Social Decision Theory: Choosing within and between Groups*

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Abstract

We provide an axiomatic foundation for interdependent utilities, where the outcome obtained by others affects the preferences of the decision maker. The dependence may take place in two conceptually different ways, depending on how the decision maker evaluates the outcomes of the others. In one, he values his own outcome as well as those of others on the basis of his own utility. In the second, he ranks outcomes according to a socially accepted value. These two different views of the interdependence have separate axiomatic foundation.

We then provide a systematic way to characterize preferences according to the relative importance assigned to social gains and losses, in other words to pride and envy. Finally, we provide a theory of the relative comparison among preferences, defining precisely when a preference is more averse to social ranking, and when it is more socially sensitive. Both concepts can be expressed in terms of the relative aversion to envy and love of pride.

Preliminary Version. Do not quote

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"In Silicon Valley, millionaires don't feel rich," *The New York Times*[1]

1 Introduction

The modern economic formulation of the idea that the welfare of an agent depends on the relative as well as the absolute consumption is usually attributed to Veblen (1899):

> ... soon as the possession of property becomes the basis of popular esteem, therefore, it becomes also a requisite to the complacency which we call self-respect. In any community where goods are held in severalty it is necessary, in order to his own peace of mind, that an individual should possess as large a portion of goods as others with whom he is accustomed to class himself; and it is extremely gratifying to possess something more than others ...

The intuition that an agent's well-being is determined not only by the intrinsic utility of his material consumption, but also by his relative standing in the society or in his peer group had a huge impact on the socioeconomic thought (e.g., Duesenberry 1949, Easterlin 1974, Layard 1980, Frank 1985, and Schor 1998) and the phenomenon called *keeping up with the Joneses* has been heating economic debate for the last two decades.

The significance of one's relative outcome standing has been widely studied in the economics and psychology of subjective well-being (e.g., Easterlin 1995 and Frey and Stutzer 2002, and the references therein) and there is a large body of direct and indirect empirical evidence in support of this fundamental hypothesis (e.g., Easterlin 1974, van de Stadt, Kapteyn, and van de Geer 1985, Tomes 1986, Clark and Oswald 1996, McBride 2001, Zizzo and Oswald 2001, Luttmer 2005, Ravina 2005, and Dynan and Ravina 2007).

At the same time, the introduction of agents' concerns for relative outcomes, especially in consumption and income, into economic models has been shown to carry serious implications cutting across different fields such as demand analysis (e.g., Leibenstein 1950, Gaertner 1974, Pollak 1976, Kapteyn, Van de Geer, Van de Stadt, and Wansbeek 1997, and Binder and Pesaran 2001), taxation and expenditure policy (e.g., Boskin and Sheshinski 1978, Layard 1980, Oswald 1983, Ng 1987, Villar 1988, Blomquist 1993, Ljungqvist and Uhlig 2000, and Abel 2005), equilibrium and asset pricing (e.g., Abel 1990, Galí 1994, Abel 1999, Campbell and Cochrane 1999, Chan and Kogan 2002, and Dupor and Liu 2003), labor search and wage determination (e.g., Frank 1984, Akerlof and Yellen 1990, Neumark and Postlewaite 1998, and Bowles and Park 2005), growth (e.g., Carroll, Overland, and Weil 1997, Corneo and Jeanne 2001, and Liu and Turnovsky 2005), and corporate investments (e.g., Goel and Thakor 2005).[2]

Despite their intuitive appeal and empirical relevance, there is surprisingly very little theoretical work on preferences of agents who care about their relative status. We are only

[1] Article by Gary Rivlin, August 5, 2007.

[2] Other rank/status concerns have been considered by many authors. See, for example, the following articles (and the references therein): Weiss (1976), Jones (1984), Basu (1989), Baumol (1990), Robson (1992), Cole, Mailath, and Postlewaite (1992), Fershtman and Weiss (1993), Bernheim (1994), Ireland (1994), Mui (1995), Pesendorfer (1995), Bagwell and Bernheim (1996), Fershtman, Murphy, and Weiss (1996), Akerlof (1997), Weiss and Fershtman (1998), Ball, Eckel, Grossman, and Zame (2001), Brock and Durlauf (2001), Sameulson (2004), Becker, Murphy, and Werning (2005), Rayo and Becker (2007).

aware of the works of Ok and Koçkesen (2000) and Gilboa and Schmeidler (2001), which, however, adopt a very different standpoint than ours. An even more different approach has been proposed by Michael and Becker (1973), Becker (1974), and Stigler and Becker 1977 (see also Lancaster 1966 for a related approach), in which utility analysis is reformulated by considering basic needs as arguments of agents' objective functions, in place of market consumption goods.[3] The latter are viewed as inputs in household production functions, whose outputs are the basic needs. In contrast, in our economic applications (Section 8) we still regard market consumption goods as arguments of our objective functions, and the role of emotions is to shape the objective functions' form.

1.1 The Representation and its Interpretation

Our objective here is to provide an extension of the subjective expected utility model that takes into account the effect on the well being of an individual of the distribution of consumption in a society. Specifically, we will look for necessary and sufficient conditions on the preferences of an agent o that guarantee the following representation.

Let $\left(f_o, (f_i)_{i\in I}\right)$ represent the situation in which agent o takes act f_o while each member i of the agent's reference group takes act f_i. Then our decision maker evaluates this situation according to:

$$V\left(f_o, (f_i)_{i\in I}\right) = \int_S u\left(f_o\left(s\right)\right) dP\left(s\right) + \int_S \varrho\left(v\left(f_o\left(s\right)\right), \sum_{i\in I} \delta_{v(f_i(s))}\right) dP\left(s\right) \qquad (1)$$

The first term of this representation is very familiar: The index $u\left(f_o\left(s\right)\right)$ represents the agent's intrinsic utility of outcome $f_o\left(s\right)$, P represents his subjective probability over states, and so the first term represents his expected utility from the act f_o. The effect on o's wefare of the outcome of the other individuals is reported in the second term. The index $v\left(f_o\left(s\right)\right)$ represents the social value o attaches to outcome $f_o\left(s\right)$. This index may or may not be the same as u. This point is discussed in detail in section 1.1.1 below.

Given a profile of acts, the agent's peers will get outcomes $(f_i(s))_{i\in I})$ once state s obtains. If o does not care about who gets the value $v(f_i(s))$, then he will only be interested in the distribution of these values. If δ_x is the measure giving mass one to x, this distribution is represented by the term $\sum_{i\in I} \delta_{v(f_i(s))}$ in (1) above.

Finally, the function $\varrho\left(\cdot,\cdot\right)$ is increasing in the first component and stochastically decreasing in the second. This term represents o's satisfaction/dissatisfaction deriving from the comparison of his consumption with the distribution of consumption in his reference group. The feeling is experienced *ex-post*, after the realization of the state: in each state s the agent's well being depends positively from the value of his consumption and negatively from that of the remaining members of the society.

For fixed $(f_i)_{i\in I}$, the preference functional (1) represents agent's within group preferences over consumption, which are conditional on a group consuming $(f_i)_{i\in I}$. For fixed f_o, the preference functional (1) instead represent between groups preferences, which are conditional on the agent's consumption.

[3]For example, Becker (1974) considers an objective function with the "need of distinction" as an argument (with its associated emotion of envy).

1.1.1 Why Envy?

The index ρ in the representation describes the effect on the well being of the decision maker of the social profile of outcomes (the social value of these outcomes is recorded by the index v). If it is equal to the index u, we have a representation reported in Theorem 1. If it is different, the representation is in Theorem 2. These two different representations correspond to two different views and explanations of the effect of the fortune of others on our preferences. To focus our analysis, we concentrate on one important emotion: envy. We propose two explanations of envy.

A Private Emotion The first is based on an introspective view: when we are envious, we consider the goods and wealth that others have thinking how we would enjoy them. We consider, that is, those goods from the point of view of our own utility, and we compare to the utility we derive from our own goods and wealth. This view of envy points to a possible functional explanation of envy: this painful awareness that others are achieving something we consider enjoyable reminds us that perhaps we are not doing the best possible use of our abilities. Envy is a powerful tool of learning how to deal with uncertainty, by forcing us to evaluate what we have achieved as compared to what we could have.

Envy is, from this point of view, the social correspondent of regret. These two emotions are both based on a counterfactual thought. Regret reminds us that we could have done better, had we chosen a course of action that was available to us, but we did not take. Envy reminds us that we could have done better, had we chosen a course of action that was available to us, but someone else actually chose, unlike us. In both cases, we are evaluating the outcome of choices that we did not make from the standpoint of our own utility function. We regret we did not buy a house that was cheap at some time in which the opportunity presented itself because we like the house: and we envy the house of the neighbor because we like the house. In both cases, we learn that next time we should be more careful and determined in the use of our talent.

This close parallel between envy and regret reduces envy to its private dimension. The fact that the good outcome we envy belongs to someone else is purely accidental: the crucial comparison is between what we have and what we could have had. Envy, however, is an essentially social emotion. We do care whether the successful outcome is simply an hypothetical thought (as in regret) or the concrete good fortune of someone else. In fact, we may feel envy even if we do not like at all the good that the other person has. There must be another reason for envy, a purely social one.

A Social Emotion The organization of societies according to a competition and dominance ranking is ubiquitous, extending from plants to ants to primates. For example, plants regulate competition toward kin (Falik, Reides, Gersani, and Novoplansky 2003 and Dudley and File, forthcoming), and examples of hierarchical structures have been documented in insects (Wilson 1971), birds (Schjelderup-Ebbe 1935 and Chase 1982), fishes (Nelissen 1985 and Chase, Bartolomeo, and Dugatkin 1994), and mammals (Greenberg-Cohen, Alkon, and Yom-Tov 1994), particularly primates (Maslow 1936, Dunbar 1988, Cheney and Seyfarth 1990, Pereira 1995, Pereira and Fairbanks 2002, and Sapolsky 2005).

Quite naturally, competition and dominance feelings play a fundamental role in human societies too, whose members have a very strong preference for higher positions in the social ranking: the proposition has been developed in social psychology (Maslow 1937, Hawley

1999, and Sidanius and Pratto 1999). Envy induced by the success of others is the painful awareness that we have lost relative positions in the social ranking. In this view, the good that the other is enjoying is not important for the utility it provides, and we do not enjoy, but for the signal it sends. This signal is important because others, in addition to us, can see it, and accordingly change their view on what our current ranking is. The outcome of others when it is better than ours produces envy because is a social signal.

Since it is a social signal, the way in which it is evaluated has to be social, and completely different, in principle, from the way in which we privately evaluate it. We may secretly dislike, or fail to appreciate, an abstract painting. But we may proudly display it in our living room if we think that the signal it sends about us (our taste, our wealth, our social network) is useful. And we may envy someone who has it, even if we would never hang it in our bedroom if we had it. When the effect of the outcome of others is interpreted in this way, the index is a function v, possibly different from the private evaluation function u.

This social index v is as subjective as u: Individuals may disagree on what society thinks is important. For example, a specific individual may be completely wrong, from the factual point of view, in his opinion of what the others think is socially important. Certainly younger and older members of the society disagree on this. But in all cases it is the perception of what others think is important, as opposed to what the decision maker values and likes, that is kept into account when evaluating the outcome of others. This is what *subjectively* (as everything else in decision theory) the individual regards as considered *socially* valuable.

The divergence between the u and v evaluation of an object is what Veblen classified as "waste".

> Nothing should be included under the head of conspicuous waste but such expenditure as is incurred on the ground of an invidious pecuniary comparison. [TLC, chapter 4]

It is clear that the qualification "waste" does not apply to the subjective perception of the object of the decision maker, as Veblen immediately notes that:

> But in order to bring any given item or element in under this head it is not necessary that it should be recognized as waste in this sense by the person incurring the expenditure. [TLC, chapter 4]

It is an interesting empirical question how variable the v is across individual. The view presented here is that the social value of an object is primarily in its being a costly signal: costly precisely because of the Veblenian "waste," the distortion between the u-utility and the social v-value:

> [...] the pervading principle and abiding test of good breeding is the requirement of a substantial and patent waste of time. [TLC, chapter 3]
>
> The utility of articles valued for their beauty depends closely upon the expensiveness of the articles. [TLC, chapter 6]

If this is true, then the variability is going to be small: we hope that the precise definitions provided here give a way to a test.

1.2 Invidia et Superbia (sketch)

What we just said about envy applies to pride as well, its specular emotion. Specifically, throughout the paper by envy (*invidia*) we mean the negative emotion that agents experience when their outcomes fall below those of their peers, and by pride (*superbia*) we mean the positive emotion that agents experience when they have better outcomes than their peers.[4]

Invidia and superbia characterize agents' attitudes on the social loss and social gain domain. They are key social emotions,[5] often explicitly considered by religious and social norms (e.g., sumptuary laws; see Vincent 1934); for example, in the early Christian tradition invidia and superbia, when carried to a sinful extreme, are the sixth and seventh deadly sins (Aquaro 2004).

In our axiomatic analysis, these two specular emotions help us to define specific features in the way the preferences of our decision maker depend on the outcome to others. Each individual may attach relatively different weight to the social gains and losses. On the basis of the axiomatic analysis of interdependent preferences we can characterize preferences on the basis of the relative weight that is given to social gains and losses.

We then also setup a comparison across preferences with respect to the attitude to gains and losses. This analysis develops an analysis which is parallel to the theory of loss aversion in the domain of private choices.

1.3 Regret and relief

[I has a section planned here to point out that the analysis can also be taken as a theory of regret. But in Tel Aviv massimo was really opposed even to mention regret. I am not sure yet why, but I have to understand why before we write anything, if we write anything at all]

1.4 Social Economics

We focus on a simple two periods economy. In the first period agents have an endowment y and can choose a consumption $c \geq 0$, from which they derive a utility $u(c)$. In the second period agents receive a stochastic endowment $Y(s)$, which depends on a finite space S of states of Nature, endowed with a probability p on S such that $p(s) > 0$ for all $s \in S$.

Agents' consumption in the second period is then given by $d(s) = Y(s) + R(y - c)$ and they derive a discounted expected utility $\beta\mathbb{E}[u(Y + R(y - c))]$. The consumption d has to be non negative in each state, so the set of feasible first period consumption is $C \equiv [0, y + R^{-1} \min_{s \in S} Y(s)]$.

The utility function of the agents has an additional term in every period for the effect of the externality of the simple form: **[attenzione γ e ϱ]**

$$\gamma(c - C)$$

[4]Smith and Kim (2007) review different meanings of envy. As a working definition, they define envy as "an unpleasant and often painful blend of feelings characterized by inferiority, hostility, and resentment caused by a comparison with a person or group of persons who possess something we desire." This is essentially the same definition that we use.

[5]See Schoeck (1969) and de la Mora (1987) for, respectively, sociological and political science perspectives on them.

where c is the consumption of the individual and C is the average consumption, and γ is an increasing function. This externality in the second period is discounted by the same discount factor β.

When deciding how much to consume in the first period, the agent has a trade-off (as, for example, explicitly noted in Binder and Pesaran 2001 and Arrow and Dasgupta 2007): if he increases his consumption today he will increase his relative ranking today, but will also decrease his standing in the next period, so he is comparing a positive effect today with a negative effect in the next period. This trade-off points to a crucial feature of the preferences: the relative strength of the effect on individual welfare of being in a dominant or dominated position in the social hierarchy.

To analyze how the relative strength of the two effects affects choice, we consider the two extreme cases of pure envy and pure pride. These are extreme cases, but give a good idea of how the outcome depends on the relative strength of these two components. The equilibrium set will be completely different in the two cases. In particular, it will be conformist in the case of pure envy (all agents consume the same) and diversified in the pure pride case (identical agents choose a different consumption).

An agent with pure envy preferences only cares about the situation in which his consumption is below the average value. For example take

$$\gamma(x) = \theta x^{-}$$

where $x^{-} \equiv \min(x, 0)$. The function is concave: so the overall program of each agent is concave, and therefore the equilibrium is symmetric: all the agents choose the same consumption. One of the equilibrium consumption levels is the equilibrium value $\hat{c}$ of the economy with no externality: envy can only reduce value, and if everyone consumes $\hat{c}$ then the no-externality equilibrium value can be achieved.

An agent with pure pride preferences has for example:

$$\gamma(x) = \theta x^{+}$$

where $x^{+} \equiv \max(x, 0)$. This function is convex, and this fact completely changes the structure of the equilibrium set. The equilibrium can only be non-symmetric: although agents are identical, they will choose different consumptions. Some will choose to have a dominant position in the current period, at the expense of a dominated one in the future, and others will choose the opposite.

The equilibrium is characterized by three values: an average consumption today, C; the two values of consumption in the current period ($a > C > b$), and a distribution of the population over the two groups, with a fraction π choosing a. Three equations uniquely determine these three values: the two equations requiring that a (and respectively b) is optimal against the average $C = \pi a + (1 - \pi)b$ under the condition that the consumption is larger than C (respectively smaller) and the equation requiring that the value at these two consumptions is the same. With appropriate conditions (for example, if $u = \log$) this solution is unique, and the two values a and b are higher and lower than the equilibrium with no externality.

We close by observing how the social nature of consumption clearly emerges in these social economies. In fact, even though we consider economies with a continuum of individually negligible agents, whose behavior does not affect per se the outcomes of the other agents, still Nash equilibrium is the natural solution concept to use. Here, agents' interact through the consumption externalities caused by the social dimension of their decisions; the social economy is in equilibrium when all these consumption externalities balance each others.

1.5 Some Methodological Issues

In this subsection, which may be skipped on a first reading without any loss of continuity, we discuss some methodological issues that arise in our analysis.

Social Theory The Veblen critique questions the basic tenet of standard consumer theory that consumers' preferences only depends on the private functions and uses of the consumer goods, that is, on their physical nature, with no role for any possible cultural/symbolic, and so social, aspect they might have. In this way, standard consumer theory can analyze consumers' decisions in isolation, without worrying about any possible externality that such decisions might generate.

In contemporary societies, however, the symbolic value of consumption has come to play a fundamental role in social interactions, much more than ever before in human history. Social scientists often describe contemporary societies as "consumer societies," with consumerism being their distinguishing feature. This is the result of improved living conditions (symbolic consumption has a smaller role in mere subsistence economies), but also of major cultural and technological changes.

For this reason, consumption and its symbolic aspects has been a central research theme in the social sciences, beginning with the seminal works of Barthes (1964) and Baudrillard (1968), (1970) and (1972) in Social Theory, of Sahlins (1976) and Douglas and Isherwood (1979) in Anthropology, and of, in a more applied context, Levy (1959) and Grubb and Grathwohl (1967) in Consumer Research.

At a theoretical level, the most influential works are probably those of Barthes and Baudrillard. Their studies move from Veblen's early analysis of conspicuous consumption, which they gave a theoretical framework by observing that the symbolic aspect of consumer goods makes them a system of signs, a communication system, and, as such, suitable to semiotic analysis.[6] In other words, their theoretical stance is that consumer theory should be viewed as part of Semiotics, to be studied with the concepts and categories elaborated in that area since the seminal works of Saussure. This means, *inter alia*, that consumer theory should be studied with reference to linguistic laws, which in Barthes' "translinguistic" view (see Eco 1976 p. 30) are the reference model for the study of all systems of signs.

However controversial, the works of Barthes and Baudrillard provide an important theoretical perspective on consumption, building on Veblen's original insights. An early application of the semantic approach to consumption is Baudrillard's generalization of Marxian political economy, with the introduction of the "sign value" as a supplement to the classic user and exchange values in order to model the symbolic side of goods (Baudrillard 1972).

This semantic theoretical perspective on consumption gives prominence to the symbolic over the functional,[7] and thus emphasizes the social nature of consumption. In fact, the

[6] Consumer goods (and, more generally, all objects) are sign-functions in the terminology of Barthes (1964) because, unlike verbal signs, they have a functional origin (see Eco (1976) pp. 48-50).

[7] Whose role is often regarded as merely ancillary, as an ex post rationalization of a prime symbolic

symbolic is, by its nature, social because its meaningfulness relies on the existence of an interpretation code, a "consumer culture," shared by all consumers (Baudrillard 1970). In the large literatures that the works of Barthes and Baudrillard originated,[8] the prominence of the symbolic over the functional became more and more accentuated, with consumption decisions viewed as essentially determined by the symbolic meaning of the goods. In Social Theory, economic exchange is thus reduced to a purely symbolic exchange.

We agree with the Veblenian and social theoretic insight that consumption decisions depend on both the functional and symbolic meanings of the chosen goods. For this reason, these decisions must be studied as social decisions and only a proper modelling of their social dimension can make them meaningful and understandable. This was, in fact, our original motivation and, in a sense, our "social" extension of standard consumer theory parallels that undertaken by Baudrillard for Marxian political economy. We disagree, however, with social theorists in some fundamental methodological and substantive issues.

On the methodological side, this is a paper in consumer theory: our purpose is to extend, incrementally, standard consumer theory by modelling a social dimension so far overlooked in economic theory. We try to do this in the most economical way, by remaining as close as possible to the standard model. We thus adopt the classic, Weberian, methodological individualism and rational action approach of standard consumer theory, as well as its revealed preference method. Our agents have preferences that, in principle, can be behaviorally elicited and that are represented by objective functions that agents maximize. Unlike standard consumer theory, where the objective function to maximize is a function u that models the intrinsic, material, utility of consumption as determined by its uses, in our general representation (1) the objective function depends both on a conventional function u and on a new function v that models the social dimension of consumption.[9] In Weber (1968)'s terminology, our agents' intentional states have both a private and a social dimension.

The presence of the function u in our representation reflects another major, substantive, difference of our approach relative to Social Theory. In fact, we believe that the functional dimension of consumption still plays an important role in consumer behavior and we do not agree with the social theoretic almost exclusive focus on the symbolic. As Lucretius wrote, "*utilitas expressit nomina rerum.*"[10]

Instrumental Approach As we have discussed at length, our approach lies within the neoclassical framework and generalizes the standard model by enlarging the scope of agents' preferences. A different route to study some social decision in a neoclassical setting has been pursued by Cole, Mailath, and Postlewaite in a series of influential papers.[11] In a matching model with conventional agents who only care about their own private

meaning. As Barthes (1964) writes "... once a sign is constituted, society can very well refunctionalize it, and speak about as it were an object made for use: a fur-coat will be described as it served only to protect from the cold." (p. 42 in the English translation).

[8] For reviews, see, e.g., Mick (1986), McCracken (1988), Bocock (1993), and Slater (1997).

[9] In Baudrillard's generalized Marxian political economy, we can view u and v as modelling functional value and symbolic value, respectively.

[10] "Need and use did mould the names of things," *De Rerum Natura*, translation of W. E. Leoanard. We owe this quotation to Rossi-Landi (1968).

[11] See their (1992), (1995), (1998), and (2006) articles, as well as the methodological piece by Postlewaite (1998).

consumption (and that of their offspring), they elegantly show how status/rank concerns may arise for purely instrumental reasons: an higher status allows better consumption opportunities, which in turn enhance agents' welfare. As Postlewaite (1998) p. 785 said, "individuals have a concern for relative standing because relative standing is instrumental in determining ultimate consumption levels."

The instrumental approach is very appealing and insightful, as Postlewaite (1998) eloquently discusses. There are, however, a few reasons why here we pursue a different approach.

First (and foremost), we believe that envy and pride are fundamental emotions, which shape our attitudes toward competition and dominance, our fundamental social attitudes. Envy and pride are key traits in human behavior, possibly hard-wired over time through evolution (see Robson 2001). Who we are, our "personality," is substantially shaped by these two basic emotions, no less than by the traditional, "utilitarian," emotions of pleasure and pain that agents derive from private, material, consumption and that underlie standard utility functions.[12]

We thus take as primitive the social emotions of envy and pride, on equal footing with the traditional "private" emotions of pleasure and pain. In other words, we do not regard these private emotions as more fundamental for economic modelling. The reason why we believe that it is time to enrich the emotional scope of utility analysis is that in our contemporary societies social emotions play a bigger and bigger role, partly because of major cultural and technological changes, as we argued earlier in this section. This is a basic insight of Social Theory, which we fully agree with. Neglecting these social emotions has been for a long time a reasonable simplifying assumption, certainly at the time when neoclassical utility theory was born. Veblen's analysis was much ahead of his time also because, back then, it was arguably less relevant empirically.[13] But, this is no longer true now, as empirical research is currently showing.[14] To conclude, one should never forget that, like all social sciences, Economics is an historically determined discipline and even its more fundamental assumptions might need an update.

Even if one disagrees with our basic view, there is a different, more pragmatic, reason why it is useful to model social decisions by enlarging preferences' domain. In fact, the objective functions we derive can be viewed as a reduced form of a more complex, possibly not so easily modelled, setting where social considerations may be properly viewed as instrumental. The large number of empirical papers that incorporate social traits into agents' objective functions is a clear proof of the pragmatic usefulness of our modelling strategy. From this standpoint, the main contribution of our axiomatic analysis is to provide some theoretical discipline and insight on these otherwise ad hoc manipulations of agents' objective functions. As we mentioned before, despite the large empirical literature, very little theoretical work exists on this subject.

[12]As well known, Pareto showed that the hedonic interpretation of utility functions is not a theoretical necessity. It is, however, a perfectly legitimate interpretation (see the discussion below on revealed preference) that is still pervasive in Economics, as the widespread reference to marginal utilities shows.

[13]Except, of course, for Veblen's social milieu, which motivated his theory. See Matt (2003) for a description of American consumer society at the time of Veblen.

[14]See in particular the cited works of Dynan, Luttmer, and Ravina, which find evidence of relative consumption concerns, our primary motivation.

Revealed Preference We conclude by observing that there is no conceptual inconsistency, both in standard consumer theory and in its extended version presented here, between adherence to the revealed preference methodology and an emotional interpretation of preference rankings and of the derived objective functions. This was recognized since the very beginning of revealed preference analysis, which "does not preclude the introduction of utility by any who may care to do so, nor will it contradict the results attained by use of related constructs," as Samuelson (1938) p. 62 observed.

Revealed preference analysis is the fundamental Decision Theory methodology that bases, through axiomatic analysis, the derivation of decision makers' objective functions on actual choice behavior. This gives empirical content to utility analysis since, still today, choice behavior is the best observable, and so testable, aspect of human economic behavior.[15]

Whenever possible, it is thus very important to anchor, through axiomatic analysis, objective functions to choice behavior.[16] That said, one can always interpret observed choices as the result of an emotional calculus, be either the traditional pain/pleasure utilitarian calculus or the more general pain/pleasure plus envy/pride calculus advocated here. Interpretation is a semantic exercise and, as such, is legitimate insofar as it provides a reasonable interpretation of the formal model (i.e., of the axioms), whose scientific status, however, is determined by its testable/falsifiable choice foundations.

[15]Some recent technical advances, especially in the neurosciences (e.g., neuro scans), might suggest a future where other sources of data will acquire a status comparable to that of choice behavior. In this case, revealed preference analysis will have to expand its scope accordingly.

[16]As Schumpeter (1954) p. 1059 simply put it, "... nobody will deny that it is preferable to derive a given set of propositions from externally or 'objectively' observable facts, if it can be done, than to derive the same set of propositions from premisses established by introspection..."

2 Preliminaries

2.1 Setup

We consider a standard Anscombe and Aumann (1963) style setting. Its basic elements are a set S of *states of nature*, an algebra Σ of subsets of S called *events*, and a convex set C of *consequences*.

We denote by o a given *agent*, our protagonist, and by N the non-empty, possibly infinite, set of all agents in o's world that are different from o himself, that is, the set of all his possible peers (the "Joneses," as they are often called in the literature).

We denote by $\wp(N)$ the set of all finite subsets of N; notice that $\emptyset \in \wp(N)$. Throughout the paper, I denotes an element of $\wp(N)$, even where not stated explicitly. For every I, we denote by I_o the set $I \cup \{o\}$; similarly, if j does not belong to I, we denote by I_j the set $I \cup \{j\}$.

A *(simple) act* is a Σ-measurable and finite-valued function from S to C. We denote by $\mathcal{A}$ the set of all acts and by $\mathcal{A}_i$ the set of all acts available to agent $i \in N_o$; finally

$$\mathcal{F} = \left\{ \left(f_o, (f_i)_{i \in I}\right) : I \in \wp(N), \ f_o \in \mathcal{A}_o, \text{ and } f_i \in \mathcal{A}_i \text{ for each } i \in I \right\}$$

is the set of all *act profiles*. Each act profile $f = \left(f_o, (f_i)_{i \in I}\right)$ describes the situation in which o selects act f_o and his peers in I select the acts f_i.

When I is the empty set (i.e., o has no reference group of peers), we have $f = (f_o)$ and we often will just write f_o to denote such a "Robinson Crusoe" profile.

Here it is important to observe how the outcomes obtained by the agents in each state of nature do not depend on the acts chosen by the other agents.

The constant act taking value c in all states is still denoted by c. With the usual slight abuse of notation, we thus identify C with the subset of the constant acts. The set of acts profiles consisting of constant acts is denoted by $\mathcal{X}$, that is,

$$\mathcal{X} = \left\{ \left(x_o, (x_i)_{i \in I}\right) : I \in \wp(N), \ x_o \in C \cap \mathcal{A}_o, \text{ and } x_i \in C \cap \mathcal{A}_i \text{ for each } i \in I \right\}.$$

Clearly, $\mathcal{X} \subseteq \mathcal{F}$ and we denote by c_{I_o} an element $x = \left(x_o, (x_i)_{i \in I}\right) \in \mathcal{X}$ such that $x_i = c$ for all $i \in I_o$.[17]

Throughout the paper (except in Section 10) we make the following structural assumption.

Assumption. $\mathcal{A}_o = \mathcal{A}$ and each $\mathcal{A}_i$ contains all constant acts.

In other words, we assume that o can select any act and that his peers can, at least, select any constant act. Notice that this latter condition on peers implies that $f(s) = \left(f_o(s), (f_i(s))_{i \in I}\right) \in \mathcal{X}$ for all $f = \left(f_o, (f_i)_{i \in I}\right) \in \mathcal{F}$ and all $s \in S$.

2.2 Some Notation

If $I \in \wp(N)$ is not empty and $\mathbf{e} = (e_i)_{i \in I} \in \mathbb{R}^I$ is a vector of real numbers, $\mu_{\mathbf{e}} = \sum_{i \in I} \delta_{e_i}$ denotes the distribution of $\mathbf{e}$. In particular, for all $t \in \mathbb{R}$,

$$\mu_{\mathbf{e}}(t) = \sum_{i \in I} \delta_{e_i}(t) = |\{i \in I : e_i = t\}|.$$

[17] Similarly, c_I denotes a constant $(x_i)_{i \in I}$.

Moreover, for all t in $\mathbb{R}$,

$$F_{\mathbf{e}}(t) = \mu_{\mathbf{e}}(-\infty, t] = |\{i \in I : e_i \leq t\}|, \text{ and}$$
$$G_{\mathbf{e}}(t) = \mu_{\mathbf{e}}(t, \infty) = |\{i \in I : e_i > t\}| = |I| - F_{\mathbf{e}}(t)$$

are the increasing and decreasing distribution functions of $\mathbf{e}$, respectively. When $I = \emptyset$, we set $\mu_{\mathbf{e}} = 0$ (and so $F_{\mathbf{e}} = G_{\mathbf{e}} = 0$).

Given two vectors $\mathbf{a} = (a_i)_{i \in I}$ and $\mathbf{b} = (b_j)_{j \in J}$, we say that:

(i) $\mu_{\mathbf{a}}$ *upper dominates* $\mu_{\mathbf{b}}$ if $G_{\mathbf{a}}(t) \geq G_{\mathbf{b}}(t)$ for all $t \in \mathbb{R}$,

(ii) $\mu_{\mathbf{a}}$ *lower dominates* $\mu_{\mathbf{b}}$ if $F_{\mathbf{a}}(t) \leq F_{\mathbf{b}}(t)$ for all $t \in \mathbb{R}$,

(iii) $\mu_{\mathbf{a}}$ *stochastically dominates* $\mu_{\mathbf{b}}$ if $\mu_{\mathbf{a}}$ both upper and lower dominates $\mu_{\mathbf{b}}$.

Given an interval K of real numbers, let $\mathcal{M}(K)$ be the collection of all positive integer measures μ on K with finite support and such that $\mu(K) \leq |N|$. That is,[18]

$$\mathcal{M}(K) = \left\{ \sum_{i \in I} \delta_{e_i} : I \in \wp(N) \text{ and } e_i \in K \text{ for all } i \in I \right\}.$$

In other words, $\mathcal{M}(K)$ is the set of all possible distributions of vectors $\mathbf{e} = (e_i)_{i \in I}$ in K^I while I ranges in $\wp(N)$.

Set $\mathrm{pim}(K) = K \times \mathcal{M}(K)$. Pairs $(z, \mu) \in \mathrm{pim}(K)$ are understood to be of the form

(payoff to o, distribution of peers'payoffs).

A function $\varrho : \mathrm{pim}(K) \to \mathbb{R}$ is *diago-null* if

$$\varrho(z, n\delta_z) = 0, \qquad \forall z \in K, 0 \leq n \leq |N|.$$

That is, a diago-null function ϱ is zero whenever o and all his peers are getting the same payoff z.

3 The Basic Axioms

Our main primitive notion is a binary relation $\succsim_o$ on the set $\mathcal{F}$ that describes o's preferences. As anticipated in the introduction, the ranking

$$\left(f_o, (f_i)_{i \in I}\right) \succsim_o \left(g_o, (g_j)_{j \in J}\right)$$

is the agent's ranking among societies (peer groups). To ease notation, we will often just write $\succsim$ instead of $\succsim_o$.

Axiom A. 1 (Weak Order) *$\succsim$ is nontrivial, complete, and transitive.*

Axiom A. 2 (Monotonicity) *Let $f, g \in \mathcal{F}$. If $f(s) \succsim g(s)$ for all s in S, then $f \succsim g$.*

[18] We adopt the convention that any sum of no summands (i.e., over the empty set) is zero.

Axiom A. 3 (Archimedean) *For all* $\left(f_o,(f_i)_{i\in I}\right)$ *in* $\mathcal{F}$*, there exist* $\underline{c}$ *and* $\bar{c}$ *in* C *such that*

$$\underline{c}_{I_o} \precsim \left(f_o,(f_i)_{i\in I}\right) \text{ and } \left(f_o,(f_i)_{i\in I}\right) \precsim \bar{c}_{I_o}.$$

Moreover, if the above relations are both strict, there exist $\alpha,\beta\in(0,1)$ *such that*

$$\left(\alpha\underline{c}+(1-\alpha)\bar{c}\right)_{I_o} \prec \left(f_o,(f_i)_{i\in I}\right) \text{ and } \left(f_o,(f_i)_{i\in I}\right) \prec \left(\beta\underline{c}\ +(1-\beta)\bar{c}\right)_{I_o}.$$

These first three axioms are standard. The only thing to observe is that the Monotonicity Axiom just requires that if an act profile f is, state by state, better than another act profile g, then $f \succsim g$.

[Vogliamo dire qualcosa in più?]

Axiom A. 4 (Independence) *Let* α *in* $(0,1)$ *and* f_o,g_o,h_o *in* $\mathcal{A}_o$*. If* $f_o\succ g_o$*, then*

$$\alpha f_o+(1-\alpha)\,h_o \succ \alpha g_o+(1-\alpha)\,h_o.$$

This is a classic *independence axiom*, which we only require on "solo" preferences, with no peers.

Axiom A. 5 (Conformistic Indifference) $c_{I_o}\sim c_{I_o\cup\{j\}}$ *for all* c *in* C*,* I *in* $\wp(N)$*, and* j *not in* I*.*

[Aggiungere discussione su quest'assioma]

Axioms A.1-A.5 guarantee that, for each $\left(f_o,(f_i)_{i\in I}\right)\in\mathcal{F}$, there exists $c_o\in C$ such that $\left(f_o,(f_i)_{i\in I}\right)\sim(c_o)$ (see Lemma **??** in Appendix **??**). Such an element c_o will be denoted by $c\left(f_o,(f_i)_{i\in I}\right)$.

Axiom A. 6 (Anonimity) *Let* $\left(x_o,(x_i)_{i\in I}\right),\left(x_o,(y_j)_{j\in J}\right)$ *in* $\mathcal{X}$*. If there is a bijection* $\pi:J\to I$ *such that* $y_j=x_{\pi(j)}$ *for all* $j\in J$*, then* $\left(x_o,(x_i)_{i\in I}\right)\sim\left(x_o,(y_j)_{j\in J}\right)$*.*

4 The Private Utility Representation

In this section we present our first representation, which models the private emotion discussed in the introduction.

The basic Axioms A.1-A.6 are common to our two main representations, the "private" and the, more general, "social." The next two axioms are, instead, peculiar to the private representation.

Axiom B. 1 (Negative Dependence) *If* $\bar{c}\succsim\underline{c}$*, then*

$$\left(x_o,(x_i)_{i\in I},\underline{c}_{\{j\}}\right)\succsim\left(x_o,(x_i)_{i\in I},\bar{c}_{\{j\}}\right)$$

for all $\left(x_o,(x_i)_{i\in I}\right)\in\mathcal{X}$ *and* $j\notin I$*.*

Axiom B. 2 (Comparative Preference) *Let* $\left(x_o, (x_i)_{i\in I}\right), \left(y_o, (x_i)_{i\in I}\right) \in \mathcal{X}$. *If* $x_o \succsim y_o$, *then*

$$\frac{1}{2}c\left(x_o, (x_i)_{i\in I}\right) + \frac{1}{2}y_o \succsim \frac{1}{2}x_o + \frac{1}{2}c\left(y_o, (x_i)_{i\in I}\right).$$

These axioms only involve deterministic act profiles, that is, elements of $\mathcal{X}$. Axiom B.1 captures the negative dependence of agent o welfare on his peers' outcomes.

Axiom B.2 is based on the idea that the presence of a society stresses the perceived differences in consumption. In fact, interpreting x_o as a gain and y_o as a loss, the idea is that winning in front of a society is better than winning alone, losing alone is better than loosing in front of a society, and, "hence," a fifty-fifty randomization of the better alternatives is preferred to a fifty-fifty randomization of the worse ones.

We can now state our first representation, where we use the notation introduced in Subsection 2.2.

Theorem 1 *A binary relation* $\succsim$ *on* $\mathcal{F}$ *satisfies Axioms A.1-A.6 and B.1-B.2 if and only if there exist a non-constant affine function* $u : C \to \mathbb{R}$, *a diago-null function* $\varrho : \mathrm{pim}\left(u\left(C\right)\right) \to \mathbb{R}$ *increasing in the first component and decreasing (w.r.t. stochastic dominance) in the second, and a probability* P *on* Σ *such that the function* $V : \mathcal{F} \to \mathbb{R}$ *defined by*

$$V\left(f_o, (f_i)_{i\in I}\right) = \int_S u\left(f_o\left(s\right)\right) dP\left(s\right) + \int_S \varrho\left(u\left(f_o\left(s\right)\right), \sum_{i\in I} \delta_{u(f_i(s))}\right) dP\left(s\right) \qquad (2)$$

represents $\succsim$ *and satisfies* $V\left(\mathcal{F}\right) = u\left(C\right)$.

The preferences described by Theorem 1 can be represented by a triplet (u, ϱ, P). Next we give the uniqueness properties of this representation.

Proposition 1 *Two triplets* (u, ϱ, P) *and* $(\hat{u}, \hat{\varrho}, \hat{P})$ *represent the same relation* $\succsim$ *as in Theorem 1 if and only if* $\hat{P} = P$ *and there exist* $\alpha, \beta \in \mathbb{R}$ *with* $\alpha > 0$ *such that* $\hat{u} = \alpha u + \beta$, *and*

$$\hat{\varrho}\left(z, \sum_{i\in I} \delta_{z_i}\right) = \alpha\varrho\left(\alpha^{-1}\left(z-\beta\right), \sum_{i\in I} \delta_{\alpha^{-1}(z_i-\beta)}\right),$$

for all $\left(z, \sum_{i\in I} \delta_{z_i}\right) \in \mathrm{pim}\left(\hat{u}\left(C\right)\right)$.

5 The Social Value Representation

In this section we consider the possibility that agents might feel envy/pride as a social emotion, because of the symbolic value of consumer goods. To illustrate, consider the example of the "silver spoon" of Veblen, who clearly brings out the contrast between use and symbolic values of objects:

> A hand-wrought silver spoon, of a commercial value of some ten to twenty dollars, is not ordinarily more serviceable – in the first sense of the word – than a machine-made spoon of the same material. It may not even be more serviceable than a machine-made spoon of some "base" metal, such as aluminum, the value of which may be no more than some ten to twenty cents. [TLC, chapter 6]

The conceptual structure we have developed so far allows us to make more precise the classic Veblenian distinction. An object may be serviceable for the utility it provides to the user abstracting from the social signal it sends; for instance, if the object is used completely in private. But the social value (for example, "the utility of the articles valued for their beauty") is a different evaluation.

We formalize this idea through the induced preference $\dot{\succsim}$ on C, defined as follows: say that

$$\bar{c} \mathrel{\dot{\succsim}} \underline{c} \tag{3}$$

if and only if

$$\left(x_o, (x_i)_{i\in I}, \underline{c}_{\{j\}}\right) \succsim \left(x_o, (x_i)_{i\in I}, \bar{c}_{\{j\}}\right)$$

for all $\left(x_o, (x_i)_{i\in I}\right) \in \mathcal{X}$ and $j \notin I$.

The relation $\dot{\succsim}$ is trivial for conventional, asocial, agents because for them it always holds $\left(x_o, (x_i)_{i\in I}, \underline{c}_{\{j\}}\right) \sim \left(x_o, (x_i)_{i\in I}, \bar{c}_{\{j\}}\right) \sim (x_o)$. But, before further commenting on $\dot{\succsim}$, consider the following properties.

Axiom A. 7 (Social Dependence) *The relation $\dot{\succsim}$ is an archimedean and independent weak order.*[19]

This axiom amounts to requiring the existence of a non-constant affine function $v : C \to \mathbb{R}$ representing $\dot{\succsim}$. We interpret v as a numerical representation of the social emotion. In fact, we have $\bar{c} \mathrel{\dot{\succ}} \underline{c}$ if there is a society $I \cup \{j\}$ where o strictly prefers, ceteris paribus, that his peer j gets $\underline{c}$ rather than $\bar{c}$. Since o's outcome is the same, the ranking (3) reflects a consumption externality of j on o. This externality can be due to the private emotion we discussed before (and in this case $v = u$), but, more generally, can be due to a cultural/symbolic aspect of j's consumption. For instance, in the above Veblen example, the silver and aluminum spoons have very similar u values, but very different v values.

Like u, also v is a purely subjective construct because $\dot{\succsim}$ is derived from the agent's subjective preference $\succsim$. As such, it may depend solely on subjective considerations.

In terms of specifications, the most frequently considered in the literature is that in which there is just one homogeneous consumption good and v is its (sure or expected) quantity. That is, either $C = \mathbb{R}$ and $v(r) = r$ or $C = \Delta(\mathbb{R})$ and $v(p) = \sum_{r\in\mathbb{R}} rp(r)$.

Next axiom is simply the social version of Axiom B.2.

Axiom A. 8 (Social Comparative Preference) *Let $\left(x_o, (x_i)_{i\in I}\right), \left(y_o, (x_i)_{i\in I}\right)$ in $\mathcal{X}$ If $x_o \mathrel{\dot{\succsim}} y_o$, then*

$$\frac{1}{2}c\left(x_o, (x_i)_{i\in I}\right) + \frac{1}{2}y_o \succsim \frac{1}{2}x_o + \frac{1}{2}c\left(y_o, (x_i)_{i\in I}\right)$$

We can now state our more general representation result.

Theorem 2 *A binary relation $\succsim$ on $\mathcal{F}$ satisfies Axioms A.1-A.8 if and only if there exist two non-constant affine functions $u, v : C \to \mathbb{R}$, a diago-null function $\varrho : \mathrm{pim}(v(C)) \to \mathbb{R}$ increasing in the first component and decreasing (w.r.t. stochastic dominance) in the*

[19]Notice that when restricted to C the Archimedean and Independence Axioms take the usual forms:

3. If $\bar{c} \mathrel{\dot{\succ}} c \mathrel{\dot{\succ}} \underline{c}$, there are $\alpha, \beta \in (0,1)$ such that $\alpha\bar{c} + (1 - \alpha\underline{c}\ ) \mathrel{\dot{\succ}} c \mathrel{\dot{\succ}} \beta\bar{c} + (1 - \beta\underline{c}\ )$.
4. If $\bar{c} \mathrel{\dot{\succ}} \underline{c}$, then $\alpha\bar{c} + (1 - \alpha c) \mathrel{\dot{\succ}} \alpha\underline{c} + (1 - \alpha c)$ for all $\alpha \in (0,1)$ and $c \in C$.

second, and a probability P on Σ, such that v represents $\dot{\succsim}$ and the function $V : \mathcal{F} \to \mathbb{R}$, defined by

$$V\left(f_o, (f_i)_{i\in I}\right) = \int_S u\left(f_o(s)\right) dP(s) + \int_S \varrho\left(v\left(f_o(s)\right), \sum_{i\in I} \delta_{v(f_i(s))}\right) dP(s) \tag{4}$$

represents $\succsim$ and satisfies $V(\mathcal{F}) = u(C)$.

The preferences described by Theorem 2 can be represented by a quadruple (u, v, ϱ, P). Next we give the uniqueness properties of this representation.

Proposition 2 *Two quadruples (u, v, ϱ, P) and $(\hat{u}, \hat{v}, \hat{\varrho}, \hat{P})$ represent the same relations $\succsim$ and $\dot{\succsim}$ as in Theorem 2 if and only if $\hat{P} = P$ and there exist $\alpha, \beta, \dot{\alpha}, \dot{\beta} \in \mathbb{R}$ with $\alpha, \dot{\alpha} > 0$ such that $\hat{u} = \alpha u + \beta$, $\hat{v} = \dot{\alpha} v + \dot{\beta}$,*

$$\hat{\varrho}\left(z, \sum_{i\in I} \delta_{z_i}\right) = \alpha \varrho\left(\dot{\alpha}^{-1}\left(z - \dot{\beta}\right), \sum_{i\in I} \delta_{\dot{\alpha}^{-1}\left(z_i - \dot{\beta}\right)}\right)$$

for all $\left(z, \sum_{i\in I} \delta_{z_i}\right) \in \operatorname{pim}\left(\hat{v}(C)\right)$.

5.1 Private vs Social: negatively dependent preferences

The fact that the functional (2) appearing in Theorem 1 is a special case of the functional (4) appearing in Theorem 2, might suggest that Theorem 1 is a special case of Theorem 2. This is in general false because of the requirement in Theorem 2 that the affine and non-constant function v represents $\dot{\succsim}$. What is true is that Theorem 1 is a special case of Theorem 2 provided u represents $\dot{\succsim}$; that is, provided $\succsim$ coincides with $\dot{\succsim}$ on C.

Notice that Axiom B.1 guarantees that $\succsim$ implies $\dot{\succsim}$. The converse implication is obtained by mildly strengthening Axiom B.1. The new axiom requires that the agent is "sufficiently sensible to externalities."

Axiom B. 3 (Strong Negative Dependence) *If $\bar{c} \succsim \underline{c}$, then*

$$\left(x_o, (x_i)_{i\in I}, \underline{c}_{\{j\}}\right) \succsim \left(x_o, (x_i)_{i\in I}, \bar{c}_{\{j\}}\right)$$

for all $\left(x_o, (x_i)_{i\in I}\right) \in \mathcal{X}$ and $j \notin I$.

Moreover, if the first relation is strict, the second is strict for some $\left(x_o, (x_i)_{i\in I}\right) \in \mathcal{X}$ and $j \notin I$.

Notice that the first part of this axiom is literally Axiom B.1, the strenghtening starts with "Moreover...".

Proposition 3 *Let $\succsim$ on $\mathcal{F}$ be a binary relation that satisfies Axioms A.1-A.6. The following statements are equivalent:*

(i) $\succsim$ satisfies Axioms A.7 and B.1;

(ii) $\succsim$ satisfies Axiom B.3;

(iii) $\succsim$ coincides with $\dot{\succsim}$ on C.

Remark 1 *Assume $\succsim$ is represented as in Theorem 1. Clearly, Axiom B.3 is satisfied whenever ϱ is strictly increasing in the second component (w.r.t. stochastic dominance). On the contrary, if $\varrho \equiv 0$, we are in the standard expected utility case: Axiom B.1 is satisfied while Axiom B.3 is violated.*

As already observed, Axiom B.1 guarantees that $\dot{\succsim}$ coarser than $\succsim$. Next example shows that this can happen in nontrivial ways.

Example 1 *Assume $|S| = |N| = 1$ and $C = \mathbb{R}$, and consider the preferences on $\mathcal{F}$ represented by*

$$V(x_o) = x_o,$$
$$V(x_o, x_{-o}) = x_o + \left((x_o)^+ - (x_{-o})^+\right)^{1/3},$$

*for all $x_o, x_{-o} \in \mathbb{R}$. Using Theorem 1, it is easy to check that these preferences satisfy Axioms A.1-A.6 and B.1-B.2. They have this natural interpretation: there is a poverty line at 0, our agent is not affected by externalities when both his neighbor and himself are poor, but money changes people (**ci deve essere un modo di dire simile in inglese**). Moreover, it is easy to check that Axiom B.3 is violated. In fact, $\succsim$ coincides on $\mathbb{R}$ with the usual order while $\dot{\succsim}$ is trivial on $\mathbb{R}^-$ and the usual order on $\mathbb{R}^+$ (Proposition 3 implies that Axiom B.3 is violated).*

6 Special Cases

We consider three special cases of Theorem 2. In the first one, the closest to the functional forms adopted in the existing literature, the influence of the society depends only on the average social payoff of its members. In the second one, only the maximum and minimum payoffs of the other members of the society matter. In the third and last, the distributions of the dominating and dominated members of the society (with respect to o) are explicitly differentiated, thus separating the *invidia* (envy) effect from the *superbia* (pride) effect.

6.1 Average Payoff

Let n be a positive integer and $\left(x_o, (x_i)_{i\in I}\right)$ an element of $\mathcal{X}$. Intuitively, an *n-replica* of $\left(x_o, (x_i)_{i\in I}\right)$ is a society in which each agent i in I has spawned $n-1$ clones of himself, each with the same endowment x_i.

We denote such replica by $\left(x_o, n(x_i)_{i\in I}\right)$, which therefore corresponds to an element

$$\left(x_o, \left(x_{i_{J_i}}\right)_{i\in I}\right) \in \mathcal{X},$$

where $\{J_i\}_{i\in I}$ is a class of disjoint subsets of N with $|J_i| = n$ for all $i \in I$.[20]

Axiom A. 9 (Replica Independence) *Let $\left(x_o, (x_i)_{i\in I}\right), \left(y_o, (y_i)_{i\in I}\right) \in \mathcal{X}$. If $\left(x_o, (x_i)_{i\in I}\right) \succsim \left(y_o, (y_i)_{i\in I}\right)$ then*

$$\left(x_o, n(x_i)_{i\in I}\right) \succsim \left(y_o, n(y_i)_{i\in I}\right)$$

for all n in $\mathbb{N}$.

[20] Remember that $x_{i_{J_i}}$ is the constant vector taking value x_i on each element of J_i. Notice also that, if $I = \emptyset$, then $\left(x_o, n(x_i)_{i\in I}\right) = (x_o) = \left(x_o, (x_i)_{i\in I}\right)$, if $n|I| > |N|$, then $\left(x_o, (x_i)_{i\in I}\right)$ admits no n-replicas.

Axiom A. 10 (Randomization Independence) *Let* $\left(x_o,(x_i)_{i\in I}\right),\left(x_o,(y_i)_{i\in I}\right)\in\mathcal{X}$. *If*

$$\left(x_o,(\alpha x_i+(1-\alpha)\,w_i)_{i\in I}\right)\succ\left(x_o,(\alpha y_i+(1-\alpha)\,w_i)_{i\in I}\right)$$

for some α *in* $(0,1]$ *and* $\left(x_o,(w_i)_{i\in I}\right)\in\mathcal{X}$, *then*

$$\left(x_o,(\beta x_i+(1-\beta)\,z_i)_{i\in I}\right)\succsim\left(x_o,(\beta y_i+(1-\beta)\,z_i)_{i\in I}\right)$$

for all β *in* $(0,1]$ *and* $\left(x_o,(z_i)_{i\in I}\right)\in\mathcal{X}$.

Axioms A.9 and A.10 say, respectively, that the agent's preferences are not reversed either by an n-replica of the societies $(x_i)_{i\in I}$ and $(y_i)_{i\in I}$ or by a randomization with a common society $(w_i)_{i\in I}$.

Next we have a standard continuity axiom.

Axiom A. 11 (Continuity) *For all* $\left(x_o,(x_i)_{i\in I}\right),\left(x_o,(y_i)_{i\in I}\right),\left(x_o,(w_i)_{i\in I}\right)\in\mathcal{X}$, *the sets*

$$\begin{gathered}\left\{\alpha\in[0,1]:\left(x_o,(\alpha x_i+(1-\alpha)\,w_i)_{i\in I}\right)\succsim\left(x_o,(y_i)_{i\in I}\right)\right\},\ \text{and}\\ \left\{\alpha\in[0,1]:\left(x_o,(\alpha x_i+(1-\alpha)\,w_i)_{i\in I}\right)\precsim\left(x_o,(y_i)_{i\in I}\right)\right\},\end{gathered}$$

are closed.

To state our result we need some notation. The natural version of diago-nullity for a function ϱ on $K\times(K\cup\{\infty\})$ requires that $\varrho(z,z)=0=\varrho(z,\infty)$ for all $z\in K$ (with the convention $0/0=\infty$). Moreover, a function $\varphi:K\to\mathbb{R}$ is *continuously decreasing* if it is a strictly increasing transformation of a continuous and decreasing function $\psi:K\to\mathbb{R}$.[21]

If we add Axioms A.9-A.11 to those in Theorem 2, then we obtain the following intuitive representation:

Theorem 3 *Let* N *be infinite. A binary relation* $\succsim$ *on* $\mathcal{F}$ *satisfies Axioms A.1-A.11 if and only if there exist two non-constant affine functions* $u,v:C\to\mathbb{R}$, *a diago-null function* $\varrho:v(C)\times(v(C)\cup\{\infty\})\to\mathbb{R}$ *increasing in the first component and continuously decreasing in the second on* $v(C)$, *and a probability* P *on* Σ, *such that* v *represents* $\dot{\succsim}$ *and the function* $V:\mathcal{F}\to\mathbb{R}$, *defined by*

$$V\left(f_o,(f_i)_{i\in I}\right)=\int_S u\left(f_o(s)\right)dP(s)+\int_S\varrho\left(v\left(f_o(s)\right),\frac{1}{|I|}\sum_{i\in I}v\left(f_i(s)\right)\right)dP(s)\tag{5}$$

represents $\succsim$ *and satisfies* $V(\mathcal{F})=u(C)$.

The uniqueness part becomes:

Proposition 4 *Two quadruples* (u,v,ϱ,P) *and* $(\hat{u},\hat{v},\hat{\varrho},\hat{P})$ *represent the same preferences as in Theorem 3 if and only if there exist* $\alpha,\beta,\dot{\alpha},\dot{\beta}\in\mathbb{R}$ *with* $\alpha,\dot{\alpha}>0$ *such that* $\hat{u}=\alpha u+\beta$, $\hat{v}=\dot{\alpha}v+\dot{\beta}$, $\hat{P}=P$, *and*

$$\hat{\varrho}(z,r)=\alpha\varrho\left(\frac{z-\dot{\beta}}{\dot{\alpha}},\frac{r-\dot{\beta}}{\dot{\alpha}}\right)$$

for all $(z,r)\in\hat{v}(C)\times(\hat{v}(C)\cup\{\infty\})$.

[21] Strictly decreasing functions φ $(=\bar{\varphi}\circ(-\mathrm{id})$ where $\bar{\varphi}(t)=\varphi(-t)$ for all $t)$ and continuous decreasing functions φ $(=\mathrm{id}\circ\varphi)$ are clearly continuously decreasing, while decreasing step functions are not (unless they are constant).

6.2 Maximum and Minimum Payoffs

In some cases, the agent might only care about the best and worst outcomes that his peers get. This property is captured by the next axiom.

Axiom C. 1 (Best-Worst) *Let* $\left(x_o, (x_i)_{i\in I}\right), \left(x_o, (y_j)_{j\in J}\right) \in \mathcal{X}$. *If*

(i) for all $i \in I$ *there is* $j \in J$ *such that* $y_j \dot{\succsim} x_i$,

(ii) for all $j \in J$ *there is* $i \in I$ *such that* $y_j \dot{\succsim} x_i$,

then $\left(x_o, (x_i)_{i\in I}\right) \succsim \left(x_o, (y_j)_{j\in J}\right)$.

The intuition here is that, for a fixed "level of consumption" of o, in society $(y_j)_{j\in J}$ is more difficult to *keep up with the Joneses* (point (i)), while in society $(x_i)_{i\in I}$ is easier to *stay ahead of them* (point (ii)).

Given a non-singleton interval $K \subseteq \mathbb{R}$, set

$$K^{1,2} = \left\{(z, r, R) \in K^3 : r \leq R\right\} \cup \left(K \times \{+\infty\} \times \{-\infty\}\right).$$

Diago-nullity on $K^{1,2}$ takes the form $\eta(z, z, z) = 0 = \eta(z, +\infty, -\infty)$ for all $z \in K$, with the conventions $\min \emptyset = +\infty$ and $\max \emptyset = -\infty$.

Theorem 4 *Let* $|N| > 1$. *A negatively dependent preference* $\succsim$ *on* $\mathcal{F}$ *satisfies Axiom 1 if and only if there exist a non-constant affine function* $u : C \to \mathbb{R}$, *a diago-null function* $\eta : u(C)^{1,2} \to \mathbb{R}$, *increasing in the first component and decreasing in the second and third, and a probability* P *on* Σ *such that the functional* $V : \mathcal{F} \to \mathbb{R}$, *defined by*

$$\begin{aligned} V\left(f_o, (f_i)_{i\in I}\right) = &\int_S u\left(f_o(s)\right) dP(s) \\ &+ \int_S \eta\left(u\left(f_o(s)\right), \min_{i\in I} u\left(f_i(s)\right), \max_{i\in I} u\left(f_i(s)\right)\right) dP(s) \end{aligned} \tag{6}$$

represents $\succsim$ *and satisfies* $V(\mathcal{F}) = u(C)$.[22]

Here uniqueness takes the following form:

Proposition 5 *Two triplets* (u, η, P) *and* $(\hat{u}, \hat{\eta}, \hat{P})$ *represent the same negatively dependent preferences* $\succsim$ *as in Theorem 4 if and only if there exist* $\alpha, \beta \in \mathbb{R}$ *with* $\alpha > 0$ *such that* $\hat{u} = \alpha u + \beta$, $\hat{P} = P$, *and*

$$\hat{\eta}(z, r, R) = \alpha\eta\left(\frac{z-\beta}{\alpha}, \frac{r-\beta}{\alpha}, \frac{R-\beta}{\alpha}\right)$$

for all $(z, r, R) \in \hat{u}(C)^{1,2}$.

[22] To be precise, since Axiom 1 implies Axiom 1, the latter axiom is actually superfluous in Theorem 4.

6.3 Separating Invidia and Superbia

We can now separate the different effects of *envy* (keeping up with the Joneses) "painful or resentful awareness of an advantage enjoyed by another joined with a desire to possess the same advantage" and *pride* (staying ahead of the Smiths) "satisficing or gratifying awareness of enjoying an advantage not enjoyed by another joined with a desire to maintain this advantage"

Axiom 1 *Let* $\left(x_o, (x_i)_{i\in I}\right) \in \mathcal{X}$, $j \notin I$, *and* $c \in C$.

(i) If $c \dot{\succsim} x_o$, *then* $\left(x_o, (x_i)_{i\in I}\right) \succsim \left(x_o, (x_i)_{i\in I}, c_{\{j\}}\right)$

(ii) If $c \dot{\prec} x_o$, *then* $\left(x_o, (x_i)_{i\in I}\right) \precsim \left(x_o, (x_i)_{i\in I}, c_{\{j\}}\right)$.

The importance of Axiom 1 is that it describes reactions to the addition of a new agent.

If K is an interval of real numbers, we denote by $\mathrm{pid}\,(K)$ the set of pairs (z, μ, ν) such that $z \in K$, μ and ν are positive integer measures finitely supported in $K \cap (-\infty, z)$ and $K \cap [z, \infty)$, with $(\mu + \nu)(K) \le |N|$. The elements of $\mathrm{pid}\,(K)$ are understood to be (payoff to o, distribution of payoffs of those who are worse of, distribution of payoffs of those who are better of) triplets. If $I \in \wp(N)$, $\mathbf{e} = (e_i)_{i\in I}$ is a vector of real numbers, and $z \in \mathbb{R}$ we denote by $\mu_{e_i<z}$ the distribution of the vector $(e_i)_{i\in I: e_i<z}$, $\mu_{e_i\ge z}$ is defined analogously. The natural version of the definition of diago-nullity for a function ξ defined on $\mathrm{pid}\,(K)$ requires that $\xi\,(z, 0, n\delta_z) = 0$ for all $z \in u\,(C)$ and $0 \le n \le |N|$.

Theorem 5 *A binary relation* $\succsim$ *on* $\mathcal{F}$ *satisfies A.1-B.2, and* **??**-**??** *if and only if there exist a non-constant affine function* $u : C \to \mathbb{R}$, *a diago-null function* $\xi : \mathrm{pid}\,(u\,(C)) \to \mathbb{R}$ *increasing in the first component, decreasing in the second and third components w.r.t. lower dominance and upper dominance respectively, and a probability* P *on* Σ *such that the functional* $V : \mathcal{F} \to \mathbb{R}$, *defined by*

$$\begin{aligned} V\left(f_0, (f_i)_{i\in I}\right) = & \int_S u\,(f_o\,(s))\,dP\,(s) + \\ & + \int_S \xi\left(u\,(f_o\,(s))\,, \mu_{u(f_i(s))<u(f_o(s))}, \mu_{u(f_i(s))\ge u(f_o(s))}\right) dP\,(s) \end{aligned} \tag{7}$$

represents $\succsim$ *on* $\mathcal{F}$ *and satisfies* $V\,(\mathcal{F}) = u\,(C)$.

Proposition 6 (u, ξ, P) *and* $(\hat{u}, \hat{\xi}, \hat{P})$ *represent the same negatively dependent preferences* $\succsim$ *as in Theorem 5 if and only if there exist* $\alpha, \beta \in \mathbb{R}$ *with* $\alpha > 0$ *such that* $\hat{u} = \alpha u + \beta$, $\hat{P} = P$, *and*

$$\hat{\xi}\left(z, \sum_{i\in I} \delta_{z_i}, \sum_{j\in J} \delta_{r_j}\right) = \alpha \xi \left(\alpha^{-1}(z - \beta)\,, \sum_{i\in I} \delta_{\alpha^{-1}(z_i-\beta)}, \sum_{j\in J} \delta_{\alpha^{-1}(r_j-\beta)}\right)$$

for all $\left(z, \sum_{i\in I} \delta_{z_i}, \sum_{j\in J} \delta_{r_j}\right) \in \mathrm{pid}\,(\hat{u}\,(C))$.

If in Axioms **??**.b, $y_j \succsim x_o$ is replaced by $y_j \succ x_o$, and, in Axiom **??**.b, $y_j \prec x_o$ is replaced with $y_j \precsim x_o$, representation (7) still holds, provided $\mu_{u(f_i(s))<u(f_o(s))}$ is replaced with $\mu_{u(f_i(s))\le u(f_o(s))}$ and $\mu_{u(f_i(s))\ge u(f_o(s))}$ is replaced with $\mu_{u(f_i(s))>u(f_o(s))}$. The difference between this variation and the original axioms capture different attitudes towards the addition of an agent with the "same" consumption as o.

7

7.1 The Special Cases Revisited

Although for brevity we omit details, also the min-max representation (6) of Theorem 4 can be generalized as follows:

$$V\left(f_o,(f_i)_{i\in I}\right)=\int_S u\left(f_o\left(s\right)\right)dP\left(s\right)+\int_S \eta\left(v\left(f_o\left(s\right)\right),\min_{i\in I} v\left(f_i\left(s\right)\right),\max_{i\in I} v\left(f_i\left(s\right)\right)\right)dP\left(s\right)$$

8 Behavioral Attitudes

The axiomatization of preferences given in the first two basic theorems opens now the way for a behavioral foundation of the analysis of preferences. We will typically assume axioms Axioms A.1-A.5, A.9-A.11, and A.7-A.6, so that the representation (5) holds. These axioms allow us to define the derived preference $\dot{\succ}$ as in (3) naturally associated with $\succ$.

If, in addition, we assume Axioms B.2 and B.1, then we get that, for every c and d in C, we have $c\dot{\succ}d$ if and only if $c\succ d$; therefore, $u(c)>u(d)$ if and only if $v(c)>v(d)$.

In this section, we say that an event $E\in\Sigma$ is *(socially) essential* if for some $\bar{c}$ and $\underline{c}$ in C, we have neither $\bar{c}\dot{\sim}\bar{c}E\underline{c}$ nor $\bar{c}E\underline{c}\dot{\sim}\underline{c}$. We say that E *ethically (socially) neutral* if, in addition, $\bar{c}E\underline{c}\dot{\sim}\underline{c}E\bar{c}$.

It is sometimes useful to consider attitudes on subsets of C. For this reason, throughout this section we denote by D a convex subset of C.

8.1 Social Risk Aversion

A decision maker is averse to social risk is he prefers that his peers have a constant than an uncertain act, even when the uncertain act is indifferent from the point of view of social value to the constant one.

Formally, say that a preference $\succsim$ is *averse to social risk* if there is an essential event E such that, for all $x_o\in D$,

$$(x_o,w_i)\succsim(x_o,x_iEy_i) \tag{8}$$

for all $x_i,y_i,w_i\in D$ such that $x_iEy_i\dot{\sim}w_i$.

The next result characterizes social risk aversion through the convexity of the function η.

Proposition 7 *Suppose $\succsim$ admits a representation (5). Then, $\succsim$ is averse to social risk if and only if $\eta\left(r,\cdot\right)$ is concave on $v\left(D\right)$ for all $r\in v\left(D\right)$.*

Propensity to social risk is defined analogously and characterized by concavity of $\eta\left(v\left(x_o\right),\cdot\right)$ on $v\left(D\right)$. More importantly, the standard analysis of risk attitudes applies to our more general "social" setting: for example, for every level of the reference value $v\left(x_o\right)$ we can measure the coefficient of social risk aversion.

An immediate implication of Proposition 7 is that (8) holds for all essential E; in the definition of social risk aversion the choice of E is thus immaterial.

8.2 Envy and Pride

An outcome profile where your peers get a better outcome than yours can be classified as social loss, and, conversely, a profile where you get more than them can be classified as a social gain. This taxonomy is important because individuals might well have different attitudes toward such social gains and losses, similarly to what happens for standard private gains and losses.

Formally, we say that a preference $\succsim$ is *more envious than proud on D* if there is an ethically neutral event E such that, for all $x_o \in D$,

$$(x_o, x_o) \succsim (x_o, x_i E y_i) \tag{9}$$

for all $x_i, y_i \in D$ such that $x_i E y_i \dot{\sim} x_o$.

The intuition is that agent o tends to be more frustrated by envy than satisfied by pride.

Proposition 8 *Suppose $\succsim$ admits a representation (5). Then, $\succsim$ is more envious than proud on D if and only if*

$$\eta(r, r+h) \leq -\eta(r, r-h) \tag{10}$$

for all $r \in D$ and all $h \geq 0$ such that $r \pm h \in D$. In this case, (9) holds for all ethically neutral events, and[23]

$$\underline{D}_2^+ \eta(r, r) \leq \overline{D}_2^- \eta(r, r). \tag{11}$$

Similarly to what happened for social risk aversion, also here it is immediate to see that the choice of E in the definition of more envious than proud is immaterial.

9 Comparative Interdependence (non toccato)

Next we show that comparative attitudes for negatively dependent preferences are determined by the function ϱ.

9.1 Aversion to Social Ranking

An agent is more averse to social ranking if he has more to lose (in subjective terms) from social comparisons.

An agent 1 is *more (absolutely) ranking averse than* another agent 2 if and only if, for all $\left(x_o, (x_i)_{i \in I}\right) \in \mathcal{X}$ and $c \in C$,

$$\left(x_o, (x_i)_{i \in I}\right) \succsim_1 c_{I_o} \Rightarrow \left(x_o, (x_i)_{i \in I}\right) \succsim_2 c_{I_o} \tag{12}$$

Denote by ϱv the composition: $(\varrho v)\left(x_o, (x_i)_{i \in I}\right) \equiv \varrho\left(v(x_o), \sum \delta_{v(x_i)}\right)$

Proposition 9 *Given two negatively dependent preferences $\succsim_1$ and $\succsim_2$ that satisfy the axioms in Theorem 2, the following conditions are equivalent:*

(i) $\succsim_1$ is more ranking averse than $\succsim_2$,

[23] Set

$$\underline{D}_2^+ \eta(r, r) = \liminf_{h \downarrow 0} \frac{\eta(r, r+h) - \eta(r, r)}{h} \quad \text{and} \quad \overline{D}_2^- \eta(r, r) = \limsup_{h \downarrow 0} \frac{\eta(r, r+h) - \eta(r, r)}{h}.$$

(ii) $u_1 \approx u_2$ *and (provided* $u_1 = u_2$*)* $\varrho_1 v_1 \geq \varrho_2 v_2$.

Here $u_1 \approx u_2$ means that there exist $\alpha > 0$ and $\beta \in \mathbb{R}$ such that $u_1 = \alpha u_2 + \beta$. This proposition helps to unbundle the behavioral content of (12), which is going to be made precise in proposition (10) below.

As one can see from the first part of *(ii)* of the proposition, if two preferences $\succsim_1$ and $\succsim_2$ can be ordered by risk aversion, then they are *intrinsically equivalent*, that is they coincide on the set C (or precisely on $\{(c) : c \in C\}$).

If we consider the preferences on the general set of acts profiles, then we can see that the comparability according to risk aversion has two components:

(a) $x_o \succ_2 y_o \succsim_2 \left(x_o, (x_i)_{i\in I}\right)$ implies $x_o \succ_1 y_o \succsim_1 \left(x_o, (x_i)_{i\in I}\right)$, and

(b) $\left(x_o, (x_i)_{i\in I}\right) \succsim_1 y_o \succ_1 x_o$ implies $\left(x_o, (x_i)_{i\in I}\right) \succsim_2 y_o \succ_2 x_o$.

Condition (a) says that, if a society consuming $(x_i)_{i\in I}$ makes agent 2 dissatisfied of her consumption x_o, then it makes agent 1 dissatisfied too. That is, $\succsim_1$ is *more envious than* $\succsim_2$. Analogously, (b) means that every time agent 1 prefers to consume the intrinsically inferior x_o in a society consuming $(x_i)_{i\in I}$ than the superior y_o in solitude (or in egalitarianism), the same is true for agent 2. That is, $\succsim_1$ is *less proud than* $\succsim_2$.

The next Proposition clarifies the relations between ranking aversion and the behavioral traits described above, showing that one can express the relative aversion to ranking in terms of the two components separately:

Proposition 10 *Given two negatively dependent preferences* $\succsim_1$ *and* $\succsim_2$*, the following conditions are equivalent:*

(i) $\succsim_1$ *is more ranking averse than* $\succsim_2$*,*

(ii) $\succsim_1$ *is intrinsically equivalent to* $\succsim_2$*, more envious and less proud.*

9.2 Social Sensitivity

An agent is more socially sensitive if he has more at stake, in subjective terms, from social comparisons: intuitively, if he is at the same time more proud and more envious. To introduce the formal definition of social sensitivity, notice that leaving (a) unchanged and reverting the implication in (b) amounts to say that $\succsim_1$ is more envious and more proud than $\succsim_2$.

Proposition 11 *Given two negatively dependent preferences* $\succsim_1$ *and* $\succsim_2$*, the following conditions are equivalent:*

(i) $\succsim_1$ *is intrinsically equivalent to* $\succsim_2$*, more envious, and more proud,*

(ii) $u_1 \approx u_2$ *and (provided* $u_1 = u_2$*)* $|\varrho_1| \geq |\varrho_2|$ *and* $\varrho_1 \varrho_2 \geq 0$.

Then relative insensitivity (or inequality indifference) amounts to $\varrho(z, \mu) = 0$ for all $(z, \mu) \in \operatorname{pim}(u(C))$, that is

$$\left(x_o, (x_i)_{i\in I}\right) \sim x_o$$

for all $\left(x_o, (x_i)_{i\in I}\right) \in \mathcal{X}$.

10 Social Economics

We now investigate some economic consequences of our axiomatic analysis. We first introduce a storage two-period economy where agents have our social preferences. We then specialize this economy in order to focus on two distinct important economic phenomena that arise with our preferences, that is, overconsumption/workaholism and conformism/anticonformism. The last part of the Section shows that, in a market economy, conformism/anticonformism of agents' behavior leads to no trade/trade results.

Since we want to abstract from any possible strategic interaction among agents, we consider economies with a continuum of individually negligible agents. Formally, the set I of agents is $[0, 1]$, and is endowed with a σ-algebra Λ and a nonatomic probability measure λ.

10.1 Storage Economy

There is a single consumption good, which can be either consumed or saved. We first consider a *storage economy*, in which a storage technology is available that allows agents to store for their own future consumption any amount of the consumption good they do not consume in the first period.

As we will see momentarily, in the storage economy there is no room for trade: each agent produces, consumes, and saves/stores for his own future consumption. There are no markets and prices, and, with conventional asocial objective functions, this economy is in equilibrium (Definition 1) when agents just solve their intertemporal problems (13).

It is an equilibrium notion limited in scope, with no need of considering any form of mutual compatibility of agents' choices. If, however, agents have our social objective functions, this is no longer the case. In fact, when agents' own consumption choices are affected by their peers' choices, a link among all such choices naturally emerges. Even without any trading, in this case there is a sensible notion of mutual compatibility of the agents' choices and, as a result, a more interesting equilibrium notion becomes appropriate (Definition 2).

In the storage economies, therefore, interaction among agents only arises with a social dimension of consumption. This allows to study the equilibrium effects of this social dimension in "purity," without other factors intruding into the analysis. This is why we first consider these economies. Later, in Subsection 8.2, we will also consider a market economy.

Turn now to the formal model. We denote by σ the amount of the consumption good that is saved/stored. We assume that the storage technology gives a real (gross) return $R \geq 1$.

Agents leave two periods and in each of them they work and consume. In the first period each agent i selects a consumption/effort pair $(c_i, e_i) \in C_i \times E_i \subseteq \mathbb{R}^2_+$, evaluated by a utility function $u_i : C_i \times E_i \to \mathbb{R}$. Effort is transformed in consumption good according to an individual production function $F_i : E_i \to \mathbb{R}$.

In the second period there is technological uncertainty, described by a stochastic production function $G_i : E_i \times S \to \mathbb{R}$, which depends on a finite space S of states of Nature, endowed with a probability p on S such that $p(s) > 0$ for all $s \in S$. The production functions F and G use a physical capital, whose amount is exogenously fixed in each period and state (capital accumulation is thus not studied here).

In the second period too, each agent i works and consumes. He thus selects, in each state of Nature, a consumption/effort pair $(d_i(s), l_i(s)) \in C_i \times E_i$, again evaluated by the utility function $u_i : C_i \times E_i \to \mathbb{R}$ of the first period.[24]

Summing up, the intertemporal problems of agent i in the storage economy is:

$$\max_{(c_i,d_i,e_i,l_i)} u_i(c_i, e_i) + \beta\mathbb{E}[u_i(d_i, l_i)] \tag{13}$$

$$\text{s.t.} \quad \begin{array}{l} c_i + \sigma_i = F_i(e_i), \ \sigma_i \geq 0 \text{ and} \\ d_i(s) = G_i(l_i, s) + R\sigma_i, \quad \forall s \in S \end{array}$$

Set $C = \times_{i \in I} C_i$ and $E = \times_{i \in I} E_i$. A first period consumption profile c is a function $c : I \to C$ that assigns to each agent i a consumption c_i. We assume that c is almost everywhere bounded; that is, $c \in L_+^\infty(\lambda)$.

Second period consumption profiles $d(s) : I \to C$ are similarly defined (one per each state of nature), as well as first and second period effort profiles $e : I \to E$ and $l(s) : I \to E$, respectively. We denote by S^C and S^E the collection of all second period consumption and effort profiles, respectively.

To ease notation, define $U_i : C_i \times E_i \times S^{C_i} \to \mathbb{R}$ by

$$U_i(c, e, d) = u_i(c, e) + \beta\mathbb{E}\left[u(d_i(s), G_i^{-1}(d_i - R(F(e_i) - c_i), s))\right]$$

where we replace the constraints in (13) in the objective function.

Definition 1 *An intertemporal consumption/effort quadruple* $(c^*, d^*, e^*, l^*) \in C \times S^C \times E \times S^E$ *of consumption and effort profiles is an* (asocial) equilibrium profile *for the storage economy if*

(i) $U_i(c_i^*, e_i^*, d_i^*) \geq U_i(c_i, e_i, d_i)$ *for all* $(c_i, e_i, d_i) \in C_i \times E_i \times S^{C_i}$ *and* λ*-a.e.*

(ii) $l_i^*(s) = G_i^{-1}(d_i^* - R(F(e_i^*) - c_i^*), s))$ *for each* $s \in S$ *and* λ*-a.e.*

As we mentioned before, this equilibrium notion just requires that agents individually solve their problems (13), with no interaction whatsoever among themselves.

Turn now to our social preferences. Assume that the preferences of our agents are represented by the preference functional (5), with $\eta_i(r, s) = \gamma_i(r - s)$, where $\gamma_i : \mathbb{R} \to \mathbb{R}$ is an increasing function. Given $v_i : C_i \to \mathbb{R}$, the social objective function is thus

$$u_i(c, e) + \beta\mathbb{E}[u(d, l)] + \gamma(v(c) - m_1) + \beta\mathbb{E}[\gamma(v(d) - m_2)], \tag{14}$$

where $m_1 = \int v(d_i) d\lambda$ and $m_2(s) = \int v(d_i(s)) d\lambda$ for each $s \in S$.

Define $w_i : C_i \times E_i \times S^{C_i} \times \mathbb{R} \times \mathbb{R}^{|S|} \to \mathbb{R}$ by

$$\begin{aligned} & w_i(c, e, d, m_1, m_2) \\ & = U_i(c, e, d) + \gamma(v(c) - m_1) + \beta\mathbb{E}\gamma(v(d_i(s)) - m_2). \end{aligned} \tag{15}$$

Using this function, we can define the equilibrium notion relevant for our social preferences. It is a Nash equilibrium for a continuum of agents, based on Schmeidler (1973). In reading condition (i) it is important to keep in mind that agents are negligible and so, if they deviate, they would still face the same averages m_1^* and m_2^*.

[24]Notice how d and l are acts on S; that is, $d : S \to C_i$ and $l : S \to E_i$. We denote, respectively, by S^{E_i} and S^{C_i} the set of all these acts. We have $S^{E_i}, S^{C_i} \in \mathbb{R}^{|S|}$.

Definition 2 *An intertemporal quadruple* $(c^*, d^*, e^*, l^*) \in C \times S^C \times E \times S^E$ *of consumption and effort profiles is a* social equilibrium profile *for the storage economy if*

(i) $w_i(c_i^*, e_i^*, d_i^*, m_1^*, m_2^*) \geq w_i(c_i, e_i, d_i, m_1^*, m_2^*)$ *for all* $(c_i, e_i, d_i) \in C_i \times E_i \times S^{C_i}$ *and* λ*-a.e.*

(ii) $l_i^*(s) = G_i^{-1}(d_i^* - R(F(e_i^*) - c_i^*), s))$ *for each* $s \in S$ *and* λ*-a.e.*

(iii) $m_1^* = \int v_i(c_i^*)\, d\lambda(i)$ *and* $m_2^*(s) = \int v(d_i^*(s))\, d\lambda$ *for each* $s \in S$.

The novelty here is condition (iii), which, when combined with the other two conditions, requires a mutual compatibility of agents' choices. This equilibrium notion is thus qualitatively very different from that of Definition 1, a difference entirely due to the social dimension of our preferences.

A theoretical key issue is the existence of a social equilibrium. To prove this, we need the following (rather mild) assumption.

A.1 For each agent $i \in I$:

(i) $C_i = [a_i, b_i]$ and $E_i = [0, h_i]$, where $a, b, h : I \to \mathbb{R}_+$ are λ-integrable;

(ii) u_i is continuous on $\mathbb{R}_+^2$;

(iii) F_i is such that $F_i' > 0$ and $F_i'' < 0$ on $(0, \infty)$, and $0 \leq F_i(0) \leq F_i(h_i) \leq b_i$, and the same holds for each $G_i(\cdot, s)$;

(iv) v_i and γ_i are strictly increasing and continuous on their domains, with $\gamma_i(0) = 0$;

(v) the functions u_i, G_i^{-1}, v_i, and γ_i are Λ-measurable on $[0, 1]$ when regarded as functions on i.

We can now prove a general existence result for storage economies.

Theorem 6 *In a storage economy satisfying assumption A.1 there exists a social equilibrium provided all agents share the same value function* v.

10.1.1 Consumerism: Overconsumption and Workaholism

The first phenomenon we consider is how overconsumption and workaholism can arise in a social equilibrium. This is an often mentioned behavioral consequence of concerns for relative outcomes and here we show how it emerges in our general analysis.[25]

We focus on a single period version of the storage economy; that is, we set $\beta = 0$. In fact, as we pointed out in the Introduction, trade-offs arise in more general intertemporal setting (i.e., consuming more today leads to lower saving and, possibly, to lower future consumption). The tendency to overconsumption and workaholism that here we identify in the single period setting might be then offset by other forces.

[25] Empirical evidence on this phenomenon can be found, for example, in the labor economics papers mentioned in the Introduction (see, e.g. Bowles and Park 2005 for a recent study). Recent anecdotal evidence is reported in Rivlin (2007), who describes Silicon Valley workaholic executives as "working class millionaires."

The asocial problem of each agent $i \in I$ is thus given by

$$\max_{(c_i,e_i)\in C_i\times E_i} u_i(c_i,e_i) \qquad (16)$$
$$\text{s.t. } c_i = F_i(e_i)$$

Here a consumption profile $c : I \to C$ is an *asocial equilibrium* if, λ-a.e., c_i solves the asocial problem (16).

Set $\phi_i(c) = u_i\left(c, F_i^{-1}(c)\right)$ for all $c \in C$. We make the following assumption.

A.2 For each agent $i \in I$:

(i) u_i is such that on $\mathbb{R}^2_{++}$ we have $\partial u_i/\partial c > 0$, $\partial u_i/\partial e < 0$, and the Hessian matrix $\nabla^2 u_i$ is negative definite;

(ii) F_i is such that $F_i' > 0$ and $F_i'' < 0$ on $(0,\infty)$, and $0 \leq F_i(0) \leq F_i(h_i) \leq b_i$;

(iii) $\phi_i'(a_i) < 0 < \phi_i'(b_i)$, λ-a.e.

Lemma 1 *Under assumptions A.1 and A.2, there exists a unique asocial equilibrium $\widehat{c}$.*

Given $\gamma_i : \mathbb{R} \to \mathbb{R}$ and $v_i : C_i \to \mathbb{R}$, define $w_i : C_i \times \mathbb{R} \to \mathbb{R}$ by

$$w_i(c,m) = u_i\left(c, F_i^{-1}(c)\right) + \gamma_i\left(v_i(c) - m\right).$$

This is the special version of (15) relevant here. We make the following assumptions on the function γ_i and v_i.

A.3 For each $i \in I$:

(i) $\gamma_i : \mathbb{R} \to \mathbb{R}$ is such that $\gamma' > 0$ and $\gamma(0) = 0$;

(ii) $v_i : C_i \to \mathbb{R}$ is such that $v_i' > 0$ on $(0,\infty)$;

(iii) $\inf_{i\in I} v_i'(c)$ is measurable on I for each c, and $\inf_{i\in I} v_i'(c) > 0$.

A consumption profile $c^* : I \to \mathbb{R}$ is a *social equilibrium profile* if:

(i) $w_i(c_i^*, m^*) \geq w_i(c_i, m^*)$ for all $c_i \in C_i$ and λ-a.e.

(ii) $\int v_i(c_i^*)\, d\lambda(i) = m^*$.

A consumption profile $c^* : I \to \mathbb{R}$ is *strongly Pareto inefficient* if it is strongly Pareto dominated, that is, there is $\varepsilon > 0$ and $c \in L^\infty_+(\lambda)$ such that

$$w_i\left(c_i, \int v_i(c_i)\, d\lambda(i)\right) \geq w_i\left(c_i^*, \int v_i(c_i^*)\, d\lambda(i)\right) + \varepsilon, \qquad \forall i \in I.$$

Theorem 7 *Suppose assumptions A.1-A.3 hold. Then, social equilibria are strongly Pareto inefficient and exhibit overconsumption and workaholism.*[26]

[26] That is, λ-a.e., $c_i^* > \widehat{c}_i$ and $e_i^* > \widehat{e}_i$, where (c^*, e^*) and $(\widehat{c}, \widehat{e})$ are, respectively, social and asocial consumption and effort equilibrium pairs.

10.1.2 Conformism and Anticonformism

We now study how conformism and anticonformism can characterize the consumption choices of agents in social equilibria. We consider a version of the storage economy in which all agents are identical and labor is supplied inelastically, say $e_i = \overline{e}$ and $l_i = \overline{l}$ for all $i \in I$.

To ease notation, we set $F_i(\overline{e}) = y$, $G_i\left(\overline{l}(s), s\right) = Y(s)$, and we drop e and l as arguments of the utility function u.

The set of feasible first period consumption is $C \equiv [0, y]$. Agents' standard asocial intertemporal problem is thus

$$\max_{c \in C} u(c) + \beta \mathbb{E}\left[u(Y + R(y - c))\right]. \tag{17}$$

Define $U : C \to \mathbb{R}$ by $U(c) = u(c) + \beta \mathbb{E}\left[u(Y + R(y - c))\right]$.

B.1 We have:

(i) $u' > 0$ and $u'' < 0$ on $(0, +\infty)$;

(ii) $U'(0) \geq 0 \geq U'(y)$.

A (first period) consumption profile $c : I \to \mathbb{R}_+$ is an asocial (competitive) equilibrium if, λ-a.e., c_i solves problem (17). Clearly, all asocial equilibria are symmetric.

Lemma 2 *Under assumption B.1 there exists a unique asocial equilibrium.*

Given $\gamma : \mathbb{R} \to \mathbb{R}$, when agents choose a first period consumption c, this induces an average $m = (m_1, m_2)$, where $m_1 = \int_I v(c_i)\, d\lambda(i)$ and

$$x_2(s) = \int_I v(Y(s) + R(y - c_i)) d\lambda(i), \qquad \forall s \in S. \tag{18}$$

Given $\gamma : \mathbb{R} \to \mathbb{R}$ and $v : C \to \mathbb{R}$, agents' social objective function (15) becomes $w : C \times \mathbb{R} \to \mathbb{R}$, with:

$$w(c, x) \equiv u(c) + \beta \mathbb{E}\left[u(Y + R(y - c))\right] + \gamma(v(c) - m_1) + \beta \mathbb{E}\left[\gamma(v(Y + R(y - c)) - m_2)\right]$$

B.2 $v : C_i \to \mathbb{R}$ is concave and such that $v' > 0$ on $(0, \infty)$.

A (first period) consumption profile $c^* : I \to \mathbb{R}$ is a *social equilibrium profile* if:

(i) $w_i(c_i^*, m^*) \geq w_i(c_i, m^*)$ for all $c_i \in C_i$ and λ-a.e.

(ii) $\int v_i(c_i^*)\, d\lambda(i) = m^*$.

Theorem 8 *Suppose assumptions B.1 and B.2 hold. Then:*

(i) all social equilibria are asymmetric provided

$$\underline{\gamma}'_+(0) > \overline{\gamma}'_-(0) \geq 0; \tag{19}$$

(ii) all social equilibria are symmetric provided $\gamma(t) = 0$ for all $t \geq 0$, and $\gamma'(t) > 0$ for all $t < 0$. If, in addition, $\overline{\gamma}'_-(0) = 0$, then the asocial symmetric equilibrium $\widehat{c}$ is actually the unique social equilibrium.

For example, if agents only care about pride in a linear way, with $\gamma(y) = y^+$, then (19) is satisfied. Instead, the condition $\gamma(t) = 0$ for all $t \geq 0$ corresponds to pure envy.

10.2 A Market Economy: Autarky and Trade

In the storage economy there was no room for trade. We now make the simplest modification of the storage economy that allows trade. Specifically, we change the "saving technology" and we assume that agents no longer can store the consumption good for future consumption. They can, however, borrow and lend amounts of the consumption good, which is now also a real asset. Agents can save by lending any amount of the consumption good they do not consume in the first period.

In the (real) asset economy agents interact by trading in the real asset market. The asset economy is thus a market economy, a major difference relative to the storage economy. It is, however, a market economy very close to the storage economy. This allows to meaningfully study what form the results derived for the storage economy take when there exists a market where agents interact.

Denote by b the amount of the consumption good that is borrowed/lent in the real asset market. Assume that the consumption good, as a real asset, gives a (gross) return of R. The intertemporal problems of agent i in the asset economy is:

$$\max_{(c_i,d_i,e_i,l_i)} u_i\left(c_i, e_i\right) + \beta \mathbb{E}\left[u_i(d_i, l_i)\right] \tag{20}$$

$$\text{s.t.} \quad \begin{aligned} & c_i + b_i = F_i\left(e_i\right), \text{ and} \\ & d_i\left(s\right) = G_i\left(l_i, s\right) + Rb_i, \quad \forall s \in S \end{aligned}$$

The equilibrium notions relevant here are natural adaptations of Definitions 1 and 2. The only thing to observe is that now equilibria are quintuples $(c^*, d^*, e^*, l^*, R^*)$ that involve an equilibrium return R^* and satisfy a market clearing condition $\int b_i d\lambda\left(i\right) = 0$ in the real asset market.

In this market economy the conformism/anticonformism phenomena take an especially stark form. To see why this is the case, let us go back to the setting of Subsection 8.2.1, with identical agents and inelastic labor supply. In any symmetric equilibrium profile we necessarily have, λ-a.e., $b_i = 0$. In fact, by symmetry $b_i = b$ λ-a.e., and so the market clearing condition $\int b_i d\lambda\left(i\right) = 0$ implies $b_i = 0$, that is, autarky. Formally:

Lemma 3 *Autarky is the unique possible social symmetric equilibrium for the asset economy.*

In the market economy we are now considering, symmetry (and so conformism) thus amounts to autarky, that is, to no trade. In contrast, asymmetry (and so anticonformism) makes trade valuable to agents, and in this case markets do operate.

These simple considerations leads to the following version of Theorem 8.

Proposition 12 *In an asset economy, we have:*

(i) all social equilibria are asymmetric provided $\underline{\gamma}'_+\left(0\right) > \overline{\gamma}'_-\left(0\right) \geq 0$;

(ii) autarky is the unique social equilibrium provided $\gamma\left(t\right) = 0$ *for all* $t \geq 0$, $\overline{\gamma}'_-(0) = 0$, *and* $\gamma'\left(t\right) > 0$ *for all* $t < 0$.

By (ii), envy leads to autarky while, by (i), pride leads to a proper market economy, with operating markets.

11 Conclusions (sketch)

The view that we have developed here has several important components. The first is that the way the utility of an individual depends on the outcome of others is always filtered through a subjective point of view. Outcomes per se are meaningless: what matters is always in the eye of the beholder.

We may, however, look at the outcome of others in two completely different ways. We may consider them from the point of view of our utility, valuing what the others have as we would value it if we had it. This may hold in the good and in the bad: we may be envious if the utility we would have with the goods of the others is larger than our present one; and we may be happy in the opposite circumstance. Or we may look at the goods of the others with the eyes of the entire society, valuing them not for the utility that they provide but for the social signal that they send. This second view is close to the original Veblen idea that separates the ...

The role of social gains and losses in our analysis parallels that of gains and losses in the private domain.

This raises an important empirical issue: does the relative weight of gains and losses match the one we observe in private choices?

This issue is important because the equilibria depend on the shape of the dependence. For example, envy seems to produce equal societies, pride differentiated societies. We also expect that societies where pride prevails turn out to be more dynamic than societies where envy prevails.

The proofs section is available upon request.

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