Interdependent Preferences and Aggregate Saving

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Abstract

The effect of relative consumption on aggregate saving is analyzed in a two-period model. It is assumed that people care about their rank in the consumption distribution at each date. It is shown that individuals concentrate their consumption in the period in which the distribution of consumption is the most egalitarian. As a result, a rise in consumption inequalities has a negative impact on saving compared to the case without a status-seeking motive.

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1 Introduction

The personal saving rate in the United States has markedly declined for the last fifteen years. It has fallen from 10 percent in the middle of the 1980s to 2.3 percent in 1999. This fall is commonly referred to as the low saving rate puzzle. To the extent that consumption inequality is positively correlated to income inequality, this paper suggests that one of the possible cause of a low saving rate could be the rise of income inequality experienced by this country. Indeed, the Gini coefficient of inequality for household incomes rose between 1968 and 1992 by 3.5 percentage points, which is quite significant (Atkinson (1997)). In the present paper, a link is shown between these two phenomenons by assuming that people are concerned by their relative consumption.

Relative consumption is defined as the level of personal consumption compared to the consumption level of a given reference group. This group can be neighbors or at a broader level the entire society. The idea that individual consumption may be affected by the level of consumption enjoyed by others has first been suggested by Veblen (1922) and later by Duesenberry (1949). Indeed, a relatively high consumption level may be a signal to human and physical wealth and may inform about the social position of the person who enjoys it. It may also be a direct source of social rewards insofar as it involves admiration or envy by others.

In this paper I interpret these various motivations by assuming that individuals are to some extent concerned by their ranking in the consumers' hierarchy and I derive aggregate saving implications. To do so, a simple two-period model is used in which individuals' wealth differs. People care at each date about their rank in the time-varying consumption distribution. It is shown that a rise in consumption inequalities has a negative impact on saving. The basic mechanism captured by the model is the following: one motive of saving is to increase in the future one's relative position by consuming more. However, the rise of consumption inequalities weakens this motive since it is easier to raise one's rank today than in the future.

Several empirical papers have argued that some form of interdependent utility may play an important role in determining consumption. Di Tella, MacCulloch and Oswald (1997) examine the evolution of happiness by looking at responses to survey questions in 13 industrialized countries since the early 70s. They find no trend in the US and a decline in Italy and Germany for example. Conventional models with absolute utility fail to explain these trends since meanwhile, real incomes have more than tripled over the period. Solnick and Hemenway (1998) use survey data to provide some empirical information about concerns regarding relative standing. Half of the respondents preferred to have a real income 50% smaller but high relative income. Kapteyn, Van de Geers and Van de Stadt (1985) estimate a model in which both one's own past consumption and the consumption of others influence utility. They cannot reject the proposition that utility is entirely relative (see also Kapteyn et al. (1997)).

The theoretical link between saving and status seeking has been studied by several papers. Here I report only some of them that share similarities with the present model (see Weiss and Fershtman (1998) for a general survey). Corneo and Jeanne (1997) consider a model in which individuals derive utility from their rank in the distribution of wealth. They show that the growth rate of the economy increases with the initial equality of wealth distribution. The present model essentially departs from theirs by assuming that higher consumption rather than higher wealth confers a greater status. This difference can be motivated by the fact that consumption is easier to advertize than wealth, a point first noted by Veblen (1922). It leads to very different implications on saving. Contrary to their model the initial level of wealth inequality does not play a major role. Rather, results crucially depend on the dynamics of consumption inequalities. Corneo and Jeanne (1999) propose a second model in which the link between wealth inequalities and saving is more ambiguous. However the same remarks regarding the differences with the present model apply here.

Knell (1999) analyzes the effect of relative consumption on saving in an overlapping generation model. There are two classes of wealth, whereas in the present model there is a continuum of wealth. He shows that a concern for relative standing produces a negative link between wealth inequality and growth if two conditions are fulfilled: individuals have a higher concern for their present than for their future relative standing and they refer to people that are wealthier than they are. These restrictive conditions are not displayed here. Yet an impact of inequalities on saving still remains.

The first condition of Knell (1999) for status to have a negative impact on saving is reminiscent of the papers by Franck (1985) or Corneo and Jeanne

(1998). In particular Franck (1985) assumes that individuals care about their relative rank in consumption distribution. In his model saving is depressed because only first period rank matters. This straightforward mechanism is not reproduced in the present model. Indeed, contrary to these three papers I assume that individuals equally care about today's and tomorrow's status.

The paper proceeds as follows. In section 2, I describe the model. Then the link between aggregate saving and the evolution of the consumption dispersion is analyzed and the equilibrium conditions are derived in section 3. Section 4 studies the impact on saving in a linear economy. Section 5 concludes the paper.

2 Model

I consider a single-good economy with two dates: $t = 0, 1$ and a size-one continuum of agents. A period can be thought of as a half of a consumer's life. Agents differ in their first period endowment denoted by $y_0^i \geq 0$. Their second period endowment is zero but they can transfer goods from the first to the second period by using a linear production function which produces R for each unit invested at date 0[1].

The endowments are exogenous and distributed over $\left[y_0^-, y_0^+\right]$ according to the cumulative distribution function $F(.)$. Let $f(.)$ denote the associated probability density function. The following properties of $f(.)$ are assumed[2]:

H1 $f(.)$ is continuously differentiable over $\left]y_0^-, y_0^+\right[$, left continuous at y_0^+, right continuous at y_0^- and such that $f(y_0^-) = 0$.

Let (c_0^i, c_1^i) be the consumption pattern of an individual endowed with $y_0^i \in \left[y_0^-, y_0^+\right]$. Let $c_0 = Q_0(y_0)$ and $c_1 = Q_1(y_0)$ be the consumption rules (to be defined later) of all the consumers but i. The rules $Q_0(.)$ and $Q_1(.)$ are exogenously given for i as his consumption level is assumed to be too small

[1] R can be interpreted as a fixed gross interest rate. The exogeneity of R is appropriate if the economy is a small open economy or if the interest rate is controlled by the monetary authority.

[2] The hypothesis $f(y_0^-) = 0$ in H1 will be necessary in the following to ensure that the second order condition is a sufficient condition for the maximization problem stated below. See cases (I) and (II) in Appendix B for more details.

to affect other consumption decisions. Let us define the set Ω_c^t, $t = 0, 1$, of individuals who consume less than c:

$$\Omega_c^t = \left\{ y_0^i ; Q_t(y_0^i) < c \right\}$$

The fraction $G_t(c)$ of the population which consumes less than c at date $t = 0, 1$ is expressed as:

$$G_t(c) = \int_{\Omega_c^t} f(y_0) dy_0$$

It is assumed that people derive utility from social status which is represented by their rank $G_t(c)$ in the consumers' hierarchy. All individuals have identical preferences which depend on consumption and on status:

H2 Let $T_t(c_t^i) : [0, \infty[\rightarrow \mathcal{R}$ denote the reduced form of the instantaneous utility function at $t = 0, 1$. $T_t(.)$ is defined by:

$$T_t(c_t^i) = u(c_t^i) + \alpha G_t(c_t^i)$$

where $u(.)$ is an increasing, concave and twice continuously differentiable function.

The rank term $G_t(c_t^i)$ captures the relative consumption motive. It is exogenously given at the individual's level. The assumption that the utility function is linear in the rank term is equivalent to assuming that the utility gain associated with a marginal increase in the rank is the same whatever the initial rank of the person[3]. The coefficient α reflects the strength of the status-seeking motive.

Let β denote the psychological discount rate. Each individual evaluates his consumption path by taking as given the evolution of the consumption distribution. The optimal consumption path (c_0^i, c_1^i) of an individual endowed with y_0^i is solution to the following problem $(\mathcal{P})$:

[3] Robson (1992) provides arguments in favor of the convex case while Corneo and Jeanne (1997) only consider the concave case. In the latter case the poor has a higher concern for status than the rich (see also the analysis in Corneo and Jeanne (1997)). Note that the present model could be extended in either direction without changing its basic results.

$$(\mathcal{P}) \quad \begin{cases} \max\limits_{\{c_0^i, c_1^i\}} T_0(c_0^i) + \beta T_1(c_1^i) \\ s.c. \quad c_0^i + c_1^i/R = y_0^i \\ c_0^i, c_1^i \geq 0 \quad y_0^i, G_0(.) \text{ and } G_1(.) \text{ given} \end{cases}$$

At the aggregate level however, the consumers' decisions must be compatible with each other. This compatibility condition can be stated as follows. Let $c_t^i = q_t(y_0^i)$ be the optimal consumption rule at date $t = 0, 1$ derived from $(\mathcal{P})$. Then compatibility implies: $Q_t(y_0^i) = q_t(y_0^i)$ for all $y_0^i \in \left[y_0^-, y_0^+\right]$.

An equilibrium is defined as a set of consumptions $\{(c_0^i, c_1^i)\}$ for all i that satisfies (a) maximization: each individual i chooses (c_0^i, c_1^i) by solving $(\mathcal{P})$ and (b) compatibility of individuals' decision at the aggregate level.

In order to analyze further the resulting allocation, I focus on equilibria in which the wealth expansion path is continuously increasing over $\left[y_0^-, y_0^+\right]$:

$$Q_0'(y_0) > 0 \text{ and } Q_1'(y_0) > 0 \tag{1}$$

These conditions simply say that demand is increasing in wealth, or in other words, that the good is normal at both dates. This is a minimal requirement insofar as the good is a large aggregate. In this environment, a rank-preserving property must hold, that is, the consumption rank reached at equilibrium by any individual is his rank in the wealth hierarchy:

$$G_0(c_0^i) = G_1(c_1^i) = F(y_0^i) \tag{2}$$

for all i[4]. According to H1, $F(.)$ is twice continuously differentiable and so are $G_0(.)$ and $G_1(.)$. Hence $G_t(.)$, $t = 0, 1$, is the cumulative distribution function of the consumption distribution at date t. The restriction (2) therefore implies that a first order condition for $(\mathcal{P})$ can be derived: $T_0'(c_0^i) - \beta R T_1'(c_1^i) = 0$ for all $y^i \in \left]y_0^-, y_0^+\right[$ or:

$$u'(c_0^i) - \beta R u'(c_1^i) + \alpha \left[g_0(c_0^i) - \beta R g_1(c_1^i)\right] = 0 \tag{3}$$

[4]This property does not imply however that the status seeking motive does not play any role in determining consumption. As it will become clear, each individual, facing given consumption distributions at the two dates, tries to improve his position by distorting his consumption strategy. In equilibrium, the consumption distributions are affected by the status seeking motive but they are still such that no one can obtain more than his rank in the wealth hierarchy at the two dates.

$g_t(.)$ is the density function of the consumption distribution at date t. The condition (3) is a standard optimality condition excepted that marginal utilities are now affected by variations of the consumer's position in the distribution. The consumer i benefits from a rank increase of $g_0(c_0^i)$ by marginally increasing his first period consumption. The corresponding decrease in second period consumption lowers his related rank by $Rg_1(c_1^i)$.

Last, the following condition is assumed:

H3 $u''(c_t^i) + \alpha g_t'(c_t^i) < 0$ for $t = 0, 1$ and for all i.

The first term of the inequality is negative by assumption. The second term is relative to the status concern. If $g_t(c)$ is upward sloping, an additional amount of consumption implies overtaking a greater fraction of individuals. This introduces a convex element in the utility function as a marginal increase in consumption leads to a larger increase in ranking. So, H3 says that wherever the consumption density function is increasing, the concavity of $u(.)$ must be sufficiently strong or the weight α must be sufficiently small for H3 to be satisfied[5].

The assumption H3 can be summarized by $T_t''(c_t^i) < 0$. It has two important implications. First, the second order condition of $(\mathcal{P})$ for all i:

$$T_0''(c_0^i) + \beta R^2 T_1''(c_1^i) < 0 \tag{4}$$

is necessarily verified[6]. Second, the initial restriction that the good is normal at both dates is also satisfied under H3. Indeed, the optimal rule $c_0 = Q_0(y_0)$ is implicitly given by: $T_0'(c_0) - \beta R T_1'(Ry_0 - Rc_0) = 0$. Using the

[5]Interestingly, Yoram Weiss suggested that the convexities arising from caring about relative consumption may overcome the concavity in utility. The relatively poor would spend more on conspicuous consumption, because the observed density rises at low incomes. This means that the condition in H3 would not be fulfilled for those agents. Therefore, some poor would consume more than some rich in one of the periods. Thus, concerns for status would lead to short bursts or "over spending". Unfortunately we didn't find a satisfying way to capture this idea. The consumption distributions are discontinuous in that case (equivalently, H1 is violated), preventing a Nash-equilibrium to exist.

[6]This condition only ensures that the first order condition provides a local maximum. However it can be shows that it is also a global one under no additional restrictions. The general idea is that if an allocation is a local maximum for *all* individuals, it is also a global one for *everyone* (proof available on request).

implicit function theorem:

$$Q_0'(y_0) = \frac{\beta R^2 T_1''(Ry_0 - Rc_0)}{T_0''(c_0) + \beta R^2 T_1''(Ry_0 - Rc_0)}$$

Since the second order condition ensures that the denominator is negative, $Q_0'(y_0)$ is positive following H3: $T_1''(c_1) < 0$. The optimal second period consumption is equivalently given by: $c_1 = Q_1(y_0) = R(y_0 - Q_0(y_0))$. The slope of $Q_1(y_0)$ is then:

$$Q_1'(y_0) = R\left\{1 - \frac{\beta R^2 T_1''(Ry_0 - Rc_0)}{T_0''(c_0) + \beta R^2 T_1''(Ry_0 - Rc_0)}\right\}$$

which is positive if $T_0''(c_0) < 0$[7].

How does the relative consumption concern affect the saving decision? A simple answer arises in the particular case $R = 1/\beta$:

Proposition 1. If $R = 1/\beta$ then $c_0^i = c_1^i = \frac{R}{R+1} y_0^i \;\; \forall \; \alpha \geq 0$.

Proof. The first order condition is: $T_0'(c_0^i) = T_1'(c_1^i)$. A natural guess is therefore: $c_0^i = c_1^i = Ry_0^i/(R+1)$. In this case the consumption distribution is stationary: $G_0(c) = G_1(c) \; \forall c \in \mathcal{R}^+$, and so is the instantaneous utility function: $T_0(c) = T_1(c)$. Hence the guessed solution does satisfy the first order condition. □

The case $R = 1/\beta$ implies that the consumption distribution is time-invariant. A marginal gain of rank is exactly compensated by a discounted loss of rank in the other period. Hence each individual is induced to consume his permanent income as in the case without relative consumption in which $\alpha = 0$. Note that this result remains true for any consumption distribution $G(.)$ and therefore for any level of consumption inequality. This particular case shows that saving decision is not directly related to a given level of consumption inequality.

[7] H3 ensures that all consumers choose an interior solution. This property rules out "bunching" and ensures the normality of the goods. Continuity of $Q_t(.)$ results from the absence of bunching and the differentiability of $f(.)$ together with the rank-preserving property.

However the evolution of consumption distribution does affect individuals' consumption in the general case $R \neq 1/\beta$. Consequently, it has to be solved for in order to assess the impact on saving. This is done in the next section by solving the problem $(\mathcal{P})$ in the special case of a linear economy.

3 Aggregate saving in a linear economy

The interaction between saving decisions and the time evolution of consumption distribution is now analyzed. First, the environment is further restricted in order to get simple intuitions about the properties of equilibria with relative consumption. Second, the saving rule is solved and third, the results are interpreted.

3.1 Additional assumptions

To keep the problem analytically tractable, I assume that the wealth density function takes a linear form:

H1' $f(y_0^i) = ay_0^i + b \; \forall y_0^i \in \left[y_0^-, y_0^+\right]$,
$a > 0$ and $b = 1/(y_0^+ - y_0^-) - a(y_0^+ + y_0^-)/2$.

Since the hypothesis H1: $f(y_0^-) = 0$ must hold, it follows that the wealth distribution has a triangular form with a positive slope $a > 0$ and $f(y_0^+) > 0$[8]. The expression of b ensures that $f(.)$ is a probability density function. The direct utility function is assumed to be quadratic[9]:

H2' $T(c_t) = c_t - (\theta/2)(c_t)^2 + \alpha G_t(c_t)$.

[8]If $f(y_0^-) > 0$ the poorest could always increase his rank by consuming more in one period without losing any rank in the other period. A Nash equilibrium could not be well defined in this case. The distribution of wealth postulated here does not resemble real distributions. However, the discussion about the first order condition in the previous section should convince the reader that this does not affect the qualitative result about *aggregate* saving, which is the focus of the paper.

[9]I assume throughout the remaining of the paper that the marginal utility is always positive. This is the case if $1/\theta > c_t^i \; \forall \; y^i \in [y_0^-, y_0^+]$ and $\forall \; t = 0, 1$ which is a sufficient condition here.

3.2 Solving the model

The first order condition (3) implicitly provides the optimal consumption rule. However, the consumers' problems are not independent and interact through the distributions of consumption. As previously noted, I restrict my attention to equilibria in which $Q_0'(y_0) > 0$ and $Q_1'(y_0) > 0$ hold. Hence $Q_0(.)$ and $Q_1(.)$ can be inverted. These functions are respectively denoted by $Y_0(.)$ and $Y_1(.)$: $y_0 = Y_0(c_0) = Q_0^{-1}(c_0)$ and $y_0 = Y_1(c_1) = Q_1^{-1}(c_1)$. Exploiting the rank-preserving property of the model: $G_0(c_0) = F(Y_0(c_0))$ and $G_1(c_1) = F(Y_1(c_1))$ and taking the derivative, the first order condition (3) can be expressed as:

$$u'(c_0) - \beta R u'(c_1) + \alpha f(y_0)\left[Y_0'(c_0) - \beta R Y_1'(c_1)\right] = 0 \qquad (5)$$

The policy rule $Q_0(y_0)$ is solved by the method of undetermined coefficients. It is guessed that the policy function takes a linear form:

$$Q_0(y_0) = \eta + \gamma y_0$$

where η and γ are unknown parameters. The budget constraint gives the second period policy function:

$$Q_1(y_0) = R[(1-\gamma)y_0 - \eta].$$

Hence the first order condition (5) can be simplified to:

$$1 - \theta c_0 - \beta R[1 - \theta(Ry_0 - Rc_0)] + \alpha(a + by_0)\left[\frac{1}{\gamma} - \frac{\beta}{1-\gamma}\right] = 0$$

A linear function of c_0 in terms of y_0 obtains. As a result the parameters η and γ are readily identified:

Proposition 2. the optimal rule for date 0 consumption takes the following form: $c_0^i = \eta + \gamma y_0^i$ in which η and γ satisfy:

$$(1+\beta R^2)\theta\gamma^3 - (2\beta R^2 + 1)\theta\gamma^2 + (\theta\beta R^2 - \alpha b(1+\beta))\gamma + \alpha b = 0$$

$$\eta = \frac{1 - \beta R + \alpha a((1/\gamma) - \beta/(1-\gamma))}{\theta(1+\beta R^2)}$$

The slope γ is the solution of a polynomial of degree 3. A numerical determination of η and γ is performed. As an illustration, let the parameters of the economy be:

θ	α	β	a	b
0.01	5.512	0.64	0.0004	-0.0122

The saving decision is solved for different values of gross interest rate R. θ is taken sufficiently small in order for the marginal utility to be always positive. Given the slope of the wealth density function a, α is small enough for the condition H3 to be verified. Importantly, the qualitative results of this section are robust to any modifications of the parameters in a way that preserves H3.

There are three real roots for γ. However two roots are rejected since they do not satisfy the assumption H3. It follows that the policy rule as well as the equilibrium are unique[10].

3.3 Relative consumption and aggregate saving

Figure 1 plots aggregate saving rate as a function of the gross interest rate in the cases with and without a status-seeking motive.

It can be seen that the status-seeking motive promotes the saving rate when the gross interest rate R is greater than $1/\beta$.

This result directly comes from the link between the saving decision and the evolution of the consumption distribution. Indeed, it can be seen from the first order condition (3) that if the growth rate of the density function $g_1(c_1)/g_0(c_0)$ is smaller than βR, the last term of (3) is positive. Consequently the status-seeking motive implies less saving than in the case without status. The converse is true if $g_1(c_1)/g_0(c_0)$ is greater than βR. This result can be explained by noting that the density function of consumption $g_t(c_t)$ reflects how many individuals can be overtaken by marginally increasing consumption at period $t = 0, 1$. Therefore the status-seeking motive leads individuals to concentrate consumption in the period in which the discounted rank improvement is the strongest.

[10] This result is preserved when the parameters of the economy are modified while preserving H3.

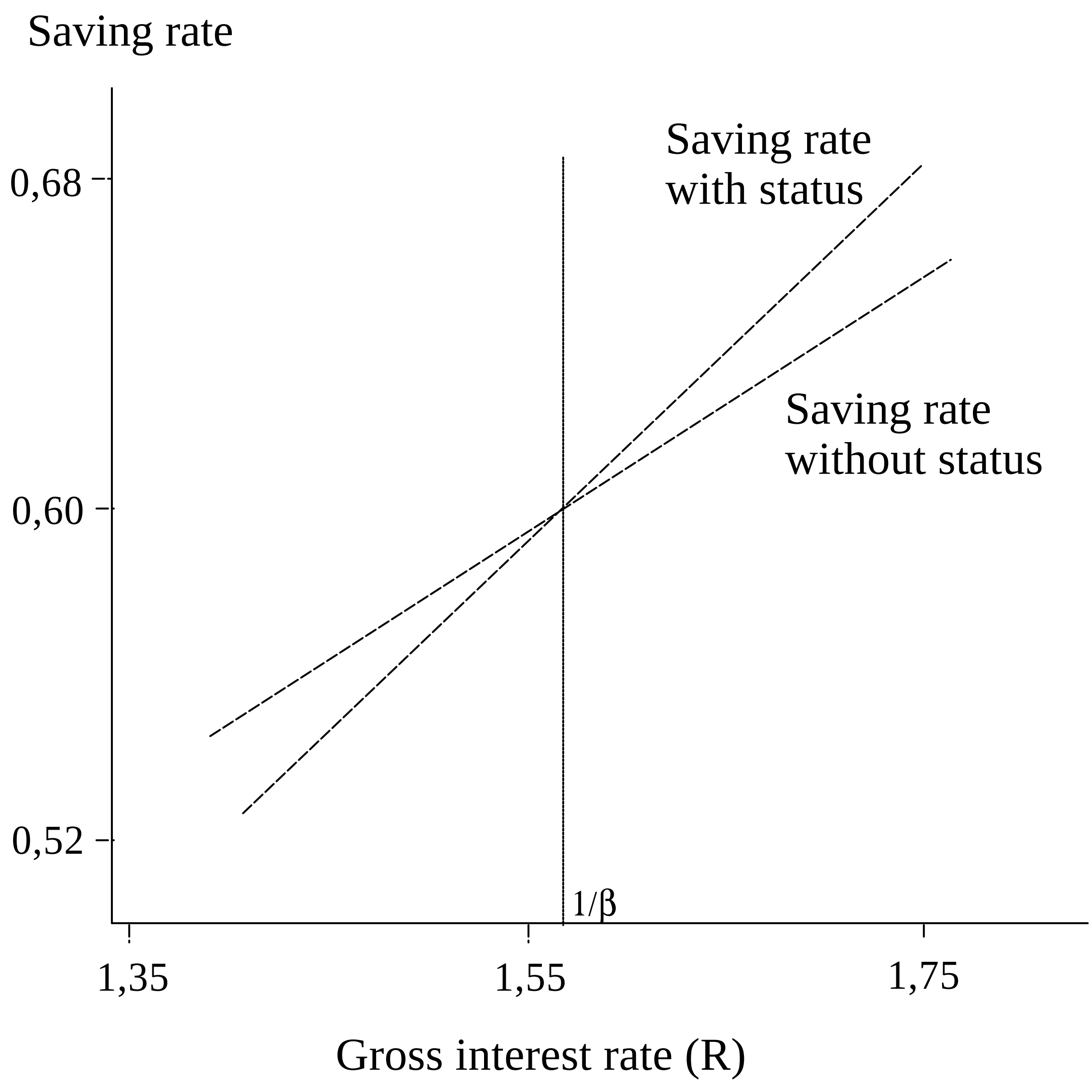
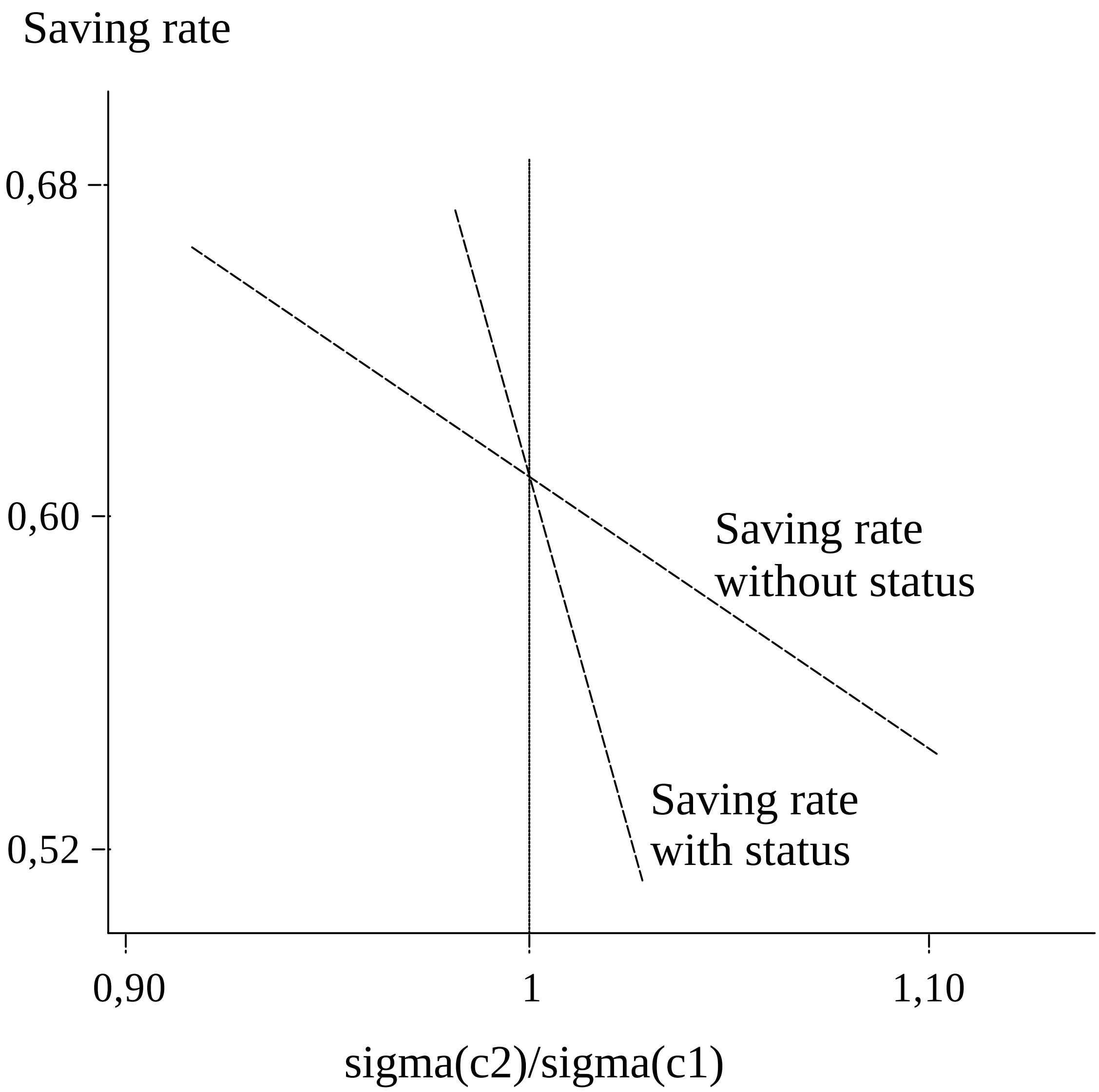

Saving rate
0,68
0,60
0,52
Saving rate
with status
Saving rate
without status
1/β
1,35
1,55
1,75
Gross interest rate (R)

Figure 1: Saving rate and interest rate

The density function growth rate is related to the evolution of consumption inequalities. If the density function decreases from date 0 to date 1 for all individuals, this means that the second period consumption distribution is a spread of the first period one, i.e. consumption inequalities increase. In other words, the first order condition reveals that individuals choose to transfer consumption in the period in which the distribution of consumption is the most egalitarian. Hence if consumption inequalities increase sufficiently (that is $g_1(c_1^i)/g_0(c_0^i)$ is greater than βR), saving is lower than in the case without status motive. This effect can be verified in Figure 2.

The consumption dispersion in period j is captured by the standard deviation of the consumption distribution and is denoted by $\sigma(c_j)$. Aggregate saving rate is plotted as a function of the ratio $\sigma(c_2)/\sigma(c_1)$ when the gross interest rate varies from 1.4 to 1.7. The greater $\sigma(c_2)/\sigma(c_1)$, the larger the consumption inequalities. This figure shows that saving decreases when inequalities increase, that is $\sigma(c_2)/\sigma(c_1) > 1$.



Saving rate
0,68
0,60
0,52
Saving rate
without status
Saving rate
with status
0,90
1
1,10
sigma(c2)/sigma(c1)

Figure 2: Saving rate and evolution of the standard deviation of consumption (sigma(c))

When $R\beta = 1$ the consumption distribution is time invariant both with and without a status-seeking motive, as demonstrated in proposition 1. In this case, individuals consume the same amount in the two dates and cannot improve their relative position by transferring consumption from a period to the other.

When $R > 1/\beta$ the distribution of the second period consumption is more concentrated than the distribution of the first period consumption in models with and without status-seeking motive. Consumption inequalities are declining. As a result, individuals can improve their position by transferring consumption from the first period to the second period as $\beta R g_2(R(y - c_1)) > g_1(c_1)$ for all level of equilibrium consumption c_1. This asymmetry provides an additional incentive to save compared to the case without status. The converse case in which $R < 1/\beta$ leads symmetrically to a rise in consumption inequalities and therefore to less saving than in the case without a status-seeking motive.

4 Concluding remarks

In this paper, it is shown how a concern for the rank in the consumption distribution may affect saving. Consumption is higher in the period in which the distribution of consumption is relatively more concentrated. Aggregate saving is therefore negatively correlated with a rise in consumption inequalities.

If a positive link between income inequality and consumption inequality is presumed and insofar as saving is the driving force of growth, the main result of the paper has potential interest for the literature which studies the link between growth and inequality. Person and Tabellini (1994) report a strong negative relationship between growth and inequality. However, this result has been recently challenged by Forbes (2000). She argues that there is an omitted variable bias in their regression. After correcting for this bias, she finds a positive correlation between growth and inequality. Nevertheless these empirical correlations cannot be used to test the main prediction of the paper since the dynamics of inequality matters in our model instead of a given level of inequality. I plan to test this prediction of the model in a future empirical work.

The model has other potential implications not investigated in the present paper. First, using a more realistic wealth distribution framework would allow to examine which class of people according to their wealth are the most sensitive to the status effect. Second, attitude towards risk could be analyzed in the present model by considering contingent goods instead of dated goods. The extension is not straightforward as the rank preserving property of the model does not hold anymore. Yet, integrating a relative concern into a theory of attitude toward risk could be interesting, as previously suggested by Harbaugh (1996) or Robson (1992).

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