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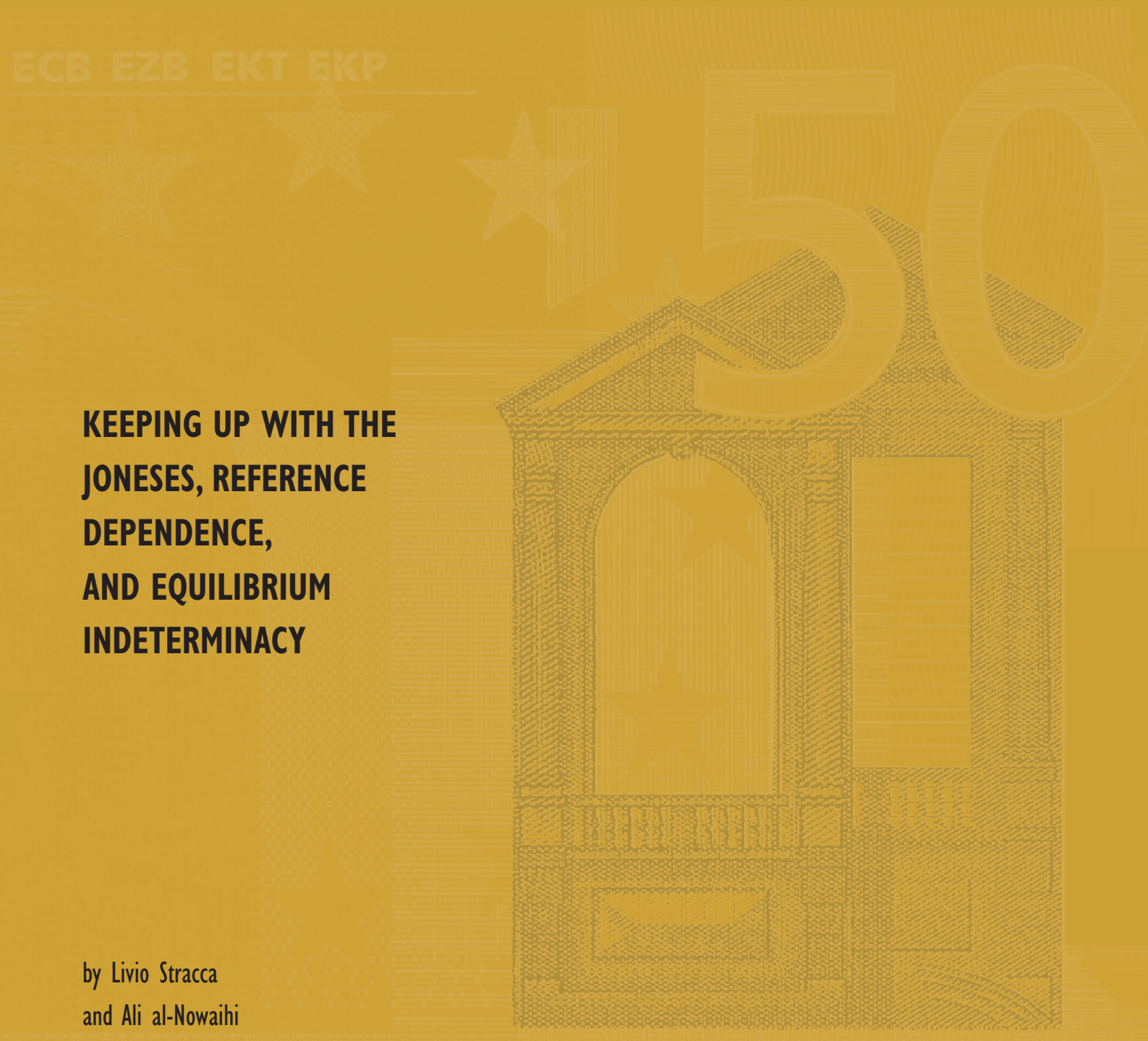


# KEEPING UP WITH THE JONESES, REFERENCE DEPENDENCE, AND EQUILIBRIUM INDETERMINACY

by Livio Stracca
and Ali al-Nowaihi

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by Livio Stracca [2]
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*1 The views expressed in this paper are only those of the authors and are not necessarily shared by the European Central Bank. We thank the editorial board and a referee for many useful suggestions.*
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**Abstract**

This model extends the keeping up with the Joneses (KUJ) model to incorporate the notion that positional concerns in consumption are best modelled with a reference dependence specification of preferences, as postulated by Tversky and Kahneman (1991) in the context of riskless choice. In line with this specification, which has received substantial empirical support in the literature, we assume that the marginal returns on the own consumption are increasing below the aggregate per capita levels of consumption (which is the reference point in our model). The main conclusion of the paper is that in our KUJ model aggregate consumption may be subject to sunspot fluctuations and the equilibrium level of consumption is not uniquely pinned down. The paper also discusses the role that fiscal policy can play in order to undo the effect of consumption externalities on both the determinacy and the desirability of the equilibrium.

**Keywords**: Consumption externalities, keeping up with the Joneses, reference dependence, equilibrium indeterminacy, optimal taxation.

**JEL codes**: D11, H21.

## Non-technical summary

There is a growing recognition in the economics literature of the role of positional concerns in consumption (Easterlin, 1995; Clark and Oswald, 1996; Layard, 2003). A widely used model giving emphasis to positional concerns is the keeping up with the Joneses model, henceforth KUJ (Gali, 1994). This model assumes that agents derive utility from their own consumption as well as from the difference between their own and aggregate per capita consumption. This makes the marginal utility of consumption for each individual dependent on the aggregate level of per capita consumption.

The main contribution of this paper to the existing literature on consumption externalities is the observation that consumption externalities essentially imply that agents evaluate their welfare compared with a reference point. In this respect, there is a large literature on the effects that reference dependence has on the functional form of the utility function (Kahneman and Tversky, 2000). In particular, reference dependence preferences are characterized by

- Loss aversion, whereby losses (defined in terms of outcomes below the reference point) matter comparatively more than gains (outcomes above the reference point);
- Diminishing sensitivity, whereby marginal departures from the reference point are more (less) important the less (more) away they are from it.

As a consequence of these two properties, the utility function with reference dependence is S-shaped, steeper below the reference point than above it, and convex below the reference point and concave above it. While this form of utility function has been mainly developed to model risky choice, Tverksy and Kahneman (1991) have also extended the concept to riskless choice.

The modelling of consumption externalities with a reference dependence utility function introduces a kind of lexicographic preferences specification, according to which agents can afford to pursue leisure in addition to consumption goals only under the precondition that they have satisfied the minimal requirement of consuming at least the reference point level of consumption, owing to the convex form of the utility function below the reference point. In other words, the aggregate per capita level of

consumption becomes de facto a subsistence level for our agent, where subsistence is defined in social and not in physical terms.

Against this background, a main result of this paper is that under such specification of preferences there is no determinate solution to the consumption decision problem (equilibrium indeterminacy). Aggregate consumption may be affected by sunspot fluctuations with no underlying rationale in tastes and technology.

In addition, our paper also deals with the optimal tax policy in an economy with KUJ preferences featuring reference dependence. In the framework of a standard KUJ model, Ljungqvist and Uhlig (2000) have shown that the task of tax policy is to undo the effect of consumption externalities and this can be accomplished by taxing consumption at a flat marginal rate. This solution, however, is generally insufficient to lead to a unique equilibrium in our case, and inefficient sunspot fluctuations may still arise.

We show that in our framework the optimal tax policy has two conceptually distinct tasks. The first task is to concavify the utility function below the reference point by taxing consumption at an increasing marginal rate (progressive tax). This ensures the uniqueness of the equilibrium. The second task is the same as in Ljungqvist and Uhlig, namely to tax consumption at a flat marginal rate to ensure that the marginal utility of consumption is reduced to the level which would prevail with no consumption externalities.

# 1 Introduction

There is a growing recognition in the economics literature of the role of positional concerns in consumption (Easterlin, 1995; Clark and Oswald, 1996; Layard, 2003). From a normative standpoint, consumption externalities may call for a welfare-enhancing role of government policy aimed at undoing the effect of the positional concerns and restoring the efficient level of consumption (Ljungqvist and Uhlig, 2000). A widely used model giving emphasis to positional concerns is the *keeping up with the Joneses* model, henceforth KUJ (Gali, 1994). This model assumes that agents derive utility from their own consumption as well as from the difference between their own and aggregate per capita consumption. This makes the marginal utility of consumption for each individual dependent on the aggregate level of per capita consumption.

The main purpose of this paper is to expand the KUJ model to take into account an important modification to the standard setting which is, in our view, very plausible. Our starting point is that positional concerns almost by definition naturally imply that agents compare themselves with a *reference* level of consumption. We observe that the subject of how preferences are shaped by the presence of reference points has been studied extensively in the literature and a large body of experimental and empirical work has emerged. Importantly, it has generally been found that the presence of reference points changes the functional form of agents' utility function to a significant extent, in both risky and riskless choice (Kahneman and Tversky, 2000). In particular, reference points leads to a different curvature of the utility function compared with the standard case, whereby the utility function is *steeper and convex* for outcomes *below* the reference point, and *flatter and concave* for outcomes *above* it. Since there is relatively strong evidence pointing to this functional form, a main suggestion made in this paper is that utility functions including positional concerns on consumption might have the same features.

With the above as the background, we introduce a simple specification of KUJ preferences with a modified functional form in order to take these aspects into account. A notable feature of this specification is that returns on consumption are increasing, rather than decreasing, for consumption levels below the reference point. Therefore, the aggregate per capita level of consumption becomes de facto a *subsistence level* of consumption for our agent, where subsistence is defined in social and not in material terms.

The main conclusion of this paper is that under a reference dependence version of the KUJ model there is no unique equilibrium consumption level; rather, there may be multiple equilibria driven by non-

fundamental factors. Aggregate consumption can thus be influenced by agents' animal spirits which have no foundation in changes in underlying tastes and technology. If our line of reasoning is correct and, in particular, if reference dependence is a fair representation of positional concerns in consumption, this result implies that agents' concern for relative status may have more profound effects than previously recognized. Indeed, such concerns may not only lead to an excessively high level of consumption, as stressed for example by Ljungqvist and Uhlig (2000); more fundamentally, they may lead to equilibrium indeterminacy, as shown by our analysis.

Our result is also related to the literature on endogenous business cycles driven by sunspots initiated by Benhabib and Farmer (1994). In Benhabib and Farmer, increasing returns and equilibrium indeterminacy originate in the production side. In our case, by contrast, sunspot fluctuations are driven by the fact that the returns on consumption are increasing below the reference point due to the psychology of consumers. Nevertheless, it is interesting to note that the end-result is essentially the same.

In addition, our paper also deals with the *optimal tax policy* in an economy with KUJ preferences featuring reference dependence. In the framework of a standard KUJ model, Ljungqvist and Uhlig (2000) have shown that the task of tax policy is to undo the effect of consumption externalities and this can be accomplished by taxing consumption at a flat marginal rate. This solution, however, is generally insufficient to lead to a unique equilibrium in our case, and inefficient sunspot fluctuations may still arise. We show that in our framework the optimal tax policy has two conceptually distinct tasks. The first task is to *concavify* the utility function below the reference point by taxing consumption at an increasing marginal rate (progressive tax). This ensures the *uniqueness* of the equilibrium, in line with similar remarks in the literature on Benhabib-Farmer type of business cycles (Guo and Lansing, 1998; Christiano and Harrison, 1999). The second task is the same as in Ljungqvist and Uhlig, namely to tax consumption at a flat marginal rate to ensure that the marginal utility of consumption is reduced to the level which would prevail with no consumption externalities.

The paper is organized as follows. Section 2 introduces the standard KUJ model and recalls the determinants of equilibrium consumption in this setting. A KUJ model with reference dependence preferences is then introduced in Section 3. Section 4 describes the equilibrium in this model. Section 5 contains some considerations on the optimal tax policy in this framework. Section 6 concludes.

## 2 Positional concerns in a keeping up with the Joneses model: the standard specification

Positional concerns in consumption have received some attention in the recent literature (Easterlin, 1995; Solnick and Hemenway, 1998) and may also have important economic policy implications (Ljungqvist and Uhlig, 2000; Layard, 2003).[1] Importantly, research findings show that positional concerns have important effects on consumption but little, if any, on leisure (Clark and Oswald, 1996; Layard, 2003). This implies that positional concerns may lead to an increase in the marginal utility of consumption at the aggregate level. As a result, society as a whole may suffer from overconsumption (Schor, 1998).

Reflecting these considerations, the KUJ model introduced by Gali (1994) postulates that – owing to positional concerns in consumption – the marginal utility of consumption of each economic agent is higher, the higher aggregate consumption. To represent the main idea behind KUJ preferences, we assume that a representative consumer-producer has an utility function with the following general specification:

$$u = V(c, C) - \beta c, \tag{1}$$

where $c$ is own consumption, $C$ the per capita aggregate consumption, and $V_c > 0$, $V_{cc} < 0$, and $V_{cC} > 0$ (consumption externality). The latter assumption is the crucial one in the KUJ model as it implies a complementarity between own and aggregate consumption.[2] The parameter $\beta$ captures the disutility of the work effort associated with consumption, and depends on both the relative importance of leisure in the utility function and the prevailing technology (for example, technical progress allows the agent to economize in work effort for each consumption level $c$, which implies a lower level of $\beta$). It should be noted that, as in Ljungqvist and Uhlig (2000), we are assuming that the marginal disutility of work effort is constant. This assumption is a plausible one if we are modelling levels of work effort which might be thought as "normal", but of course becomes completely unrealistic for very high work effort levels, for which the marginal dis-utility should be strongly increasing and ultimately go to infinity. This implies that the results of this study are plausible and interesting only for normal levels of work effort, and this is a caveat that should be kept in mind in the continuation.

[1] Older classic references are Duesenberry (1949) and Hirsch (1976).

[2] It should be mentioned that the KUJ model is conceptually different from a model featuring jealousy (Dupor and Liu, 2003). The KUJ model makes an assumption on the *marginal* utility of consumption given aggregate consumption, while jealousy is an assumption on the utility *level*.

Under the assumption that $V_{cC} > 0$, it is clear that the optimal level of consumption by each agent will be higher, the higher the aggregate level of consumption:

$$c^* = \arg\max[V(c, C) - \beta c] = r(C), \tag{2}$$

where $r_C > 0$.

At the aggregate level and assuming a symmetric solution where all agents are identical[3], the equilibrium will be given by the fixed point:

$$C^* = r(C^*) \tag{3}$$

The conditions under which the condition (3) leads to a determinate solution are spelled out in the following Proposition:

**Proposition 1** *If, for $C \subset D$, where $D$ is a subset of the domain of $C$, $r_C \geq 1$, then the equilibrium is a sink and multiple equilibria may arise in $D$. Otherwise, if for all $C$ $r_C < 1$, then the equilibrium is a saddle and multiplicity does not arise.*

**Proof.** It follows directly from the fixed point relationship in (3) (see Farmer, 1999). ■

It is interesting to note that Proposition 1 illustrates that the KUJ model may lead to equilibrium indeterminacy. Intuitively, this may happen if a sunspot change in aggregate consumption prompts a proportional (or more than proportional) rise in individual consumption, which then makes the initial change in aggregate consumption self-fulfilling. So, the KUJ model has the potential to create self-fulfilling fluctuations in consumption. It is worth noting that this possibility has not been adequately emphasized in the literature and most KUJ models have focused on specifications of the utility function, such as power or loglinear, where multiple equilibria do *not* arise. However, as we argue in the next section, there may be reasons to believe that a specification of the KUJ model which is realistic from a behavioural standpoint *does* give rise to equilibrium indeterminacy. Hence, and this the main point of our paper, we argue that consumption externalities may create self-fulfilling fluctuations in consumption levels.

[3]Note that we consider, as in Ljungqvist and Uhlig (2000), only symmetric equilibria in this paper. Hence, we do not discuss possible issues arising from agents' heterogeneity as regards tastes and productivity.

## 3 Keeping up with the Joneses and reference dependence

Positional concerns imply that agents evaluate their consumption level relative to a reference point, which in the KUJ model is taken to be the aggregate per capita level of consumption. So, we argue that preferences including positional concerns lend themselves very well to be modelled as *reference dependence* preferences.

There is in fact a large literature on the effects that reference dependence has on the functional form of the utility function, and such effects have been confirmed in a large number of studies (for a review of this literature see, in particular, Kahneman and Tversky, 2000). In this framework, there are two features which may be particularly important in our modelling of positional concerns in consumption. First, reference dependence preferences are characterized by *loss aversion*, whereby losses (defined in terms of outcomes below the reference point) matter comparatively more than gains (outcomes above the reference point) in the utility function. Second, and more relevant for the present analysis, marginal departures from the reference point are more (less) important the less (more) away they are from it (*diminishing sensitivity*). As a consequence of these two properties, the utility function is S-shaped, namely *steeper* below the reference point than above it, and it is *convex* below the reference point and *concave* above it. The reference dependence utility function looks like the one shown in Fig. 1 above.

Reference dependence is a concept traditionally associated with agents' preference to maintain the status quo (endowment effect), and most experimental evidence has been derived by assuming the status quo to be the reference point. However, reference dependence is a much broader concept than just the preference for the status quo. This was emphasized in particular by Tversky and Kahneman (1991), who introduced the concept of reference dependence in riskless choice.[4] According to Tversky and Kahneman,

> although the reference state usually corresponds to the decision maker's current position, it can also be influenced by aspirations, expectations, norms, *and social comparisons* (page 1046-1047, emphasis ours)

To our knowledge, there is no empirical analysis available testing directly whether social comparisons give rise to the kind of S-shaped value function typically observed in experimental studies when other types of

[4]For a forceful criticism of the narrow interpretation of reference dependence as the endowment effect, see also Koszegi and Rabin (2004).

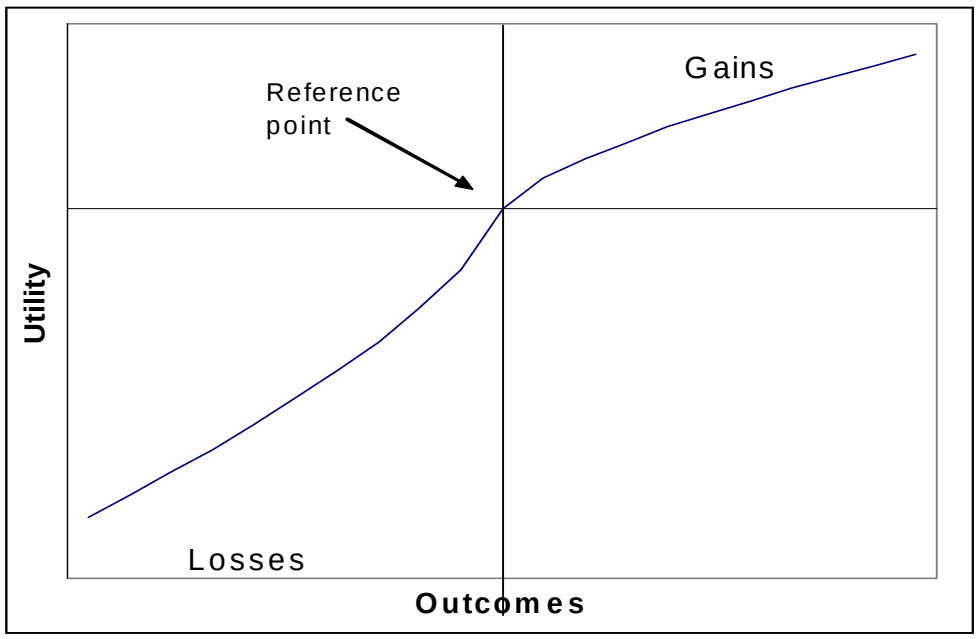


Figure 1: Traditional form of the reference dependence utility function.

reference points, such as standards of value, are given to agents. This is related to the fact that the behavioural economics literature, of which reference dependence and S-shaped preferences are key elements, and the literature on relative utility and positional concerns have evolved quite independently of each other. Nonetheless, it appears relatively straightforward to assume that utility functions including social comparisons may be characterized by the same type of S-shaped form observed in experimental studies when agents compared their welfare with some other type of standard, e.g. the status quo. In fact, it should be emphasized that what gives rise to the S-shaped form of utility highlighted by Tversky and Kahneman is *the comparison with a given standard of value*, irrespective of its concrete determination, as illustrated for example in the above quote from their 1991 paper. In our model, the standard of value is based on a social comparison with total per capita consumption.[5]

With these considerations in mind, we find it very plausible to assume that the utility function for each agent is S-shaped, namely convex below the level of per capita aggregate consumption $C$ and concave above it. This implies that the marginal utility of own consumption is *increasing*

[5]These considerations are not to deny, of course, that direct empirical evidence bearing on the functional form of utility with consumption externalities would be highly welcome.

below the reference point $C$. As a consequence, as long as the marginal disutility of the work effort is constant (as in our model) or not very strongly increasing, agents will want to pursue the reference level of consumption no matter its costs in terms of higher work effort.

The basic idea is that agents are willing to push themselves to the limit because they cannot afford (in social terms) to be left behind the per capita aggregate consumption level. This introduces a kind of lexicographic preferences specification, according to which agents can afford to pursue leisure in addition to consumption goals only under the precondition that they have satisfied the minimal requirement of consuming at least the reference point level of consumption. In other words, the aggregate per capita level of consumption becomes de facto a subsistence level for our agent, where subsistence is defined in social and not in physical terms.

It is interesting that the idea that returns associated to positional concerns may be insatiable as opposed to those derived from the absolute level of consumption, which are satiable, was recognized already by Keynes (1930), as evident in this citation:

> Now it is true that the needs of human beings may seem to be insatiable. But they fall into two classes - those needs which are absolute in the sense that we feel them whatever the situation of our fellow human beings may be, and those which are *relative* in the sense that we feel them only if their satisfaction lifts us above, makes us feel superior to, our fellows. *Needs of the second class, those which satisfy the desire for superiority, may indeed be insatiable*; for the higher the general level, the higher still are they. But this is not so true of the absolute needs - a point may soon be reached, much sooner perhaps than we are all of us aware of, when these needs are satisfied in the sense that we prefer to devote our further energies to non-economic purposes. J. M. Keynes, *Economic Possibilities for our Grandchildren*, 1930 [emphasis ours]

Looking at the more recent literature, our model is also related to that by Bowman, Minehart and Rabin (1999) (henceforth BMR), who assume habit formation in consumption based on a reference dependence specification of preferences. The similarity between BMR and this work is in the fact that consumption is evaluated relative to a standard of value, and not (only) in absolute terms. There is, however, a key difference the BMR model and ours. BMR assume the reference point to be the past level of the *own* consumption (habit formation), while we are interested in positional concerns, i.e. in the own consumption level *relative to that by others* at the same point in time. Moreover, BMR

focus on intertemporal, rather than intra-temporal choice as it is the case with our model. Alonso-Carrera, Caballe and Raurich (2004) also have a model with consumption externalities, but again their focus is on dynamic equilibrium, rather than intratemporal choice. In addition, Alonso-Carrera, Caballe and Raurich do not mention the possible non-concavities which may be associated with consumption externalities.

Operationally, we specify our assumptions about preferences as a general utility function:

$$u = V(c, C) - \beta c \tag{4}$$

where, as before, $V_{cC} > 0$, $V_{cc} < 0$ if $c > C$, but (unlike in the baseline specification) $V_{cc} < 0$ if $c \leq C$. This implies that, for $c < C$, the existence of positional concerns implies that the returns on the own consumption are *increasing* if individual consumption is below aggregate per capita consumption. This creates a convexity in the utility function for a region of the consumption possibilities which implies that the condition $c \geq C$ becomes a binding constraint, and $c - C$ plays the role of "supernumary" consumption (i.e. consumption in excess of the required level).

Hence, the maximization of the utility function in (4) is the optimal consumption level $c^*$ satisfying

$$c^* = \arg\max_{c \geq C} V(c, C) - \beta c \tag{5}$$

## 4 Determination of the equilibrium under reference dependence

As in Section 2, the optimal level of the own consumption $c^*$ will be an increasing function $r(C)$ of $C$ as well as satisfy the condition that

$$c^* \geq C \tag{6}$$

As noted, if $c < C$ each agent will always want to bring his own consumption at least to $C$, because returns on consumption are increasing below the reference point. This implies that $r_c(C) = 1$ for all $c \leq C$.

These considerations lead to:

**Proposition 2** *Under a reference dependence specification of KUJ preferences as in (4), the symmetric equilibrium solution is characterized by a sunspot component subject to the restriction that $b \geq 0$. Hence, there is an infinite number of equilibria characterized by a positive sunspot component in the consumption level.*

**Proof.** In a symmetric equilibrium, $c^* = C$, whereby:

$$C^* = r(C^*), \tag{7}$$

with:

$$r_C^+(C^*) = 1, \tag{8}$$

where the superscript + indicates the positive derivative (for $C \geq C^*$), and this is valid for any $C^*$. This implies that, if $C^*$ is an equilibrium level of consumption, $C^* + b$, where $b > 0$, must also be an equilibrium. Hence, equilibrium indeterminacy is obtained. ■

The key message of Proposition 2 is that *there is no determinate solution to the consumption decision problem.* Intuitively, this is explained by the observation that in a reference dependence specification of preferences individual agents have to keep up with aggregate consumption, owing to the convex form of the utility function below the reference point. Under these assumptions, any aggregate consumption immediately becomes the subsistence level for each agent and therefore self-fulfilling. This also implies that attempting to derive agents' tastes and technology from their observed consumption and work effort would be difficult, as actual consumption and labour supply behaviour might well be driven by sunspots.

How realistic and relevant is the set-up of this model to explain consumption in reality? Of course, the assumption of identical consumers, while of analytical convenience, is not very plausible. Real consumers are characterized by heterogeneity in tastes, endowments, standards of value, and so on.[6] Nevertheless, we believe that despite its simplifications our model may still be capturing dynamics which are plausible and relevant. Assume, for example, the more realistic situation in which each agent compares his consumption to that of his *reference group*, and that the consumption level of the reference group becomes the required standard for individuals. For example, agents may compare their consumption to that in their neighborhood, or in their workplace. As long as there are standards of consumption which become mandatory in agents preference due to the functional form of the utility function in the presence of reference points, the consumption of each group (and hence of the economy as a whole) may remain subject to sunspot fluctuations. Therefore, the simple analytical framework developed in this paper appears to have something interesting to say about this type of process.

Interestingly, the result of Proposition 2 has a lot in common with the idea of endogenous business cycles introduced by Benhabib and Farmer

[6] See Falk and Knell (2004) for an interesting analysis of the choice of endogenous reference standards for different groups of agents.

(1994). There, economic fluctuations are driven by self-fulfilling expectations caused by increasing returns in the production side. In Benhabib and Farmer, because there are increasing returns to scale at society's level, agents may coordinate on "good" (high activity) as well as on "bad" (low activity) equilibria which become self-fulfilling. By contrast, in our study, multiple equilibria and sunspots arise from consumers' concerns for relative status, which creates strong complementarity among them. Of course, Benhabib and Farmer's and our theory are not mutually exclusive and may actually reinforce each other in leading to multiple equilibria and sunspot fluctuations in aggregate consumption.

In our view, the result of Proposition 2 may be highly relevant from both a positive and a normative standpoint. First and foremost, it may help to *explain ongoing consumption developments* in a very different way compared with alternative approaches. Although the role of a static model (such as that proposed in this paper) is necessarily limited to explain dynamics, we believe that the idea that sunspots drive aggregate consumption may turn out to be relevant and useful on some occasions, for observers and policy-makers alike. Notably, consumption fluctuations driven by sunspots may respond to policy stimuli in a very different way than fluctuations driven by tastes and technology which can be derived from traditional models. For instance, in a model with equilibrium indeterminacy the role of economic policy might be more useful in leading economic agents to coordinate on a certain equilibrium, say by means of a careful use of communication, than by providing incentives which are directly able to pin down equilibrium outcomes.

From a a more normative perspective, it has to be emphasized that the multiplicity of equilibria created by reference dependence may lead to an *upward* bias in consumption levels, but in no case to a *downward* bias, due to the functional form of the utility function in the presence of reference points. This creates a fundamental asymmetry in aggregate consumption and, indirectly, in labour supply. We then analyze the normative implications of this result in the next section.

## 5 Can tax policy restore the uniqueness and efficiency of the equilibrium?

As discussed in detail by Ljungqvist and Uhlig (2000), positional concerns in consumption represent a negative externality leading to higher equilibrium consumption than socially efficient. This creates a scope for government intervention aimed at correcting the effects of the externality.

Ljungqvist and Uhlig (2000) show that in the context of a KUJ model the government can restore the first best level of consumption by using

tax policy to undo the effect of positional concerns. The impact of concerns about relative status on consumption (and labour effort) choices is felt through a higher marginal utility of consumption (than otherwise). Let $\overline{u_c}$ be the marginal utility of consumption which would obtain if $V_{cC} = 0$, i.e. if there were no complementarity between own and aggregate consumption. Since, as shown by Ljungqvist and Uhlig, the efficient level of consumption is that obtained when the marginal utility of consumption is $\overline{u_c}$, the government can optimally introduce a tax schedule on consumption $t(c)$ such that:

$$u_c = V_c(c - t(c), C) - \beta c = \overline{u_c} \tag{9}$$

Ljungqvist and Uhlig show that in a power-linear utility specification of the KUJ model this result can be obtained through proportional taxes which are redistributed to agents in lump sum transfers. In that model, the optimal tax schedule is:

$$t(c) = k + \tau c, \tag{10}$$

where $\tau > 0$ is a scalar and $k < 0$ ensures that the overall net effect of the tax on the financial wealth of the private sector is zero. Intuitively, the effect of the tax is to reduce the marginal utility of consumption by an amount exactly equal to the importance attributed to positional concerns, with the result that the effect of positional concerns is fully corrected for. This tax policy results in a Pareto improvement in that each agent is made better off by it.

However, when reference dependence comes into play, the linear tax policy proposed by Ljungqvist and Uhlig alone is unlikely to lead to the efficient level of consumption, apart from the very special case in which, by chance, $b = 0$. This is due to the fact that a constant marginal tax rate may have little effect on the curvature of the utility function below the reference point, which will generally remain convex. As a consequence, the equilibrium consumption will still be affected by sunspot fluctuations which would put it above the efficient level of consumption. How can tax policy cope with this additional challenge?

Intuitively, the task of leading to a determinate solution can be accomplished by a *progressive tax schedule*. Indeed, in the context of endogenous business cycles driven by increasing returns in production in the spirit of Benhabib and Farmer (1994), Guo and Lansing (1998) and Christiano and Harrison (1999) have found that a progressive tax system can undo the effect of increasing returns and lead to a unique equilibrium. In our model, however, returns on individual consumption are increasing only for $c < C$ and not for $c \geq C$, so there is no need for a

progressive tax for consumption levels above the aggregate per capita level of consumption. This suggests that the optimal tax schedule is likely to be progressive only for consumption levels below the aggregate per capita consumption $C$.

These considerations lead to the following Proposition:

**Proposition 3** *Let $\overline{u_c}$ be the efficient marginal utility of consumption, which would obtain if $V_{cC} = 0$, $V_{cc} < 0$ everywhere, and let $\overline{C}$ be the corresponding aggregate per capita level of consumption. A tax schedule $t(c)$ is optimal in a KUJ model with reference dependence if the solution to*

$$\arg\max_{c \geq C} V(c - t(c), C) - \beta c, \tag{11}$$

*is the efficient level of consumption $\overline{C}$.*

*Sufficient conditions for a tax schedule to be optimal are: (1) that the utility function $V(c-t(c), C) - \beta c$ is concave everywhere (concavification); (2) that $V_c(c-t(c), C) - \beta = \overline{u_c}$ for any $c$ (undoing of positional concerns).*

The intuition of Proposition 3 is that the optimal tax policy can be defined in two conceptually separate steps. In the first step, the function of the tax schedule $t(c)$ is to concavify the overall utility function of the agent. The only way to do so is to make $t(c)$ a (possibly highly) convex function for $c < C$, so that $V(c - t(c), C)$ becomes a concave function. Once this first result is accomplished, the second task of the optimal tax policy is to ensure that the marginal utility of consumption for each agent is equal to its first best level $\overline{u_c}$. Of course, this distinction is for illustrative purposes only since, in practice, the same non-linear tax policy $t(c)$ might accomplish both objectives in one go.

These considerations point to a tax system which is highly progressive at relatively low levels of consumption with an increasing marginal tax rate. Above the per capita level of consumption, a constant marginal tax rate is sufficient to achieve a first best level of consumption. Interestingly, this appears to be close to the income tax systems prevailing in most industrialized countries, which are typically very progressive at low income levels but with a relatively flat marginal tax rate after a certain income threshold. Although the undoing of positional concerns is arguably not an explicit rationale of the existing tax systems, it is interesting to note that the type of redistribution they imply might have quite favorable properties from the standpoint of countering the effects of positional concerns on the determinacy and desirability of equilibrium consumption.

## 6 Conclusions

This paper has studied the effect of reference dependence in riskless choice (Tversky and Kahneman, 1991) on the determination of equilibrium consumption in a model where agents are concerned about consumption by others. This specification of preferences implies that the aggregate per capita level of consumption becomes a subsistence level for each agent, where subsistence has a social rather than physical dimension.

The main result of this paper is that, under this (in our view quite realistic) setting, aggregate consumption may be subject to multiple equilibria and be driven by sunspot fluctuations, although it is reasonable to expect that such fluctuations would happen within limits, i.e. at not too high levels of work effort where the marginal dis-utility of work is likely to be strongly increasing. The result about equilibrium indeterminacy has positive (the potential to explain consumption developments) as well as normative (the optimal tax policy) implications that may be quite important.

The main lesson that we draw from this analysis is that it is realistic to expect that positional concerns in consumption may have more profound and disturbing effects than previously thought. Not only would they affect the desirability of the equilibrium, leading – if uncorrected – to overconsumption compared with the first-best situation (Ljungqvist and Uhlig, 2000). According to our analysis, they might also create the conditions for sunspot fluctuations, unrelated to fundamentals, to drive equilibrium consumption. This might make the case for public intervention in dampening the effect of this type of negative externalities even more compelling than typically recognized (see the interesting discussion on this matter in Layard, 2003).

Our results might also shed a new light on the effects that factors like advertising and, more in general, social norms have on the actual aggregate level of consumption. Since in our model the aggregate level of consumption is indeterminate (at least to the extent that it is not adequately corrected for by tax policy), it may be interesting to speculate whether factors which are external to the model can act as catalyst for the selection of a particular equilibrium. For example, the advertising industry may have an obvious interest in raising the aspiration level of consumers by representing fictitious agents who have a (very) high level of consumption. In a standard model and if agents are rational (so that they can discount the incentives of the advertising industry), this has no effect on aggregate consumption. But in a model where equilibrium consumption is not pinned down by tastes and preferences and is driven by sunspots, we believe that factors such as advertising might have a

significantly stronger role to play in determining aggregate behaviour than normally thought.

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