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Wealth-sensitive positional competition as a source of dynamic complexity in OLG models

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Abstract

This paper examines the interactions between economic activity and consumption externalities in an overlapping generations model. Existence of multiple steady states is studied from a global point of view, and possible mechanisms producing cycles and chaotic behaviour are analysed. Wealth-sensitive positionality is found to be able to generate persistent endogenous fluctuations, whereas wealth-neutral positionality doesn't. Under wealth-sensitive positionality, the economy may moreover experience complex dynamics, with sensitivity to initial conditions, leading to poverty traps even when starting from relatively large endowments of capital assets.

1 Introduction

One of the main research issues in macroeconomic dynamics in recent years is to investigate how, and to what extent, it is possible to produce persisting deterministic endogenous fluctuations without introducing non-structural or external 'impulse' factors such as stochastic components and exogenous shocks. Actually, the issue dates back to the early stages of the mathematically-based macrodynamic literature, where, on the one side, the classical Frisch-Timbergen paradigm ([1-2]; see also [3] for a critical analysis) conceptualized dynamics in terms of impulse-propagation models, whereas, some time later, Goodwin [4] made a case for an entirely endogenous dynamics generated by some form of nonlinear 'engine'. Interestingly, the subsequent unfolding of the debate through several generations of researchers has basically solidified the two competing positions, contraposing new waves of shock-based vs. nonlinear deterministic models (see e.g. [5-7]; [8]). From the conceptual point of view, shock-based models work on the contraposition between an underlying structure and external factors acting

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on it under certain circumstances: Implicit in this vision is the idea that the economic system rests upon structural factors (the 'fundamentals') which, under ideal conditions, stabilize the system around an equilibrium state, possibly with socially optimal properties. In principle, the system might even be linear and admit a very simple benchmark equilibrium, whereas dynamic complexity is basically traceable to the impulse part: The action of the external shocks makes the system deviate from the 'ideal' state, but prompts at the same time the adjustment dynamics that snaps it back to it (or at least well toward it), until the next shock comes and the quest toward the 'right' equilibrium starts again. Deterministic endogenous models, on the contrary, do not admit in general the focusing upon a specific equilibrium as the 'natural' one that will prevail in ideal conditions. There are in principle several, equally plausible equilibria, some of which more desirable than others, and which one will prevail (or whether any simple equilibrium will prevail at all) is a very open ended question that depends on specific conditions and on the past history of the system. Also, it will be generally possible that the system lands on non-pointwise attractors leading to persistent cyclic or quasi-cyclic oscillations, but also to more complex and even chaotic dynamic regimes. Thus, the endogenous fluctuations approach is likely to be conducive to a more critical vision of the system's ability to self-stabilize around simple, well-behaved equilibrium regimes with respect to the one emerging from the shock-based approach.

From the model-building perspective, one useful test for the comparative evaluation of the theoretical soundness of the two approaches is to reason in terms of their micro-economic foundations: An important leap forward if compared to the *ad-hoc* models that were the backbone of the early literature. One advantage of the micro-founded approaches is that one can focus on specific behavioral mechanisms that can be associated to the dynamic behavior of the model, and consequently one can design specific tests to check their empirical relevance in real world settings. In the endogenous fluctuations approach, a particularly important role is played by Overlapping Generations (OLG) models [9-10]. OLG models often present interesting dynamic behavior as, unlike models with infinitely lived agents, they impose some limitations upon agents' trading opportunities due to the fact that only a limited number of agents, belonging moreover to different cohorts, is alive at any given time. Thus, the opportunity set faced by agents of a given generation is determined to some extent by the choices of agents belonging to earlier generations, and this may often generate very subtle and interesting dynamic effects. In particular, OLG models prove to be a fertile ground for deterministic, endogenous fluctuations: In a pioneeristic work, Reichlin [11] shows that endogenous fluctuations are possible in perfectly competitive OLG economies with constant returns to scale, albeit for small values of the elasticity of substitution between capital and labor; Grandmont et al. [12] generalize the result to a monetary economy. Other elements that bring about interesting dynamic effects are, among others, increasing returns to scale [13], public spending [14], open economies [15], or environmental factors and defensive expenditure [16]. The OLG approach thus sets the stage for plenty of different dynamic factors that, whether isolated or suitably combined, provide

plausible accounts of why and how an economy may be subject to persistent fluctuations.

The present paper aims at adding up another brick to this construction, by considering yet another element that may be of substantial theoretical and empirical interest as an explanatory factor for persisting fluctuations: Namely, the social dimension of consumption. Traditional microeconomic accounts of consumption choices tend to characterize consumers in terms of a certain preference structure that has to be optimized on the basis of the price structure and of the available budget; the possibility that preferences depend in turn on the consumption choices of others is admitted but is not generally considered an essential feature of the model (see e.g. the canonical presentation of [17]). Strong cases for the essential role that sociality plays in consumption choices have been made by influential thinkers at various times [18-20], but it is especially in the past two decades that there has been an increasingly generalized interest in introducing the social dimension of consumption into the core of state-of-the-art microeconomic theory [21-22]. Today, we are entering into a phase where it is more and more difficult to maintain that one can seriously reason about current forms of consumption while filtering the psycho-social dimension away [23,24]. This momentum is also partially the consequence of the global recognition given to the work of distinguished economists whose research program is entirely centered upon the establishment of a 'middle ground' framework between economics and sociology [25]. Seen from the sociological side, the issue of the social dimension of consumption is, not surprisingly, nothing but evident, and especially so in the current post-industrial scenario where consumption appears increasingly decoupled from the satisfaction of life needs, focusing instead on issues of identity building [26; see also 27]. Therefore, introducing this element in the OLG framework amounts to something more than adding yet another element of dynamic complexity: It is a basic requisite for the consumption model to be realistic enough. In principle, the social dimension of consumption could pave the way to both cooperative and competitive forms of interaction. The former would include, for instance, psychological benefits from the joint cultivation of common interests (e.g. reading the books of a specific author and sharing materials, information, and emotions), and more generally, the so called relational goods [28], i.e. goods whose enjoyment is enhanced by the simultaneous participation of others. The latters includes all kinds of positional competition, i.e. situations where the level of satisfaction deriving from the enjoyment of a given good are determined to some extent (and, in limit cases, exclusively) by the level of consumption of the same good by individuals belonging to a given social reference group[1] [29]. In this case, the social dimension, rather than being welfare-enchancing, easily becomes welfare destroying and is likely to be conducive to suboptimal over-consumption outcomes that closely replicate the social dynamics of arms races.

The circumstances that cause the emergence of a cooperative or competitive social consumption attitude are generally complex and may be regarded as the

[1] In the literature, this effect is also known as 'keeping up with the Jones'.

outcome of a cultural evolution process acting on different motivational orientations [30]. In this paper, we do not want to tackle the general problem of attitude selection, but rather to explore the implications of a given social mode of consumption. Specifically, we will focus here upon positional competition, i.e. on a form of social consumption that is potentially welfare destroying. The reasons for this choice are various. On the one side, positional competition has been widely studied in the past and thus it is especially interesting to characterize its dynamic implications in an OLG framework. Secondly, current forms of post-industrial consumption are very sensitive to the positional dimension [31], which is often invoked as an explicit motivational leverage for prospective buyers of goods and services, especially in the luxury segments of the consumption spectrum (which include intriguing hybrid forms as the so called 'affordable luxury' which is especially targeted at prompting positional consumption in segments with limited capacity of expenditure [32]). Finally, since the endogenous fluctuations approach is especially interested at evaluating the economic system's capacity of self-stabilization, it is of particular relevance to study whether potentially welfare-destroying elements such as positional consumption have a relevant destabilizing effect or not. Thus, in this paper we will present an example of a complex dynamics, entailing limit cycles or chaotic behaviour, that is driven by *consumption externalities*[2]. Rather unsurprisingly, it is found that the presence of such externalities affects allocation decisions and the dynamics of capital accumulation. We however depart from the existing literature by proposing a slightly different specification of the consumption spillover, and, in accordance to empirical studies (see e.g. [33]), we allow a non-costant intensity of the consumption spillover, assuming in particular that the intensity of positional competition is positively affected by the level of wealth (that is to say, the affluent tend to compete more than the poor)[3]. We find that even a simple specification of the model, with logarithmic utility and a Cobb-Douglas production function, may yield multiple steady states and complex dynamics, thus suggesting that competitive social consumption may indeed weaken the stabilizing capacity of the economic system.

The paper is organized as follows. Section 2 presents a concise review of the literature on positional consumption. Section 3 introduces the basic model and characterizes the dynamics of competitive equilibrium. Section 4 introduces the hypothesis of a non-constant level of consumption externality and studies how this causes the emergence of complex dynamic behaviour. Section 5 concludes.

[2] Recently, the role of consumption spillover is studied in different papers both in continuus time and in discrete framework with respect to the consequences in terms of asset allocation, political economy and well-being but at our best knowledge only few works (Mino (1976) and REjevenulities) investigate the dynamic behaviour of this kind of models.

[3] This positive relationship seems to apply also to intra-generational consumption patterns in emerging economies: That is to say, with progress in socio-economic condition and with the consequent increase in average income and wealth, positional incentives seem to grow accordingly: see e.g. [34]. and, for a more systematic reflection, [35-36] .

2 The causes and consequences of positional consumption

As already mentioned in the introduction, the literature on positional consumption is rich and diverse. Its basic message seems, however, relatively clear: As far as the economy is concerned, positional consumption has more shadows than lights. It is a source of dynamic inefficiency [37] and of welfare losses [38]; it is a wasteful social activity that causes the allocation of resources toward unnecessary and ephemeral uses, much like what happens in arms races and in other cases of 'perverse effects' of social action [39]. Moreover, positional competition produces dysfunctional social adaptations under the form of hedonic treadmills: Individuals devote increasing amounts of time and effort to raising extra income to be spent in more positional goods and services, with the effect of compromising quality of life while at the same time being baffled by similar behaviors of peers in their reference group [40-41]. This rather negative view of the consequences of positional consumption is at odds with that of some of the founding fathers of modern political economy, such as Bernard Mandeville, who, in his classic *Fable of the Bees* [42] celebrated private vices like greed and vanity as a public virtue. The latter, in particular, by fuelling affluent consumption gave a vital impulse to the economy's level of activity: An analogous praise of affluent consumption, although in a different perspective, comes by another founding father of political economy, Thomas Malthus [43]. The reason why contemporary literature is so unanimously hostile to positional consumption in all of its various forms and variants is that its potentially positive effects on the level of economic activity are canceled by the corresponding motivational crowding out: Positionality, and more generally the associated work-and-spend treadmills, cause profound, permanent distortions in behaviors and habits that negatively affect the social interest [44] - a behavioral trap that was difficult to assess at the beginnings of the industrial revolution.

But what causes the emergence of positional consumption in the first place? Whereas traditional forms of affluent consumption were the reflection of the socio-economic order of the ancien regime, there is no reason in principle why, in modern industrial and post-industrial societies, people should compete for goods and services as markers of social status. Research in anthropology and sociobiology stresses the fact that the quest for status may be a consequence of a deep behavioral programming aimed at the conquest of higher hierarchical positions in the social group, and so at better controlling economic and social resources to enhance fitness. For instance, Henrich and Gil-White [45] develop a theory of social prestige as a mechanism for enhancing the benefits and evolutionary advantages of cultural transmission - one could thus regard positional consumption as a complex, non necessarily functional derivative of an adaptational social learning strategy. That positionality may be the outcome of some kind of social learning strategy is suggested by the fact that positional concerns seem to be more focused toward certain kinds of goods and services than others - income more than leisure, consumption goods more than health and safety

[46,47], and empirical analyses tend to confirm this [48], although there seems to be also some evidence of a trade-off between conspicuous consumption and conspicuous leisure [49], with the former as an imperfect substitute of the latter; moreover, sorting out the two effects may be tricky [50]. Empirical studies also suggest that a large share of survey respondents seem to prefer prospects of higher relative in a given reference group also at the cost of a lower absolute income, and that positionality seems to focus preferentially on self-esteem related aspects like attractiveness and supervisor's praise rather than on truly hedonic aspects like vacation time [51], once more hinting somewhat at an underlying adaptational value. But the selection of goods that carry a positional value seems to be highly culture-specific: In the case of China, for instance, vacation time gets strongly positional [52]. Positionality thus appears as a way to transmit, by means of competitive imitation, bits of socio-cognitive skills that play an important role in defining consumption (and thus resource use) styles in a given social context, and to preserve cognitively-based social hierarchies, in line with the adaptational hypothesis [53, 54]. Moreover, the adaptational value of positionality seems to be confirmed by the fact that people seem to be willing to adopt risk taking behaviors under certain circumstances in order to get positional advantages, even if in other spheres they tend to be risk averse [55].

If positionality originally seems to emerge as a socially adaptive practice, then, why it becomes so dysfunctional in modern industrial and post-industrial societies? One reason may be that our societies have meanwhile devised less socially expensive ways of social learning and information transmission, whereas at the same time positional consumption seems to have lost its expressive and communicational value to become, as already noticed, a wasteful treadmill, thus calling for new social policies of consumption that help people to re-program their behavioral routines in their own and in the social interest [56]. The social cost of positional (over)consumption clearly raises environmental sustainability concerns [57-59], and easily leads to charges of social inadmissibility [60]. On the other hand, as Hirsch [20] originally pointed out, positionality need not be the consequence of a purposeful choice, but may simply be a natural outcome of the socio-economic organization of socio-economically developed societies (see also [61]). Might then be the case that, in spite of its long-term unsustainability, positionality survives in modern economies in that it is a short-medium run useful leverage of growth in an era where growth is generally slow and fragile and thus often needs a kick? In fact, it has been shown that positional consumption may produce characteristic growth patterns with specific dynamic properties [62]. But the welfare implications are, by and large, ambiguous, as they still seem too model-specific [37; 63-68]. The fact that positional consumption is empirically relevant seems beyond question [69-71], but understanding why, how, and to what extent still remains a challenging issue. There is reason to believe that positionality is an ineliminable feature of the social environment: Context matters for choice, and the income, the possessions and benefits of others provide an inescapable context for our daily social and economic life [72] that fuels the quest for status [73-74]. From the policy side, the issues posed by positional

consumption closely remind those linked to environmental pollution - so that we could regard the former as an instance of social pollution [75-76] - that is to say, a somewhat inescapable but ideally controllable by-product of our socio-economic organization. In this paper, we will study the long-run, dynamic implications of positional consumption without keeping into account external issues such as environmental sustainability. We will only focus on the direct dynamic implications of the social dimension of consumption, to evaluate to what extent it may work as a stabilizing or de-stabilizing factor. This is, in itself, a novelty in the literature. There have been previous attempts at looking at positionality as a source of deterministic endogenous fluctuation, but it has been done in the limited context of a two-players status game [77]. Here, we study the issue in the context of an otherwise standard OLG model with an homogenous good for, thus electing a well known and largely understood benchmark for our analysis.

3 The basic model

Consider a classical overlapping generations (OLG) model a là Diamond [10], where, in each period t, a new generation of identical individuals is born. We assume no population growth, and we normalize the size of each generation to one. Each individual lives for two periods, works only when young, supplying inelastically her time endowment (normalized to one) to the productive sector, and receiving a wage w_t. Thus she has to allocate the wage between current consumption c_t and saving s_t for next-period consumption. Preferences of individuals are defined over private consumption when young, c_t, and over consumption in old age d_{t+1}. In addition, departing from the standard OLG model, we assume that a negative social consumption externality affects the utility of the individuals. Such externality amounts to a weighted mean of the average consumption of the old and of the young, $((1-\sigma)\overline{c}_t + \sigma\overline{d}_t)$, which reduces[4] the utility of the individual in the *young* age; σ is the parameter that measures the relative weight of the consumption of the young vs. that of the old in determining the social benchmark. Specifically, the higher σ, the more the consumption of others at old age negatively affects the individual's utility, and vice versa. Average consumption is considered given by the single agent (this is why it is an externality rather than a variable subject to strategic manipulation). In order to keep the analysis simple, we assume a logarithmic (Stone-Geary) specification of the utility function:

$$U(c_t, \overline{c}_t, \overline{d}_t, d_{t+1}) = \ln(c_t - \rho((1-\sigma)\overline{c}_t + \sigma\overline{d}_t)) + \beta \ln(d_{t+1})$$

where ρ measures the intensity of consumption spillover.

It is useful to discuss the interpretation of the parameters defining the attitude of individuals toward the social dimension of consumption. We have

[4]Two extreme cases are possible: if $\sigma = 0$, then the agent considers only the young-consumption, the opposite if $\sigma = 1$.

already pointed out that positional competition only affects the young, whereas the old are not affected by social externalities in consumption. Indeed, empirical studies confirm that positional comparisons in consumption levels tend, ceteris paribus, to be more frequent in the young rather than in the mature age, at least for males [78]. This may be due to several, distinct factors. On the one side, the young are socially (and possibly genetically) programmed to 'show off' when young, as this enhances their reproductive fitness: Being able to consume more than their peers could be regarded as a differential advantage for the attraction of potential mates. This effect, however, is ruled out in the present model where population is constant and no mating occurs between individuals. Another possibility has to with perceived $efficacy$ of choice: The young know that their current choices will affect their social standing (in terms of consumption levels), and therefore evaluate their choices against a social benchmark, whereas the old have no choice but to consume what is left and so, being unable to modify the situation, have no interest in comparing their position to that of others. Notice that the young may be interested in evaluating *today* the consequences of their choices in terms of (consumption based) social standing also when they are *old*. Or, the young might be aware of their own bounded rationality as to their ability to evaluate their psychological state when old, and could take the comparison between their consumption level and the social average as a positive or negative signal of self-confidence, depending on the sign of the gap. For the actual interpretation of the social externality, it is very important to study the implications of σ. It can be characterized in terms of *retirement envy*: When σ is relatively large, the focus of the young's positional competition is on the consumption of the old, rather than on that of their peers. This may be due to two different factors: On the one side, the young could be interested in a direct social competition with the old (generational war). Or, they could see the consumption of the current old as a benchmark for the evaluation of their own future levels of consumption when old (projective envy). Retirement envy as generational war does not imply bounded rationality, and the same is true when the young focus mainly upon positional competition with their young peers (i.e., when σ is small): They focus on their *actual* level of relative consumption and thus on their current corresponding psychological state, and not upon a projection of a hypothetical future state. Retirement envy as projective envy, instead, entails some degree of bounded rationality: Individuals when young misrepresent their actual psychological state once old: The better off the retired people they see around while young, the less the satisfaction individuals are able to extract from their *current* consumption, as they anticipate that it takes money away from their retirement budget, and that this will make them feel relatively poor when they will look into their wallet once old. On the other hand, since positional competition only matters for the young, when they are *actually* old individuals do not suffer from the negative consumption externality anymore, as they have already anticipated the old age consumption level, and have adjusted their benchmark and expectations accordingly (an effect that is well documented in the literature; see e.g. [72, 79]). Thus, depending on the kind of retirement envy that σ actually measures, it may also imply a corresponding level of bounded

rationality or not. As to ϱ, its interpretation is considerably simpler: the larger it is, the more relevant, ceteris paribus, positional competition in the choices of the young. Interestingly, however, the dynamic property of the model do not depend on the assumed level of individuals' bounded rationality in the anticipation of their future psychological state, and not even on the particular form of positional competition adopted. In fact, it can be shown that our results are unaffected when one works with an alternative specification of utility that allows for positional consumption *both* in the young and in the old age:

$$U(c_t, \overline{c}_t, d_{t+1}) = \ln(c_t - \rho\overline{c}_t) + \ln(d_{t+1}) - v(\overline{d}_{t+1})$$

where $v'(\cdot) > 0$; thus, provided that positional competition has been introduced into the model, there is (within certain limits) room for alternative specifications, which may, or may not, extend positionality concerns to individuals when old. Accordingly, the v function amounts to a suitable restatement of the retirement envy effect (*without* bounded rationality). In this paper, we will stick to the hypothesis that positional competition only matters for the young, i.e., to the former specification of the utility function.

The representative firm produces the private good using a very simple Cobb-Douglas technology with a capital externality:

$$y = A\Omega(\overline{k}_t)f(k_t) = A\overline{k}_t^{\delta}k_t^{\alpha}$$

where k_t is physical capital, A is a positive parameter representing technological progress and $\Omega(\overline{k}_t) = \overline{k}_t^{\delta}$ is an externality on production (see [80]) for the role of the capital externality in OLG models). The economy is assumed to be perfectly competitive and so, in each period t, the representative firm maximizes the profit function

$$A\Omega(\overline{k}_t)f(k_t) - w_t - r_t \cdot k_t \tag{1}$$

taking the wage rate w_t and the interest factor r_t as exogenously given. As usual, this assumption gives rise to the following equilibrium equations for wage and interest rate:

$$w_t = A \cdot (1-\alpha) \cdot k_t^{\alpha}\overline{k}_t^{\delta} \tag{2}$$

$$r_t = A \cdot \alpha \cdot k_t^{\alpha-1}\overline{k}_t^{\delta} \tag{3}$$

The first order condition for the representative individual's choice defines the saving function

$$s_t = k_t^{\alpha}\overline{k}_t^{\delta}\left\{\beta A\frac{1-\alpha-[(1-\alpha)(1-\sigma)+\sigma\alpha]\,\rho}{1+\beta-\beta\rho(1-\sigma)}\right\} \tag{4}$$

with the constraint on the magnitude of $\rho < \frac{1-\alpha}{(1-\alpha)(1-\sigma)+\sigma\alpha} \equiv D$. For the subsequent analysis it is useful to note that $D < 1 \Leftrightarrow \alpha > 1/2$.

Because we have assumed a logarithmic specification of the utility function, saving doesn't depend on the interest rate (that is, the income and substitution effects cancel out). Moreover (see 4), saving is negatively affected by the parameter ρ. The explanation is straightforward: The more intense the positional competition, the more agents are induced to allocate resources to consumption when young. Thus, the constraint on ϱ that is necessary to yield a well defined savings function amounts to require that positional competition be not strong enough to prevent individuals from saving at all.
Finally, the market clearing condition defines the following one-dimensional dynamic system:

$$k_{t+1} = k_t^{\alpha+\delta} \left\{ \beta A \frac{1-\alpha-[(1-\alpha)(1-\sigma)+\sigma\alpha]\rho}{1+\beta-\beta\rho(1-\sigma)} \right\}$$

The map generates a really simple dynamics, that may be summarized as follows:

Proposition 1 *The map admits a unique, positive steady state.*

$$k^* = \left\{ \beta A \frac{1-\alpha-[(1-\alpha)(1-\sigma)+\sigma\alpha]\rho}{1+\beta-\beta\rho(1-\sigma)} \right\}^{\frac{1}{1-(\alpha+\delta)}} \tag{5}$$

a) If $\alpha+\delta<1$, the steady state is globally attracting;
b) if $\alpha+\delta>1$ the steady state is repelling.

In the case (a) each initial condition converges to the interior equilibrium, whereas in case (b), economies starting at the right of the steady state (i.e., economies with high initial capital endowment) experience an unbounded growth path, while economies starting at the left (i.e., initially under-capitalized economies) die out (i.e., they converge to the null attractor). Notice, in particular, that the stability properties of the economy in this simple case basically depend on the joint effect of the elasticity of capital and on the strength of the capital externality (we synthetically call $\alpha+\delta$ the extended elasticity of capital; one can equivalently reason in terms of decreasing vs. increasing returns). What Proposition 1 tell us is, rather intuitively, that a low extended elasticity of capital tends to stabilize the economy's growth path upon the interior steady state, whereas on the contrary a high extended elasticity tends to destabilize it. Interestingly, positional competition does not seem to play a major role in determining the system's dynamics, that is to say, it does not change substantially the dynamic behavior with respect to the case of a standard OLG model with a capital externality. This does not mean, however, that the parameters defining the level and type of positional competition do not have a bearing on the actual dynamic path of the model and on the economy's steady state. In particular, we have the following:

Proposition 2 *a) If $\alpha+\delta<1$, then k^* is negatively related to ρ. If $\alpha>\frac{1}{2}$ and $1+\frac{2\alpha-1}{\alpha\beta}<\rho<D$, then k^* is positively related to σ. In the remaining cases the relationship is reversed;*

b) if $\alpha + \delta > 1$ *then* k^* *is positively related to* ρ *and negatively related to* σ. *If* $\alpha > \frac{1}{2}$ *and* $1 + \frac{2\alpha - 1}{\alpha\beta} < \rho < D$, *then* k^* *is negatively related to* σ. *In the remaining cases the relationship is reversed.*

Proof. We consider only the case $\alpha + \delta < 1$, the other one runs in a similar way.
Applying straightforward algebra, it is simple to verify that the sign of the derivative of (5) with respect to ρ is equal to the the sign of $-[(1-\alpha)(1-\sigma) + (\beta+1)\sigma\alpha] < 0$.
In a similar way, taking the derivative of (5) with respect to σ we deduce that, inside the domain of definition of the utility function, its sign is equal to the sign of $+1 + \alpha\beta\rho - 2\alpha - \alpha\beta$. Hence, the derivative is positive if and only if $\rho \in (1 + \frac{2\alpha-1}{\alpha\beta}, D)$. Furthermore, considering the dependence of the extremes of the interval on α, it is simple to verify that if $\alpha > 1/2$ the set is null. ■

The result is quite interesting: If the capital externality is low enough to make extended elasticity of capital relatively low in turn ($\alpha + \delta < 1$), we enter the stable regime and ρ negatively affects the economy's steady state (remember the effect of ϱ on savings decisions). Moreover, if the elasticity of capital α and positional pressure ϱ are high enough (remember that ϱ cannot be larger than D), then the strength of retirement envy σ has a positive effect on the steady state - as it drives individuals to give more relevance to their consumption level when old, in a situation where postponing consumption is rewarding given that the elasticity of capital is high, and positional competition is at the same time fierce and focused upon consumption at old age. Otherwise, with low elasticity of capital and low positional pressure, retirement envy has a negative impact on the steady state - in that the increased relevance of the consumption of currently old individuals in the young's positional balance is more conveniently addressed by canceling it out by means of an increased consumption when young.

If, on the contrary, the capital externality is strong enough to make extended elasticity of capital high ($\alpha + \delta > 1$), we enter the unstable regime, and the effect of an increase in positional pressure ϱ is that of widening the basin of attraction of the no-activity equilibrium (i.e., of enhancing the likelihood of a poverty trap where the economy eventually dies out), whereas, correspondingly, narrowing down the range of initial conditions for which the unbounded growth path prevails. As to the effect of retirement envy σ, when the elasticity of capital and positional pressure are high enough, the effect on the steady state is now negative (i.e., the likelihood of an unbounded growth path is increased by widening up its basin), as an effect of the increased focus on consumption at old age and on savings. Conversely, retirement envy pulls up the steady state and thus the basic of attraction of the poverty trap when the elasticity of capital and positional pressure are low, and focusing on current consumption becomes more attractive.

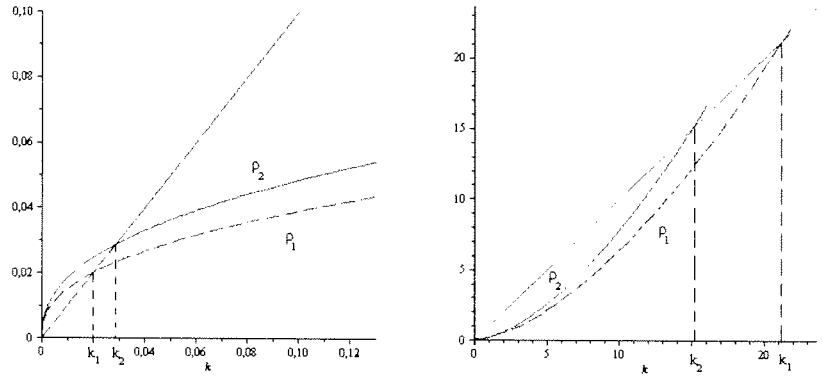

Figure 1: (a) Case $\alpha + \delta < 1$, with $\rho_1 > \rho_2$; (b) Case $\alpha + \delta > 1$, with $\rho_1 > \rho_2$.

We can thus conclude that the introduction of positional competition in a standard OLG setting provides interesting insights on the role that positional pressure and retirement envy may play in determining the actual level of the economy's steady state and the likelihood of poverty traps or of unbounded growth regimes. However, we also have to notice that it does not alter substantially the repertoire of the economy's possible dynamic behaviors. Thus, under these premises, considering the impact of social externalities of consumption adds realism to the model but does not provide valuable insights as to the generation of deterministic endogenous fluctuations.

4 Variable intensity of consumption spillover

Sticking to a relatively simple formulation of positional competitions thus produces substantially innocuous results as to the model's dynamics. But what happens if we consider more articulate, and possibly more realistic, specifications of what positional competition really is about? One intriguing possibility is to assume that the intensity of positional competition depends on the level of wealth (which, in the present model, coincides with income). Simple exercises of casual empiricism do suggest that the rich tend to be very focused upon outperforming each other as to their relative levels of wealth, and in particular as to the level and quality of status goods such as yachts, villas, cars (and even spouses), and more rigorous confirmations arrive from empirical studies (for instance see [33]). There is an intuitive reason for this: The rich can devote a large part of their budget to the purchase of goods whose main or even *sole* purpose is exactly that of demonstrating the owner's status, and so they have (both in absolute and relative terms) more resources to invest in positional races. On the contrary, less affluent people must devote a substantial part of their budget to the purchase of goods meant to meet everyday needs - and although for such goods one may also single out status-related features (e.g. in terms of price, packaging and presentation, ingredients, and so on) and motivations, it is nevertheless the case that such features and motivations make up only part

of the picture, and that in this case individuals objectively have less time and resources to invest in positional races. As the well known columnist George F. Will [81] puts it:

> "...It is increasingly expensive to be rich. The Forbes CLEW Index (the Cost of Living Extremely Well) - yes, there is such a thing - has been rising much faster than the banal CPI (consumer price index)...This is the outer symptom of a fascinating psychological phenomenon: Envy increases while - and perhaps even faster than - wealth does. When affluence in the material economy guarantees that a large majority can take for granted things that a few generations ago were luxuries for a small minority (a nice home, nice vacations, a second home, college education, comfortable retirement), the 'positional economy' becomes more important. Positional goods and services are inherently *minority* enjoyments. These are enjoyments...available only to persons with sufficient wealth to pursue the satisfaction of 'positional competition' [emphasis original].

Thus, we now assume that there is a positive relationship between the level of wealth (income) and the intensity of positional competition, and thus between the level of w_t and the magnitude of ρ. In particular, we adopt a simple functional specification, which can be suitably calibrated to accommodate a wide range of different cases:

$$\rho_t \equiv g \cdot \left[D \cdot \left(1 - e^{-f \cdot w_t} \right) \right] \tag{6}$$

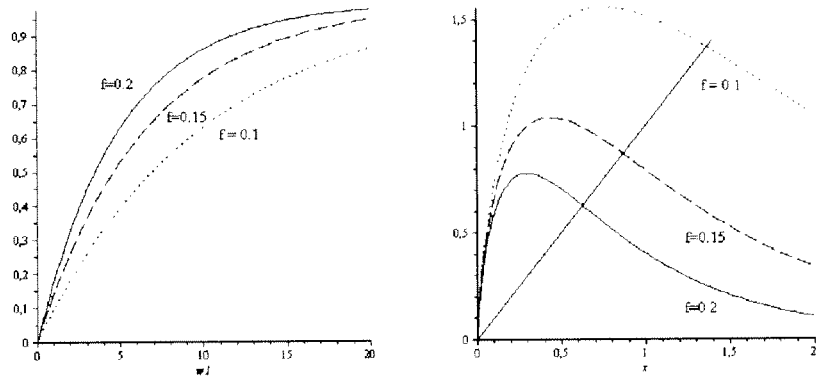

Figure 2: (a) Shapes of ρ_t as a function of w_t for different values of f: ceteris paribus, the higher f , the stronger positional competition; (b) different shapes of the map obtained by varying f with $\alpha + \delta < 1$.

ρ_t is an increasing function of w_t, and f captures the strength of the spillover of the wage on ρ_t (see Figure 2-a); $g \in (0, 1]$ places a bound on the intensity of

positional competition ρ_t. In the limit case $g = 1$, for high values of w_t the positionality of consumption tends to destroy completely the satisfaction deriving from private consumption. Notice in particular that, in this new specification, g measures the intensity of positional competition as a whole, whereas f measures its wealth-sensitive component.

Under these new assumption, the map describing the economy's dynamics becomes

$$k_{t+1} = \beta A k_t^{\alpha+\delta} \left\{ \frac{1-\alpha-[(1-\alpha)(1-\sigma)+\sigma\alpha]\cdot g\cdot D\left(1-e^{-fA(1-\alpha)k_t^{\alpha+\delta}}\right)}{1+\beta-\beta\cdot g\cdot D\left(1-e^{-fA(1-\alpha)k_t^{\alpha+\delta}}\right)(1-\sigma)} \right\} \equiv G(k_t) \tag{7}$$

This expression is strongly nonlinear, and we are unable to derive explicitly the value of the steady state. Nonetheless, several qualitative results can be obtained. We divide the analysis into to three possible scenarios.

Scenario 1: $0 < \alpha + \delta < 1$, $g \leq 1$

We begin by considering the case of small extended elasticity (or, equivalently, of decreasing returns). In this scenario a unique fixed point exists.

Proposition 3 *The map has an unique fixed point.*

Proof. It is sufficient to notice that an interior fixed point can be characterized as a solution to the following equation:

$$k^{1-(\alpha+\delta)} = \beta A \left\{ \frac{1-\alpha-[(1-\alpha)(1-\sigma)+\sigma\alpha]\cdot g\cdot D\left(1-e^{-fA(1-\alpha)k^{\alpha+\delta}}\right)}{1+\beta-\beta\cdot g\cdot D\left(1-e^{-fA(1-\alpha)k^{\alpha+\delta}}\right)(1-\sigma)} \right\} \tag{8}$$

The left side is a increasing function of k, while the right side is a decreasing function of k. Thus, the solution is unique. ■

It is straightforward to check that the interior fixed point is a decreasing function of f (see Figure 1-b). We thus have that (analogously to what happened in the wealth-neutral case), wealth-sensitive positional competition has a negative bearing upon the economy's steady state level - although we need to check what are the economy's dynamic properties, and so the relevance of the steady state in the economy's representative growth paths. In any case, since positional competition negatively affects individuals' well-being, we can conclude that the well-being associated to the steady state is, ceteris paribus, lower than the one found in the wealth-neutral case (that is, when $f = 0$).

As to the model's dynamic properties, we notice that, for $f > 0$ the map is now unimodal, and presents the typical pattern of complex of dynamic regimes as f increases. Thus, unlike the simpler version of the OLG model with wealth-neutral positional competition, we have now that wealth-sensitive positional competition indeed has an impact on the model's dynamic behavior, and in

particular that it can generate persistent endogenous fluctuations. This can be easily checked by means of a numerical example. For instance, we set $\alpha = 0.13$, $\beta = 0.9$, $A = 30$, $\sigma = 0.3$, $g = 1$, $\delta = 0.21$.
Starting from a low value of $f < 0.025$, the dynamics are monotonic, as in the wealth-neutral case. After a mild increase of f, the fixed point maintains its stability, but the convergence becomes oscillatory. If we let f increase further, we run into the first flip bifurcation for $f \simeq 0.281$, which creates a stable 2-period cycle. From this value onwards, the map undergoes a classical period-doubling route to chaos[5]. In the following Figure 3-a, we present the bifurcation diagram that summarizes the evolution of the dynamics with respect to the value of f. In Figure 3-b, a typical monotonic convergence to the steady state is reported for $f = 0.025$, while in Figure 2-c a chaotic evolution of k is simulated for $f = 0.2$. Thus,there is a direct link in this scenario between wealth-sensitive positionality and complex dynamic behavior.

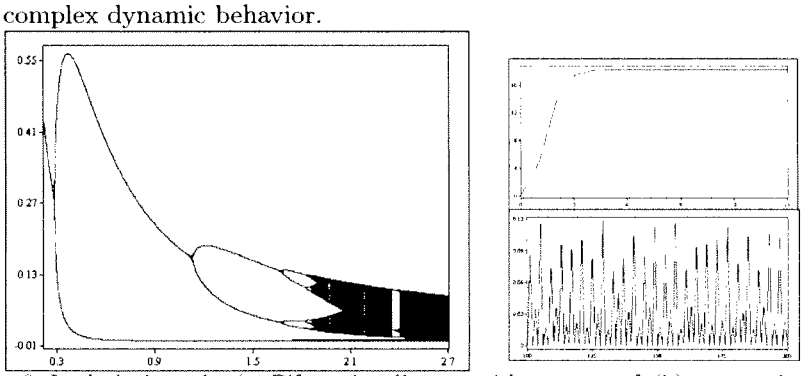

Figure 3: In clockwise order (a) Bifurcation diagram with respect to f; (b) monotonic convergence to the steady state; (c) chaotic behaviour around the steady state.

Scenario 2 $\alpha + \delta > 1$, $g = 1$

In this scenario we draw out a somewhat limit situation: Increasing returns plus extreme positional competition ($g = 1$). It is simple to check that, now, dynamics are bounded and perpetual growth is not possible because of the negative impact of huge consumption externalities on saving[6]. Contrary to the previous case, multiple attractors (fixed points, periodic cycles or chaotic attractors) may now coexist, as stated by the following proposition.

Proposition 4 *Let $\alpha + \delta > 1$, $g = 1$. Then, there exists a sufficiently high A such that two interior steady states k^*, k^{**}, $k^* < k^{**}$, coexist. In this case, 0 is attractive, whereas k^* is repulsive.*

Proof. It is sufficient to notice that $\lim_{k\to 0} G(k) = \lim_{k\to\infty} G(k) = 0$, and that the map is increasing and unbounded with respect to A. Hence, there exists an A^*

[5] In fact, as f increases, the shape of the map changes and presents a more pronounced hump.

[6] In fact, $\lim_{k\to+\infty} G(k) = 0$

such that no interior fixed point exists for $A < A^*$, and two fixed points exist for $A > A^*$. ■

Because of the initial convexity of the map, 0 is attracting for every constellation of parameters. When multiple attractors exist, this fixed point again becomes a poverty trap, that is to say, it represents a stable low level of economic activity (and of well-being), which absorbs all trajectories with 'unlucky' initial conditions. It is worth noting that the basin of attraction of 0 is now disconnected, as shown in Figure 4: The repulsive fixed point defines a bound for the *close-by* portion of the basin of attraction of 0. However, since the map is not invertible, there exists a another *remote* portion of the basin of attraction of 0 *on the right* of $\overline{k}$ in figure 4 (where $\overline{k}$ is defined as the unique value such that $f(\overline{k}) = k^*$, with $\overline{k} \neq k^*$). Consequently, the dynamic complexity of the model makes it now possible that even a very developed economy (whose initial capital endowment lies beyond the threshold $\overline{k}$) may end up imprisoned into a poverty trap. The reason is that young agents, to react to the fierce positional competition, use almost their whole wage to consume, and save only a very low share of their wage, thus causing a sharp fall in capital accumulation and the eventual convergence to the no-activity steady state.

In this extreme scenario, the impact of f on the economy's dynamic complexity is even more pronounced than in the previous case. For instance, in Figure 4 we set $\beta = 0.15$, $\alpha = .83$, $A = 50, \sigma = 0.5$, $\delta = 0.91$. Letting f vary, once it is assumed that $g = 1$, it is sufficient that f gets barely greater than 0 to drastically change the shape of the map from monotonic increasing to unimodal. This induces chaotic behavior around the points near to the high fixed point. But further increases of f cause the map, evaluated at the fixed point, to become less steep. Consequently, the dynamics are periodic at first, and then ($f \simeq 0.06$) converge to the fixed point. In Figure 4, with $f = 0.004$ we evidence the coexistence of a 2-period cycle and of the poverty trap. The grey zone represents the basin of attraction of the poverty trap. Thus, in this rather extreme scenario, relatively high levels of welth-sensitive positional competition stabilize the economy upon the interior steady state as a nonlinear consequence of the interplay between *strong* wealth-sensitive consumption externalities and *increasing* returns.

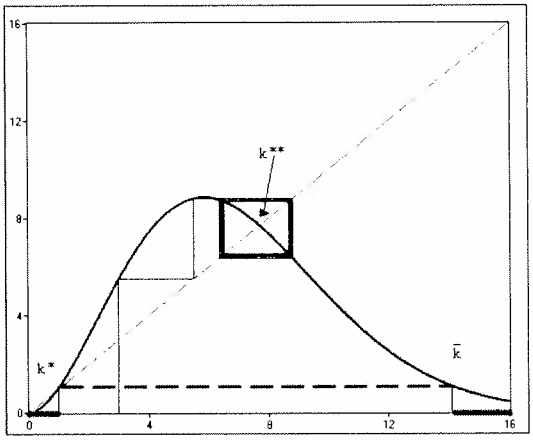

Figure 4: Coexistence of a 2-period limit cycle and poverty trap. The gray zone represents the basin of attraction of 0.

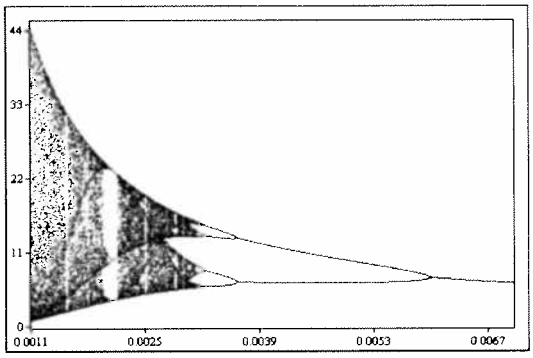

Figure 5: Bifurcation diagram with respect to f, when the capital externality is strong.

Scenario 3 $\alpha + \delta > 1$, $g < 1$

In this last scenario, as in the previous one, we analyze a situation characterized by increasing returns, but where at the same time positional competition ρ cannot reach such extreme levels. The direct consequence of this limitation upon ϱ is that now infinity becomes an attractor for the system and thus the economy may experience an unbounded growth like in the unstable wealth-neutral positional competition case. Nonetheless, other kinds of (complex) dynamic behaviour are possible.

Proposition 5 *Let $\alpha + \delta > 1$, $g < 1$. Then, 0 and infinity are both attractors for the system. Generically, an odd number of interior steady states exists and the steady states with an even index are unstable.*

The simplest case is when a unique interior fixed point exists. This case is quite similar to the one described at point b) in Proposition (1): The fixed point

separates the basin of attraction of the poverty trap 0 from that of unbounded growth. But more interesting cases are possible when the map is bi-modal (see [82] [83]), and three interior fixed points $k^* < k^{**} < k^{***}$ exist. In the following example, we fix $\beta = 0.99$, $\alpha = .1$, $A = 9.5$, $\sigma = 0.4$, $g = .99$, $\delta = 2.6$ and we let f vary. We start from $f = 0.11$: The map has two critical points of rank 0: A minimum $k_{\min}$, and a maximum $k_{\max}$. The respective critical points of rank 1 $G(k_{\min}) = c_m$, $G(k_{\max}) = c_M$ separate the range of the domain in 3 zones, $Z_1 = (0, c_m)$, $Z_3 = (c_m, c_M)$, $Z_1' = (c_M, +\infty)$ whose points have one, three, and one preimages, respectively. The steady states 0 and infinity are attractors, and their basins of attraction are given by $[0, k^*)$ and $(k^{***}, +\infty)$, respectively, whereas trajectories starting in the interval $R = (k^*, k^{***})$ stay in R and converge to a chaotic attractor[7] inside the absorbing area $[k_m, c_{\min}]$. Notice that, differently from the previous case, attractors have now connected basins of attraction.

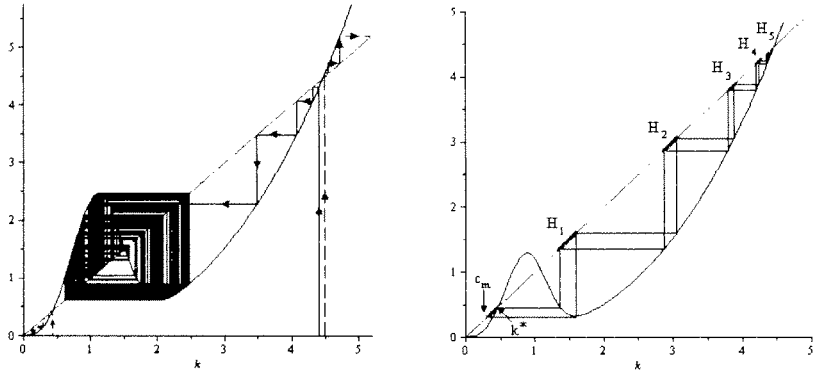

Figure 6: (a) For f=0.11 we witness the coexistence of three attractors: The chaotic one, infinity and 0, with three connected basins of attraction. When f=0.21, (c_m, k^*) is in Z_3, and an infinity of portions of the basin of attraction of 0, H_1, H_2, H_3..., lie inside R.

However, if we let f increase a little bit, the behaviour of the dynamics drastically changes once again. In this case, c_m slips below k^*, and R loses its invariance. After this (basin boundary) bifurcation, the portion (c_m, k^*) enters Z_3. and infinitely many pre-images of this interval enter inside R. At this stage, the basins of attraction of the poverty trap and of the chaotic attractor become non-connected, but in a more complex way than previously seen. Infinitely many disjoint portions of the basin of attraction of 0 and of the attractor are now nested in R (see Figure 6). This situation causes a sort of indeterminacy (see [84] for a similar use of this term[8]) about the destiny of an economy starting in the area near the fixed point k^{***}: A small change in the initial conditions may cause a transition between different basins of attraction and, as a consequence, the convergence to a different equilibrium. In this turbulent region, even small fluctuations are then enough to lead the economy into the poverty trap. Not

[7] With different constellations of parameters that allow for three fixed points. k^{**} could be attracting or surrounded by limit cycles.

[8] The above indeterminacy has not to be confused with the other type of indeterminacy, arising in models where a dynamic control variable is introduced (see e.g. [85]).

only, then, the economy is now subject to persistent endogenous fluctuations; it is also very fragile in terms of its self-stabilization capacity, so that the possibility of catastrophic dynamic effects and the eventual fall into a poverty trap become possible, and in certain conditions likely, long run outcomes.

5 Conclusions

In this paper, we have investigated whether positional competition may be a source of endogenous dynamic complexity in an OLG context. This is a policy-relevant issue, since there is ample evidence that consumption in post-industrial economic environments tends to be characterized by high levels of social externalities in consumption, since positionality is a powerful motivator for purchase of goods and services in a socio-economic environment where people do not have to strive anymore to meet daily survival needs and issues and could otherwise be less interested in invest time and effort in raising relatively high incomes to maintain high levels of expenditure. In the simple setting examined in the paper, we have shown that positional competition per se in not enough for the economy to display dynamic complexity and persistent endogenous fluctuations. As positional competition is not influenced by the individuals' wealth levels, no matter its intensity, it is never the case that it yields exotic dynamic behavior such as chaotic growth or sentitivity to initial conditions. It may well happen that the economy ends up into a poverty trap, and that positional competition may be partly responsible of this (in the sense of making this outcome relatively more likely), but in fact poverty traps might already occur in standard OLG models.

What really makes a difference is the possibility that positional competition becomes wealth-sensitive, and in particular that it is increasing in the level of wealth. In this instance, depending on the structural parameters and on the strength of positional competition itself, we can observe a variety of complex dynamic behaviors. In most cases, the more pronounced the wealth-sensitive component of positionality, the more complex the dynamics becomes, although there is a (somewhat extreme) case where wealth-sensitive positionality may act as a *stabilizer*. The most subtle and delicate implication of the model is that wealth-sensitive positionality goes much further than simply causing the economy to deviate from the steady state. It makes possible, and sometimes even likely, that the economy falls into a long run poverty trap, and this even starting from relatively safe conditions where initial levels of the capital endowment are high. Moreover, this final outcome may be very difficult to predict even during the actual transition toward the poverty trap.

A simple lesson coming from this model is, therefore, that it might be unwise trying to stimulate the economy's level of activity by pushing on the consumers' positional motivations, as it is commonly done, for instance, in mass media commercials. Although this may, at the moment, cause a rise in consumption expenditure, this may also, in a more long-run oriented perspective, subtly erode the sustainability of the economy in terms of the preservation of its productive

stock, and this is all the more dangerous the more the economy progresses along the affluence scale and the more, consequently, positional competition is fuelled by the increase in the level of wealth. Our analysis suggests that there may be other channels to stimulate the economy's level of activity, that are socially more sustainable, and that the undermining effects of strong (wealth-sensitive) positionality might be subtle and deceivingly difficult to evaluate in the immediate, to manifest their destabilizing effects only when it is too late.

Obviously, there could be other forms of positional competition that might be of interest for the sake of our analysis, and we are interested in exploring them in future research, also to proceed to a comparative evaluation with respect to the results obtained here. We feel that the issue of positional competition as an engine of persistent economic fluctuations is a relevant one, and that the large amount of literature devoted so far to the analysis of the causes and effects of positionality suggests that a similar effort should be done with reference to its dynamic long-run implications.

6 References

[1] R. Frisch, Propagation problems and impulse problems in dynamic economies, in: Essays in honour of Gustav Cassel, Allen & Unwin, London, 1933, pp. 171-205.

[2] J. Timbergen, Annual survey: Suggestions on quantitative business cycle theory, Econometrica 3 (1935) 241-308.

[3] S. Zambelli, A rocking horse that never rocked: Frisch's 'Propagation problems and impulse problems', Hist. Polit. Econ. 39 (2007) 145-166.

[4] R.M. Goodwin, The nonlinear accelerator and the persistence of business cycles, Econometrica 19 (1951) 1-17.

[5] R.E. Lucas Jr., Understanding business cycles, Carnegie-Rochester Conf. Series Publ. Policy 5 (1977) 7-29.

[6] F. Kydland, E.C. Prescott, Time to build and aggregate fluctuations, Econometrica 50 (1982) 1345-1370.

[7] J.B. Long Jr., C.I. Plosser, Real business cycles, J. Polit. Econ. 91 (1983) 39-69.

[8] C. Chiarella, P. Flaschel, R. Franke, Foundations for a disequilibrium theory of the business cycle, Cambridge University Press, Cambridge, 2005.

[9] P.A. Samuelson, An exact consumption loan model of interest with or without the social contrivance of money, J. Polit. Econ. 66 (1958) 467-482.

[10] P.A. Diamond, National debt in a neoclassical growth model, Amer. Econ. Rev. 55 (1965) 1126-1150.

[11] P. Reichlin, Equilibrium cycles in an overlapping generations economy with production, J. Econ. Theory 40 (1986) 89-102.

[12] J.M. Grandmont, P. Pintus, R. De Vilder, Capital-labor substitution and competitive nonlinear endogenous business cycles, J. Econ. Theory 80 (1998) 14-59.

[13] G. Cazzavillan, T. Lloyd-Braga, P. Pintus, Multiple steady states and endogenous fluctuations with increasing returns to scale in production, J. Econ. Theory 80 (1998) 60–107.

[14] G. Cazzavillan, Public spending, endogenous growth, and endogenous fluctuations, J. Econ. Theory, 71 (1996) 394-415.

[15] M. Aloi, H.D. Dixon, T. Lloyd-Braga, Endogenous fluctuations in an open economy with increasing returns to scale, J. Econ. Dyn. Control (2000) 97-125.

[16] A. Antoci, M. Sodini, Indeterminacy, bifurcations and chaos in an overlapping generations model with negative environmental externalities, Chaos, Solitons & Fractals (2009), 1439-1450

[17] A. Mas-Colell, M.D. Whinston, J.R. Green, Microeconomic theory, Oxford University Press, New York, 2004.

[18] T. Veblen, The theory of the leisure class. An economic study of institutions, Macmillan, London, 1915 (orig. ed. 1898).

[19] J.K. Galbraith, The affluent society, Houghton Mifflin, New York, 1958.

[20] F. Hirsch, The social limits to growth, Routledge & Kegan Paul, London, 1976.

[21] R.H. Frank, Luxury fever: Money and happiness in an era of excess, Princeton University Press, Princeton, 2000.

[22] R.H. Frank, Microeconomics and behavior, sixth edition, McGraw-Hill, New York, 2005.

[23] G. Loewenstein, Exotic preferences. Behavioral economics and human motivation, Oxford University Press, Oxford, 2007.

[24] D. Ariely, Predictably irrational. The hidden forces that shape our decisions, HarperCollins, New York, 2008.

[25] G.A. Akerlof, R.E. Kranton, Identity economics. How our identities shape our work, wages, and well-being, Princeton University Press, Princeton, 2010.

[26] Z. Bauman, Liquid life, Polity Press, Cambridge, 2005.

[27] S. Binkley, Liquid consumption. Anti-consumerism and the fetishized de-fetishzation of commodities, Cult. Stud. 22 (2008) 599-623.

[28] C.J. Uhlaner, Relational goods and participation: Incorporating sociability into a theory of rational action, Publ. Choice 62 (1989) 253-285.

[29] R.H. Frank, Positional externalities, in: R. Zeckhauser (Ed.), Strategy and choice: Essays in honor of Thomas C. Schelling, MIT Press, Cambridge, pp. 25-47.

[30] D. Menicucci, P.L. Sacco, Evolutionary selection of socially sensitive preferences in random matching environments, J. Math. Sociol. 33 (2009) 241-276.

[31] N.R. Goodwin, F. Ackerman, D. Kiron (Eds.), The consumer society, Island Press, Washington DC, 1997.

[32] D. Thomas, Deluxe. How luxury lost its luster, Penguin, New York, 2007.

[33] A. Stutzer, The role of income aspirations in individual happiness, J. Econ. Beh. Organ. 54 (2004) 89-109.

[34] Sina, Clothing luxury war can fully occupy the Chinese, http://blog.sina.com.cn/s/blog_629e89530100f2z3.html, accessed June 2, 2010.

[35] J. James, Positional goods, conspicuous consumption and the international demonstration effect reconsidered, World Devel. 15 (1987) 449-462.

[36] J. James, Do consumers in developing countries gain or lose from globalization?, J. Econ. Issues 34 (2000) 537-551.

[37] J. Alonso-Carrera, J. Caballé, X. Raurich, Growth, habit formation, and catching-up with the Joneses, Eur. Econ. Rev. 49 (2005) 1665-1691.

[38] R.H. Frank, Positional externalities cause large and preventable welfare losses, Amer. Econ. Rev. Papers Proc. 95 (2005) 137-141.

[39] R. Boudon, The unintended consequences of social action, Palgrave Macmillan, London, 1982.

[40] J.B. Schor, Work, free time and consumption, Time Soc. 7 (1998) 119-127.

[41] J.B. Schor, The new politics of consumption. Why Americans want so much more than they need, Boston Rev. 24 (1999) Summer: 4-9.

[42] B. de Mandeville, The fable of the bees: Or, private vices, publick benefits, in: The fable of the bees and other writings, Hackett, Indianapolis, 1997 (orig. 1714).

[43] T.R. Malthus, Principles of political economy, Cambridge University Press, Cambridge, 1989 (orig. 1820).

[44] C. Sanne, Willing consumers - or locked in? Policies for a sustainable consumption, Ecol. Econ. 42 (2002) 273-287.

[45] J. Henrich, F.J. Gil-White, The evolution of prestige. Freely conferred deference as a mechanism for enhancing the benefits of cultural transmission, Evol. Hum. Beh. 22 (2001) 165-196.

[46] R.H. Frank, The demand for unobservable and other positional goods, Amer. Econ. Rev. 75 (1985), 101-116.

[47] R.H. Frank, C.R. Sunstein, Cost-benefit analysis and relative position, Univ. Chicago Law Rev. 68 (2001) 323-375.

[48] S.J. Solnick, D. Hemenway, Are positional concerns stronger in some domains than in others?, Amer. Econ. Rev. Papers Proc. 95 (2005) 147-151.

[49] P. Frijters, A. Leigh, Materialism on the march: From conspicuous leisure to conspicuous consumption?, J. Socio-Econ. 37 (2008) 1937-1945.

[50] M. Pingle, M. Mitchell, What motivates positional concerns for income?, J. Econ. Psych. 23 (2002), 127-148.

[51] S.J. Solnick, D. Hemenway, Is more always better? A survey on positional concerns, J. Econ. Beh. Organiz. 37 (1998) 373-383.

[52] S.J. Solnick, L. Hong, D. Hemenway, Positional goods in the United States and China, J. Socio-Econ. 36 (2007) 537-545.

[53] D.B. Holt, How consumers consume: A typology of consumption practices, J. Consum. Res. 22 (1995) 1-16.

[54] D.B. Holt, Does cultural capital structure American consumption?, J. Consum. res. 25 (1998) 1-25.

[55] S.E. Hill, D.M. Buss, Risk and relative social rank: Positional concerns and risky shifts in probabilistic decision-making, Evol. Hum. Beh. 31 (2010) 219-226.

[56] J.B. Schor, Toward a new politics of consumption, in: J.B. Schor and D.B. Holt (Eds.), Consumer society reader, New Press, New York, 2000, pp. 446-462.

[57] T. Jackson, Live better by consuming less? Is there a 'double dividend' in sustainable consumption?, J. Ind. Ecol. 9 (2005) 19-36.

[58] T. Jackson, Evolutionary psychology in ecological economics: Consilience, consumption, and contentment, Ecol. Econ. 41 (2002) 289-303.

[59] T. Jackson, L. Michaelis, Policies for sustainable consumption, Sustainable Development Commission, 2003.

[60] J. Lintott, Beyond the economics of more: The place of consumption in ecological economics, Ecol. Econ. 25 (1998) 239-248.

[61] J. Lintott, Evaluating the 'Hirsch hypothesis': A comment, Ecol. Econ. 52 (2005) 1-3.

[62] F. Alvarez-Cuadrado, G. Monteiro, S.J. Turnovsky, Habit formation, catching up with the Joneses, and economic growth, J. Econ. Growth 9 (2004) 47-80.

[63] R. Harbaugh, Falling behind the Joneses: RElative consumption and the growth-savings paradox, Econ. Lett. 53 (1996) 297-304.

[64] M. Rauscher, Conspicuous consumption, economic growth, and taxation, J. Econ. 66 (1997), 35-42.

[65] G. Corneo, O. Jeanne, On relative wealth effects and the optimality of growth, Econ. Lett. 54 (1997) 87-92.

[66] G. Corneo, O. Jeanne, On relative-wealth effects and long-run growth, Res. Econ. 55 (2001) 349-358.

[67] B.-L. Chen, M. Hsu, Admiration is a source of indeterminacy, Econ. Lett. 95 (2007) 96-103.

[68] J. Komlos, P. Salamon, The poverty of growth with interdependent utility functions, J. Socio-Econ. 37 (2008) 2242-2247.

[69] M.C. Daly, D.J. Wilson, N.J. Johnson, Relative status and well-being: Evidence from suicide data, Federal Reserve Bank of San Francisco Working Paper 2007-12.

[70] A. Chao, J.B. Schor, Empirical tests of status consumption: Evidence from women's cosmetics, J. Econ. Psych. 19 (1998) 107-131.

[71] E. Ravina, Habit formation and keeping up with the Joneses: Evidence from micro data, mimeo, Columbia University, New York.

[72] R.H. Frank, Frames of reference and the quality of life, Amer. Econ. Rev. Papers Proc. 79 (1989) 80-85.

[73] G. Corneo, O. Jeanne, Conspicuous consumption, snobbism and conformism, J. Publ. Econ. 66 (1997) 55-71.

[74] G. Corneo, O. Jeanne, Social organization, status, and savings behavior, J. Publ. Econ. 70 (1998) 37-51.

[75] R.H. Frank, Should public policy respond to positional externalities?, J. Publ. Econ. 92 (2008) 1777-1786.

[76] B. Dupor, W.-F. Liu, Jealousy and eqiulibrium overconsumption, Amer. Econ. Rev. 93 (2003) 423-428.

[77] M. Rauscher, Keeping up with the Joneses. Chaotic patterns in a status game, Econ. Lett. 40 (1992) 287-290.

[78] U. Gneezy, A. Rustichini, Gender and competition at a young age, Amer. Econ. Rev. Papers Proc. 94 (2004) 377-381.

[79] R.H. Frank, Does absolute income matter?, in: P.L. Porta and L. Bruni, Economics and happiness: Framing the analysis, Oxford University Press, Oxford, pp. 65-90.

[80] M. Boldrin, Dynamic Externalities, Multiple Equilibria and Growth, J. Econ. Theory, 58 (1992),

198-218.

[81] G.F. Will, A Lexus in every garage, The Washington Post, October 11, 2007.

[82] R. Lupini, S. Lenci, L. Gardini, Bifurcations and multistability in a class of two-dimensional endomorphisms, Nonlinear Analysis, 28, (1996), 61-85.

[83] A. Agliari, Global bifurcations in the basins of attraction in noninvertible maps and economic applications, Nonlinear Analysis TMA, 47 (2001), 5241-5252.

[84] G.I.Bischi, M. Kopel, A. Naimzada, On a rent-seeking game described by a non-invertible iterated map with denominator, Nonlinear Analysis TMA, 47 (2001), 5309-5324.

[85] A. Antoci, L. Brugnano, M. Galeotti, Sustainability, indeterminacy and oscillations in a growth model with environmental assets, Nonlinear Analysis RWA, 5 (2004), 571-587.