The Scandinavian
Journal of Economics

Scand. J. of Economics 114(3), 949–973, 2012
DOI: 10.1111/j.1467-9442.2012.01714.x

Envy and Inequality*

Francisco Alvarez-Cuadrado

McGill University, Montreal QC H3A 2T7, Canada
francisco.alvarez-cuadrado@mcgill.ca

Ngo Van Long

McGill University, Montreal QC H3A 2T7, Canada
ngo.long@mcgill.ca

Abstract

We present an overlapping generations economy, populated by heterogeneous agents who care about both consumption relative to others and the bequest they leave to their offspring. We show that saving and bequest rates vary across the income distribution, and we obtain several interesting results. First, envy reduces the steady-state capital stock and increases the degree of inequality in consumption, capital ownership, and bequests. Second, if the bequest motive is sufficiently strong the equalizing effect of bequests disappears. Third, income inequality for a given cohort increases with age. Fourth, the distribution of inherited wealth becomes more unequal than that of wealth in general. Fifth, economic position becomes more persistent across generations.

Keywords: Income distribution; relative consumption; social mobility

JEL classification: *D*62; *E*21; *H*21

I. Introduction

The assumption that preferences are independent across households is standard in the economic literature, although it is not particularly appealing. Indeed, social scientists have long stressed the relevance of status-seeking as being an important characteristic of human behavior. In the field of economics, it has been long recognized that the overall level of satisfaction derived from a given level of consumption depends not only on the consumption level itself, but also on how it compares to the consumption of other members of society. Although the origins of this proposition can be traced as far back as Smith (1759) and Veblen (1899), it was not until the work of Duesenberry (1949) that an effort was made to provide this idea with some microtheoretic foundations.[1]

*We would like to thank Isabel Galiana and two anonymous referees for useful comments and suggestions. The usual disclaimer applies. F. Alvarez-Cuadrado acknowledges financial support from the FQRSC and the Spanish Ministry of Science and Technology through the ECO2008-06395-C05-03 project.

[1] In the subsequent body of literature, this type of interdependence has often been referred to as "catching up with the Joneses" (Abel, 1990), "keeping up with the Joneses"

Recent empirical evidence has confirmed the importance of preference interdependence. Neumark and Postlewaite (1998) have proposed a model of relative income to rationalize the striking rise in the employment of married women in the US during the past century. Using a sample of married sisters, they have found that a married woman is 16–25 percent more likely to work outside the home if her sister's husband earns more than her own husband. Charles *et al.* (2009) have documented important differences in the consumption patterns for visible goods (clothing, jewelry, and cars) across races. After controlling for differences in permanent income, racial minorities spend about 25 percent more on visible goods than white people. They have shown that most of the racial differences in visible consumption can be explained by accounting for differences in the income characteristics of the reference group. Furthermore, differences in visible consumption disappeared when they restricted their sample to older households, which suggests that the relative importance of interpersonal comparisons decreases with age.[2]

In line with this evidence, we present an overlapping generations economy populated by heterogeneous agents who care about consumption relative to others and who derive a "warm glow" from the bequest they leave to their descendants. Our aim is to study the effect of envy on inequality. The introduction of positional concerns not only reduces aggregate saving and the steady-state stock of capital, but also induces variation in the income elasticities of demand across goods and households. These differences in elasticities are translated into saving and bequest rates that vary across the income distribution, with rich households saving and bequeathing a larger proportion of their lifetime resources than their poor neighbors. This cross-sectional dispersion in the rates of asset accumulation is the key mechanism by which envy influences the degrees of intragenerational wealth inequality and intergenerational social mobility.

Focusing on stationary distributions and using the coefficient of variation as a measure of inequality, we present a number of analytical propositions with several interesting results. First, the degrees of inequality in consumption, saving, and bequests increase with envy, with inequality of bequests

(Gali, 1994), "status-seeking" (Ireland, 1994), "jealousy" (Dupor and Liu, 2003), "envy" (Konrad, 2004), "relative consumption" (Samuelson, 2004), or "consumption externalities" (Turnovsky and Monteiro, 2007).

[2] Additionally, a growing body of experimental research (e.g., Johansson-Stenman *et al.*, 2002) highlights the importance of consumption externalities. These experiments present the subjects with a series of hypothetical questions regarding their choice among alternative outcomes, where these choices reveal their concern for their consumption relative to others. Roughly half of the participants are willing to accept a lower level of absolute income in order to achieve a higher relative income. A closely related stream of literature, the research on subjective happiness, highlights the importance of relativity concerns as a key determinant of self-reported well-being. See Clark *et al.* (2008) for a recent survey.

having the greatest increase, followed by wealth inequality, and lastly by consumption inequality. The latter always remains below the exogenous level of labor income inequality. Second, income inequality for any given cohort increases with age. Third, the distribution of inherited wealth is more unequal than that of wealth in general. Fourth, if the bequest motive is sufficiently strong, the equalizing effect of bequests (as found in Bossmann *et al.*, 2007) disappears. Fifth, in the presence of status concerns, economic position becomes more persistent across generations.

The intuition underlying our results is best understood by first looking at a framework that differs from ours in that envy is absent (Bossmann *et al.*, 2007). In their set-up, the possibility of transferring wealth from one generation to the next increases the average wealth holdings more than it does the variance of wealth. As a result, wealth inequality, as measured by the coefficient of variation, falls. When we introduce interpersonal comparisons of consumption into the model of Bossmann *et al.*, we see that envy incites poorly endowed individuals to reduce their saving/income ratio, and it induces increases in wealth inequality and reductions in the degree of intergenerational social mobility.

Finally, we compare the competitive solution with the outcome under a central planner, who internalizes the negative impacts of consumption externalities. When positional externalities are stronger in the first period of life, the competitive solution results in inefficiently high levels of first-period consumption, and therefore in inefficiently low levels of saving. In order to restore allocative efficiency, the government can introduce a progressive consumption tax along the lines proposed by Frank (2007).

Our results complement the theoretical body of literature that explores the relationship between intergenerational transfers and wealth inequality. In their leading work, Becker and Tomes (1979) have stressed the equalizing effects of bequests in a model where parents optimize the welfare of the whole family line (or dynasty). They have shown that in a world where personal labor productivity is random, bequests serve as an instrument for intergenerational luck-sharing within a family line. Bossmann *et al.* (2007) have found similar equalizing effects, even when individuals do not pursue an optimal allocation of dynastic income between themselves and their offspring. These theoretical effects of intergenerational transfers are in sharp contrast with popular wisdom, the empirical evidence (Mulligan, 1997), and early studies (Meade, 1976), which suggest that bequests are an important source for the concentration of wealth. With its emphasis on positional concerns, our model suggests that the equalizing effects of intergenerational transfers decrease as the relative importance of the bequest motive rises. We show that after a certain threshold, bequests increase wealth inequality.

Our framework and results are closely related, and complementary, to those of Bossmann *et al.* (2007), who abstract from consumption externalities, and Alonso-Carrera *et al.* (2008), where each generation is populated by identical agents. The introduction of envy in an economy populated by heterogeneous agents allows us to fully explore the impact of positional concerns on intragenerational wealth inequality and on its intergenerational transmission. Our results cannot be inferred from the aforementioned papers. In contrast to Bossmann *et al.* (2007), we show that bequests might increase the degree of wealth inequality, and in contrast to Alonso-Carrera *et al.* (2008), we show that consumption externalities might affect the steady-state level of capital, even in the presence of an operative bequest motive. Our assumption of the non-positional nature of bequests lies at the heart of these differences.[3]

There is sparse evidence for the positionality of bequests. However, their limited observability and their concentration in the upper tail of the wealth distribution suggest that they possess important non-positional features. Along these lines, Moav and Neeman (2008) have presented a signaling game of status where agents derive utility from consumption, status, and a bequest, which they have modeled as non-observable. The non-observability of bequests in a signaling game is equivalent to the non-positionality of bequests in a model of relative consumption. Heffetz (2011) has conducted a survey on the degree of visibility of 31 goods and services, ranging from cars and watches to medical insurance and education. Although bequests are not included in his list, the closest expenditure item surveyed – life insurance – ranks penultimate in terms of visibility, only ahead of underwear. The high concentration of bequests on the upper tail of the wealth distribution is a well-documented empirical regularity. Mulligan (1997) has estimated that, in the US, the proportion of estates bequeathing sufficient wealth to be subject to inheritance tax was between 2 and 4 percent in the period 1960–1995. The fact that most households do not leave a substantial bequest is consistent with the limited positionality of these transfers.

The paper is organized as follows. In Section II, we set out the basic model and we characterize the competitive solution. In Section III, we explore the impact of envy on inequality. In Section IV, we characterize efficient allocations and we present an efficiency-inducing fiscal package. In Section V, we offer some concluding remarks.

[3] As we show, this non-positionality of bequests implies that their income elasticity of demand exceeds unity (i.e., bequests are luxury goods). In contrast, Alonso-Carrera *et al.* (2008) follow the pure altruism approach of Barro (1974), and as a result bequests inherit the same degree of positionality and the same elasticity of demand as consumption.

II. The Model

Consider a closed economy populated by overlapping generations of households. Time is discrete and infinite with $t = 0, 1, 2, \ldots \infty$.

Production

Every period, our economy produces a composite good that can be consumed or invested. Output Y_t is produced by combining physical capital K_t and labor L_t. The production function $F(K_t, L_t)$ is homogeneous of degree one and it satisfies the usual Inada conditions. Because markets are competitive, factors are paid their marginal products

$$w_t = f\left(\frac{K_t}{L_t}\right) - \left(\frac{K_t}{L_t}\right) f'\left(\frac{K_t}{L_t}\right) \tag{1}$$

and

$$r_t = f'\left(\frac{K_t}{L_t}\right) - \delta. \tag{2}$$

Here, f denotes the production function in per capita terms, and capital is assumed to depreciate at the exponential rate δ.

Households

Individuals live for two periods: youth and old age. At the end of their youth, each individual gives birth to $1 + n$ offspring. At any point in time, there are two generations alive. The generation born in period t consists of N_t households, indexed by i. Our agents are altruistic toward their children, deriving a warm glow (as in Adreoni, 1989) from the bequest b_t^i that they leave to their descendants. There are alternatives to this approach of modeling the motives for intergenerational transfers. Barro (1974) has considered pure altruism, while in Abel (1985) accidental bequests arise from market incompleteness, and Bernheim *et al.* (1985) have proposed a bequest-as-exchange model. The empirical evidence for the reasons for intergenerational transfers is mixed. None the less, the evidence reviewed by Arrondel *et al.* (1997) and Davies and Shorrocks (2000) suggests that an important fraction of the observed inheritances seems to reflect some kind of impure altruism close to the warm-glow approach that we adopt.

Individuals within a given generation differ in their productive endowment l_t^i, and in the bequest they inherit from their parent $b_t^i/(1 + n)$. Specifically, we assume that their labor productivity is the realization of a stationary random variable that is identically and independently distributed with mean $\bar{l} = 1$ and standard deviation σ_l. The resulting distribution of wages for period t has mean $\bar{w}_t \equiv w_t$ and standard deviation $\sigma_{wt} \equiv w_t \sigma_l$.

Let us focus on the ith individual born in period t. In the first period of his life, he inelastically supplies his endowment of labor, earning an income $w_t^i = l_t^i w_t$. The sum of his wage income and inheritance is divided between first-period consumption c_t^i and saving s_t^i. His first-period budget constraint is given by

$$c_t^i + s_t^i = \frac{b_t^i}{1+n} + w_t^i \equiv y_t^i, \tag{3}$$

where we denote by y_t^i the ith individual's lifetime resources.

In the second period of his life, the individual is retired. His only source of income is the return on the savings he made when young $R_{t+1}s_t^i$, which he allocates to second-period consumption d_{t+1}^i and bequests,

$$R_{t+1}s_t^i = d_{t+1}^i + b_{t+1}^i. \tag{4}$$

The preferences of an individual born in period t are given by the following life-cycle utility function,

$$U\left(\hat{c}_t^i, \hat{d}_{t+1}^i, b_{t+1}^i\right) = \ln\left(c_t^i - \gamma \bar{c}_t\right) + \beta\left[\ln\left(d_{t+1}^i - \eta \bar{d}_{t+1}\right) + \mu \ln\left(b_{t+1}^i\right)\right] \tag{5}$$

where $\beta < 1$ is the subjective discount factor and $\mu > 0$ governs the importance of the bequest motive.[4]

Our key behavioral assumption is that the satisfaction derived from consumption does not depend on the absolute level of consumption itself, but rather on how it compares to the consumption of some reference group. Following Ljungqvist and Uhlig (2000), we adopt an additive specification for consumption relative to others: $\hat{c}_t^i = c_t^i - \gamma \bar{c}_t$ and $\hat{d}_{t+1}^i = d_{t+1}^i - \eta \bar{d}_{t+1}$. Here, $\bar{c}_t \equiv (1/N_t)\sum_{j=1}^{N_t} c_t^j$ and $\bar{d}_{t+1} \equiv (1/N_t)\sum_{j=1}^{N_t} d_{t+1}^j$ are the average consumption levels of the generation born and t, and $0 < \gamma < 1$ and $0 < \eta < 1$ are measures of the importance of positional concerns when young and old, respectively.[5] As Frank (1985, p. 111) has pointed out, "the sociological literature on reference group theory stresses that an individual's personal reference group tends to consist of others who are similar in terms of age". Consequently, our specification restricts interpersonal comparisons to individuals within the same generation, as opposed to Abel (2005) and Alonso-Carrera *et al.* (2008). Concerning the relative magnitude of γ to η, we can consider the work of development psychologists and sociologists (Coleman, 1961; Simmons and Blyth, 1987; Corsaro and Eder, 1990), which suggests that interpersonal comparisons and peer effects are more

[4] Our results can easily be generalized to the case of a constant relative risk aversion (CRRA) utility function.

[5] According to the terminology of Clark and Oswald (1998), our preference specification is comparison-concave, and therefore, by implication, individuals tend to emulate their neighbors.

pronounced early in life. In the first period of life, people work, find partners, raise children, and they are exposed to, and therefore influenced by, a wide variety of social networks. More direct evidence, already discussed in the introduction, comes from Charles *et al.* (2009). Therefore, we assume that the importance of positional concerns decreases with age. This is represented by a simple proportionality factor on the relationship between the degrees of envy in both periods of life, $\eta = \xi\gamma$, where $0 < \xi \leq 1$. Finally, as previously argued, we model bequests as non-positional; our results remain essentially unchanged when bequests are positional, but less so than consumption.

In addition, we place restrictions on the stationary distribution of productive endowments to guarantee that everyone's relative consumption is positive.

Competitive Solution

Given the level of saving s_t^i, an old individual at time $t+1$ chooses d_{t+1}^i and b_{t+1}^i to maximize

$$V \equiv \ln\left(d_{t+1}^i - \xi\gamma\bar{d}_{t+1}\right) + \mu \ln\left(b_{t+1}^i\right),$$

subject to equation (4). The solutions to this problem are

$$d_{t+1}^i = \frac{1}{1+\mu}\left(R_{t+1}s_t^i + \xi\gamma\mu\bar{d}_{t+1}\right), \tag{6}$$

$$b_{t+1}^i = \frac{\mu}{1+\mu}\left(R_{t+1}s_t^i - \xi\gamma\bar{d}_{t+1}\right), \tag{7}$$

and therefore

$$V\left(Rs_t^i\right) = (1+\mu)\ln\left(R_{t+1}s_t^i - \xi\gamma\bar{d}_{t+1}\right) + \ln\left(\frac{1}{1+\mu}\right) + \mu\ln\left(\frac{\mu}{1+\mu}\right).$$

The young individual at time t then chooses c_t^i and s_t^i to maximize

$$\ln\left(c_t^i - \gamma\bar{c}_t\right) + \beta V(Rs_t^i), \tag{8}$$

subject to equation (3). The necessary conditions for problem (8) yield

$$\frac{1}{\left(c_t^i - \gamma\bar{c}_t\right)} = \frac{\beta R_{t+1}(1+\mu)}{R_{t+1}s_t^i - \xi\gamma\bar{d}_{t+1}}, \tag{9}$$

which combined with equation (3) implies

$$s_t^i\left[1+\beta(1+\mu)\right] = \beta(1+\mu)\left(y_t^i - \gamma\bar{c}_t\right) + \xi\gamma\frac{\bar{d}_{t+1}}{R_{t+1}}. \tag{10}$$

Let us begin by characterizing the optimal behavior of the average household, that is, the household that earns the average income given by

$$\bar{y}_t = \frac{1}{N_t}\sum_{i=1}^{N_{t-1}} b_t^i + \frac{1}{N_t}\sum_{i=1}^{N_t} w_t^i = \frac{\bar{b}_t}{1+n} + \bar{w}_t. \tag{11}$$

Combining equations (4), (6), and (7), we reach the following expressions for the optimal second-period choices:

$$\bar{d}_{t+1} = \frac{1}{1+\mu(1-\xi\gamma)} R_{t+1}\bar{s}_t; \tag{12}$$

$$\bar{b}_{t+1} = \frac{\mu(1-\xi\gamma)}{1+\mu(1-\xi\gamma)} R_{t+1}\bar{s}_t. \tag{13}$$

Using the first result, equation (9) becomes

$$\bar{c}_t = \frac{1}{\beta[1+\mu(1-\xi\gamma)]}\bar{s}_t. \tag{14}$$

Combining equation (4) with equations (10)–(14), we reach the following choices for the average household:

$$\bar{s}_t = \frac{\beta[1+\mu(1-\xi\gamma)](1-\gamma)}{(1-\xi\gamma)+(1-\gamma)\beta[1+\mu(1-\xi\gamma)]}\bar{y}_t; \tag{15}$$

$$\bar{c}_t = \frac{(1-\xi\gamma)}{(1-\xi\gamma)+(1-\gamma)\beta[1+\mu(1-\xi\gamma)]}\bar{y}_t; \tag{16}$$

$$\bar{d}_{t+1} = \frac{R_{t+1}\beta(1-\gamma)}{(1-\xi\gamma)+(1-\gamma)\beta[1+\mu(1-\xi\gamma)]}\bar{y}_t; \tag{17}$$

$$\bar{b}_{t+1} = \frac{R_{t+1}\beta\mu(1-\gamma)(1-\xi\gamma)}{(1-\xi\gamma)+(1-\gamma)\beta[1+\mu(1-\xi\gamma)]}\bar{y}_t. \tag{18}$$

We now use the results for the average household to characterize the behavior of the ith individual of the same generation. Combining equations (10), (16), and (17), his optimal saving choice is given by

$$\begin{aligned} s_t^i = {} & \frac{\beta(1+\mu)}{1+\beta(1+\mu)} \\ & \times\left[y_t^i - \frac{(1+\mu)(1-\xi\gamma)\gamma - \xi\gamma(1-\gamma)}{(1+\mu)\{(1-\xi\gamma)+(1-\gamma)\beta[1+\mu(1-\xi\gamma)]\}}\bar{y}_t\right]. \end{aligned} \tag{19}$$

Combining this result with equations (6), (7), (9), and (17), we reach the remaining choices for the ith individual born at t:

$$c_t^i = \frac{1}{1+\beta(1+\mu)}\left[y_t^i + \phi_c\bar{y}_t\right]; \tag{20}$$

$$d^i_{t+1} = \frac{R_{t+1}\beta}{1+\beta(1+\mu)}\left[y^i_t + \phi_d \bar{y}_t\right]; \tag{21}$$

$$b^i_{t+1} = \frac{R_{t+1}\beta\mu}{1+\beta(1+\mu)}\left[y^i_t - \phi_b \bar{y}_t\right]. \tag{22}$$

Here

$$\begin{aligned}\phi_c &\equiv \frac{\beta\left[(1+\mu)(1-\xi\gamma)\gamma - \xi\gamma(1-\gamma)\right]}{(1-\xi\gamma)+(1-\gamma)\beta\left[1+\mu(1-\xi\gamma)\right]} > \phi_d \\ &\equiv \frac{\xi\gamma\mu(1-\gamma)\beta + \xi\gamma(1-\gamma) - (1-\xi\gamma)\gamma}{(1-\xi\gamma)+(1-\gamma)\beta\left[1+\mu(1-\xi\gamma)\right]} > 0\end{aligned}$$

and

$$\phi_b \equiv \frac{(1-\xi\gamma)\gamma + \xi\gamma(1-\gamma)\beta}{(1-\xi\gamma)+(1-\gamma)\beta\left[1+\mu(1-\xi\gamma)\right]} > 0.$$

Consumption of the ith household (equations (20) and (21)) is composed of two components. The first increases with his lifetime income, while the second reflects the influence of interpersonal comparisons, and this increases with the lifetime income of the reference group. As a result, wealth accumulation depends on relative, rather than absolute, income. When individual satisfaction depends on consumption comparisons across households, the relevant variable driving saving choices is the comparison between individual i's income and the income of his reference group, relative income. The following result follows immediately.

Proposition 1. *In the presence of age-specific interpersonal comparisons (i.e., $\gamma > 0$ and $\xi > 0$), the income elasticities of demand for consumption when young,* $\varepsilon^{y^i}_{c^i}$*, consumption when old,* $\varepsilon^{y^i}_{d^i}$*, and bequests,* $\varepsilon^{y^i}_{b^i}$*, satisfy the following inequalities:*

$$\begin{aligned}\varepsilon^{y^i}_{c^i} &\equiv \left[1+\phi_c\left(\frac{\bar{y}_t}{y^i_t}\right)\right]^{-1} < \varepsilon^{y^i}_{d^i} \\ &\equiv \left[1+\phi_d\left(\frac{\bar{y}_t}{y^i_t}\right)\right]^{-1} < 1 < \varepsilon^{y^i}_{b^i} \equiv \left[1-\phi_b\left(\frac{\bar{y}_t}{y^i_t}\right)\right]^{-1}.\end{aligned} \tag{23}$$

In the absence of interpersonal comparisons, $\gamma = 0$, our model reduces to that of Bossmann *et al.* (2007) with unitary income elasticities of demand (i.e., $\varepsilon^{y^i}_{c^i} = \varepsilon^{y^i}_{d^i} = \varepsilon^{y^i}_{b^i} = 1$). The variation in the elasticities of demand in our model is driven by the various degrees of interpersonal comparisons, with consumption when young being more positional than consumption when old, which is, in turn, more positional than bequests. As a result, our preference specification implies that both positional goods are necessities while the non-positional good, bequests, is a luxury.[6] Finally, note that these elasticities vary not only across goods, but also across individuals. The consequences of this variation for the rates of asset accumulation are summarized in the following proposition.

Proposition 2. *In the presence of interpersonal comparisons (i.e., with* $\gamma > 0$*), both the proportion of lifetime income saved and the fraction of lifetime income bequeathed are greater for wealthier individuals:*

$$\frac{\partial\left(s_t^i/y_t^i\right)}{\partial y_t^i} = \frac{\phi_c}{\left[1+\beta\left(1+\mu\right)\right]}\frac{\bar{y}_t}{\left(y_t^i\right)^2} > 0; \tag{24}$$

$$\frac{\partial\left(b_{t+1}^i/y_t^i\right)}{\partial y_t^i} = \frac{R_{t+1}\beta\mu\phi_b}{\left[1+\beta\left(1+\mu\right)\right]}\frac{\bar{y}_t}{\left(y_t^i\right)^2} > 0. \tag{25}$$

In contrast to Bossmann *et al.* (2007), where the saving and bequest rates are independent of one's position in the income distribution, the introduction of positional concerns induces poor households to save and bequeath a smaller fraction of their income than their wealthier neighbors. This result is in line with the empirical findings of Dynan *et al.* (2004) and Altonji and Villanueva (2007). Dynan *et al.* have found a strong positive relationship between saving rates and the measures of permanent income, while Altonji and Villanueva have found that the fraction of every extra dollar of lifetime resources that parents pass on to their children increases with income.

The differences in the income elasticities of demand, and the associated variations in the saving and bequest rates across households, are the primary channel for envy to impact on the degrees of intragenerational wealth inequality and intergenerational mobility, as described in the next section.

Finally, with quasi-homothetic preferences (and perfect capital markets), saving is an affine function of income, a property that ensures that the distribution of wealth does not affect the aggregate evolution of the economy. None the less, the evolution of the economy along the transitional path affects the distribution of wealth.

[6] In this sense, our approach is similar to that of De Nardi (2004), who explicitly modeled bequests as a luxury good in an attempt to reproduce the high concentration in the upper tail of the wealth distribution.

Dynamics of the Aggregate Capital Stock

Because aggregate dynamics are independent of the distribution of income, the evolution of the capital stock in period $t+1$ is given by

$$K_{t+1} = N_t \bar{s}_t.$$

So,

$$k_{t+1} = \frac{K_{t+1}}{N_{t+1}} = \frac{1}{(1+n)} \bar{s}_t \tag{26}$$

From equations (13), (15), and (26), we have

$$(1+n)k_{t+1} = \bar{s}_t = \frac{(1-\gamma)\beta\left[1+\mu\left(1-\xi\gamma\right)\right]}{(1-\xi\gamma)+(1-\gamma)\beta\left[1+\mu\left(1-\xi\gamma\right)\right]} \times \left[\frac{\mu\left(1-\xi\gamma\right)}{1+\mu\left(1-\xi\gamma\right)} \frac{R_t \bar{s}_{t-1}}{1+n} + \overline{w}_t\right],$$

where

$$\frac{R_t \bar{s}_{t-1}}{1+n} = R_t k_t = k_t[1-\delta+f'(k_t)].$$

Hence

$$k_{t+1} = \frac{(1-\gamma)\beta\{f(k_t) - k_t f'(k_t) + \mu(1-\xi\gamma)[f(k_t) + k_t(1-\delta)]\}}{(1+n)\{(1-\xi\gamma)+(1-\gamma)\beta[1+\mu(1-\xi\gamma)]\}} \equiv \phi(k_t, \gamma, \xi). \tag{27}$$

This equation describes the dynamics of the economy. Clearly, $\phi(0,\gamma,\xi) = 0$, $\phi_k(0,\gamma,\xi) = \infty$, and

$$\lim_{k\to\infty} \frac{\phi(k,\gamma,\xi)}{k} = \frac{\beta(1-\delta)\mu(1-\gamma)\left(1-\xi\gamma\right)}{(1+n)\left\{(1-\xi\gamma)+(1-\gamma)\beta\left[1+\mu\left(1-\xi\gamma\right)\right]\right\}} < 1. \tag{28}$$

It follows that the curve $\phi(k,\gamma,\xi)$ cuts the 45° line at least once. That is, there exists a positive steady-state capital stock $k^* \in (0,\infty)$, which satisfies

$$k^* = \frac{(1-\gamma)\beta\{f(k^*) - k^* f'(k^*) + \mu(1-\xi\gamma)[f(k^*) + k^*(1-\delta)]\}}{(1+n)\{(1-\xi\gamma)+(1-\gamma)\beta[1+\mu(1-\xi\gamma)]\}} \equiv \phi(k^*, \gamma, \xi). \tag{29}$$

A sufficient condition for a unique interior steady state is that $\phi_{kk}(k^*,\gamma,\xi) < 0$, that is, $\mu(1-\xi\gamma)f''(k^*) - k^* f'''(k^*) - f''(k^*) < 0$ at any $k^* > 0$ that satisfies equation (29). Notice that this condition is immediately satisfied when the production function is Cobb–Douglas.

Let us assume the uniqueness of the interior steady state k^*. Then, it follows from equation (28) that $\phi_k(k^*,\gamma,\xi) < 1$.

Proposition 3. *Assume that k^* is unique. Then, the steady-state capital stock, k^*, is decreasing in the degree of envy, γ.*

Proof: Define the function

$$G(k, \gamma, \xi) \equiv k - \phi(k, \gamma, \xi).$$

The steady state k^* satisfies

$$G(k^*, \gamma, \xi) \equiv k^* - \phi(k^*, \gamma, \xi) = 0. \tag{30}$$

Then

$$\frac{dk^*}{d\gamma} = -\frac{G_\gamma}{G_k} = \frac{\phi_\gamma(k^*, \gamma, \xi)}{1 - \phi_k(k^*, \gamma, \xi)}.$$

Because $\phi_k(k^*, \gamma, \xi) < 1$ by the uniqueness assumption, $\text{sign}(dk^*/d\gamma) = \text{sign}[\phi_\gamma(k^*, \gamma, \xi)]$. We find

$$\frac{\partial \phi}{\partial \gamma} = -\frac{\beta\{\mu[f(k^*) + k^*(1-\delta)](1-\xi\gamma)^2 + \beta\mu\xi k^* R(k^*)(1-\gamma)^2 + w(k^*)(1-\xi)\}}{(1+n)\{(1-\xi\gamma) + (1-\gamma)\beta[1+\mu(1-\xi\gamma)]\}^2} < 0.$$

This completes the proof. ■

Agents in our economy save for two reasons. First, as in the standard overlapping generations model, young agents save to finance their old-age consumption. Second, in the presence of the intergenerational transfer motive, agents save to leave a bequest to their offspring. The first saving motive is positional, because old agents care about their consumption relative to the average level of consumption of their generation. However, the second saving motive is non-positional. As a result, an increase in the degree of interpersonal comparisons, γ, would shift resources from non-positional uses to positional uses (i.e., consumption when young and when old), leading to a reduction of the fraction of income saved and to a decrease in the steady-state capital stock. It is interesting to contrast this result with the existing body of literature on consumption externalities. In an economy populated by an infinitely lived representative agent, Liu and Turnovsky (2005) have found that consumption externalities have no effect on the steady-state level of capital, as long as labor is inelastically supplied. Alonso-Carrera *et al.* (2008) have explored an overlapping generations economy under pure altruism. In their model, the positionality of bequests is equal to that of consumption, and hence consumption externalities do not affect the long run stock of capital. In both models, households want to keep up with the Joneses today and at every future date. Given this symmetry, the resulting steady-state level of saving is independent of interpersonal comparisons. In contrast, by introducing a non-positional saving motive, our framework opens a channel for consumption externalities to affect the steady-state level of capital. Our result is related to those of Corneo and Jeanne (1998) and Fisher and Heijdra (2009). Corneo and Jeanne have explored the implications for aggregate saving in the context of a signaling game of status. In their separating equilibrium, where only the upper class engages in conspicuous consumption, aggregate saving decreases as long as the status contests take place when young. Fisher and Heijdra have considered a perpetual-youth model with consumption externalities. In their set-up, an increase in positional concerns increases the generational turnover term in the Euler equation, lowering the steady-state level of capital.[7]

Remark 1. *By inspecting equation (29), we can see that if the degree of interpersonal comparisons is independent of age (i.e.,* $\xi = 1$*), and if there is no bequest (i.e.,* $\mu = 0$*),then the steady-state capital stock,* k^**, is independent of envy,* γ*.*

The intuition behind this result is that saving would be for old-age consumption only, which, if $\xi = 1$, exhibits the same degree of positionality as first-period consumption.

Let us return to the general case where ξ is not identically unity. At first sight, it might be expected that the steady-state capital stock k^* would increase with the relative importance of second-period envy ξ. However, this conjecture is not correct, in general. To see this, we differentiate equation (30) to obtain

$$\frac{dk^*}{d\xi} = -\frac{G_\xi}{G_k} = \frac{\phi_\xi(k^*, \gamma, \xi)}{1 - \phi_k(k^*, \gamma, \xi)}.$$

Because $\phi_k(k^*, \gamma, \xi) < 1$, by the uniqueness assumption, $\text{sign}(dk^*/d\xi) = \text{sign}[\phi_\xi(k^*, \gamma, \xi)]$. Also, the sign of ϕ_ξ is ambiguous:

$$\frac{\partial\phi}{\partial\xi} = \frac{(1-\gamma)\beta\gamma\left\{[f(k^*) - k^* f'(k^*)] - \mu(1-\gamma)\beta k^*\left[1 + f'(k^*) - \delta\right]\right\}}{(1+n)\left\{(1-\xi\gamma) + (1-\gamma)\beta\left[1 + \mu\left(1-\xi\gamma\right)\right]\right\}^2} \lesseqgtr 0. \tag{31}$$

[7] In addition to relative consumption, there is a stream of literature that models interpersonal comparisons in terms of relative wealth. In this alternative framework, status-seeking tends to increase the steady-state level of capital (see Konrad, 1992).

Remark 2. *The ambiguity in the sign of equation (31) disappears when $\mu = 0$. Thus, in an economy without bequests, the steady-state capital stock, k^* (assumed to be unique), increases with the relative importance of second-period comparisons, ξ.*

Intuitively, an increase in the relative importance of positional concerns when old increases the amount of resources saved for second-period consumption while it decreases savings for bequest purposes. As a result, the overall impact on the steady-state capital stock is ambiguous. When the saving motive associated with bequests is absent, $\mu = 0$, increases in the relative importance of second-period comparisons ξ undoubtedly increase saving and the steady-state capital stock.[8]

Stationary Distributions

Along a macroeconomic steady state (where R and $\bar{w}$ are constant), we reach the following difference equation for the evolution of the average bequest:

$$\overline{b}_{t+1} = \frac{R\beta\mu(1-\gamma)(1-\xi\gamma)}{(1-\xi\gamma)+(1-\gamma)\beta\left[1+\mu(1-\xi\gamma)\right]}\left(\frac{\overline{b}_t}{1+n}+\overline{w}\right). \quad (32)$$

We make the following assumption in order to ensure that the average bequest eventually reaches a stable steady state:[9]

$$R\beta\mu(1-\gamma)(1-\xi\gamma) < (1+n)\{(1-\xi\gamma)+(1-\gamma)\beta\left[1+\mu(1-\xi\gamma)\right]\}, \quad (33)$$

for all $0 \leq \gamma < 1$ and $0 \leq \xi \leq 1$. This assumption implies that

$$R\beta\mu < (1+n)\left[1+\beta(1+\mu)\right]. \quad (34)$$

Taking expectations in both sides of equation (22), we have

$$E[b^i] = \bar{b} = \psi(1+n)R\beta\mu(1-\gamma)(1-\xi\gamma)\bar{w}, \quad (35)$$

[8] In the next section, it will become evident that an increase in ξ unambiguously decreases the steady-state average (aggregate) bequest, as can be deduced from equation (35). The steady-state saving and the steady-state bequest need not respond to an increase in ξ in the same way, because of the changes in the wage rate and the interest rate.

[9] Notice that this restriction is the standard stability condition requiring that the rate at which agents discount the future is large relative to the exogenously given interest rate.

where equation (33) implies

$$\psi \equiv \frac{1}{(1+n)\{(1-\xi\gamma)+(1-\gamma)\beta[1+\mu(1-\xi\gamma)]\}-R\beta\mu(1-\gamma)(1-\xi\gamma)} > 0. \tag{36}$$

Because, by assumption, the wage earned in the labor market and the bequest inherited from the previous generation are uncorrelated, $\mathrm{cov}[w_t^i, b_t^i] = 0$, it is easy to characterize the variance of bequests by applying the variance operator to both sides of equation (22):

$$\mathrm{Var}[b^i] = \frac{[(1+n)R\beta\mu]^2}{\{(1+n)[1+\beta(1+\mu)]\}^2-(R\beta\mu)^2}\sigma_w^2. \tag{37}$$

Combining equations (35) and (37) with equations (19)–(21), we reach the following means and variances that characterize the stationary distributions of all the relevant variables:

$$E[c^i] = \bar{c} = \frac{(1-\xi\gamma)}{(1-\gamma)\beta R}E[d^i] = \psi(1+n)(1-\xi\gamma)\bar{w}; \tag{38}$$

$$\mathrm{Var}[c^i] = \left(\frac{1}{\beta R}\right)^2 \mathrm{Var}[d^i] = \frac{(1+n)^2}{\{(1+n)[1+\beta(1+\mu)]\}^2-[R\beta\mu]^2}\sigma_w^2; \tag{39}$$

$$E[s^i] = \bar{s} = \psi(1+n)\beta[1+\mu(1-\xi\gamma)](1-\gamma)\bar{w}; \tag{40}$$

$$\mathrm{Var}[s^i] = \frac{[(1+n)\beta(1+\mu)]^2}{\{(1+n)[1+\beta(1+\mu)]\}^2-[R\beta\mu]^2}\sigma_w^2. \tag{41}$$

A convenient measure of the relative inequality in the distribution of a random variable is the coefficient of variation (i.e., the ratio of its standard deviation to its mean). Combining the stationary distribution of wages with equations (35)–(41), we obtain the following measures of inequality for labor income, consumption when young and when old, capital holdings, and bequests:

$$CV(w^i) = \frac{\sigma_w}{\bar{w}}; \tag{42}$$

$$
\begin{aligned}
CV\left(c^i\right) &= \frac{(1-\gamma)}{(1-\xi\gamma)} CV(d^i) = \frac{[1+\mu(1-\xi\gamma)](1-\gamma)}{(1+\mu)(1-\xi\gamma)} CV\left(s^i\right) \\
&= (1-\gamma) CV(b^i) \qquad (43)\\
&= \frac{1}{\psi(1-\xi\gamma)[\{(1+n)[1+\beta(1+\mu)]\}^2 - (R\beta\mu)^2]^{1/2}} \frac{\sigma^w}{\bar{w}}.
\end{aligned}
$$

Finally, we characterize the correlation coefficient between the levels of wealth held by two members of the same dynasty belonging to two consecutive generations, a measure of intergenerational mobility. This correlation coefficient takes the general form

$$
\begin{aligned}
\operatorname{Corr}\left(s_t^i, s_{t+1}^i\right) &= \frac{\operatorname{Cov}\left(s_t^i, s_{t+1}^i\right)}{\left(\operatorname{Var}\left[s_t^i\right] \operatorname{Var}\left[s_{t+1}^i\right]\right)^{1/2}} \\
&= \left\{ \frac{[\beta(1+\mu)]^2 R\beta\mu}{[1+\beta(1+\mu)]^3 (1+n)} \left[\sigma_w^2 + \frac{\operatorname{Var}\left[b_t^i\right]}{(1+n)^2} \right] \right\} \qquad (44)\\
&\quad \times \left[\left(\operatorname{Var}\left[s_t^i\right] \operatorname{Var}\left[s_{t+1}^i\right]\right)^{1/2} \right]^{-1},
\end{aligned}
$$

where $\operatorname{Cov}(s_t^i, s_{t+1}^i)$ is derived by combining equation (19) with the fact that $\operatorname{cov}[w_t^i, b_t^i] = \operatorname{cov}[w_t^i, w_{t+1}^i] = 0$. Finally, by replacing equations (37) and (41) in equation (45), we find the degree of intergenerational transmission of inequality along the steady state,

$$
\operatorname{Corr}(s, s') = \frac{R\beta\mu}{(1+n)[1+\beta(1+\mu)]}, \qquad (45)
$$

where s' denotes the saving of an individual of the next generation who belongs to the same dynasty.

III. Envy and Inequality

In this section, we explore the impact of positional concerns on the stationary distributions of consumption, wealth (saving), and bequests. We are particularly interested in characterizing the impact of envy on the intragenerational distribution of wealth and on the intergenerational transmission of inequality. We provide analytical results under a simple production technology linear in capital and labor.[10] Along the lines of Caballe and Moro-Egido (2009), we assume the following technology,

$$
F(K_t, L_t) = wL_t + rK_t. \qquad (46)
$$

[10] In an appendix, available upon request, we show numerically that results for a Cobb–Douglas technology are consistent with the analytical results reported in this section.

Under constant marginal products, factor prices, which are independent of the degree of positional concerns, are given by

$$w_t = w \tag{47}$$

$$R_t = R = 1 - \delta + r. \tag{48}$$

Differentiating equations (35), (38), and (40) with respect to the degree of positional concerns, we find the following effects of envy on the average bequest, consumption, and saving (wealth) in the steady state:

$$\frac{\partial \bar{b}}{\partial \gamma} = -\psi^2(1+n)^2 \beta R \mu[(1-\xi\gamma)^2 + \beta\xi(1-\gamma)^2]\bar{w} < 0; \tag{49}$$

$$\begin{aligned}\left[\frac{\partial \bar{c}}{\partial \gamma}\right]_{\xi=1} &= \left[\frac{\partial \bar{d}}{\partial \gamma}\right]_{\xi=1} \\ &= -\frac{(1+n)\,\beta\,[\mu\,(R-1-n)]\,\bar{w}}{[(1+n)\,\{1+\beta\,[1+\mu(1-\gamma)]\} - R\beta\mu(1-\gamma)]^2} < 0;\end{aligned} \tag{50}$$

$$\begin{aligned}&\frac{\partial \bar{s}}{\partial \gamma} = \\ &-\psi^2\,(1+n)\,\beta \left\{ \begin{array}{c} [1+\mu\,(1-\xi\gamma)]\,(1+n)\,[(1-\xi\gamma)-\xi(1-\gamma)] \\ +\mu(1-\gamma)\xi\,[(1+n)\,(1-\xi\gamma)+R\beta(1-\gamma)] \end{array} \right\} \bar{w} < 0.\end{aligned} \tag{51}$$

An increase in positional concerns decreases the average bequest and the average level of saving in the steady state. If the economy is dynamically efficient, in the sense that the interest rate exceeds the population growth rate $R > 1 + n$ and envy is symmetric through life $\xi = 1$, then an increase in positional concerns decreases the average level of consumption. Moreover, although the propensity to consume out of lifetime income increases with envy (see equation (16)), the decrease in lifetime resources induced by the lower level of inherited wealth more than offsets this increased propensity, thus leading to a decrease in average steady-state consumption.

The following proposition explores the impact of bequests on inequality under constant factor prices.

Proposition 4. *Assume the degree of envy is symmetric through life, $\xi = 1$, and population is constant, $n = 0$. An increase in the importance of bequests beyond a threshold, $\underline{\mu}$, increases consumption, wealth, and bequest inequality. This threshold decreases if the strength of envy γ increases.*

Proof: Equation (43) implies that the impact of μ on wealth and bequest inequality is proportional to its impact on consumption inequality. As a result, we concentrate our proof in the latter variable. Given equation (34),

$$\frac{\partial CV(c)}{\partial \mu} \propto -\left[R(1+\beta)(1-\gamma)+\gamma(1+\beta)-\mu(R-1)\beta(R+\gamma)\right].$$

This derivative is positive if and only if

$$\mu > \frac{R(1+\beta)(1-\gamma)+\gamma}{(R-1)\beta(R+\gamma)} \equiv \underline{\mu}. \tag{52}$$

Furthermore

$$\frac{\partial \underline{\mu}}{\partial \gamma} = -\frac{R^2(1+\beta)}{\beta(R+\gamma)^2(R-1)} < 0.$$

■

Remark 3. *In the absence of envy, an increase in the importance of bequests* μ *always reduces inequality. To see this, note that condition (34) implies that inequality (52) cannot hold when* $\gamma = 0$.

Remark 4. *For any positive degree of envy, the introduction of a negligible bequest motive (i.e., a small increase in* μ *from zero) reduces inequality.*

Now, we turn to a discussion of the effects of consumption externalities on inequality. In the textbook version of our model, with neither bequests nor positional concerns, the degree of wage inequality is transmitted into identical degrees of consumption and wealth inequality. Under homothetic preferences and perfect capital markets, agents that differ only in their endowments of efficient labor allocate identical fractions of their wage income into first-period consumption and saving. As a result, the degrees of income, consumption, and wealth inequality are identical. Bossmann *et al.* (2007) have introduced a warm-glow bequest motive into this standard model and they have explored its implications on the distribution of wealth. They point out that "in contrast to the intuition and general perception" (p. 1257) bequests reduce wealth inequality. This reduction in inequality occurs despite of the fact that, in contrast to Becker and Tomes (1979), parents do not purposefully compensate the luck of their offspring in the labor market. In this overlapping generations framework without pure altruism, in the absence of interpersonal comparisons, both consumption and wealth are more evenly distributed than labor income when $\mu > 0$.[11] The intuition behind this result of Bossmann *et al.* (2007) lies in the impact

[11] Assuming $\gamma = 0$, then

$$CV(s^i) = CV(c^i) = \frac{(1+n)[1+\beta(1+\mu)] - R\beta\mu}{[\{(1+n)[1+\beta(1+\mu)]\}^2 - [R\beta\mu]^2]^{1/2}} CV(w^i) < CV(w^i).$$

on inequality of the introduction of a second source of income, bequests. Because parental bequests are uncorrelated with the labor income of offspring, and because the coefficient of variation of bequests is smaller than that of labor income, bequests exert an equalizing influence on the distribution of lifetime resources.[12] Again, with homothetic preferences, the degree of inequality in lifetime resources is transmitted into identical degrees of consumption and wealth inequality.[13]

When we introduce positional concerns, several interesting results emerge. First, as can be seen from equations (42), (43), and (49)–(51), envy increases the degrees of inequality in wealth, in bequests, and, when $\xi = 1$, in consumption. Second, in line with the popular belief and contrary to the results presented by Bossmann *et al.* (2007), our Proposition 4 highlights the inequality-increasing effect of bequests. If the bequest motive is strong, a strengthening of this motive will increase wealth and consumption inequality.[14] Third, if comparative concerns are strong, wealth (saving) becomes more unequally distributed than labor income.[15] This is consistent with the empirical evidence summarized by Wolff (1994) and Davies and Shorrocks (2000). As Davies and Shorrocks have pointed out, for developed countries, the Gini coefficients for income range from 0.3 to 0.4, while for wealth they range from 0.5 to 0.9. Fourth, because wealth is the only source of income when old, our model suggests that income (and consumption, if the importance of envy falls with age) inequality for any given cohort increases with age, as Deaton and Paxson (1994) have reported. Fifth, in line with the stylized facts summarized by Davies and

[12] For any two independent random variables x and z, if $\sigma_x/\overline{x} < \sigma_z/\overline{z}$ where $\overline{x} > 0$, $\overline{z} > 0$, $\sigma_x > 0$ and $\sigma_z > 0$, the following statement is true

$$\frac{\sigma_x + \sigma_z}{\overline{x} + \overline{z}} < \frac{\sigma_z}{\overline{z}}.$$

[13] Bossmann *et al.* (2007) have considered a second channel through which bequests affect the degree of inequality in lifetime resources. In their model, with endogenous factor prices, bequests also affect wealth inequality through the interest rate.

[14] Kotlikoff and Summers (1981) have decomposed wealth into its life-cycle and inherited components. Their decomposition suggests that the inherited component ranges from 46 to 81 percent. Davies and Shorrocks (2000) have concluded that a reasonable estimate for this inherited component lies in the range of 35–45 percent. These estimates suggest that μ can easily exceed $\underline{\mu}$ in the empirically relevant case.

[15] Direct evidence for the value of the envy parameter γ is sparse. Frey and Stutzer (2002) have evaluated the time series and cross-sectional properties of several measures of self-reported happiness. Their findings are consistent with preference specifications that place half of the weight on relative consumption. Alpizar *et al.* (2005) have conducted several experiments to assess the importance of relative consumption. In the case of cars and housing, their median estimate is between 0.5 and 0.75. Using individual consumption data, Ravina (2007) has estimated a weight of relative consumption close to one-third.

Shorrocks (2000), the distribution of inherited wealth is more unequal than that of wealth in general.

Finally, we briefly explore the impact of envy on the intergenerational transmission of inequality as measured by equation (45). Because dynastic labor income is uncorrelated through time, wealth inequality is only transmitted through bequests. As a result, when this channel is closed, $\mu = 0$, there is perfect social mobility, $\text{Corr}(s, s') = 0$. As long as factor prices are independent of envy, positional concerns do not affect the degree of social mobility. None the less, this is just an artifact of our restrictive technological assumption. In general, status concerns increase the steady-state interest rate (Proposition 3) and therefore reduce the degree of social mobility.

IV. Efficient Solution

In our economy, where agents differ in their luck in the labor market, a utilitarian planner that gives identical weights to all individuals of a given generation will transfer resources from rich to poor individuals, making sure that after-transfer income is equated within a generation. Our focus is not on redistributive taxation. Hammond (1988) and Harsanyi (1995) have convincingly argued that the social welfare function should exclude any interpersonal transfers. As a result, we restrict the role of our planner to reallocations of consumption that are Pareto efficient from the individual perspective, abstracting from intragenerational transfers and the dynamics of capital accumulation.[16]

The planner maximizes the following social welfare function where, given our previous considerations, only one generation is represented:

$$SW = \frac{1}{N}\sum_{i=1}^{N}\{\ln(c^i - \gamma\bar{c}) + \beta[\ln(d^i - \xi\gamma\bar{d})]\}. \tag{53}$$

Subject to a lifetime constraint for each of the individuals of this generation,

$$c^i + \frac{d^i}{R} = w^i + s^i, \tag{54}$$

where R and w^i are the factor prices faced by the ith individual of our representative generation in the competitive solution, because the planner's problem abstracts from capital accumulation.

[16] Issues related to dynamic inefficiency in the presence of relative consumption have been carefully explored by Abel (2005) and Alonso-Carrera *et al.* (2008) in models where each generation is populated by a representative individual.

Solving this program, where the superscript "p" denotes the planner's choices and λ^i is the Lagrange multiplier, we reach[17]

$$\frac{1}{c^{i,\mathrm{p}} - \gamma \bar{c}^{\,\mathrm{p}}} - \frac{\gamma}{N} \sum_{j=1}^{N} \frac{1}{c^{j,\mathrm{p}} - \gamma \bar{c}^{\,\mathrm{p}}} = \lambda^i \tag{55}$$

and

$$\frac{1}{d^{i,\mathrm{p}} - \gamma \bar{d}^{\,\mathrm{p}}} - \frac{\xi\gamma}{N} \sum_{j=1}^{N} \frac{1}{d^{j,\mathrm{p}} - \xi\gamma \bar{d}^{\,\mathrm{p}}} = \frac{\lambda^i}{R\beta}. \tag{56}$$

Because the planner acknowledges that each individual contributes to the externality by a constant fraction of his consumption, the social marginal utilities of consumption include a negative adjustment term that captures these external effects: $C \equiv (\gamma/N) \sum_{j=1}^{N} [1/(c^{j,\mathrm{p}} - \gamma \bar{c}^{\,\mathrm{p}})]$ for first-period consumption and $D \equiv (\xi\gamma/N) \sum_{j=1}^{N} [1/(d^{j,\mathrm{p}} - \xi\gamma \bar{d}^{\,\mathrm{p}})]$ for second-period consumption. Furthermore, because the marginal impact of an additional unit of consumption is independent of the level of consumption, these adjustment terms are identical for all the individuals of a given generation.

Combining equations (55) and (56) with equations (9) and (6), we reach the following relationship between the private and social marginal rates of substitution evaluated at the same levels of consumption:

$$MRS_{c,d}^{i,\mathrm{m}} \equiv \frac{(d^i - \xi\gamma\bar{d})}{(c^i - \gamma\bar{c})} > \frac{(d^i - \xi\gamma\bar{d})}{(c^i - \gamma\bar{c})} \frac{[1 - C(c^i - \gamma\bar{c})]}{[1 - D(d^i - \xi\gamma\bar{d})]} \equiv MRS_{c,d}^{i,\mathrm{p}}. \tag{57}$$

Because positional concerns are higher when young, the planner reduces the private marginal utility of first-period consumption by a higher factor than the marginal utility of second-period consumption. As a result, the private marginal rate of substitution exceeds its social counterpart by a factor $[1 - D(d^i - \xi\gamma\bar{d})]/[1 - C(c^i - \gamma\bar{c})] > 1$. Equivalently, the willingness of agents in the competitive economy to increase first-period consumption at the expense of second-period consumption exceeds that of the efficient solution. In the special case, where the degree of positional concerns is constant through life, $\xi = 1$, the private and social marginal rates of substitution coincide.

Finally, as becomes clear in the limiting case where second-period interpersonal comparisons are irrelevant, $\xi = 0$, the size of the gap between the private and social marginal rates of substitution, $1/[1 - C(c^i - \gamma\bar{c})]$,

[17] We restrict ourselves to interior solutions (i.e., the first-order conditions implicitly impose restrictions to guarantee that the social marginal utility of consumption is always positive). These restrictions play a similar role to the ones placed in representative-agent versions of our model, to guarantee that the marginal utility of consumption, after taking into account external effects, is positive (see Liu and Turnovsky, 2005, assumption 1(i).

increases with income. This just reflects the fact that wealthy individuals, with their high levels of first-period consumption, contribute in a disproportionate way to average consumption, creating substantial welfare losses for their neighbors.

Optimal Tax Policy

Now, we characterize the optimal tax package that induces agents living in the competitive economy to choose the efficient allocation of resources between first- and second-period consumption. Because envy distorts the private marginal rate of substitution of consumption, the government can restore allocative efficiency by means of a tax on first-period consumption, τ_c^i. The revenues of this tax are returned as lump-sum transfers, $T^i = \tau_c^i c^i$. The modified versions of equations (3) and (4) are

$$\frac{b^i}{1+n} + w^i + T^i = \left(1+\tau_c^i\right) c^i + s^i \tag{58}$$

and

$$Rs^i = d^i + b^i. \tag{59}$$

Under the proposed tax structure, we find the relevant marginal rate of substitution for the competitive solution, and we equate it to the efficient marginal rate of substitution:

$$\frac{(d^i - \xi\gamma\bar{d})}{(c^i - \gamma\bar{c})(1+\tau_c^i)} = \frac{(d^i - \xi\gamma\bar{d})}{(c^i - \gamma\bar{c})}\frac{[1 - C(c^i - \gamma\bar{c})]}{[1 - D(d^i - \xi\gamma\bar{d})]}. \tag{60}$$

The implied tax on first-period consumption is given by

$$\tau_c^i = \frac{C(c^i - \gamma\bar{c}) - D(d^i - \xi\gamma\bar{d})}{1 - C(c^i - \gamma\bar{c})} > 0. \tag{61}$$

Because the distortion increases the willingness to increase first-period consumption at the expense of second-period consumption, the optimal tax on first-period consumption is positive. Given that high income households contribute a disproportionate share of average consumption, the optimal tax is progressive, with rich households being taxed at higher rates than their low income neighbors. Frank (2007) has proposed a similar tax structure and has illustrated its practical implementation using only income and saving data.[18]

[18] Notice that we can use equations (16), (17), (20), and (21) to express the tax rate as a function of parameters and variables that are exogenous from the standpoint of the individual household.

V. Conclusions

We have developed an overlapping generations model where agents care about their consumption relative to others, as well as the bequest they leave to their offspring. In this heterogeneous agent economy, we have explored the interaction between envy and inequality. The introduction of positional concerns generates variation in the income elasticities of demand along two crucial dimensions: (1) across goods (i.e., consumption when young, consumption when old, and bequests); (2) across individuals. This variation in elasticities induces a non-degenerate distribution of saving rates that serves to increase the degree of wealth inequality and reduces intergenerational mobility. Focusing on stationary distributions, we have presented a number of analytical propositions where several interesting results emerge.

Our theoretical model provides possible explanations of stylized facts about the distributions of income and wealth. In the presence of consumption externalities, poor households save a lower fraction of their lifetime resources than their rich neighbors. This reduction in their willingness to save, which is especially acute in those resources saved for bequest purposes, seems to be an important factor in justifying the strikingly low levels of assets held by the poor. Furthermore, the non-positional nature of bequests leads to a substantial wealth concentration in the upper tail of the income distribution, which allows wealthy individuals to pass their economic status onto future generations.

References

Abel, A. (1985), Precautionary Saving and Accidental Bequests, *American Economic Review 75* (4), 777–791.

Abel, A. (1990), Asset Prices under Habit Formation and Catching up with the Joneses, *American Economic Review 80* (2), 38–42.

Abel, A. (2005), Optimal Taxation when Consumers Have Endogenous Benchmark Levels of Consumption, *Review of Economic Studies 72*, 21–42.

Adreoni, J. (1989), Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence, *Journal of Political Economy 97*, 1447–1458.

Alonso-Carrera, J., Caballé, J., and Raurich, X. (2008), Estate Taxes, Consumption Externalities, and Altruism, *Journal of Public Economics 92*, 1751–1764.

Alpizar, F., Carlsson, F., and Johansson-Stenman, O. (2005), How Much do we care about Absolute versus Relative Income and Consumption?, *Journal of Economic Behavior and Organization 56*, 405–421.

Altonji, J. and Villanueva, E. (2007), The Marginal Propensity to Spend on Adult Children, *The BE Journal of Advances in Economic Analysis and Policy 7*, 1488–1488.

Arrondel, L., Perelman, S., and Pestieau, P. (1994), The Effect of Bequest Motives on the Composition and Distribution of Assets in France, in T. Tachibanaki (ed.), *Savings and Bequests*, University of Michigan Press, Ann Arbor.

Barro, R. J. (1974), Are Government Bonds Net Wealth?, *Journal of Political Economy 82*, 1095–1117.

Becker, G. and Tomes, N. (1979), An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility, *Journal of Political Economy 87*, 1153–1189.

Bernheim, B., Schleifer, A., and Summers, L. (1985), The Strategic Bequest Motive, *Journal of Political Economy 93*, 1045–1075.

Bossmann, M., Kleiber, C., and Walde, K. (2007), Bequests, Taxation and the Distribution of Wealth in a General Equilibrium Model, *Journal of Public Economics 91*, 1247–1271.

Caballe, J. and Moro-Egido, A. I. (2009), The Effect of Aspirations, Habits, and Social Security on the Distribution of Wealth, mimeo Universitat Autonoma de Barcelona.

Charles, K. K., Hurst, E., and Roussanov, N. (2009), Conspicuous Consumption and Race, *Quarterly Journal of Economics 124*, 425–467.

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

Clark, A. E., Frijters, P., and Shields, M. A. (2008), Relative Income, Happiness, and Utility: An Explanation for the Easterlin Paradox and Other Puzzles, *Journal of Economic Literature 46*, 95–144.

Coleman, J. (1961), *The Adolescent Society*, Free Press, New York.

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

Corsaro, W. A. and Eder, D. (1990), Children's Peer Cultures, *Annual Review of Sociology 16*, 197–220.

Davies, J. B. and Shorrocks, A. F. (2000), The Distribution of Wealth, in A. B. Atkinson and F. Bourguignon (eds.), *Handbook of Income Distribution*, Elsevier, Amsterdam, 605–675.

Deaton, A. and Paxson, C. (1994), Intertemporal Choice and Inequality, *Journal of Political Economy 102*, 437–467.

De Nardi, M. C. (2004), Wealth Inequality and Intergenerational Links, *Review of Economic Studies 71*, 743–768.

Duesenberry, J. S. (1949), *Income, Saving and the Theory of Consumer Behavior*, Harvard University Press, Cambridge, MA.

Dupor, B. and Liu, W-F. (2003), Jealousy and Equilibrium Overconsumption, *American Economic Review 93* (1), 423–428.

Dynan, K., Skinner, J., and Zeldes, S. P. (2004), Do the Rich Save More?, *Journal of Political Economy 112*, 397–444.

Eaton, B. C. and Eswaran, M. (2003), The Evolution of Preferences and Competition: A Rationalization of Veblen's Theory of Invidious Consumption, *Canadian Economic Review 36*, 832–859.

Fisher, W. H. and Heijdra, B. J. (2009), Keeping up with the Ageing Joneses, *Journal of Economic Dynamics and Control 33*, 53–64.

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

Frank, R. H. (2007), *Falling Behind: How Income Inequality Harms the Middle Class*, University of California Press, Berkeley.

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

Gali, J. (1994), Keeping up with the Joneses: Consumption Externalities, Portfolio Choice, and Asset Prices, *Journal of Money, Credit, and Banking 26*, 1–8.

Hammond, P. (1988) Altrusim, in J. Eatwell, M. Milgate, and P. Newman (eds.), *New Plagrave: A Dictionary of Economics*, Macmillan Press, London.

Harsanyi, J. (1995), A Theory of Social Values and a Rule Utilitarian Theory of Morality, *Social Choice and Welfare 12*, 319–344.

Heffetz, O. (2011), A Test of Conspicuous Consumption: Visibility and Income Elasticities, *Review of Economics and Statistics 93*, 1101–1117.

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

Johansson-Stenman, O., Carlsson, F., and Daruvala, D. (2002), Measuring Future Grandparents Preferences for Equality and Relative Standing, *Economic Journal 112*, 362–383.

Konrad, K. A. (1992), Wealth Seeking Reconsidered, *Journal of Economic Behavior and Organization 18*, 215–227.

Konrad, K. A. (2004), Altruism and Envy in Contests: An Evolutionarily Stable Symbiosis, *Social Choice and Welfare 22*, 479–490.

Kotlikoff, L. J. and Summers, L. H. (1981), The Role of Intergenerational Transfers in Aggregate Capital Accumulation, *Journal of Political Economy 89*, 706–732.

Liu, W-F. and Turnovsky, S. J. (2005), Consumption Externalities, Production Externalities, and Long-Run Macroeconomic Efficiency, *Journal of Public Economics 89*, 1097–1129.

Ljungqvist, L. and Uhlig, H. (2000), Tax Policy and Aggregate Demand Management under Catching up with the Joneses, *American Economic Review 90* (3), 356–366.

Meade, J. E. (1976), *The Just Economy*, Allen & Unwin, London.

Moav, O. and Neeman, X. (2008), Conspicuous Consumption, Human Capital, and Poverty, CEPR Discussion Papers 6864.

Mulligan, C. (1997), *Parental Priorities and Economic Inequality*, University of Chicago Press, Chicago.

Neumark, D. and Postlewaite, A. (1998). Relative Income Concerns and the Rise in Married Women's Employment, *Journal of Public Economics 70*, 157–183.

Ravina, E. (2007), Keeping up with the Joneses: Evidence from Micro Data, mimeo New York University Stern School of Business.

Samuelson, L. (2004), Information-Based Relative Consumption Effects, *Econometrica 72*, 93–118.

Simmons, R. and Blyth, D. (1987), *Moving into Adolescence: The Impact of Pubertal Change and School Context*, Aldine Press, New York.

Smith, A. (1759), *The Theory of Moral Sentiments*, Clarendon Press, Oxford.

Turnovsky, S. J. and Monteiro, G. (2007), Consumption Externalities, Production Externalities, and Efficient Capital Accumulation under Time Non-Separable Preferences, *European Economic Review 51*, 479–504.

Veblen, T. B. (1899), *The Theory of the Leisure Class: An Economic Study of Institutions*, Modern Library, New York.

Wolff, E. N. (1994), Trends in Household Wealth in the United States, 1962–1983 and 1983–1989, *Review of Income and Wealth 40*, 143–174.

First version submitted February 2010;
final version received January 2011.