.

[2] Together, $\{\alpha_j(N(i))\}_{j\in N(i)}$ and $\theta(N(i))$ determine how social comparison is actually carried out. For instance, if $\alpha_j = 1/n_i$ for any $j \in N(i)$ and $\theta(N'(i))/n'_i > \theta(N(i))/n_i$ for any $N(i), N'(i)$ such that $n'_i = n_i + 1$, then V^i satisfies peer-comparison.

which can be either positive, negative or nil. Therefore, although existence of the incentive to increase consumption when others increase theirs stems from social motivations only, the marginal benefit of consumption – for a given amount of leisure – is ambiguously affected by the weight given to social motivations.

In the model of Clark and Oswald (1998) this is true also for the ratio between marginal utility of consumption and marginal utility of leisure. The reason is that Clark and Oswald (1998) assume that the utility function is additive in the cost of consumption (here represented by the disutility of work) which is not multiplied by s_i. In other words, they assume that economic motivations do not affect the utility of leisure or, equivalently, that economic motivations affects only utility of consumption. Under such an assumption, the results of Section 3.3 imply that stronger economic motivations may induce a greater complementarity of consumption which moves the "box" of equilibria toward a region characterized by greater consumption, longer work time and, possibly, lower utility.[3]

Instead, under specifications (4.1)-(4.2), we obtain

$$\frac{\partial \Phi_i}{\partial h_j} = \frac{w_i w_j (1 - s_i)\theta \alpha_j \rho''}{s_i(w_i^2 \mu_{c_i c_i} - w_i \mu l_i c_i - w_i \mu_{c_i l_i} + \mu_{l_i l_i}) + w_i^2 (1 - s_i)\rho''} \tag{4.5}$$

which is unambiguously decreasing in s_i if V^i is strictly convex in h_i, implying that – as one may expect – social motivations increase people's reactiveness to others' consumption and move upwards the "box" containing all equilibria.

4.1.1 A Sufficient Condition for Equilibrium Uniqueness

Building on an elementary result by Kennan (2001) which exploits a weak type of concavity (see Appendix 4.4), sufficient conditions for equilibrium uniqueness are provided in the case of single valued best reply functions.

Proposition 11 *Consider a game Σ where $\Phi(\mathbf{h}) = (\Phi_1(\mathbf{h}), \ldots, \Phi_n(\mathbf{h})) : \Re^n \to \Re^n$. If for any $i \in N$*

[3] It easy to see why this can happen if (4.1) is substituted with $V^i = s_i \mu^i(c_i) + \mu^i(l_i) + (1 - s_i)\rho(r_i)$.

i) $\Phi_i(0) > 0$,

ii) $\sum_{j \in N \setminus \{j\}} k_j \dfrac{\partial \Phi_i}{\partial h_j} \leq 1$ *for any* $\{k_j\}_{j \in N \setminus \{j\}}$ *such that* $\sum_{j \in N \setminus \{j\}} k_j = 1$ *and* $k_j > 0$,

then Σ *has a unique Nash equilibrium which is positive.*

Proof. I first show that $g(\mathbf{h}) \equiv \Phi(\mathbf{h}) - \mathbf{h}$ is strictly radially concave. By direct computation, the directional derivative of any Φ_i with respect to the direction identified by the vector $\mathbf{k}(\mathbf{h}) \equiv \mathbf{h}/\sum_{i \in N} h_i$ is equal to

$$\lim_{t \to 0} \frac{\Phi_i(\mathbf{h} + t\mathbf{k}) - \Phi_i(\mathbf{h})}{t} = \sum_{j \in N \setminus \{j\}} \frac{\partial \Phi_i}{\partial h_j} k_j \tag{4.6}$$

which, by hypothesis ii), is smaller than one (notice that the $\partial \Phi_i / \partial h_i$ is always zero). Therefore, for any $\mathbf{h} > 0$, the restriction of Φ_i to the ray of direction $\mathbf{k}(\mathbf{h})$ has a slope which is smaller than 1. Hence, if $g(\mathbf{h}) = 0$ for some $\mathbf{h} > 0$, then $g(\lambda \mathbf{h}) > 0$ for $0 < \lambda < 1$, otherwise hypothesis i) cannot not be satisfied. This yields strict radial quasi-concavity.

Moreover, since Φ is non-decreasing in $\mathbf{h}$, then it is also quasi-increasing in $\mathbf{h}$. Hence, by Theorem 6 we have that there is at most one positive Nash equilibrium. Finally, from the fact that $\Phi(\mathbf{h}) > 0$ and Theorem 2 it follows that there exists at least one positive Nash equilibrium which, therefore, is unique.■

Hypothesis i) means that people find it convenient to supply a positive amount of labour even in the case no one else in society works. This is rather reasonable if we agree that zero consumption is unsustainable.

Hypothesis ii) is instead more controversial. It means that people react to an increase of one one unit of any neighbours' work time by increasing their own work time by not more than one unit. Actually, this may or may not be case. For instance, under specifications (4.1)-(4.2) and provided that V^i is strictly concave in h_i, if (but not only if) the following condition is satisfied for any $i \in N$ and $j \neq i$

$$(1 - s_i)w_i(w_j\theta\alpha_j - w_i)\rho'' > s_i(w_i^2\mu^i_{c_ic_i} - w_i\mu^i_{l_ic_j} - w_i\mu^i_{c_il_i} + \mu^i_{l_il_i}) \qquad (4.7)$$

then hypothesis ii) holds.

Hence, we see that if i) is satisfied and μ^i is strictly convex in h_i, then there exist $\{s_i\}_{i\in N}$ that allow for equilibrium uniqueness. In fact, if $(w_j\theta\alpha_j - w_i) \leq 0$ then (4.7) is satisfied for any $0 < s_i < 1$. If $(w_j\theta\alpha_j - w_i) > 0$ then there exists $\bar{s}_i < 1$ such that (4.7) is satisfied for any $s_i \in [\bar{s}_i, 1)$. This suggests that strong social motivations may induce equilibrium multiplicity by increasing people's responsiveness to others' choices.

4.2 Upward and Downward-looking

4.2.1 Definitions

According to Veblen (1899) social comparison is characterized by "upward-looking" behaviour

> "[...] to stand well in the eyes of the community, it is necessary to come up to a certain, somewhat indefinite, conventional standard of wealth; just as in the earlier predatory stage it is necessary for the barbarian man to come up to the tribe's standard of physical endurance, cunning, and skill at arms. A certain standard of wealth in the one case, and of prowess in the other, is a necessary condition of reputability, and anything in excess of this normal amount is meritorious [...] The leisure class stands at the head of the social structure in point of reputability; and its manner of life and its standards of worth therefore afford the norm of reputability for the community. The observance of these standards, in some degree of approximation, becomes incumbent upon all classes lower in the scale. In modern civilized communities the lines of demarcation between social classes have grown vague and transient, and wherever this

happens the norm of reputability imposed by the upper class extends its coercive influence with but slight hindrance down through the social structure to the lowest strata. [...]"

In order to capture the kind of social comparison described by Veblen a different specification of (4.2) is assumed. In particular, a parameter γ is introduced to account for the degree of people's upward-looking. In order to simplify notation it is also assumed that $\alpha_j = 1/n_i$, for any $j \in N(i)$.

$$r_i(c_i, A_i) = c_i - A_i \tag{4.8}$$

$$A_i(\gamma, \mathbf{c}, N(i)) = \begin{cases} \theta \left(\dfrac{1}{n_i} \displaystyle\sum_{j \in N(i)} c_j^{\gamma} \right)^{\frac{1}{\gamma}} & \text{if } \gamma \neq 0 \\ \theta \exp \left(\dfrac{1}{n_i} \displaystyle\prod_{j \in N(i)} \ln (c_j) \right) & \text{if } \gamma = 0 \end{cases} \tag{4.9}$$

Notice that (4.9) is the γ-power mean of $\{c_j\}_{j \in N(i)}$. Individual i compares her consumption with A_i which can be interpreted as the "condition of reputability" indicated by Veblen. In addition, the nice properties of (4.9) provide a natural interpretation of γ as the degree of upward-looking.[4] For $\gamma \to -\infty$, $A_i \to \min_{j \in N(i)} c_j$ meaning that weight is given only to the individual with the lowest consumption. This represents the case of minimum upward-looking (maximum downward-looking). On the contrary, for $\gamma \to \infty$, $A_i \to \max_{j \in N(i)} c_j$ meaning that weight is given only to the individual with the greatest consumption. This is the case of maximum upward-looking (minimum downward-looking). Inbetween these two extremes A_i is increasing in γ, unless $c_j = c$ for any $j \neq i$ in which case it is constant.[5] Moreover,

[4]When the generic $\alpha_j \neq 1/n_i$ function A_i becomes a γ-power weighted mean, a slight generalization of the γ-power mean. Technical references on power mean functions and their properties are in Hardy et al. (2002) and Witowski (2004).

[5]Instead, the γ-power weighted mean is non-decreasing in γ and not everywhere constant unless $c_j = c$ for any $j \neq i$.

equal upward and downward-looking happens for $\gamma = 1$, with function A_i simplifying to the standard mean of $\{c_j\}_{j\in N(i)}$. So, it is natural to address individuals as upward-lookers if $\gamma > 1$ or as downward-lookers if $\gamma < 1$.[6] In addition, since a greater value of γ implies that the richest people in $N(i)$ determine to a larger extent what i believes to be the "condition of reputability", we also have that γ is a measures of the social influence exerted by high-consumption people. Finally, denote with $\Sigma^V \equiv (N, (V^i, N(i), H)_{i\in N}, \geq)$ a game Σ where $U^i = V^i$ and $r_i = c_i - A_i$.

4.2.2 Implications of upward-looking Behaviour

A natural question to ask is how individuals' choices and welfare are affected by γ. In this framework the causes of the modification of γ are not investigated. However, in order to fix ideas one can refer to Veblen's suggestion that the softening (hardening) of established social divisions increases (reduces) the degree of upward-looking (see Carlssona et al. (2005) for recent evidence on this).

Again, it is easy to check that under (4.8) and (4.9), V^i satisfies A1-A7. Equations (4.3) and (4.4) become respectively

$$V^i_{c_j} = -(1-s_i)\rho' \frac{\theta}{n_i} A_i^{1-\gamma} c_j^{\gamma-1} \leq 0 \tag{4.10}$$

$$V^i_{c_i c_j} = -(1-s_i)\rho'' \frac{\theta}{n_i} A_i^{1-\gamma} c_j^{\gamma-1} \geq 0 \tag{4.11}$$

where, for $-\infty < \gamma < \infty$, equality holds only if $c_j = 0$. Therefore, we have that for any $\mathbf{h} > 0$ both (4.10) and (4.11) hold with strict inequality.[7] For the remainder of the chapter it is assumed that $\Phi_i(0) > 0$ and only $\mathbf{h} > 0$ will be considered.

[6] For the sake of completeness, note that for $\gamma = 0$ function A_i is the geometric mean of $\{c_j\}_{j\in N(i)}$ while, for $\gamma = -1$, A_i gives the harmonic mean of $\{c_j\}_{j\in N(i)}$. Moreover, as $\gamma \to 0$ function A_i converges to the geometric mean which implies that A_i is continuous in γ. The same holds if A_i is a γ-power weighted mean, with the only difference that instead of the cited means we have their weighted counterparts.

[7] For $\gamma \to \infty$, if c_j is not the maximum in $\{c_k\}_{k\in N(i)}$ then both $V^i_{c_j}$ and $V^i_{c_i c_j}$ are nil. The same holds for $\gamma \to -\infty$ if c_j is not the minimum in $\{c_k\}_{k\in N(i)}$.

The following statements summarize the impact of γ.

LEMMA 3 *Consider $\{V^i\}_{i\in N}$ as defined in Σ^V and $\mathbf{h} > 0$. If $w_j h_j = z_i > 0$ for each $j \in N(i)$ and some z_i, then $V^i(\mathbf{h})$ is constant in γ; otherwise $V^i(\mathbf{h})$ is strictly decreasing in γ.*

Proof. Since A_i is a γ-power mean and $\mathbf{h} > 0$ implies that $\{c_j\}_{j\in N(i)}$ are positive for any $i \in N$, A_i is strictly increasing in γ unless $\{c_j\}_{j\in N(i)}$ are all equal. Then, result follows from the fact that V^i is monotonically decreasing in A_i.■

LEMMA 4 *Consider $\{V^i\}_{i\in N}$ as defined in Σ^V and $\mathbf{h} > 0$. If $w_j h_j = z_i > 0$ for each $j \in N(i)$ and some z_i, then $V^i_{c_i}(\mathbf{h})$ is constant in γ; otherwise $V^i_{c_i}(\mathbf{h})$ is strictly increasing in γ.*

Proof. Since A_i is a γ-power mean and $\mathbf{h} > 0$ implies that $\{c_j\}_{j\in N(i)}$ are positive for any $i \in N$, A_i is strictly increasing in γ unless $\{c_j\}_{j\in N(i)}$ are all equal. Then, result follows from the fact that $V^i_{c_i} = s_i w_i \mu^i_{c_i} + (1 - s_i)\rho'(r_i)$ and $\rho'' < 0$.■

LEMMA 5 *Consider Σ^V and let $\mathbf{h}^*$ be a Nash equilibrium. The following statements are equivalent*

i) there exists $\hat{\gamma}$ for which $w_j h^*_j = z_i$ for each $j \in N(i)$, some z_i and any $i \in N$

ii) $\mathbf{h}^*$ is an equilibrium for γ' and γ'' where $\gamma' \neq \gamma''$,

iii) $\mathbf{h}^*$ is an equilibrium for any γ,

iv) $V^i(\mathbf{h}^*)$ is constant in γ for any $i \in N$.

Proof. The proposition is proved by showing that i) ⇒ iii) ⇒ ii) ⇒ i) and i) ⇔ iv).

Suppose there exists $\hat{\gamma}$ for which $w_j h_j^* = z_i$ for each $j \in N(i)$, some z_i and any $i \in N$. Then, by Lemma 4, $V_{c_i}^i(\mathbf{h}^*)$ is constant in γ for any $i \in N$. Therefore since $V_{l_i}^i(\mathbf{h}^*)$ is unaffected by γ, each $i \in N$ best replies to $\mathbf{h}_{-i}^*$ by choosing h_i^* for any value of γ which implies that $\mathbf{h}^*$ is an equilibrium for any γ. In particular, there exists $\gamma'' \neq \gamma'$ for which $\mathbf{h}^*$ is an equilibrium.

On the other hand, since $V_{l_i}^i(\mathbf{h}^*)$ is unaffected by γ, in order for $\mathbf{h}^*$ to be an equilibrium under γ' and γ'', $\gamma' \neq \gamma''$, it must be, by Lemma 4, that $w_j h_j^* = z_i$ for each $j \in N(i)$, some z_i and any $i \in N$. Point iv) follows by Lemma 3.■

As one may expect, the intensity of upward-looking behaviour is likely to be a bad from a societal point of view. In fact, unless an individual interacts with people showing an equal level of consumption, a higher γ implies, *ceteris paribus*, a greater frustration (or less satisfaction) for any level of actual consumption. This because more upward-looking increases the importance of the richest people in the neighbourhood as terms of comparison and, therefore, reduces one's perceived social status.[8]

In addition, unless individuals interact with people having the same consumption level, a higher degree of upward-looking increases people's marginal utility of consumption which, in turn, increases the competition for status and induces further welfare losses.

Proposition 12 *Consider Σ^V and let $\underline{\mathbf{h}}^*$ and $\overline{\mathbf{h}}^*$ be, respectively, the smallest and the greatest Nash equilibrium. If there not exists any $\hat{\gamma}$ for which $w_j \underline{h}_j^* = \underline{z}_i$ for each $j \in N(i)$, some $\underline{z}_i$ and any $i \in N$ then $\underline{\mathbf{h}}^*$ is non-decreasing and non-constant in γ, and similarly for $\overline{\mathbf{h}}^*$. If, on the contrary, such a $\hat{\gamma}$ exists, then i) $\underline{\mathbf{h}}^*$ is non-*

[8] Actually, one may be surprised by the fact that, if i's neighbours have the same level of consumption, then i's perceived social status is unaffected by the degree of upward-looking. The reason is that the degree of upward-looking only affects how i distributes the weights – which can be interpreted as individuals' "social relevance" – among her neighbours and leaves unaltered the sum of the weights.

decreasing for $\gamma < \hat{\gamma}$ and constant for $\gamma \geq \hat{\gamma}$, and ii) $\overline{\mathbf{h}}^*$ is non-decreasing for $\gamma > \hat{\gamma}$ and constant for $\gamma \leq \hat{\gamma}$.

Proof. By Lemma 1 and Lemma 4 follow that, for any $\mathbf{h} \in H^n$, $\inf \Phi_i(\mathbf{h}_{-i})$ and $\sup \Phi_i(\mathbf{h}_{-i})$ are non-decreasing in γ. Moreover, by Lemma 2 we have that $\underline{\mathbf{h}}^* = (\inf \Phi_1(\underline{\mathbf{h}}^*{}_{-1}), ..., \sup \Phi_n(\underline{\mathbf{h}}^*{}_{-n}))$ and $\overline{\mathbf{h}}^* = (\sup \Phi_1(\overline{\mathbf{h}}^*{}_{-1}), ..., \sup \Phi_n(\overline{\mathbf{h}}^*{}_{-n}))$. Therefore, the interval $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is non-decreasing in γ.

Furthermore, let Υ be the set of all strategy profiles $\mathbf{h}^*$ which are equilibria of Σ^V such that there exists $\hat{\gamma}$ for which $w_j h_j^* = z_i$ for each $j \in N(i)$, some z_i and any $i \in N$. Suppose $\Upsilon = \emptyset$. Then, by Lemma 5, if $\mathbf{h}^*$ is the smallest or greatest equilibrium of Σ^V for some γ' then it cannot be such for any $\gamma'' \neq \gamma'$. Therefore $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is non-constant in γ.

Alternatively, suppose $\Upsilon \neq \emptyset$ and $\underline{\mathbf{h}}^* \in \Upsilon$ for some $\hat{\gamma}$. Consider $\mathbf{h} \leq \underline{\mathbf{h}}^*$, $\mathbf{h} \neq \underline{\mathbf{h}}^*$. By construction $\mathbf{h}$ is not an equilibrium for $\gamma = \hat{\gamma}$ and there is some $i \in N$ such that $\Phi_i(\mathbf{h}_{-i}) > h_i$. If $\mathbf{h}$ is such that $w_j h_j = z_i$ for each $j \in N(i)$, some z_i and any $i \in N$, then from Lemma 4 follows that $V_{c_i}^i(\mathbf{h})$ is constant in γ for any $i \in N$ and, therefore, $\mathbf{h}$ is never an equilibrium. Otherwise, from Lemma 4 follows that $V_{c_i}^i(\mathbf{h})$ is strictly increasing in γ for some $i \in N$ which implies that $\mathbf{h}$ cannot be an equilibrium for $\gamma > \hat{\gamma}$. A similar argument applies if $\overline{\mathbf{h}}^* \in \Upsilon$.■

Proposition 12 states that the interval containing all equilibria is, as a whole, non-decreasing in the degree of upward-looking. Moreover, it shows that constancy is obtained only in the (rather exceptional) case that the smallest and greatest equilibrium are strategy profiles such that all members of the neighbourhood of any individual consume the same.

Finally, the more "connected" a society is, the more likely that a higher degree of upward-looking results in an strict upward movement of the interval of equilibria.

Corollary 8 *Consider Σ^V and let Υ be the set of all strategy profiles $\mathbf{h}^*$ which are equilibria under any γ. If $\Upsilon = \emptyset$ and population N is strongly connected then*

$[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ *is increasing in* γ.

Proof. Suppose $\Upsilon = \emptyset$. By Lemma 5, if $\mathbf{h}^*$ is an equilibrium of Σ^V, then for any γ there exists $i \in N$ such that $w_j h_j^* \neq w_k h_k^*$ for some $j, k \in N(i)$. Therefore, by Lemma 4, for any γ', γ'', $\gamma' > \gamma''$, there exists $i \in N$ such that $V_{c_i}^i(\mathbf{h}^*)$ is greater under γ' than under γ''. In particular, this is true for $\underline{\mathbf{h}}^*$ and $\overline{\mathbf{h}}^*$. By Lemma 1 and Lemma 2 $\underline{h_i}^*$ and $\overline{h}_i^*$ are greater under γ'' than under γ'.

If, in addition, population N is strongly connected then everyone is a global term of comparison. In particular, i is such. This means that, for any $j \in N$ there exists a finite sequence of individuals $\{k_l\}_{l=1}^m$ such that $k_1 = i$, $k_m = j$ and $k_l \in N(k_{l+1})$ for $1 \leq l < m$. Consider the individual k_{l+1}. Since $k_l \in N(k_{l+1})$ by A3 (holding with strict inequality) and Lemma 1 follows that both $\inf \Phi_{k_{l+1}}$ and $\sup \Phi_{k_{l+1}}$ are increasing in h_{k_l}. Since for any γ',γ'' such that $\gamma' > \gamma''$ there exists i such that $\underline{h_i}^*$ and $\overline{h}_i^*$ are greater under γ' than under γ'', then by Lemma 2 follows that $[\underline{\mathbf{h}}^*, \overline{\mathbf{h}}^*]$ is increasing in γ.■

Proposition 12 establishes that, if there are no equilibria where each individual interacts with people showing an equal level of consumption, then a higher degree of upward-looking moves upward the interval of equilibria. Corollary 8 states that, if society is strongly connected and at least one individuals has her neighbours not consuming the same, then everybody's consumption is *strictly* increasing in the degree of upward-looking.

4.2.3 Comment

Summing up, a higher degree of upward-looking can reduce welfare for two reasons. First, as Lemma 3 shows, there is a direct negative effect due to a lower perceived social status. Second, more upward-looking means greater focus on those neighbours which consume the most and, hence, more competitiveness in social comparisons. This in turn may lead to a cascade effect which results in many, if not everybody, consuming more and having less leisure. In such a case, since the greater incentive to consume arises because of a lower perception of one's own social status (that is, people compete more to get just what they had under the lower degree of upward-looking), an additional welfare reduction takes place.

Again, we see that people can rationally choose to work more and consume more while their welfare actually reduces. More precisely, we expect that, *ceteris paribus*, the more a society is characterized by upward-looking, the highest its GDP is and lower its welfare is (in the Paretian sense).[9]

4.3 Inequality and Lump Sum Transfers under Social Comparison

4.3.1 Premise

When individuals are concerned with their relative social position, inequality may affect both labour supply and welfare by modifying what individuals perceive as their actual social status. In this subsection it is shown how the impact of a grater income inequality depends on people's degree of upward-looking.

In order to assess the impact of inequality, a precise notion of the latter is required. Since this study is not meant to discuss in detail the definition of inequality or its measures, a very basic notion is used which is compatible with a wide range of specifications. More precisely, I move from the intuition that if two distributions only differ for the income of a pair of individuals, then the more unequal one is the distribution showing the greatest difference between the income of the two. In accordance with this, the analysis is focused on pairs of distributions in which one of the two can be obtained from the other by means of a single income transfer between two individuals, taking into account individuals' choice adjustments.

[9]Some labour-supply driven economic growth might have been fostered by this kind of mechanism together with some social or cultural shock which has increased the degree of upward-looking. An example of the latter could be a greater social mobility which induces everyone to compare herself with a higher social strata (Schor (1992, 1998, 2004)).

Roughly speaking, under my restriction a greater inequality means that high consumption people consumes more while low consumption people consume less. This can affect the perceived social status in two ways. First, an individual can become richer or poorer in absolute terms, perceiving a different social status for herself because of the change in the gap between her and others' consumption. Second, an individual may find that the people she compares with show a more unequal level of consumption among themselves which, in turn, may affect her perceived social status. Intuitively, the stronger is the upward-looking the more likely it is that more inequality induces people to perceive a lower social status.

Before giving a formal argument for the previous considerations, let me emphasize one thing. Whenever a lump sum is transferred from one individual to another, it may happen that the resulting (equilibrium) distribution is such that at least one individual has her own income not increased, her labour supply not lowered and her social status not increased. In such a case, we can speak of Pareto improvements only if *ex post* compensations are considered. However, *ex post* compensations are not much appropriate for this framework. In fact, any compensation adds further effects to the transfer made in the first place so that if *ex post* compensation had to take place then further externalities would have to be taken into account in order to assess welfare. This suggests that, to rank Pareto efficient equilibria, a welfare criterion which does not depend on compensations is preferable. The latter can be obtained by assuming some kind of utility cardinality which allows the aggregation of utility functions into a single welfare measure. However, since the analysis carried out here requires the comparison of pairs of equilibria only, I do not explicitly introduce such cardinality. Instead, I find it more convenient to just state the number of people supporting or opposing an equilibrium with respect to the other.[10]

[10]Notice that if one extends this criterion beyond pairs of equilibria then cycles could arise. In other words, a total order of the alternatives in the space of equilibria induced by all possible transfers is not granted.

4.3.2 Lump Sum Transfers and Pairwise Equality

The binary relation "to be more pairwise equal" is indicated by $\succ_{ij}^e$ and defined as the set of all ordered pairs $(\mathbf{x}'', \mathbf{x}') \in \Re_+^n \times \Re_+^n$ such that there exists $i, j \in N$ for which the following conditions hold:

i) $k \notin \{i, j\} \Rightarrow x_k'' = x_k'$

ii) $x_i < \min\{x_i'', x_j''\} \leq \max\{x_i'', x_j''\} < x_j$

iii) $x_i'' + x_j'' = x_i' + x_j'$

Consider a pair of income (consumption) distributions $\mathbf{c}'', \mathbf{c}' \in R_+^n$. In intuitive terms, $\mathbf{c}''$ is more pairwise equal than $\mathbf{c}'$ (or equivalently $(\mathbf{c}'', \mathbf{c}') \in \succ_{ij}^e$ or $\mathbf{c}'' \succ_{ij}^e \mathbf{c}'$) if and only if $\mathbf{c}$ can be obtained from $\mathbf{c}'$ by means of a single income transfer from some individual j to some individual i.[11]

Let $\Omega \equiv (N, (V^i, N(i), H)_{i \in N}, \geq)$ where $r_i(\mathbf{c}, \gamma) = c_i - A_i$. Moreover, since the structure of interaction is not the fundamental issue here, it is assumed that individuals interact with the whole population, namely $N(i) = N \setminus \{i\}$ for any $i \in N$, and $\theta = 1$.[12] The basic argument about the impact of the parameter γ on the effects of inequality is provided by Proposition 13 whose proof is based on the following lemma.

Lemma 6 *Let $A(\mathbf{x}, \gamma)$ be the γ-power mean of the elements of the vector $\mathbf{x} \in \Re_+^n$, $n \geq 2$. For any $\mathbf{y} \in \Re_+^n$ such that i) $x_i > y_i > x_j$ and $x_i > y_j > x_j$ for some $i, j \in N$ and ii) $x_k = y_k$ for $k \notin \{i, j\}$, there exists $\bar{\gamma} \in \Re$ such that $A(\mathbf{x}, \gamma) \geq A(\mathbf{y}, \gamma)$ if and only if $\gamma \geq \bar{\gamma}$, where $A(\mathbf{x}, \gamma) = A(\mathbf{y}, \gamma)$ if and only if $\gamma = \bar{\gamma}$.*

[11] Notice that, since the relation "to be more pairwise equal" is not transitive, it does not induce a partial order on the set of all possible $\mathbf{c}$ such that $\sum_{i \in N} c_i$ is the same. However, a partial order is induced by the relation $\succ^e$ defined as the set of all ordered pairs $(\mathbf{x}'', \mathbf{x}') \in \Re_+^n \times \Re_+^n$ such that there exists some finite sequence of $\{\mathbf{x}^s\}_{s=1}^b$ such that $\mathbf{x}'' \succ_{i_{b+1} j_{b+1}}^e \mathbf{x}^b \ldots \mathbf{x}^1 \succ_{i_1 j_1}^e \mathbf{x}'$.

[12] This not meant to say that the structure of interactions is not important but to make clear that it is not considered because the focus is on the general effects of lump sum transfers which reduce inequality. Actually, the role played by the interaction structure may be very relevant and it is certainly worth further research.

Proof. See Appendix 4.4.■

Proposition 13 *Consider Ω and let $\mathbf{c}' \in \Re^n_+$ be an equilibrium consumption vector. For any $\mathbf{c}'' \in \Re^n_+$ such that i) $c'_i > c''_i > c'_j$ and ii) $c'_i > c''_j > c'_j$ for some $i, j \in N$ and $c'_k = c''_k$ for $k \notin \{i, j\}$, there exists $\bar{\gamma} \in \Re$ such that*

i) $\gamma > \bar{\gamma} \Rightarrow r_l(\mathbf{c}'', \gamma) > r_l(\mathbf{c}', \gamma), \forall l \in N \setminus \{i\}$,

ii) $\gamma = \bar{\gamma} \Rightarrow r_l(\mathbf{c}'', \gamma) = r_l(\mathbf{c}', \gamma), \forall l \in N \setminus \{i, j\}$,

iii) $\gamma < \bar{\gamma} \Rightarrow r_l(\mathbf{c}'', \gamma) < r_l(\mathbf{c}', \gamma), \forall l \in N \setminus \{j\}$.

Proof. Suppose that $\mathbf{c}'$ is the equilibrium consumption vector and consider any $\mathbf{c}'' \in \Re^n_+$ satisfying i) and ii). For any $k \notin \{i, j\}$, we have that

$$sign\left(r_k(\mathbf{c}', \gamma) - r_k(\mathbf{c}'', \gamma)\right) = sign\left(A_k(\mathbf{c}'', \gamma) - A_k(\mathbf{c}', \gamma)\right) \tag{4.12}$$

Then, by Lemma 6 there exists $\bar{\gamma}$ such that, for any $k \notin \{i, j\}$, $r(\mathbf{c}', \gamma) \geq r(\mathbf{c}'', \gamma)$ if and only if $\gamma \geq \bar{\gamma}$, where $r_k(\mathbf{c}', \gamma) = r_k(\mathbf{c}'', \gamma)$ if and only if $\gamma = \bar{\gamma}$. Moreover, notice that since $j \in N(i)$ while $i \notin N(i)$ and $c''_j > c'_j$, it follows that $r_i(\mathbf{c}', \gamma) > r_i(\mathbf{c}'', \gamma)$. Similarly, since $i \in N(j)$ while $j \notin N(j)$ and $c''_i < c'_i$, it follows that $r_j(\mathbf{c}'', \gamma) > r_j(\mathbf{c}', \gamma)$.■

Corollary 9 *Suppose $\mathbf{c}$ is the equilibrium consumption vector. For any $\mathbf{c}'$ such that $\mathbf{c}' \succ^e_{ij} \mathbf{c}$, we have*

i) if $\gamma > 1$ then for any $l \in N \setminus \{i\}$, $V^l(\mathbf{c}') > V^l(\mathbf{c})$,

ii) if $\gamma = 1$ then for any $l \in N \setminus \{i, j\}$, $V^l(\mathbf{c}') = V^l(\mathbf{c})$,

iii) if $\gamma < 1$ then for any $l \in N \setminus \{j\}$, $V^l(\mathbf{c}) > V^l(\mathbf{c}')$, *Proof.* The result follows from the proof of Proposition 13 by noticing that $A_k(\mathbf{c}, 1) = A_k(\mathbf{c}', 1)$ for any $\mathbf{c}'$ such that $\mathbf{c}' \succ_{ij}^{e} \mathbf{c}$ and $k \notin \{i, j\}$ and that $V_{r_l}^{l} > 0$ for any $l \in N$.■

In the light of Proposition 13 and Corollary 9 we understand that, *ceteris paribus*, if people are neither upward- nor downward-lookers then changing the income distribution of any two individuals affect only their welfare. Otherwise, if people are upward-lookers, then the greater the inequality the worse off are all but the one whose income increased while what happens to this last one is uncertain – she may be worse off too; if people are downward-looker, then the greater the inequality the better off are all but the one whose income reduced while what happens to this last one is uncertain – she may be better off too.

This, however, is only part of the story since people react to changes in the distribution of income by adjusting their choices to the new situation. Therefore, the next step is to abandon the *ceteris paribus* condition and allow consumers to adjust their consumption and labour supply. For this purpose, it is assumed that there exists a unique equilibrium. This is done in order to get rid of the *indeterminacy* problem – and the related comparative statics difficulties illustrated in the previous section – in a simple way.[13]

Suppose $\mathbf{c}'$ is the equilibrium consumption vector. Let $\mathrm{d}q$ be a marginal transfer of income from some individual j to some individual i. In order to identify which is the new equilibrium induced by such a transfer we must take into account, besides the transfer itself, two additional sources of variation in the consumption of i and j: i) the income effect and ii) the social comparison effect, that is, how each individual responds to others' new choices of consumption . Let $\Psi_l(\mathbf{c}, \tau)$ be the best response correspondence in terms of consumption choices of the generic individual $l \in N$, with the parameter τ representing a positive income transfer. Notice that $\Psi_l(\mathbf{c}, \tau)$

[13] This is not meant to suggest that the present analysis cannot be done in the presence of more than one equilibrium. It could still be carried out in either probabilistic terms (assuming a probability distribution over equilibria) or by assuming a more specific dynamics which allows for convergence to some equilibrium.

is total consumption of individual l and, hence, also accounts for the additional consumption granted by τ. In order to keep the analysis as simple as possible, it is assumed that $\{\Psi_l(\mathbf{c}, \tau)\}_{l\in N}$ are totally differentiable functions. In addition, it is postulated that

AI1. $0 < \dfrac{\partial \Psi_l}{\partial c_k} < 1$ for any $k \neq l$ and $l \in N$,

AI2. $0 < \dfrac{\partial \Psi_l}{\partial \tau} \leq 1$ for any $k, l \in N$.

Assumption AI1 means that, other things being equal, every individual reacts to a higher consumption of any other individual by increasing her own consumption by a smaller quantity than the other's increase. This seems rather reasonable. Firstly, since we do not observe people spending all their time working, AI1 certainly holds for very high levels of labour supply. Secondly, under the present formulation, we can always take a population size large enough such that AI1 holds.[14]

Assumption AI2 means that, other things being equal, people react to a positive transfer by consuming a positive number of additional units of consumption up to the value of the income transfer. This hypothesis is certainly not controversial as it always true if consumption and leisure are normal goods.

The following proposition establishes some useful insights about the behaviour of any two individuals involved in a marginal income transfer of the kind described above.

Proposition 14 *Consider Ω where individuals in $N \setminus \{i, j\}$ cannot adjust their choices. Suppose that both AI1 and AI2 hold and let $\mathbf{c}' \in \Re^n_+$ be the unique equilibrium consumption vector. Then, a marginal transfer $\mathrm{d}q > 0$ from any individual $j \in N$ to any individual $i \in N$ such that $c'_j > c'_i$, induces a new equilibrium consumption vector $\mathbf{c}''$ where*

[14] By increasing population size we reduce the impact of each individual's consumption on the social status of anyone else. Hence, everyone's reactivity to others consuming more reduces.

i) $c_i'' > (=)\, c_i' \quad \Leftrightarrow \quad \dfrac{\partial \Psi_i(\mathbf{c}', \tau_i)}{\partial c_j} \dfrac{\partial \Psi_j(\mathbf{c}', \tau_j)}{\partial \tau} > (=) \dfrac{\partial \Psi_i(\mathbf{c}', \tau_i)}{\partial \tau}$

ii) $c_j'' > (=)\, c_j' \quad \Leftrightarrow \quad \dfrac{\partial \Psi_j(\mathbf{c}', \tau_j)}{\partial c_i} \dfrac{\partial \Psi_i(\mathbf{c}', \tau_i)}{\partial \tau} > (=) \dfrac{\partial \Psi_j(\mathbf{c}', \tau_j)}{\partial \tau}$

where $\tau_1 \in \Re$ and $\tau_j \in \Re$ are the transfers already obtained by, respectively, i and j.

Proof. Taking into account the definition of $\Psi_i(c_j, \tau)$ and $\Psi_j(c_i, \tau)$, we can define

$$F_i \equiv \Psi_i(\Psi_j(c_i, (\tau_j - q)), \tau_i) - c_i = 0 \tag{4.13}$$

$$F_j \equiv \Psi_j(\Psi_i(c_j, \tau_i), (\tau_j - q)) - c_j = 0 \tag{4.14}$$

Since individuals in $N \setminus \{i, j\}$ cannot change their consumption choices, the system made of (4.13) and (4.14) identifies, for any value of q, the new equilibrium consumption choice c_i'' and c_j''. By assumption AI1 follows that $\partial F_i / \partial c_i < 0$ and $\partial F_j / \partial c_j < 0$. Therefore, by the implicit function theorem and AI2 we obtain

$$\frac{\mathrm{d}c_i}{\mathrm{d}q} = -\frac{\frac{\partial \Psi_i}{\partial c_j}\left(-\frac{\partial \Psi_j}{\partial \tau}\right) + \frac{\partial \Psi_i}{\partial \tau}}{\frac{\Psi_i}{\partial c_j}\frac{\partial \Psi_j}{\partial c_i} - 1} \geq 0 \Leftrightarrow \frac{\partial \Psi_i}{\partial c_j}\frac{\partial \Psi_j}{\partial \tau} \leq \frac{\partial \Psi_i}{\partial \tau} \tag{4.15}$$

$$\frac{\mathrm{d}c_j}{\mathrm{d}q} = -\frac{\frac{\partial \Psi_j}{\partial c_i}\frac{\partial \Psi_i}{\partial \tau} - \frac{\partial \Psi_j}{\partial \tau}}{\frac{\Psi_j}{\partial c_i}\frac{\partial \Psi_i}{\partial c_j} - 1} \leq 0 \Leftrightarrow \frac{\partial \Psi_j}{\partial c_i}\frac{\partial \Psi_i}{\partial \tau} \leq \frac{\partial \Psi_j}{\partial \tau} \tag{4.16}$$

where all derivatives are opportunely evaluated at either $(\mathbf{c}', \tau_i)$ or $(\mathbf{c}', \tau_j)$.■

On the basis of Proposition 13 and 14 we can study how equilibrium welfare and equilibrium labour supply are affected by a marginal transfer. The following corollary illustrates the possible outcomes and the conditions under which they take place.

Corollary 10 *Consider Ω and suppose that both AI1 and AI2 hold. Let $\mathbf{c}' \in \Re^n_+$ be the consumption vector associated with the equilibrium $\mathbf{h}^{*\prime}$ and the vector of transfers $\tau \equiv (\tau_1, \ldots, \tau_n) \in R^n$, $\sum_{k=1}^{n} \tau_k = 0$. Then, a marginal income transfer $\mathrm{d}q > 0$ from any individual $j \in N$ to any individual $i \in N$ such that $c'_j > c'_i$ induces a new equilibrium consumption vector $\mathbf{c}''$ where*

a) if $\dfrac{\partial \Psi_i}{\partial c_j}\dfrac{\partial \Psi_j}{\partial \tau} \leq \dfrac{\partial \Psi_i}{\partial \tau}$ *and* $\dfrac{\partial \Psi_j}{\partial c_i}\dfrac{\partial \Psi_i}{\partial \tau} \geq \dfrac{\partial \Psi_j}{\partial \tau}$ *with at least one strict inequality, then*

i) $V^l(\mathbf{h}^{*\prime\prime}) < V^l(\mathbf{h}^{*\prime})$ *for any* $l \in N \setminus \{i\}$ *and* $h_l^{*\prime\prime} > h_l^{*\prime}$ *for any* $l \in N \setminus \{i, j\}$,

b) if $\dfrac{\partial \Psi_i}{\partial c_j}\dfrac{\partial \Psi_j}{\partial \tau} \geq \dfrac{\partial \Psi_i}{\partial \tau}$ *and* $\dfrac{\partial \Psi_j}{\partial c_i}\dfrac{\partial \Psi_i}{\partial \tau} \leq \dfrac{\partial \Psi_j}{\partial \tau}$ *with at least one strict inequality, then*

ii) $V^l(\mathbf{h}^{*\prime\prime}) > V^l(\mathbf{h}^{*\prime})$ *for any* $l \in N \setminus \{j\}$ *and* $h_l^{*\prime\prime} < h_l^{*\prime}$ *for any* $l \in N \setminus \{i, j\}$,

c) if $\dfrac{\partial \Psi_i}{\partial c_j}\dfrac{\partial \Psi_j}{\partial \tau} < \dfrac{\partial \Psi_i}{\partial \tau}$ *and* $\dfrac{\partial \Psi_j}{\partial c_i}\dfrac{\partial \Psi_i}{\partial \tau} < \dfrac{\partial \Psi_j}{\partial \tau}$, *then there exists* $\bar{\gamma}$ *such that* $\gamma < \bar{\gamma}$ *implies i) of case a),* $\gamma > \bar{\gamma}$ *implies ii) of case b) and* $\gamma = \bar{\gamma}$ *implies that, for any* $l \in N \setminus \{i, j\}$, $V^l(\mathbf{h}^{*\prime\prime}) = V^l(\mathbf{h}^{*\prime})$ *and* $h_l^{*\prime\prime} = h_l^{*\prime}$.

with all derivatives are opportunely evaluated at either $(\mathbf{c}', \tau_i)$ *or* $(\mathbf{c}', \tau_j)$.

Proof. Let $\hat{c}_i \equiv c'_i + \mathrm{d}c_i(\mathrm{d}q)$, $\hat{c}_j \equiv c'_j + \mathrm{d}c_j(\mathrm{d}q)$ and consider first case a). By Proposition 14 follows that $\hat{c}_i \geq c'_i$ and $\hat{c}_j \geq c'_j$ with at least one strict inequality. Since $V^l_{c_l}$ is strictly increasing in any c_k, $k \neq l$, and since either $\hat{c}_i > c'_i$ or $\hat{c}_j > c'_j$, by Lemma 1 and Lemma 2 we obtain that $h_l^{*\prime\prime} > h_l^{*\prime}$ for any $l \in N \setminus \{i, j\}$ which, in turn, implies $h^{*\prime\prime}_j > \hat{h}_j \geq h^{*\prime}_j$. Furthermore, from the fact that $V^l_{c_k} < 0$ for any $l \neq k$ and $c'' > c'$ for any $l \in N \setminus \{i\}$, follows that $V^l(\mathbf{h}^{*\prime\prime}) < V^l(\mathbf{h}^{*\prime})$ for any $l \in \setminus \{i\}$, since only i may have benefitted by the transfer. An analogous proof applies to case b).

Finally, consider case c). By Proposition 14 follows that $\hat{c}_i > c'_i$ and $\hat{c}_j < c'_j$. Hence, by Proposition 13 there exists $\bar{\gamma}$ such that $\gamma > (<)\ (=)\ \bar{\gamma}$ implies that $r_l(\hat{\mathbf{c}}, \gamma) > (<)\ (=)\ r_l(\mathbf{c}', \gamma)$ for any $l \in N \setminus \{j\}$ $(\{i\})$ $(\{i, j\})$. Therefore, since $V^l_{c_l}$

is strictly decreasing in r_l, by Lemma 1 and Lemma 2 follows that $\gamma > (<)\ (=)\ \bar{\gamma}$ implies that $h_l^{*\prime\prime} < (>)\ (=)\ h_l^{*\prime}$ for any $l \in N \setminus \{i,j\}$. This in turn implies that, for any $l \in N \setminus \{i,j\}$, $V^l(\mathbf{h}^{*\prime\prime}) < (>)\ (=)\ V^l(\mathbf{h}^{*\prime\prime})$ because $V_{c_k}^l < 0$ for any $l \neq k$. Furthermore, since any transfer of income from j to i by itself benefits i and damages j, we have that if $\gamma < \bar{\gamma}$ then $V^j(\mathbf{h}^{*\prime\prime}) < V^j(\mathbf{h}^{*\prime\prime})$ and if $\gamma > \bar{\gamma}$ then $V^i(\mathbf{h}^{*\prime\prime}) > V^i(\mathbf{h}^{*\prime\prime})$.■

Remark 1. The cases a), b) and c) of Corollary 10 are exhaustive under AI1 and AI2. In fact,

$$\begin{cases} \dfrac{\partial\Psi_i}{\partial c_j}\dfrac{\partial\Psi_j}{\partial\tau} \geq \dfrac{\partial\Psi_i}{\partial\tau} \\ \\ \dfrac{\partial\Psi_j}{\partial c_i}\dfrac{\partial\Psi_i}{\partial\tau} \geq \dfrac{\partial\Psi_j}{\partial\tau} \end{cases} \Rightarrow \frac{\partial\Psi_i}{\partial c_j}\frac{\partial\Psi_j}{\partial\tau}\frac{\partial\Psi_j}{\partial c_i}\frac{\partial\Psi_i}{\partial\tau} \geq \frac{\partial\Psi_i}{\partial\tau}\frac{\partial\Psi_j}{\partial\tau} \Rightarrow \frac{\partial\Psi_i}{\partial c_j}\frac{\partial\Psi_j}{\partial c_i} \geq 1$$

which is impossible. Moreover, if $\partial\Psi_j/\ \partial\tau = \partial\Psi_i/\ \partial\tau$ then both case a) and b) are impossible while if $\partial\Psi_j/\ \partial\tau > \partial\Psi_i/\ \partial\tau$ then case b) is impossible and if $\partial\Psi_j/\ \partial\tau < \partial\Psi_i/\ \partial\tau$ then case a) is impossible.

Corollary 10 shows that the impact of a marginal transfer which goes in the direction of a more pairwise equal distribution depends on three things. First, the reactiveness of people's consumption choices to others' consumption choices, i.e. how Ψ_k changes in c_l, $l \neq k$. Second, the reactiveness of people's consumption choices to changes in personal income, i.e. how Ψ_k changes in τ_k. Third, the degree of upward-looking, i.e. the actual level of γ. It must be also noted that both the reactiveness to others' choice and the reactiveness to personal income are indirectly influenced by the degree of upward-looking since the latter affects $r(c_l, A_l)$ and, hence, marginal utility of consumption.

Let me go through cases a), b) and c) and clarify the economic meaning of the conditions which imply them.

Case a) takes place when the poorer individual, say i, is more reactive to an increase in her own income than to an increase in the consumption of some richer individual, say j, and at the same time j is more reactive to an increase of i's consumption than to an increase of her own income. In such a case, giving a unit of j's income to i makes at least all but i worse off since the consumption of both i and j increases and, hence, everyone else increases her own consumption and labour supply in order to keep up with i and j (and, as a consequence of this, every individual further increases both consumption and labour supply to keep up with everyone else). Notice that also i can end up being worse off and/or supplying more labour, provided that the social comparison effect is strong enough. So, it may happen that a marginal transfer that goes in the direction of a more pairwise equal distribution produces a lower welfare and a greater total consumption. This situation may be determined by a marked downward-looking behaviour that, in terms of social comparisons, makes i's consumption more relevant than j's. Another determinant may be that agents show a responsiveness to income transfers which is increasing in consumption.

Case b) is the opposite of case a). It takes place when j is more reactive to an increase in her own income than to an increase in i's consumption and, at the same time, i is more reactive to an increase of j's consumption than to an increase of her own income. So, giving a unit of j's income to i makes at least all but j better off since the consumption of both i and j reduces and, hence, everyone else reduces her own consumption and labour supply because there is less pressure to keep up with i and j (and, as a consequence of this, everyone further reduces consumption and labour supply). Notice that, somehow analogously to case a), also j can end up being better off and/or supplying less labour, provided that the social comparison effect is strong enough. Therefore, it may happen that a marginal transfer which goes in the direction of a more pairwise equal distribution produces a higher welfare and a smaller aggregate consumption. As opposed to case a), this situation may be determined by a marked upward-looking and/or by the fact that agents' positive responsiveness to income transfers is markedly decreasing in consumption.

Case c) is, in a certain sense, midway from case a) and case b). It takes place when both i and j are more reactive to an increase in their own income than to an increase in other's income. In such a circumstance, giving a unit of j's income to i induces, *ceteris paribus*, the former to reduce consumption and the latter to increase it. How the remaining individuals react to i' and j's new choices depends on the degree of upward-looking. In particular, the equilibrium outcome can be either like case a), like case b) or can be such that individuals not involved in the transfer are completely unaffected. In general, for any given change in i's and j's consumption, there exists a degree of upward-looking $\bar{\gamma}$ which leaves individuals not involved in the transfer, $N \setminus \{i, j\}$, with the same social status and, hence, with the same welfare and labour supply in the new equilibrium. For degrees of upward-looking greater than $\bar{\gamma}$, individuals in $N \setminus \{i, j\}$ experience an increase of their social status since they are more concerned with the reduce of j's consumption than with the increase of i's one. Therefore, they reduce both their consumption and labour supply because the overall pressure due to social comparison is lower, producing a situation like case b). For analogous reasons, an outcome similar to case a) happens for degrees of upward-looking which are lower than $\bar{\gamma}$.

A careful examination of a), b) and c) shows that the relationship between the reactiveness to a marginal increase of own income and the reactiveness to an increase in others' consumption plays a relevant role. More precisely, under the following hypothesis

AI3. $\dfrac{\partial \Psi_l}{\partial \tau} > \dfrac{\partial \Psi_l}{\partial c_k}$ for any $k \neq l$ and $l, k \in N$.

case a) and b) are impossible. Assumption AI3 means that when individuals are given an extra unit of income they increase their consumption more than when they observe any other individual consuming an extra unit.

Although at first this assumption may seem a little too restrictive, one must bear in mind that people compare themselves with a number of other individuals and, therefore, the reactiveness to a greater consumption of just one of them is likely to be smaller than the reactiveness to a greater own income. In other terms, the incentive to consume due to social comparison must be much stronger than standard material incentives in order for AI3 to not be satisfied. Even though such a case is not impossible, it seems rather exceptional.[15]

Moreover, AI3 allows to extend the analysis to transfers which are larger than a single unit of income.

PROPOSITION 15 *Consider* Ω *and suppose that both AI1, AI2 and AI3 hold. Let* $\mathbf{c}' \in \Re^n_+$ *be the consumption vector associated with the equilibrium* $\mathbf{h}^{*\prime}$ *and the vector of transfers* $\tau \equiv (\tau_1, \ldots, \tau_n) \in R^n$, $\sum_{k=1}^n \tau_k = 0$. *Then, for any income transfer* $q > 0$ *from an individual* $j \in N$ *to an individual* $i \in N$ *such that* $c'_j > c'_i$ *and* $q < (c'_j - c'_i)$, *there exists* $\bar{\gamma} \in \Re$ *such that*

i) if $\gamma < \bar{\gamma}$ *then* $V^l(\mathbf{h}^{*\prime\prime}) < V^l(\mathbf{h}^{*\prime})$ *for any* $l \in N \setminus \{i\}$ *and* $h_l^{*\prime\prime} > h_l^{*\prime}$ *for any* $l \in N \setminus \{i, j\}$,

ii) if $\gamma = \bar{\gamma}$ *then* $V^l(\mathbf{h}^{*\prime\prime}) = V^l(\mathbf{h}^{*\prime})$ *and* $h_l^{*\prime\prime} = h_l^{*\prime}$ *for any* $l \in N \setminus \{i, j\}$,

iii) if $\gamma > \bar{\gamma}$ *then* $V^l(\mathbf{h}^{*\prime\prime}) > V^l(\mathbf{h}^{*\prime})$ *for any* $l \in N \setminus \{j\}$ *and* $h_l^{*\prime\prime} < h_l^{*\prime}$ *for any* $l \in N \setminus \{i, j\}$,

where $\mathbf{h}^{*\prime\prime}$ *is the new equilibrium induced by the transfer* q.

Proof. From AI1 and AI2 follows that, for any $k \neq l$, the inequality

[15] Recent empirical evidence suggests that *everyone else* consuming one more unit has a negative impact on welfare which is of the same order of magnitude than the positive effect exerted by one more unit of personal income (Stutzer (2004), Luttmer (2005), Ferrer-i-Carbonell (2005)). It is reasonable to expect that the reactiveness to others' consumption and own income follow a pattern which is not very dissimilar from this one.

$$\frac{\partial \Psi_l}{\partial c_k}\frac{\partial \Psi_k}{\partial \tau} \geq \frac{\partial \Psi_l}{\partial \tau} \tag{4.17}$$

is satisfied only if $\partial\Psi_l/\partial c_k \geq \partial\Psi_l/\partial\tau$. Hence, AI3 implies that (4.19) is never satisfied. Therefore, case c) of Proposition 14 is the only possible result of a marginal transfer dq. Let

$$\hat{c}_i \equiv c_i' + \int_0^q \frac{\mathrm{d}c_i}{\mathrm{d}s}\mathrm{d}s \tag{4.18}$$

$$\hat{c}_j \equiv c_j' + \int_0^q \frac{\mathrm{d}c_j}{\mathrm{d}s}\mathrm{d}s \tag{4.19}$$

By Proposition 14 follows that $\mathrm{d}c_i/\mathrm{d}q > 0$ and $\mathrm{d}c_j/\mathrm{d}q < 0$ implying that $\hat{c}_i > c_i'$ and $\hat{c}_j < c_j'$. Since, by hypothesis, $\partial\Psi_i/\partial\tau \leq 1$, $\partial\Psi_j/\partial\tau \leq 1$ and $q < (c_j' - c_i')$, from $\hat{c}_i > c_i'$ and $\hat{c}_j < c_j'$ follows that $\hat{c}_i < c_j'$ and $\hat{c}_j > c_i'$. Hence, by Proposition 13 there exists $\bar{\gamma}$ such that $\gamma > (<)\ (=)\ \bar{\gamma}$ implies that $r_l(\hat{\mathbf{c}}, \gamma) > (<)\ (=)\ r_l(\mathbf{c}', \gamma)$ for any $l \in N \setminus \{j\}\ (\{i\})\ (\{i,j\})$. Then, i), ii) and iii) are proved as in Corollary 10.■

Proposition 15 is about the outcome of transfers between any two individuals that have not the same income and where the poorest receives income from the richest up to the difference between the current income of the latter and that of the former. Proposition 15 establishes that, under AI1-AI3, for any such transfer there exists a degree of upward-looking $\bar{\gamma}$ which leaves people not directly involved in the transfer totally unaffected by it because their perceived social status remains the same. Furthermore, for $\gamma > \bar{\gamma}$ people not directly involved in the transfer perceive an increase in their social status because the consumption reduction of the rich individual more than compensate the greater consumption of the poor individual and, therefore, they reduce their labour supply (and consumption) and get better off. The opposite happens for $\gamma > \bar{\gamma}$.

Notice that, in general, there exists one such $\bar{\gamma}$ for *each* transfer. Intuitively, $\bar{\gamma}$ is obtained by equating, for any individual not directly involved in the transfer, the status perceived before transfer – i.e. in the initial equilibrium – and that perceived after the adjustment done by the two individuals directly involved but before any other adjusts. So, $\bar{\gamma}$ directly depends on the initial equilibrium consumption vector and the adjusted consumption of the individuals involved in the transfer. These, however, depends on the past transfers, τ, the entity of the transfer, q, and utility functions, $\{V^i\}_{i \in N}$. The latter in turn depends on the actual degree of upward-looking γ.

At this level of generality, it is not easy to figure out how $\bar{\gamma}$ is affected by a change in the relevant parameters and variables of the model. Nevertheless, we can obtain some information by comparing the adjustments done by the two individuals involved in the transfer with their initial equilibrium consumption. Let j be the rich individual and i the poor one and $\hat{c}_j$ and $\hat{c}_i$ their adjusted consumption. If $(\hat{c}_i + \hat{c}_j) = (c_i + c_j)$ then, as suggested by Corollary 9, $\bar{\gamma} = 1$. This means that whenever the consumption reduction by the rich is of the same magnitude of the increase by the poor, then upward-looking implies that other people reduce labour and get better off while downward-looking implies that other people increase labour and get worse off.

Let $\chi \equiv (c_j - \hat{c}_j)/(\hat{c}_i - c_i)$ be the ratio between the reduce of j's consumption and the increase of i's consumption. If $\chi > 1$ then $\bar{\gamma} < 1$ while if $\chi < 1$ then $\bar{\gamma} > 1$. More in general, $\bar{\gamma}$ is decreasing in χ because the smaller $(c_j - \hat{c}_j)$ is with respect to $(\hat{c}_i - c_i)$, the greater the gain of the poor is with respect to the loss of the rich and, hence, the higher $\bar{\gamma}$ must be in order to equate the status perceived before the transfer with that perceived after the adjustment done by i and j. Therefore, everything which increases j's negative reactiveness to the transfer and/or increases i's positive reactiveness to the transfer is likely to increase $\bar{\gamma}$.

4.3.3 Further comments: Supportive Empirical Evidence and Status cardinality

This study shows that, in the presence of social comparison, the effects of an income transfer which goes in the direction of a more pairwise equal distribution depend crucially on the degree of upward-looking. If people are sufficiently upward-lookers then welfare improves and consumption/labour reduces for at least everyone but the individual whose income reduces. Otherwise, welfare reduces and consumption increases for at least everyone but the individual whose income reduced (a part from the case of $\gamma = \bar{\gamma}$). This suggest that upward-looking behaviour creates a positive relationship between inequality and consumption/labour as well as a negative relationship with inequality and welfare, whereas downward-looking behaviour creates relationships of opposite signs.

As Bowles and Park (2005) have recently pointed out, the evidence about the correlation between inequality and work time can be – at least in part – explained by means of social comparison and a particular case of upward-looking behaviour.[16] The model presented here provides a possible generalization of the Veblenian ideas embedded in the utility function they propose.[17] More precisely, Bowles and Park (2005) assume that individuals only care about the consumption of people belonging to the social strata directly above them, obtaining that negative externalities goes only downwards. My model shows that, in order to have a positive correlation between inequality and work hours – as well as a negative relationship between welfare and inequality – people need not look at their next social strata only, provided that they show a sufficiently high degree of upward-looking.

[16]Other explanations of this correlation exists. For instance, Bell and Freeman (2001) suggest that inequality induces longer work hours because those who work longer are likely to obtain a higher status in terms of the wage distribution at their workplace. Hence, a more unequal wage distribution implies a greater wage gain and, therefore, a greater incentive to work long hours. Bell and Freeman (2001) also provide evidence of this effect for the US and Germany.

[17]In addition, the present study explicitly takes into account strategic issues and develops both a statical and a dynamical analysis of equilibria.

Furthermore, it is interesting to compare the results provided here with those of Hopkins and Kornienko (2004, 2006). In Hopkins and Kornienko (2004) it is shown that a more equal distribution is a bad for poor people while it has an ambiguous impact on middle and high income people. Moreover, a more equal distribution can increase conspicuous consumption of either poor, rich, or middle income people. As the authors themselves point out in Hopkins and Kornienko (2006), such results rest on the particular way in which comparative statics is carried out. Since people's welfare is evaluated for given income, if we suppose that we are comparing the welfare of a the same poor individual in the two distributions then it must be that her income has not increased. Since for any level of income some poor individuals have their income increased (otherwise the distribution would not be more equal) the poorest individuals which have their income not increased find their status reduced. In Hopkins and Kornienko (2006) a different way to evaluate the impact of inequality on welfare under social comparison is proposed. Instead of comparing the utility of individuals with the same income (but possibly different status) in the two distribution, they suggest to compare utility of individuals having the same status (but possibly different income). They find that income dispersion matters a lot and, in particular, that a more equal distribution (i.e. redistributing income from the rich to the poor) can make the poorest better off but makes everyone else worse off, even those who have their income increase or constant. This result rests on the hypothesis of a purely *ordinal* notion of social status. In fact, under ordinal status people are indifferent about how much others consume as long as the number of those consuming strictly more and strictly less than them does not change. Therefore, for an individual who is left with the same income a more equal distribution is a bad (good) thing only if it moves more (less) people from below her to above her than people from above her to below her or requires him to consume more (less) in order to keep the same status. Indeed, increasing the income of some among the very poor and decreasing the income of some among the very rich has a small effect if few people's status is affected. Since more equality makes people nearer in terms of consumption it increases the return to consumption because it increases the number of people one can outperform by increasing her own consumption. In other words it increases the competition for status which depresses people's utility. Poorest people suffer too from this drawback of a more equal competition but their higher income more than compensate for it. This does not hold for the remaining people (including possibly some poor people who have their income increased) which find themselves worse off.

Different results arise in the model proposed here because status is assumed to be cardinal and not ordinal. More precisely, people do not care about how many individuals have above or under them but, instead, they care about the relative distance between their actual consumption and a power mean of others' consumption – where the actual power of the mean represents the degree of upward-looking. Although ordinal status has a long tradition in the literature on social comparison (Frank (1985a,b, 1999, 2005)) it seems questionable, at least in the pure form proposed by Hopkins and Kornienko (2004, 2006). The social status which is associated with a certain level of consumption should take into account the distance from the level of consumption shown by the terms of comparison. For instance, it seems implausible that the social status of an individual is unaffected by a substantial increase in the income of all individuals who are currently richer than her.

Cardinality also offers a richer variety of cases with respect to ordinality. This is due to the fact that it allows for the degree of upward-looking. In fact, depending on the degree of upward-looking, the perceived status can vary sensibly with a wide range of potential effects on either welfare and labour supply (consumption). Depending on γ, a more equal distribution can be welfare increasing and labour reducing for everybody, for someone welfare increasing and labour reducing and for someone else welfare decreasing and labour increasing, or welfare decreasing and labour increasing for everybody. With ordinal status this interesting feature is lost because the distance from another individual cannot be non-linearly weighted.

Finally, let me clarify what happens if the simplifying assumption of a fully connected society is relaxed. Results do not change at all for the people who, either directly or indirectly, observe both individuals involved in the transfer. Those who observe only the individual who increases her consumption react by consuming more and, in the new equilibrium, are worse off. The opposite is true for those observing only the individual who reduces her consumption.

4.4 Appendix

4.4.1 Concavity and Equilibrium Uniqueness

The following elementary results about equilibrium uniqueness are found in Kennan (2001). Let f be a function from $\Re^n$ to $\Re^n$ and $g \equiv f(\mathbf{x}) - \mathbf{x}$.

Definition 3 *A function $g : \Re^n \to \Re^n$ is radially quasi-concave if $g(\mathbf{x}) = 0$ and $x > 0$ implies $g(\lambda \mathbf{x}) \geq 0$, $0 \leq \lambda \leq 1$. If, in addition, $0 < \lambda < 1$ implies $g(\lambda \mathbf{x}) > 0$, then g is strictly radially concave.*

Definition 4 *A function $g = (g_1, \ldots, g_n) : \Re^n \to \Re^n$ is quasi-increasing if for any $\mathbf{x}, \mathbf{y} \in \Re^n$ such that $y_i = x_i$ and $y_j \geq x_j$ for all $j \neq i$, $g_i(\mathbf{y}) \geq g_i(\mathbf{x})$.*

Notice that g is quasi-increasing if and only if f is quasi-increasing.

Theorem 6 *If g is quasi-increasing and strictly radially concave function from $\Re^n$ to $\Re^n$ then there exists at most one positive vector $\mathbf{x}$ such that $g(\mathbf{x}) = 0$.*

Since strict concavity of f implies strict radial concavity of g, we get

Corollary 11 *If f is an increasing and strictly concave function from $\Re^n$ to $\Re^n$, then it has at most one positive fixed point.*

4.4.2 Proof of Lemma 6

Consider $\mathbf{x} > 0$ and $\mathbf{y} > 0$ satisfying the hypothesis of Lemma 6. Suppose, without any loss of generality, that $x_1 > y_1 \geq y_2 > x_2$. The inequality $A(\mathbf{x}, \gamma) \geq A(\mathbf{y}, \gamma)$ can be rewritten as

$$\left(\frac{1}{n}\sum_{i=1}^{n} x_i^\gamma\right)^{\frac{1}{\gamma}} \geq \left(\frac{1}{n}\sum_{i=1}^{n} y_i^\gamma\right)^{\frac{1}{\gamma}} \tag{4.20}$$

which is equivalent to the following three conditions

$$x_1^\gamma + x_2^\gamma \geq y_1^\gamma + y_2^\gamma \quad \text{if } \gamma > 0 \tag{4.21}$$

$$x_1 x_2 \geq y_1 y_2 \quad \text{if } \gamma = 0 \tag{4.22}$$

$$x_1^\gamma + x_2^\gamma \leq y_1^\gamma + y_2^\gamma \quad \text{if } \gamma < 0 \tag{4.23}$$

Further manipulations of (4.21) and (4.23) give

$$x_1 \geq (y_1^\gamma + y_2^\gamma - x_2^\gamma)^{\frac{1}{\gamma}} \qquad \text{if } \gamma > 0 \tag{4.24}$$

$$x_2 \geq (y_1^\gamma + y_2^\gamma - x_1^\gamma)^{\frac{1}{\gamma}} \qquad \text{if } \gamma < 0 \tag{4.25}$$

which is meaningful since $y_2^\gamma - x_2^\gamma > 0$ whenever $\gamma > 0$ and $y_2^\gamma - x_1^\gamma > 0$ whenever $\gamma < 0$. Let us study the righthand side of (4.24) as a function of γ. By applying De l'Hopital derivation rule we get

$$\lim_{\gamma \to 0^+} \frac{\ln\left(y_1^\gamma + y_2^\gamma - x_2^\gamma\right)}{\gamma} = \lim_{\gamma} \frac{\ln(y_1)y_1^\gamma + \ln(y_2)y_2^\gamma - \ln(x_2)x_2^\gamma}{y_1^\gamma + y_2^\gamma - x_2^\gamma} = \ln\left(\frac{y_1 y_2}{x_2}\right)$$

implying that

$$\lim_{\gamma \to 0^+} (y_1^\gamma + y_2^\gamma - x_2^\gamma)^{1/\gamma} = \frac{y_1 y_2}{x_2} \tag{4.26}$$

Moreover,

$$\lim_{\gamma\to+\infty}(y_1^\gamma+y_2^\gamma-x_2^\gamma)^{1/\gamma}=\lim_{\gamma\to+\infty}y_1\left[1+\left(\frac{y_2}{y_1}\right)^\gamma-\left(\frac{x_2}{y_1}\right)^\gamma\right]^{1/\gamma}=y_1 \tag{4.27}$$

Let me show now that $(y_1^\gamma+y_2^\gamma-x_2^\gamma)^{\frac{1}{\gamma}}$ is strictly decreasing in $\gamma>0$. Define

$$D\equiv(a^\alpha+b^\alpha-c^\alpha)^{\frac{1}{\alpha}}-(a+b-c) \tag{4.28}$$

where $\alpha>1$. By differentiating D with respect to c we get

$$\frac{\mathrm{d}D}{\mathrm{d}c}=1-\left[\frac{c}{(a^\alpha+b^\alpha-c^\alpha)^{\frac{1}{\alpha}}}\right]^{\alpha-1} \tag{4.29}$$

which is positive whenever $c>(a^\alpha+b^\alpha-c^\alpha)^{\frac{1}{\alpha}}$.

Now, set $\alpha\equiv\gamma'/\gamma''$, $a\equiv y_1^{\gamma''}$, $b\equiv y_2^{\gamma''}$ and $c\equiv x_2^{\gamma''}$ where, of course, $\gamma'>\gamma''$. Then,

$$D=\left(y_1^{\gamma'}+y_2^{\gamma'}-x_2^{\gamma'}\right)^{\frac{\gamma''}{\gamma'}}-\left(y_1^{\gamma''}+y_2^{\gamma''}-x_2^{\gamma''}\right)<0\Leftrightarrow$$
$$\Leftrightarrow\left(y_1^{\gamma'}+y_2^{\gamma'}-x_2^{\gamma'}\right)^{\frac{1}{\gamma'}}-\left(y_1^{\gamma''}+y_2^{\gamma''}-x_2^{\gamma''}\right)^{\frac{1}{\gamma'}}<0$$

and in addition we get

$$y_1\geq y_2>x_2\Leftrightarrow y_1^{\gamma''}\geq y_2^{\gamma''}>x_2^{\gamma''}\Rightarrow a+b>2c\Leftrightarrow \tag{4.30}$$
$$\Leftrightarrow a^\alpha+b\alpha>2c^\alpha\Leftrightarrow(a^\alpha+b^\alpha-c^\alpha)^{\frac{1}{\alpha}}>c \tag{4.31}$$

which implies that (4.29) is positive as long as $x_2<y_2$. Moreover, notice that if $x_2=y_2$ then (4.29) is still positive if $y_1>y_2$ and equals zero if $y_1=y_2$. Therefore, by setting $c=b$ we obtain a majorization of D reduces, namely

$$D < (a^{\alpha} + b^{\alpha} - b^{\alpha})^{\frac{1}{\alpha}} - (a + b - b) = (a^{\alpha})^{\frac{1}{\alpha}} - a = 0 \tag{4.32}$$

Hence $(y_1^{\gamma} + y_2^{\gamma} - x_2^{\gamma})^{\frac{1}{\gamma}}$ is strictly decreasing in $\gamma > 0$. Symmetric arguments show that

$$\lim_{\gamma \to 0^-} (y_1^{\gamma} + y_2^{\gamma} - x_1^{\gamma})^{1/\gamma} = \frac{y_1 y_2}{x_1} \tag{4.33}$$

$$\lim_{\gamma \to -\infty} (y_1^{\gamma} + y_2^{\gamma} - x_1^{\gamma})^{1/\gamma} = y_2 \tag{4.34}$$

and that $(y_1^{\gamma} + y_2^{\gamma} - x_1^{\gamma})^{\frac{1}{\gamma}}$ is strictly monotonically decreasing in $\gamma < 0$.

Finally, notice that $(y_1^{\gamma} + y_2^{\gamma} - x_2^{\gamma})^{\frac{1}{\gamma}}$ has a lower bound in $y_1 y_2 / x_2$ for $\gamma > 0$ and in $y_1 y_2 / x_1$ for $(y_1^{\gamma} + y_2^{\gamma} - x_1^{\gamma})^{\frac{1}{\gamma}}$. Therefore, if $x_1 x_2 < y_1 y_2$, then there exists one and only one $\bar{\gamma} > 0$ such that (4.24) is satisfied with strict inequality for any $\gamma > \bar{\gamma}$, with equality for $\gamma = \bar{\gamma}$ and it is not satisfied for $0 < \gamma < \bar{\gamma}$. In addition, (4.22) and (4.25) are never satisfied. If, instead, $x_1 x_2 > y_1 y_2 / x_1$ then, there exists one and only one $\bar{\gamma} < 0$ such that (4.25) is satisfied with strict inequality for any $\gamma > \bar{\gamma}$, with equality for $\gamma = \bar{\gamma}$ and it is not satisfied for $\gamma < \bar{\gamma}$. Moreover, (4.22) and (4.25) are never satisfied. Finally, if $x_1 x_2 = y_1 y_2$, then neither (4.24) nor (4.25) are ever satisfied and (4.22) is satisfied for $\gamma = \bar{\gamma} = 0$.■

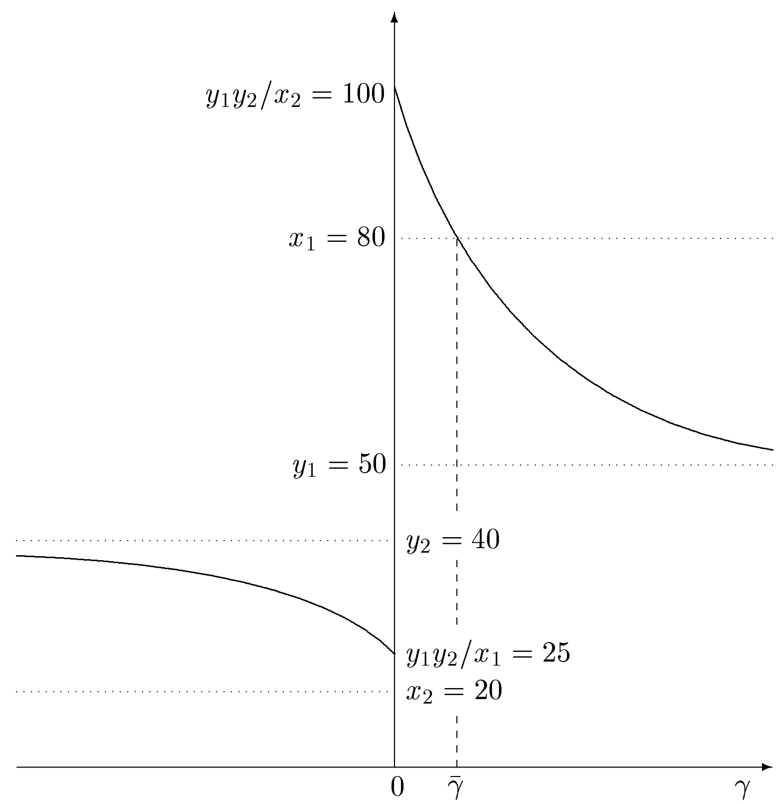

Figure 4.1. The graph of functions $(y_1^\gamma + y_2^\gamma - x_2^\gamma)^{\frac{1}{\gamma}}$ and $(y_1^\gamma + y_2^\gamma - x_1^\gamma)^{\frac{1}{\gamma}}$ for $x_1 = 80$, $x_2 = 30$, $y_1 = 50$, $y_2 = 40$ with the associated $\bar{\gamma}$.

Bibliography

S. N. Afriat. "The Construction of Utility Function from Expenditure Data". *International Economic Review*, (8):67–77, 1967.

R. G. D. Allen. "A Reconsideration of the Theory of Value II". *Economica*, (1):196–219, 1934.

F. Alpizar, F. Carlsson, and O. Johansson-Stenman. "How Much Do We Care About Absolute Versus Relative Income and Consumption?". *Journal of Economic Behavior & Organization*, (56):405–421, 2005.

L. S. Bagwell and B. D. Bernheim. "Veblen Effects in a Theory of Conspicuous Consumption". *American Economic Review*, (86):349–373, 1996.

L. Bell and R. Freeman. "The Incentive of Working Hard: Explaining Hours Worked Differences in the U.S. and Germany". *Labour Economics*, (8):181–202, 2001.

J. Bentham. *An Introduction to the Principles of Morals and Legislation.* T.Payne, London, 1789.

D. Blanchflower and A. Oswald. "Well-Being Over Time in Britain and the USA". *Journal of Public Economics*, (88):1359–1386, 2004.

M. Blaug. *The Methodology of Economics.* Cambridge Univesity Press, Cambridge, 1980.

A. Blinder. "Why Are Prices Sticky? Preliminary Results from an Interview Study". *American Economic Review*, (81):89–96, 1991.

B. L. Boulier and R. S. Goldfarb. "On the Use and Nonuse of Surveys in Economics". *Journal of Economic Methodology*, (5):1–21, 1998.

S. Bowles and Y. Park. "Emulation Inequality and Work Hours: Was Thorsten Veblen Right?". *The Economic Journal*, (115):F397–F412, 2005.

D. Broussolle. "Internal Consistency of Choice, Sen and the Spirit of Revealed Preferences: A Behaviorist Approach". *The Journa of Socio-Economics*, (34):605–620, 2005.

F. Carlssona, G. Guptab, and O. Johansson-Stenmanc. "Keeping Up with the Vaishyas: Caste and Relative Standing". *Working Papers in Economics, Göteborg University*, (171), 2005.

A. Clark, F. Etilé, F. Postel-Vinay, C. Senik, and K. Van der Straetens. "Heterogeneity in Reported Well-Being: Evidence from Twelve European Countries". *The Economic Journal*, (115):C118–C132, 2005.

A. Clark and R. J. Oswald. "Satisfaction and Comparison Income". *Journal of Public Economics*, (61):359–381, 1996.

A. Clark and R. J. Oswald. "Comparison-Concave Utility and Following Behavior in Social and Economic Settings". *Journal of Public Economics*, (70):133–155, 1998.

H. Cole, G. Mailath, and A. Postlewaite. "Social Norms, Savings Behavior, and Growth". *Journal of Political Economy*, (100):1092–1125, 1992.

H. Cole, G. Mailath, and A. Postlewaite. "Incorporating Concern for Relative Wealth into Economic Models". *Federal Reserve Bank of Minneapolis Quarterly Review*, (19):12–21, 1995.

H. Cole, G. Mailath, and A. Postlewaite. "Class Systems and Enforcement of Social Norms". *Journal of Public Economics*, (70):5–35, 1998.

M. Coleman and J. Pencavel. "Changes in Work Hours of Male Employee 1940-1988". *Industrial and Labor Relations Review*, (46):262–293, 1993a.

M. Coleman and J. Pencavel. "Trends in Market Works Behavior of Women Since 1940". *Industrial and Labor Relations Review*, (46):653–676, 1993b.

B. Cooper, C. Garcia-Penalosa, and P. Funck. "Status Effect and Negative Utility Growth". *Economic Journal*, (111):642–665, 2001.

G. Corneo and O. Jeanne. "On Relative Wealth Effects and the Optimality of Growth". *Economic Letters*, (54):87–92, 1997.

G. Corneo and O. Jeanne. "Social Organization, Status and Saving Behavior". *Journal of Public Economics*, (70):37–51, 1998.

E. Diener and R. Biwas-Diener. "Will Money Increase Subjective Well-Being?". *Social Indicators Research*, (57):119–169, 2002.

E. Diener and S. Oishi. "Money and Happiness: Income and Subjective Well-Being Across Nations?". *in Culture and Subjecive Well-Being*, (eds Diener E. and Suh E.M.):185–218, 2000.

A. Direr. "Interdependent Preferences and Aggregate Savings". *Annales d'Economie et Statistique*, (63-64):297–308, 2001.

J. S. Duesenberry. *Income, Savings and the Theory of Consumer Behaviour.* Harvard University Press, Cambridge, MA, 1949.

E. A. Easterlin. "Does Economic Growth Improve the Human Lot? Some Empirical Evidence". *Nations and Households in Economic Growth*, (eds. P.A. David):89–125, 1974.

E. A. Easterlin. "Will Rising the Incomes of All Increase the Happiness of All?". *Journal of Economic Behaviour & Organization*, (27):35–47, 1995.

E. A. Easterlin. "Income and Happiness: Toward a Unified Theory". *Economic Journal*, (111): 465–484, 2001.

R. Easterlin. *The Reluctant Economist*. Cambridge University Press, New York, 2004.

F. Echenique. "Comparative Statics by Adaptive Dynamics and the Corresponding Priciple". *Econometrica*, (70):833–844, 2002.

F. Echenique. "A Weak Corresponding Principle for Models with Complementarities". *Journal of Mathematical Economics*, (40):145–152, 2004.

F. Echenique and A. Edlin. "Mixed Equilibria in Games of Strategic Complements are Unstable". *Journal of cheno Economic Theory*, (118):61–79, 2004.

F. Y. Edgeworth. "Hedonical Calculus". *Mind*, (4):394–408, 1879.

A. Ferrer-i-Carbonell. "Income and Well-Being: An Empirical Analysis of the Comparison Income Effect". *Journal of Public Economics*, (89):997–1019, 2005.

A. Ferrer-i-Carbonell and P. Frijters. "How Important is Methodology for the Estimates of the Determinant of Happiness?". *The Economic Journal*, (114):641–659, 2004.

I. Fisher. *Mathematical Investigations in the Theory of Value and Prices*. Kelly (reprint 1991), New York, 1892.

R. H. Frank. *Choosing the Right Pond: Human Behavior and the Quest for Status*. Oxford University Press, New York, 1985a.

R. H. Frank. "The Demand for Unobservable and Other Positional Goods". *Economic Journal*, (111):642–665, 1985b.

R. H. Frank. *Luxury Fever: Why Money Fails to Satisfy in and Era of Excess*. Free Press, New York, 1999.

R. H. Frank. "Positional Externalities Cause Large and Preventable Welfare Losses". *American Economic Review*, (95), 2005.

B. Frey and A. Stutzer. *Happiness and Economics*. Princeton University Press, New Jersey, 2002a.

B. Frey and A. Stutzer. "What Can Economists Learn from Happiness Research?". *Journal of Economic Literature*, (40):402–435, 2002b.

B. Frey and A. Stutzer. "Reported Subjective Well-Being: A Challenge for Economic Theory and Economic Policy". *Schmollers Jahrbuch*, (124):191–231, 2004.

M. Friedman. "The Methodology of Positive Economics". *Essays in Positive Economics*, page University of Chocago Press, 1953.

V. Fuchs. *How We Live.* Harvard University Press, Cambridge, 1983.

P. Gabriel and S. Schmitz. "Leisure versus labour: What Do Recent Labour Market Trends Reveal About the 'Overworked American"'. *Proceedings of the Midwest Business Economics Association*, 2004.

P. Glimcher, M. Dorris, and H. Bayer. "Physiological Utility Theory and the Neuroeconomics of Choice". *Games and Economic Behavior*, (52):213–256, 2005.

F. Granot and A. F. Veinott. "Substitutes, Complements and Ripples in Network Flows". *Mathematics of Operations Research*, (10):471–497, 1985.

G. H. Hardy, J. E. Littlewood, and G. Pólya. *Inequalities.* Princeton University Press, New Jersey, 2002.

H. Hayakawa. "Bounded Rationality, Social Choice and Cultural Norms, and Interdependence via Reference Gropus". *Journal of Economic Behaviour & Organization*, (43):1–34, 2000.

H. Hayakawa and Y. Venieris. "Consumer Interdependence via Reference Groups". *Journal of Politcal Economy*, (85):599–616, 1977.

J. R. Hicks. "A Reconsideration of the Theory of Value I". *Economica*, (1):52–75, 1934.

A. R. Hochschild. *The Time Bind: When Work Becomes Home and Home Becomes Work.* Herny Holt & Company, New York, 1997.

H. Holländer. "On the Validity of Utility Statements: Standard Theory versus Duesenberry's". *Journal of Economic Behaviour & Organization*, (45):227–249, 2001.

E. Hopkins and T. Kornienko. "Running to Keep in the Same Place: Consumer Choice as Game of Status". *American Economic Review*, (94):1085–1107, 2004.

E. Hopkins and T. Kornienko. "Methods of Social Comparison in Games of Status". *Mimeo*, 2006.

M. Hout and C. Hanley. "The Overworked American Family: Trends and Non-Trends in Working Hours". *Russel Sage working paper*, 2005.

H. S. Houttaker. "Revealed Preference and the Utility Function". *Economica*, (17):159–174, 1950.

M. Huberman. "Working Hours of the World Unite? New International Evidence of Worktime". *Journal of Economic History*, (64):964–1001, 2004.

N. Ireland. "On Limiting the Market for Status Signals". *Journal of Public Economics*, (53):91–110, 1994.

N. Ireland. "Optimal Income Tax in the Presence of Status Effects". *Journal of Public Economics*, (81):193–212, 2001.

J. Jerry and K. Garson. "Overworked Individuals or Overworked Families?". *Work and Occupations*, (28):40–63, 2001.

S. Jevons. *The Theory of Political Economy.* 1888.

D. Kahneman and A. Krueger. “Developments in the Measurement of Subjective Well-Being”. *Journal of Economic Perspectives*, (20):3–24, 2006.

J. Kennan. “Uniqueness of Positive Fixed Points for Increasing Concave Functions on $\Re^n$: An Elementary Result”. *Review of Economic Dynamics*, (4):893–899, 2001.

C. Kenny. “Does Growth Cause Happiness or Does Happiness Cause Growth?”. *Kyklos*, (52):3–26, 1999.

C. Kenny. “Were People in the Poor and Miserable?”. *Kyklos*, (59):275–306, 2006.

R. Layard. *Happiness: Lessons From a New Science.* The Penguin Press, 2005.

R. Lester. “Shortcomings of Marginal Analysis for Wage-Employment Problems”. *American Economic Review*, (36):63–82, 1946.

G. Loewenstein and D. Schkade. “Wouldn’t It Be Nice? Predicting Future Feelings”. *in Well Being: The Foundations of Hedonic Psychology*, (Eds. Kahneman, D., Diener, E., Schwarz, N.): 85–105, 1999.

E. F. Luttmer. “Neighbors as Negatives: Relative Earnings and Well-Being”. *Quarterly Journal of Economics*, (120):936–1002, 2005.

F. Machlup. “Marginal Analysis and Empirical Research”. *American Economic Review*, (36): 518–554, 1946.

F. Machlup. *Essays on Economics Semantics.* Prentice Hall, Englewood Cliffs, 1963.

C. F. Manski. “Economic Analysis of Social Interactions”. *Journal of Economic Perspectives*, (14): 115–136, 2000.

A. Marshall. *Priciples of Economics.* London, 1890.

R. L. Matzkin. “Axioms of Revealed Preferences for Non-Linear Choice Sets”. *Econometrica*, (59): 1779–1786, 1991.

M. McBride. “Relaitve-Income Effects on Subjective Well-Being in the Cross-Section”. *Journal of Economic Behavior & Organization*, (45):251–278, 2001.

D. McCloskey. “The Rethoric of Economics”. *Journal of Economic Literature*, (21):481–517, 1983.

D. McCloskey. *The Rethoric of Economics.* University of Winsconsin Press, Madison, 1985.

P. Milgrom and J. Roberts. “Rationalizability, Learning and Equilibrium in Games with Strategic Complementarieties”. *Econometrica*, (62):157–180, 1990.

P. Milgrom and J. Roberts. “Adaptive and Sophisticated Learning in Normal Form Games”. *Games and Economic Behavior*, (3):82–100, 1991.

P. Milgrom and J. Roberts. "Comparing Equilibria". *American Economic Review*, (84):441–459, 1994.

P. Milgrom and C. Shannon. "Monotone Comaprative Statics". *Econometrica*, (62):157–180, 1994.

A. J. Oswald. "Happiness and Economic Performance". *Economic Journal*, (107):1815–1831, 1997.

V. Pareto. *Manual of Political Economy*. Eglish edition 1971, 1906.

A. C. Pigou. "Some Remarks on Utility". *Economic Journal*, (13):58–68, 1903.

R. A. Pollack. "Interdependent Preferences". *American Economic Review*, (66):709–720, 1976.

A. Postlewaite. "The Social basis of Interdependent Preferences". *Europea Economic Review*, (42): 779–800, 1998.

L. Rayo and G. Becker. "Evolutionary Efficiency and Happiness". *Mimeo, University of Chicago*, 2005.

M. K. Richter. "Revealed Preference Theory". *Econometrica*, (34):635–645, 1966.

J. Robinson and G. Godbey. *Time for Life: The Surprising Ways Americans Use Their Time*. Pennsyilvania State University Press, University Park, PA, 1997.

A. Robson. "Status, the Distribution of Wealth, Private and Social Attitudes to Risk". *Econometrica*, (60):837–857, 1992.

P. Rones, R. Ilg, and J. Gardner. "Trends in Hours of Work Since the Mid-1970s". *Montly Labour Review*, (120):3–14, 1997.

P. Samuelson. "A Note on the Pure Theory of Consumer's Behaviour". *Economica*, (5):61–71, 1938a.

P. Samuelson. "The Empirical Implications of Utility Theory". *Econometrica*, (6):344–356, 1938b.

P. Samuelson. *Foundations of Economics*. Harvard University Press, Cambridge, MA, 1948.

J. B. Schor. *The Overworked American: The Unexpected Decline of Leisure*. Basic Book, New York, 1992.

J. B. Schor. *The Overspent American: Upscaling, Downshifting and the New Consumer*. Basic Book, New York, 1998.

J. B. Schor. "Assessing the Controversy About Trends in Time-Use". *in Working Time: International Trends, Theory and Policy*, (eds. Deb Figart and Lonnie Golden), 2000.

J. B. Schor. *Born to Buy: The Comemrcialized Child and the New Consumer Culture*. Scribner, New York, 2004.

T. Scitovsky. *The Joyless Economy*. Oxford University Press, New York, 1976.

A. Sen. "Choice Functions and Revealed Preference". *Review of Economic Studies*, pages 307–317, 1971.

A. Sen. "Behaviour and the Concept of Preference". *Economica*, (40):241–259, 1973.

A. Sen. "Internal Consistency of Choice". *Econometrica*, (61):495–521, 1993.

C. Senik. "Income Distribution and Well-Being: What Can We Learn from Subjective Data". *Journal of Economic Surveys*, (19):43–63, 2005.

R. Shiller. "Discussion". *American Economic Review*, (81):97–98, 1991.

E. Slutsky. "On the Theory of Consumer's Balance". *Giornale degli Economisti*, (published in italian), 1915.

S. Solnick and D. Hemenway. "Is More Always Better? A Survey on Positional Concerns". *Journal of Economic Behavior and Organization*, (37):373–383, 1998.

A. Stutzer. "The Role of Income Aspirations in Individual Happiness". *Journal of Economic Behaviour & Organization*, (54):89–109, 2004.

A. Tarski. "A Lattice-Theoretical Fixed Point Theorem". *Pacific Journal of Mathematics*, (5): 285–309, 1955.

D. M. Topkins. "Minimizing a Submodular Function on a Lattice". *Operations Research*, (26): 305–321, 1978.

D. M. Topkins. "Equilibrium Points in Nonzero-Sum n-Person Submodular Games". *Siam Journal of Control and Optimization*, (17):773–787, 1979.

H. Uzawa. "Preference and Rational Choice in the Theory of Consumption". *Mathematical Methods in the Social Sciences*, (eds. J.A. Kenneth, S. Karlin, P. Suppes), 1960.

H. R. Varian. "Non-Parametric Approach to Demand Analysis". *Econometrica*, (50):945–974, 1982.

H. R. Varian. "Revealed Preference". *Mimeo, Unversity of Berkeley*, 2006.

T. Veblen. *The Theory of the Leisure Class.* Macmillan, New York, 1899.

R. Veenhoven. "Questions on Happiness: Classical Topics, Modern Answers, Blind Spots". *Subjective Well-Being: An Interdisciplinary Perspective*, (eds. F. Strack, M. Argyle, N. Schwarz):7–26, 1991.

R. Veenhoven. "Satisfaction and Social Position: within Nation Differences Comapared across Nations". *A Comparative Study of Satisfaction with life in Europe*, (eds. W. E. Saris et al.): 254–262, 1996.

X. Vives. "Nash Equilibrium with Strategic Complementarities". *Journal of Mathematical Economics*, (19):305–321, 1990.

X. Vives. "Complementarities and Games: New Developments". *Journal of Economic Literature*, (43):437–479, 2005.

H. Voth. "Time and Work in Eighteenth-Century London". *Journal of Economic History*, (58): 29–58, 1998.

P. H. Wicksteed. *The Common Sense of Political Economy.* 1910.

A. Witowski. "A New Proof of the Monotonicity of Power Means Functions on $\Re^n$: An Elementary Result". *Journal of Inequalities in Pure and Applied Mathematics*, (5), 2004.