

STATUS EFFECTS AND NEGATIVE UTILITY GROWTH*

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This paper explains the observed stagnation of ‘happiness’ measures through a growth model in which agents care about conspicuous consumption. ‘Normal goods’ confer direct utility, while ‘status goods’ confer utility only at the expense of others. Firms can improve the quality of both goods through R&D. The Nash equilibrium of the consumer game results in the share of expenditure on status goods increasing with the number of times the status good has been improved. As the economy grows, resources for innovation are transferred entirely to status-good R&D. The resulting long-run rate of utility growth is negative.

And I saw that all labour and all achievement spring from man’s envy of his neighbour. This too is meaningless, a chasing after the wind.¹

Ecclesiastes 4:4

It is easy to agree with Oswald (1997) and Ng (1997) that since most people cite happiness as their most important life-objective, then reported levels of happiness should also be an important measure of economic performance. Of course, there remains considerable doubt among economists trained in the aftermath of the ordinal revolution in utility theory that it is *possible* to measure ‘happiness’ in any meaningful way. Nevertheless, there is now a considerable body of data on happiness in the form of responses to simple survey questions. There is a question in the United States General Social Survey, for example, which asks: ‘Would you say that you are very happy, pretty happy, or not too happy?’. If we can take such data seriously, then the picture it paints of economic performance over the last thirty years is not a rosy one. In his pioneering study, Easterlin (1974) found that over the period 1946 to 1970 there is no upwards trend in measures of happiness in the United States. Using data up to 1990, Oswald (1997) concludes that happiness *has* increased in the United States, but only very slightly, while Myers and Diener (1996) reach more pessimistic conclusions. A recent paper by Di Tella *et al.* (2000) examines the evolution of happiness in thirteen industrialised countries since the early 1970s. One of their more striking findings is the diversity in the experiences of different countries. For example, they find no trend in the United States, a decline in the United Kingdom, Italy and Germany, and an increase in France.

Over the period for which we have happiness data, real incomes have more than tripled, with corresponding increases in real consumption. If happiness corresponds to cardinal utility, comparable across both agents and time, then happiness stagnation in the face of increasing affluence simply cannot be

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¹ Quoted from the New International Version of the Bible, published by Hodder and Stoughton.

explained by conventional models of growth. These models can neither give a reason for the absence of an upwards trend in happiness which mimics that observed in the GDP data, nor do they help us understand the different evolution of happiness in countries with similar growth performances. This paper seeks to provide a possible answer to these questions.

There are, of course, many potential explanations of happiness stagnation. Scitovsky (1976), for example, suggests that we respond dynamically to consumption. Pleasure, he argues, is related to increases in stimulation and, hence, to the rate of growth of consumption. There is also an expanding literature that acknowledges consumers' desire for status. This has a long pedigree: it was a century ago that Veblen coined the term 'conspicuous consumption'. Such ideas have found their way into some recent signalling models such as Bagwell and Bernheim (1996), Bernheim (1994) or Corneo and Jeanne (1998).

The two strands of literature begin to overlap when authors ask about the implications of status-seeking for aggregate economic behaviour. In the post-war debate on the consumption function, Duesenberry (1952) maintained that observed savings behaviour could only be explained if consumers cared about relative rather than absolute consumption expenditure. More recently, some authors have incorporated status seeking in models of economic growth. Cole *et al.* (1992) attempt to explain the status conferred by wealth as a consequence of equilibrium social rules when there is an underlying preference for certain types of social matching (such as marriage to 'desirable' partners). Different social-rule equilibria can result in different saving rates, hence affecting the growth rates of output and utility.² Fershtman *et al.* (1996) show that when status is ascribed to occupations that enhance growth, these may be filled by workers with high wealth but low ability. However, while these models may be able to explain suboptimal levels of utility growth, they are stretched to explain the stagnation (or decline) we observe in the happiness data.

Closer to the approach of the present paper is that of de la Croix (1998). Like ourselves, de la Croix constructs a growth model in which consumption patterns and utility patterns are not equivalent. The source of this difference is that individuals care about social norms, where these norms are determined by past aggregate consumption levels. In a Ramsey model, such preferences can result in suboptimal levels of consumption and in periods of declining utility during the transition to the steady state.

Our approach to modelling consumption is related to that in Hirsch (1977). Hirsch distinguishes between material goods and goods that confer status, which he calls 'positional goods'. In Hirsch's formulation, material goods are reproducible, but positional goods—such as works of art, access to the countryside or employment in leadership roles—are not. The result is consumer frustration as people compete for this *fixed supply* of positional goods. Hirsch never fully develops these ideas, but they have been picked up by a number of authors, including Frank (1985).

² Similar models are Basu (1989), Corneo and Jeanne (1998) and Cole *et al.* (1998). See also the comments by Landsburg (1995) and, in the same edition, the response by Cole *et al.*

Our explanation is based precisely on the observation that goods that confer status have *not* been in fixed supply in capitalist economies.³ Indeed a key feature of capitalist economies seems to be their ability to invent new products able to confer status—or re-package existing products to do the same. One cannot fail to notice, reading through a modern text-book on marketing such as Chisnall (1994), how often status is cited as a basic motivation for consumer behaviour in affluent societies. Forming an association between a product and some sort of status remains so effective in advertising that sometimes it is done overtly (the slogan for a recently launched car in the United Kingdom is ‘Envy comes as standard’).

In what follows we explore the origins and implications of conspicuous consumption, and study the resulting evolution of individuals’ utility over time. Our suggestion is that the stagnation, or decline, we observe in average utility levels is caused, in part at least, by the presence and innovation of status goods in the economy. Like Hirsch’s positional goods, status goods confer utility only at the expense of someone who consumes less of the good. To explore the strategic issues at the heart of the consumption choice facing consumers, we model it as a game. We then place these ‘status games’ in an endogenous growth model where firms are able to influence the degree of importance consumers attach to their position within the status-good consumption hierarchy, through changes in the (real or perceived) quality of status goods. These changes can be due to innovations that change the physical quality of products, or to marketing and advertising that changes how existing products are perceived. Consumers’ demand functions and, hence, firms’ research decisions depend on the quality of the status good.

We find that innovative activity in the economy is increasingly directed at the innovation of status goods, and that normal good R&D eventually comes to a halt even though it still has the potential to increase utility. We find that although output remains constant, utility may increase or decrease in the short run, but it will eventually reach a negative rate of growth. So while in the long-run we find plenty of innovative activity in the economy, this activity is increasingly directed at the innovation of status goods. Such activity cannot increase total utility. Indeed, as status goods become more and more prestigious, more and more of a consumer’s budget is diverted away from goods with intrinsic utility. In the example framework we present here this even results in a *decrease* in total utility. Moreover, correcting such a situation through policy may not be easy.

The paper is organised as follows. Section 1 presents the model and describes the role that status goods play in consumers’ preferences. Section 2 solves for both the consumers’ demand function and for firms’ optimal research employment. Both are shown to depend on the current quality of the status good. In Section 3, we examine the resulting evolution of individual utility over time. We consider possible corrective policies in Section 4. Section 5 concludes.

³ There are, of course, exceptions, such as art or (maybe) access to certain educational establishments.

1. The Model

The basic structure of the economy is shown in Fig. 1. There are two final goods sectors: a normal-good sector and a status-good sector. The current period is denoted by $t = 0, 1, 2, \dots$

Following Grossman and Helpman (1991*b*), the normal good can be supplied in a countably infinite number of qualities. Quality ν of the normal good is given by $q_\nu = (\gamma_n)^\nu$, where $\gamma_n > 1$. In order to attain quality ν , the normal good must be improved ν times after $t = 0$, each step up the quality ladder requiring the successful application of R&D (a process described in detail below). Let q_t denote the quality of the normal good with the highest quality at time t .

Similarly, the status good can be supplied in a countably infinite number of 'prestige values'. Prestige value σ of the status good is given by $\alpha_\sigma = (\gamma_s)^\sigma$, where $\gamma_s > 1$. In order to attain prestige value σ , the status good must be improved σ times after $t = 0$, each step up the prestige ladder requiring the successful application of R&D. Let α_t denote the prestige value of the status good with the highest prestige value at time t .

There is a fixed stock of skilled labour, H , that can be used in either of the two R&D sectors, and a fixed stock of unskilled labour, L , that can be used in any of the two production sectors.⁴

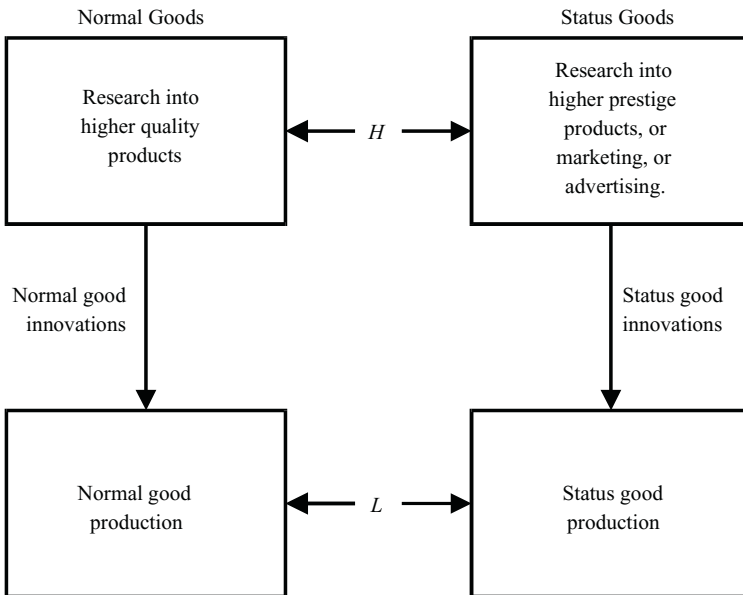


Fig. 1. *The Basic Structure of the Model*

⁴ The main implications are exactly the same when there is only one type of labour. However, having two types of labour makes it easier to see exactly what is driving the results. A model with one type of labour is solved in the Appendix.

1.1. Consumers

The utility function in a typical neoclassical model is often just an increasing, concave function of consumption; although it may also include the quality of the good. For example, Grossman and Helpman (1991*b*) develop a growth model with quality ladders in which an individual's (instantaneous) utility is assumed to take the form $v_t^i = \ln(\sum_{\nu} q_{\nu} y_{\nu t}^i)$, where $y_{\nu t}^i$ denotes consumption by consumer i of quality ν of the normal good.

We consider a utility form which is able to accommodate the consumption of status goods. Suppose the $L + H$ consumers in this economy are arranged into non-overlapping peer groups. Label the consumers in peer group k by $1, 2, \dots, N^k$, where N^k is the number of people in the group. The utility of consumer i from peer group k in period t is given by

$$u_t^{i,k} = \ln(\sum_{\nu} q_{\nu} y_{\nu t}^{i,k}) + \ln(B + \sum_{\sigma} \alpha_{\sigma} \Delta x_{\sigma t}^{i,k}), \quad (1)$$

where $B > 0$. $\Delta x_{\sigma t}^{i,k}$ is the total difference in consumption of the status good with prestige-level σ for consumer i within peer group k . That is,

$$\Delta x_{\sigma t}^{i,k} = \sum_{j=1}^{N^k} (x_{\sigma t}^{i,k} - x_{\sigma t}^{j,k}). \quad (2)$$

The left-hand term of (1) is of the same form as instantaneous utility in Grossman and Helpman (1991*b*). The right-hand term is similar. Note that just as quality can be purchased with large quantities of low quality goods or small quantities of high quality goods, so prestige can be purchased with large quantities of low prestige status goods or small quantities of high prestige status goods. However, it is the *relative* consumption of the status good that matters. It is inter-personal comparisons of status-good consumption, inducing either feelings of pride or envy, that determine a consumer's utility from consuming the product.⁵ The only other asymmetry in (1) comes from insisting that $B > 0$. We shall need this assumption when we come to solve the 'status game' being played by the consumers in their peer group, in Section 2.1.

A consumer choosing between normal goods of different quality to maximise (1) will choose the single quality $\hat{\nu}$ with the lowest quality-adjusted price $p_{\nu t}^n/q_{\nu}$, where $p_{\nu t}^n$ is the price of quality ν of the normal good at time t (assuming $\hat{\nu}$ is unique). Similarly, she will choose the single status good with prestige level $\hat{\sigma}$ with the lowest prestige-adjusted price $p_{\sigma t}^s/a_{\sigma}$, where $p_{\sigma t}^s$ is the price of prestige-level σ of the status good (assuming $\hat{\sigma}$ is unique). We show in Section 2.2 that $\hat{\nu}$ and $\hat{\sigma}$ are unique and correspond to the leading-edge products at time t . We may thus rewrite (1) as:

⁵ In an alternative class of utility functions consumer i compares his own prestige consumption $x_{\sigma t}^{i,k}$ to the average prestige consumption $x_{\sigma t}^{(-i)k} = (\sum_{j \in N^k, j \neq i} x_{\sigma t}^{j,k}) / (N^k - 1)$ in her peer group, i.e. $\Delta x_{\sigma t}^{i,k} = x_{\sigma t}^{i,k} - x_{\sigma t}^{(-i)k}$. The difference between this example and that considered in the main text matters when we study the effects of a variation of the size of peer groups N^k . As we shall see, a variation of N^k has an important effect on individual behaviour and well-being in the case considered in the main text, while it has no effect in the alternative case.

$$u_t^{i,k} = \ln(q_t y_t^{i,k}) + \ln(B + \alpha_t \Delta x_t^{i,k}). \quad (3)$$

The flow of spending by consumer i from peer group k at time t is given by $m_t^{i,k} = p_t^n y_t^{i,k} + p_t^s x_t^{i,k}$. We assume that consumers arrange themselves socially such that peer groups consist of consumers with identical incomes, so that $m_t^{i,k} = m_t^k$ for all $i = 1, \dots, N^k$. (This means that skilled labour never interacts socially with unskilled labour.) Let aggregate expenditure be $M_t = \sum_k N^k m_t^k$. Following Grossman and Helpman (1991*b*), we find it convenient to normalise prices so that nominal aggregate spending is constant each period, that is $M_t = 1$ for all t . Now m_t^k represents the share in total spending of an agent in peer group k .

Concerning consumers' intertemporal allocation of expenditures, we assume the simplest Solow-type behaviour: each period consumers save a fraction $s \in (0, 1)$ of their income and spend the remaining fraction $1 - s$ on consumption. Aggregate income is then $M_t/(1 - s)$. Our normalisation of total expenditure implies that aggregate savings, $S = sM_t/(1 - s)$, are normalised to $S = s/(1 - s)$. The only asset in the economy is a claim on future profits arising from today's innovations. Therefore, in equilibrium, savings at time t will be equal to research expenditures at t .

1.2. Final Goods Producers

Final goods are produced with a single input, which is unskilled labour. One unit of unskilled labour produces one unit of final good, regardless of quality or prestige. The cost of a unit of unskilled labour at time t is given by w_t^u . There are many firms in each sector. Hence all those qualities for which the patent has expired will be produced under perfect competition. At each point in time, the unskilled labour market clears. That is,

$$L = D_t^s + D_t^n. \quad (4)$$

1.3. Research and Development

Firms can engage in R&D in order to obtain a patent for a higher quality good. R&D for normal goods can be interpreted as a search for a higher quality product. However, R&D for status goods can be given a broader interpretation. While it could be a search for goods with higher prestige, it could also be advertising or marketing activity that, if successful, increases the perceived prestige of an already existing product.

The aggregate quantity of skilled labour devoted to normal-good R&D at time t is denoted by H_t^n , while that devoted to status-good R&D at time t is denoted by H_t^s , where $H_t^n + H_t^s = H$. We assume that innovations in a sector are governed by the quantity of skilled labour devoted to R&D in that sector in the following way. The level of research employment in a sector at time t determines the probability of an innovation occurring during that period, which becomes usable at time $t + 1$. If the quantity of skilled labour devoted to

R&D in sector $l = n$, s is H_t^l at time t , the probability of an innovation occurring in that sector during the period is given by

$$\phi(H_t^l) = Q(H_t^l) H_t^l. \quad (5)$$

As in Jones (1995), $Q(H_t^l)$ is a term capturing the externalities occurring because of duplication in the R&D process. Here we take $Q(H_t^l) = 1/(H_t^l + \lambda)$, where $\lambda > 0$, so that

$$\phi(0) = 0; \quad \lim_{H_t^l \rightarrow \infty} \phi(H_t^l) = 1. \quad (6)$$

If the number of firms in the sector is large, an individual firm makes such a small contribution to H_t^l that it takes Q as given. We assume that if an innovation occurs, then an individual firm devoting ε units of skilled labour to R&D in sector l wins the patent with a probability equal to its share of total sector research, ε/H^l .

We consider the case where a product patent lasts for just one period.⁶ After that, the state-of-the-art quality can be produced by any firm and there is perfect competition in the final good sector. We assume free entry into the two R&D sectors.

2. Solving the Model

2.1. The Demand Functions

As they decide how to allocate their budgets between the two types of good, the consumers in each peer group play a *status game* against each other in every period. The timing of the game is as follows. At the start of a period, consumers know the available quality and price of the two goods. Each agent chooses simultaneously how much of the two goods to consume.⁷

We solve for the unique Nash equilibrium of the game. For $B \geq \alpha_t m_t^k / p_t^s (N^k - 1)$, the unique Nash equilibrium is $x_t^{i,k} = 0$ for all $i = 1, \dots, N^k$. That is, low incomes, low prestige, or high status good prices may cause consumers to spend their entire budgets on normal goods.

For $B < \alpha_t m_t^k / p_t^s (N^k - 1)$, consumer i 's reaction function (her best response to $x_t^{-i,k}$, the vector of consumption choices by everyone else in the peer group) is given by:

$$R_t^{i,k}(x_t^{-i,k}) = \frac{m_t^k}{2p_t^s} - \frac{B}{2\alpha_t(N^k - 1)} + \frac{\sum_{j \neq i} x_t^{j,k}}{2(N^k - 1)}. \quad (7)$$

⁶ This is just a simplifying assumption. All our results would hold if patents were infinitely-lived as in Grossman and Helpman (1992) or Aghion and Howitt (1992). However, the model would become much more cumbersome, as the incentives to do R&D at any point in time would depend on the interval over which the firm expects to be a monopolist—ie on expectations of future research employment.

⁷ We treat the consumers' decisions as a one-shot game, rather than consider the considerable complexities of a multi-period consumption game (with an infinite horizon, a *stochastic game*). Alternatively, one could posit a known, finite horizon to the life of a peer group, in which case the solution found by backwards induction in the multi-period game would give the same result.

We require $B > 0$ to ensure these reaction functions are everywhere properly defined. Existence of equilibrium is guaranteed by the fact that they are everywhere strictly increasing; uniqueness is guaranteed by continuity and the fact that their slope is everywhere strictly less than $1/(N^k - 1)$.

In fact, the unique Nash equilibrium is symmetric: $x_t^{i,k} = x_t^k$ for all $i = 1, \dots, N^k$ and

$$x_t^k = \frac{m_t^k}{p_t^s} - \frac{B}{\alpha_t(N^k - 1)}. \tag{8}$$

By Milgrom and Roberts (1990), Theorem 4, this is a *smooth supermodular game*. Loosely speaking, if player i increases her consumption of the status good, then the other players will also want to. Such games have nice properties. By Milgrom and Roberts (1990), Theorem 5, if a game is supermodular and has a unique Nash equilibrium in pure strategies (like this one), then it is the only Nash equilibrium. Moreover, it is the only strategy combination that survives iterated deletion of strictly dominated strategies. This makes the Nash equilibrium particularly compelling, even when the players are facing a novel situation (such as a recent innovation) and have had no opportunity to learn what to do.

The demands for a consumer in peer group k are thus given by:

$$x_t^k = \begin{cases} 0; & B \geq \frac{\alpha_t m_t^k}{p_t^s} (N^k - 1) \\ \frac{m_t^k}{p_t^s} - \frac{B}{\alpha_t(N^k - 1)}; & B < \frac{\alpha_t m_t^k}{p_t^s} (N^k - 1) \end{cases}; \tag{9}$$

$$y_t^k = \begin{cases} \frac{m_t^k}{p_t^n}; & B \geq \frac{\alpha_t m_t^k}{p_t^s} (N^k - 1) \\ \frac{p_t^s}{p_t^n} \frac{B}{\alpha_t(N^k - 1)}; & B < \frac{\alpha_t m_t^k}{p_t^s} (N^k - 1). \end{cases} \tag{10}$$

To simplify aggregation, we focus on a relatively ‘affluent’ economy where all peer groups engage in some strictly positive level of status good consumption in every period. That is, we choose B and α_0 to ensure that $B < \alpha_t m_t^k L / \gamma^s (N^k - 1)$ for all k and all t (we show in section 2.2 that the maximum value that p^s can take is γ^s / L).

Let D_t^s be the aggregate demand for the status good and D_t^n that for the normal good. Aggregating gives:

$$D_t^s = \sum_k N^k x_t^k = \frac{1 - \Theta(p_t^s, \alpha_t)}{p_t^s}, \tag{11}$$

$$D_t^n = \frac{1 - p_t^s D_t^s}{p_t^n} = \frac{\Theta(p_t^s, \alpha_t)}{p_t^n}, \tag{12}$$

where the aggregate expenditure share is defined as $\Theta(p_t^s, \alpha_t) = p_t^s (B / \alpha_t) \sum_k N^k / (N^k - 1)$.

Note that $\partial\Theta/\partial\alpha < 0$ and $\partial\Theta/\partial N^k < 0$.⁸ A crucial feature of these demand functions is that they are affected by the quality of the status good, but not by that of the normal good. A higher quality of the status good implies that more utility is obtained from consuming a given amount above the consumption of any other individual in the peer group. Consequently, a greater fraction of income will be devoted to that good.

2.2. Monopoly Profits

Firms engage in R&D in order to obtain a patent for a higher quality good and hence obtain monopoly profits. If a firm innovates in a sector at time $t - 1$, it becomes the only producer in that sector for one period. The profits accruing to the leader in sector l are given by $\pi_t^l = D_t^l(p_t^l - w_t^u)$.

Prices depend on the current market state. There are, then, two possibilities in each sector. Either all firms have access to the current best product, in which case price competition forces the price down to w_t^u . Alternatively, R&D activity in the past results in *one* firm holding the patent for the current best product, with all other firms exactly one step behind. Recall that consumers always choose the normal good with the lowest quality-adjusted price, and the status good with the lowest prestige-adjusted price. This means that in a price-setting equilibrium, a normal-good sector leader (if one exists) can charge a 'limit' price just below $w_t^u\gamma_n$ and win the entire market for normal goods. Similarly, a status-good sector leader (if one exists) can charge a price just below $w_t^u\gamma_s$. Then:

$$p_t^n = z_t^n w_t^u, \text{ where } z_t^n = \begin{cases} 1 & \text{if no quality innovation at } t-1 \\ \gamma_n & \text{if quality innovation at } t-1 \end{cases}, \quad (13)$$

$$p_t^s = z_t^s w_t^u, \text{ where } z_t^s = \begin{cases} 1 & \text{if no prestige innovation at } t-1 \\ \gamma_s & \text{if prestige innovation at } t-1 \end{cases}. \quad (14)$$

There are four possible states, depending on whether an innovation has occurred in either of the two sectors. For example, if only the status good sector has innovated, we would have $z_t^n = 1$, $z_t^s = \gamma_s$, $\alpha_t = \gamma_s\alpha_{t-1}$, and $q_t = q_{t-1}$.

From the unskilled labour market clearing condition, $D_t^n + D_t^s = L$, we can calculate the equilibrium value of w^u for a given market state and prestige level,

$$L = \frac{\Theta(p_t^s, \alpha_t)}{z_t^n w_t^u} + \frac{1 - \Theta(p_t^s, \alpha_t)}{z_t^s w_t^u}. \quad (15)$$

⁸ If consumers care for their prestige consumption relative to other consumers' *average* prestige consumption (as described in footnote 5), the term $(N^k - 1)$ in (7) and in (8) disappears. In this case, the individual's demand function does not depend on the size of her peer group, and the aggregate expenditure share is simply $\Theta(p_t^s, \alpha_t) = p_t^s(B/\alpha_t)\sum_k N^k$.

Substituting from the definition of $\Theta(p_t^s, \alpha_t)$, noting that $p_t^s = z_t^s w_t^u$ and $\alpha_t = z_t^s \alpha_{t-1}$, and solving gives:

$$w^u(z_t^s, z_t^n; \alpha_{t-1}) = \frac{z_t^n \alpha_{t-1}}{z_t^s z_t^n L \alpha_{t-1} + (z_t^n - z_t^s) B \kappa}, \tag{16}$$

$$\Theta(p_t^s, \alpha_t) = \Theta(z_t^s, z_t^n; \alpha_{t-1}) = \frac{z_t^n B \kappa}{z_t^s z_t^n L \alpha_{t-1} + (z_t^n - z_t^s) B \kappa}, \tag{17}$$

where $\kappa \equiv \sum_k N^k / (N^k - 1)$.⁹ Note that $w_t^u = 1/L$ if no innovation has occurred last period (that is, $z_t^n = z_t^s = 1$).

Thus the profits to any patent holders are determined by the current market state:

$$\pi_t^n(z_t^s, z_t^n; \alpha_{t-1}) = \left(\frac{z_t^n - 1}{z_t^n} \right) \Theta(z_t^s, z_t^n; \alpha_{t-1}), \tag{18}$$

$$\pi_t^s(z_t^s, z_t^n; \alpha_{t-1}) = \left(\frac{z_t^s - 1}{z_t^s} \right) [1 - \Theta(z_t^s, z_t^n; \alpha_{t-1})]. \tag{19}$$

The four possibilities are tabulated in Table 1.

The aggregate expenditure share $\Theta(\cdot)$ is strictly decreasing in α , implying that the overall effect of a change in the quality of the status good on profits is $d\pi_t^s/d\alpha_{t-1} > 0$ and $d\pi_t^n/d\alpha_{t-1} < 0$.

2.3. *Research Intensities*

R&D firms maximise expected profits. Recall that the probability of the firm becoming the sole patent holder, conditional on an innovation occurring, is ε/H_t^l . Thus firms maximise

$$Q^l H_t^l \left(\frac{\varepsilon}{H_t^l} \right) V_t^l - w_t^h \varepsilon, \tag{20}$$

Table 1
Profits as a Function of Market state and α_t

State		Patent-holder Profits	
z_t^n	z_t^s	$\pi_t^n(z_t^n, z_t^s; \alpha_{t-1})$	$\pi_t^s(z_t^n, z_t^s; \alpha_{t-1})$
1	1	-	-
1	γ_s	-	$\left(\frac{\gamma_s - 1}{\gamma_s} \right) [1 - \Theta(1, \gamma_s, \alpha_{t-1})]$
γ_n	1	$\left(\frac{\gamma_n - 1}{\gamma_n} \right) \Theta(\gamma_n, 1, \alpha_{t-1})$	-
γ_n	γ_s	$\left(\frac{\gamma_n - 1}{\gamma_n} \right) \Theta(\gamma_n, \gamma_s, \alpha_{t-1})$	$\left(\frac{\gamma_s - 1}{\gamma_s} \right) [1 - \Theta(\gamma_n, \gamma_s, \alpha_{t-1})]$

⁹ For the alternative utility function of footnote 5 this would be $\kappa \equiv \sum_k N^k$.

where V_t^l is the value of becoming the sole patent holder of an innovation at time $t + 1$, discounted to time t , and w_t^h is the current cost of *skilled* labour. Under free entry, the expression in (20) is forced down to zero, which is true when

$$Q^l V_t^l = w_t^h. \quad (21)$$

Since product patents last for just one period, the value of becoming the sole patent holder of an innovation at time $t + 1$ is simply the discounted expected profits,

$$V_t^l = \frac{1}{(1 + r_t)} \mathbb{E}(\pi_{t+1}^l), \quad (22)$$

where r_t denotes the interest rate.

Combining (21), (22) and the fact that $Q(H_t^l) = 1/(H_t^l + \lambda)$, we get

$$w_t^h(1 + r_t) = \frac{\mathbb{E}(\pi_{t+1}^n)}{H_t^n + \lambda} = \frac{\mathbb{E}(\pi_{t+1}^s)}{H_t^s + \lambda}. \quad (23)$$

We can now calculate the expected profit to a firm engaged in R&D at time t if they succeed in becoming sole patent-holder at time $t + 1$. Re-writing (23) gives

$$\begin{aligned} & \frac{\phi(H_t^s)\pi_{t+1}^n(\gamma_n, \gamma_s, \alpha_t) + [1 - \phi(H_t^s)]\pi_{t+1}^n(\gamma_n, 1, \alpha_t)}{H_t^n + \lambda} \\ &= \frac{\phi(H_t^n)\pi_{t+1}^s(\gamma_n, \gamma_s, \alpha_t) + [1 - \phi(H_t^n)]\pi_{t+1}^n(\gamma_n, 1, \alpha_t)}{H_t^s + \lambda}. \end{aligned} \quad (24)$$

Using Table 1 and the skilled labour market clearing condition, $H_t^n + H_t^s = H$, to substitute into (24) we can calculate the equilibrium allocation of skilled labour to the two sectors for a given value of α_t , $H^{*n}(\alpha_t)$ and $H^{*s}(\alpha_t)$. That is, $H^{*s}(\alpha_t) = \max\{\min[H^s(\alpha_t), H], 0\}$, where

$$H^s(\alpha_t) = \frac{\Gamma H[1 - \Theta(\gamma_n, \gamma_s, \alpha_t)] + \Gamma \lambda[1 - \Theta(1, \gamma_s, \alpha_t)] - \lambda \Theta(\gamma_n, 1, \alpha_t)}{\Theta(\gamma_n, \gamma_s, \alpha_t) + \Gamma[1 - \Theta(\gamma_n, \gamma_s, \alpha_t)]}, \quad (25)$$

and $\Gamma \equiv [(\gamma_s - 1)/\gamma_s][\gamma_n/(\gamma_{n-1})]$. The allocation of skilled labour to normal good R&D is simply $H^{*n}(\alpha_t) = H - H^{*s}(\alpha_t)$.¹⁰

Differentiating (25) we have $\partial H^s(\alpha_t)/\partial \alpha_t > 0$. To understand why the allocation of researchers varies with α_t , look again at the demand functions given by (11) and (12). These functions are affected by the quality of the status good. As α_t grows, the demand for the status goods, and hence the profits obtained by the monopolist producing the latest vintage, increase, while the

¹⁰ Note that the allocation of research is independent of both the skilled wage, w_t^h , and the interest rate, r_t . The skilled wage is obtained from the fact that aggregate savings are equal to total research expenditures, $S = w_t^h H$. Substituting for $w_t^h = S/H$, together with $H^{*n}(\alpha_t)$ and $H^{*s}(\alpha_t)$ into (23) would allow us to solve for r_t .

profits accruing to the producer of the normal good fall. As a result, research in the status good sector becomes more profitable relative to R&D in the normal good sector, and the resources devoted to the former, H_t^{*s} , increase at the expense of H_t^{*n} . That is, as long as at time zero status R&D is undertaken, ie $H_0^{*s} > 0$, α_t will be growing and the fraction of skilled labour allocated to the status good sector will increase over time. Consequently, the rate of technological change in that sector increases over time. Clearly, this implies that technical change in the normal good sector becomes slower.

3. Utility Growth

Research affects utility but not output. Since labour costs are constant for all q_t and α_t , the level of output is, at all times, given by the supply of unskilled labour, L . However, R&D improves the quality of final goods and therefore the utility derived from them. From the individual demand functions derived in Section 3.1, we have that the equilibrium level utility for a consumer in peer group k at time t is given by

$$u_t^{*k} = 2 \ln B + \ln \left(\frac{p_t^s}{p_t^n} \right) + \ln q_t - \ln \alpha_t - \ln (N^k - 1). \quad (26)$$

What is striking about this indirect utility function is that although improvements in the quality of normal goods increase utility, a better quality of the status good *reduces* the level of utility. To understand this note that engaging in the status competition has a resource cost. A higher α_t makes conspicuous consumption more desirable and thus individuals purchase, on average, more of the status good (see (9)). A higher quality of the status good then has two effects. On the one hand, whenever an individual consumes above somebody else, she obtains more utility. On the other, a greater expenditure on the status good is required in order to attain the same relative consumption level, as all individuals are purchasing more of the good. That is, more normal good consumption—and hence more utility—is foregone in order to attain the same status ranking. The second effect always dominates, implying that a higher α_t results in lower equilibrium utility levels.

Utility also depends on the size of the individual's peer group. The larger the social group of an agent, the lower her level of utility is for a given α_t . Note that for utility to be defined, the size of the peer groups has to be finite. To understand this effect, recall that individuals perform pairwise comparisons of status competition. If N^k is infinite, the utility forgone when consuming below others is very large. An agent thus spends all her income in status consumption and none in normal-good consumption, and hence her utility is not defined. Such an effect depends crucially on the assumption of pairwise comparisons. If relative needs consisted instead of comparisons of an individual's own prestige consumption to the average prestige consumption in her peer group (see footnote 5), then there would be no such group size effect. The last term of (26) would be absent in the corresponding equation for temporary equi-

brium utility, and the level of utility level of an individual consumer would not depend on N^k .

The change in the utility of an individual in peer group k between period $t - 1$ and t can be written as

$$\Delta u_t^{*k} = \ln\left(\frac{q_t}{q_{t-1}}\right) - \ln\left(\frac{\alpha_t}{\alpha_{t-1}}\right) + \ln\left(\frac{p_t^s}{p_{t-1}^s}\right) - \ln\left(\frac{p_t^n}{p_{t-1}^n}\right). \quad (27)$$

Two things affect the evolution of utility over time: technical change in the two sectors and changes to the prices of the two goods. Technological advances have permanent effects on the utility function, determining its average rate of growth. Changes in prices are only temporary, and result in fluctuations along the trend due to one-period changes in the price of the two goods. To see this, recall that $p_t^l = z_t^l w_t^u$, where $z_t^l = 1$ or γ_l , depending on whether or not an innovation has occurred. Substituting for prices, we can express the change in utility as

$$\Delta u_t^{*k} = \ln\left(\frac{q_t}{q_{t-1}}\right) - \ln\left(\frac{\alpha_t}{\alpha_{t-1}}\right) + \ln\left(\frac{z_t^s/z_t^n}{z_{t-1}^s/z_{t-1}^n}\right). \quad (28)$$

Fig. 2 depicts part of a typical utility path. An increase in α or q following an innovation is exactly off-set by the change in prices for the duration of the patent. For example, in the period following a status-good innovation, α increases by a factor γ_s . However, status-good prices also increase by a factor γ_s . Only when the patent expires in the next period, when prices fall back again, does utility change.

Let us ignore the shocks to prices resulting from an innovation, and define

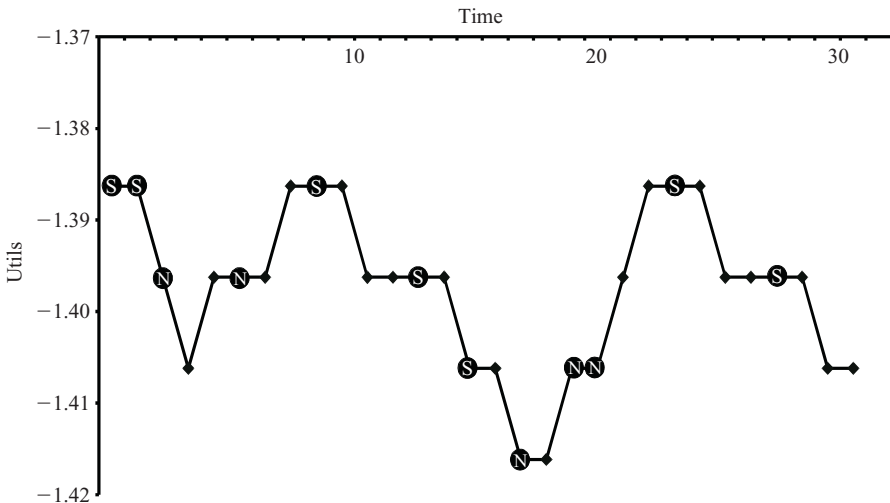


Fig. 2. A Typical Utility Path. An 'S' indicates a period in which there was a status-good innovation. An 'N' indicates a period in which there was a normal-good innovation.

the trend growth in utility to be the expected change in utility due only to product improvements. For an agent in peer group k this is given by

$$\begin{aligned}
 g_t^k &= E(\Delta \ln q_t) - E(\Delta \ln \alpha_t) \\
 &= \phi[H^{*n}(\alpha_t)] \ln \gamma_n - \phi[H^{*s}(\alpha_t)] \ln \gamma_s.
 \end{aligned}
 \tag{29}$$

This expression is the same for all agents, irrespectively of size of the individual's peer group. It in fact defines the average rate of growth of utility.

Utility grows whenever a new quality of the normal good is invented, and falls when there is an improvement in the status good sector. The relative strength of these two effects will vary over time, which implies that the rate of growth is not constant.¹¹ Using the skilled labour market clearing condition, the rate of growth of utility can be expressed as $g_t^k = \phi(H - H_t^s) \ln \gamma_n - \phi(H_t^s) \ln \gamma_s$. Differentiating with respect to H_t^s we have that $\partial g_t^k / \partial H_t^s < 0$. That is, growth is strictly decreasing in the number of researchers employed by the status good sector. Since the rate of growth takes a positive value at $H_t^s = 0$ and a negative value at $H_t^s = H$, then g_t^k will be positive for all values of H_t^s greater than a certain level \widehat{H} (defined by $g_t^k(\widehat{H}) = 0$), and negative for allocations to the status good sector above \widehat{H} .

Fig. 3 depicts a distribution of possible utility time paths. Here, initial conditions are such that H_0^{*s} is low, while still being positive. Innovations in the normal good sector occur frequently enough for the rate of growth to be positive (H_t^{*n} is high enough). However, improvements in the status good

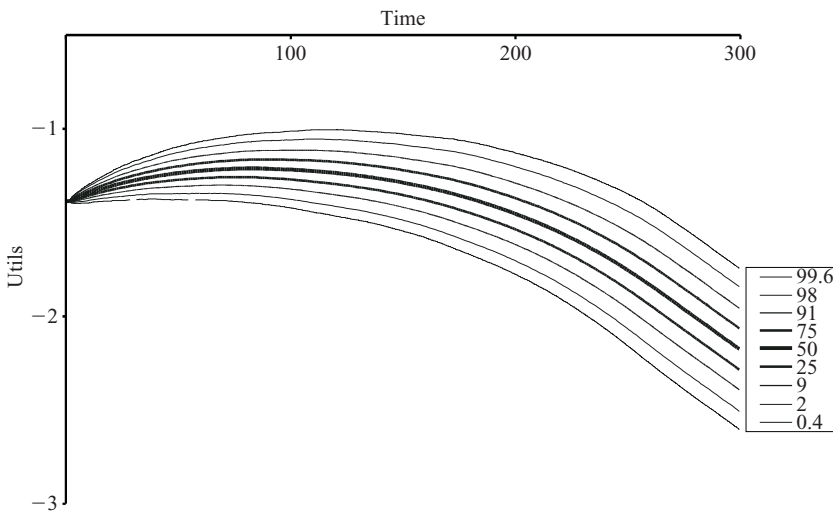


Fig. 3. Numerical Results for the Distribution of Utility to a Representative Consumer Across Different Possible Innovation Paths. (The Figure shows results for $\gamma_s = 1.01$, $\alpha_0 = q_0 = 1.2$, $B = 0.5$, $H = L = 1000$, $\gamma = 150$ and $N^k = 2$ for all k .)

¹¹ The rate of growth will be constant only if initial R&D employment in one of the sectors is zero.

imply that demand, and therefore research employment, shift from the normal to the status good sector. At some point, the effect of increases in α_t becomes strong enough (H_t^{*s} becomes high enough), and utility starts to fall.

The long-run rate of growth of utility will always be negative, as the reallocation of researchers to the status good sector will continue until all researchers are employed in it. At this point we have

$$g_\infty = -\frac{H}{\lambda + H} \ln \gamma_s. \quad (30)$$

That is, utility falls at a constant rate. In the long-run, the economy will exhibit a constant level of output and a negative rate of growth of utility.

4. Corrective Policies

4.1. Policies When the Status Good is Identifiable

When individuals care about status consumption, their expenditure choices generate an externality which affects the utility of other individuals in their peer group. There are two types of inefficiency that emerge: static and dynamic. There is a *static* inefficiency in the sense that, for any α and q , all consumers would have a higher utility level if nobody purchased the status good. Recall that an individual's utility is given by $u_t^{*k} = \ln B + \ln(q_t/p_t^n) + \ln\{Bp_t^s/[\alpha_t(N^k - 1)]\}$. The presence of status consumption thus always reduces utility relative to the level attained in the absence of status goods, $u_t^k = \ln B + \ln(q_t/p_t^n) + \ln m_t^k$, as we have assumed that $m_t^k > Bp_t^s/[\alpha_t(N^k - 1)]$. Static inefficiency is therefore caused by excessive spending on status goods. *Dynamic* inefficiency stems from the fact that the rate of growth of utility is lower than it would be in the absence of status consumption. As we have seen, the rate of growth is in fact strictly decreasing in the level of employment in status R&D, and would thus be maximised when $H_t^s = 0$.

Suppose that the policy-maker can correctly identify which is the status good. With the simple, clear-cut distinction between normal and status goods that we have in the model above, an outright ban on status goods is the first-best policy. The level of utility would be the highest possible one, $u_t^k = \ln B + \ln(q_t/p_t^n) + \ln m_t^k$, all human capital would be devoted to R&D in the normal good sector, and the rate of growth of utility would be maximised at $g_t^k = \phi(H) \ln \gamma_n$.

In practice, goods that confer status may also produce direct utility. Hence we consider the less drastic alternatives of a tax on status good consumption and a tax on status good R&D. Consider first the impact of a tax $\tau^{\text{R\&D}}$ imposed on status R&D expenditures. The cost of research is now $(1 + \tau^{\text{R\&D}})w_t^h$, and the arbitrage condition becomes $Q^s V_t^s = (1 + \tau^{\text{R\&D}})w_t^h$. In the normal good sector, it remains $Q^n V_t^n = w_t^h$. Since the wage paid to researchers has to be the same in the two sectors, it must be the case that

$$\frac{E(\pi_{t+1}^n)}{H_t^n + \lambda} = \frac{1}{(1 + \tau^{\text{R\&D}})} \frac{E(\pi_{t+1}^s)}{H_t^s + \lambda}. \quad (31)$$

We can calculate the equilibrium allocation of skilled labour to the two sectors, which is given by an expression analogous to equation (25),

$$H^s(\alpha_t) = \frac{\Gamma H[1 - \Theta(\gamma_n, \gamma_s, \alpha_t)] + \Gamma \lambda [1 - \Theta(1, \gamma_s, \alpha_t)] - \lambda(1 + \tau^{\text{R\&D}})\Theta(\gamma_n, 1, \alpha_t)}{(1 + \tau^{\text{R\&D}})\Theta(\gamma_n, \gamma_s, \alpha_t) + \Gamma[1 - \Theta(\gamma_n, \gamma_s, \alpha_t)]} \tag{32}$$

Clearly, the higher the tax rate is, the lower employment in status good research will be.

Consider now the effect of a tax on status good consumption. If a tax τ^{cons} is imposed, the price of the status good becomes $p_t^s = (1 + \tau^{\text{cons}})z_t^s w_t^u$. Using the unskilled labour market clearing condition, it is possible to show that the expenditure share in normal good consumption is now given by the expression

$$\Theta(z_t^s, z_t^n; \alpha_{t-1}, \tau^{\text{cons}}) = \frac{z_t^n B\kappa}{z_t^s z_t^n L\alpha_{t-1} + [z_t^n - z_t^s(1 + \tau^{\text{cons}})]B\kappa} \tag{33}$$

The tax increases the relative price of the status good, thus increasing the share of expenditure devoted to normal good consumption, i.e. $\partial\Theta/\partial\tau^{\text{cons}} > 0$. Profits to the status good innovator are

$$\begin{aligned} \pi_t^s &= D_t^s(z_t^s - w_t^u) \\ &= \left(\frac{z_t^s - 1}{z_t^s}\right) \left[\frac{1 - \Theta(z_t^s, z_t^n; \alpha_{t-1}, \tau^{\text{cons}})}{(1 + \tau^{\text{cons}})}\right] \end{aligned} \tag{34}$$

Using the skilled labour market equilibrium condition $E(\pi_{t+1}^n)/(H_t^n + \lambda) = E(\pi_{t+1}^s)/(H_t^s + \lambda)$, we find that the allocation of researchers is given by the same expression as in (32) above, except that the relevant expenditure shares are now given by (33). The tax has now two effects. First, for a given expenditure share, the tax increases the price of the status good, thus reducing the amount purchased and hence the profitability of a status innovation. This effect is identical to that obtained in the case of an R&D tax. Second, the consumption tax reduces the expenditure share of x , implying a further reduction in expected profits and thus in the incentives to innovate (note that $\partial H^s/\partial\Theta < 0$). The resulting reduction in research employment in the status sector will thus be greater than if an R&D tax is used.

Both types of taxes have dynamic effects on individual utility. By reducing profits to status-good patent holders, they reduce the incentives to innovate in this sector, which implies that, in the long-run, utility declines at a slower rate. However, through the general equilibrium structure of the model, a tax on status good consumption also has a static effect on utility. A tax that increases p_t^s implies that fewer units of the status good and more of the normal good are bought. We can express the utility of an individual as

$$u_i^{*k} = 2 \ln B + \ln \left[\frac{z_t^s}{z_t^n} (1 + \tau^{\text{cons}}) \right] + \ln q_t - \ln \alpha_t - \ln (N^k - 1), \quad (35)$$

which, for any level of technology and state of demand, implies a lower relative price of the normal good and hence higher current utility as compared to that obtained in the absence of the tax (see (26)). In other words, the reduction in total status good consumption, while it has no direct effect on utility (since all individuals consume the same amount in equilibrium), frees labour for normal good consumption. This increase in normal good consumption raises current utility.

Overall, when the two types of goods can be identified, a tax on status goods is preferable to a tax on research for status innovations since it results in a greater reduction of status R&D and has a level effect which is absent in the case of the research tax.

4.2. Policies When the Status Good is not Identifiable

The design of optimal policies becomes more complex when the government cannot identify which good confers direct utility and which confers status. In this case, any tax or subsidy has to be imposed on both goods, and hence will have no effect on utility. Suppose that a proportional tax on prices is imposed so that prices are given by $p_t^s = (1 + \tau^{\text{cons}}) z_t^s w_t^u$ and $p_t^n = (1 + \tau^{\text{cons}}) z_t^n w_t^u$. Using the unskilled labour market equilibrium condition, we can obtain the unskilled wage which is simply given by $w_t^u = \bar{w}_t^u / (1 + \tau^{\text{cons}})$, where \bar{w}_t^u denotes the equilibrium wage in the absence of taxes. Prices are then simply $p_t^s = z_t^s \bar{w}_t^u$ and $p_t^n = z_t^n \bar{w}_t^u$, and hence the demands for the two goods and the expenditure shares are unaffected. The tax also reduces the profitability of research, with new profit functions of the form

$$\pi_t^s = \left[\frac{\Theta(\alpha_{t+1})}{1 + \tau^{\text{cons}}} \right] \left(\frac{z_t^s - 1}{z_t^s} \right) \quad \text{and} \quad \pi_t^n = \left[\frac{1 - \Theta(\alpha_{t+1})}{1 + \tau^{\text{cons}}} \right] \left(\frac{z_t^n - 1}{z_t^n} \right).$$

Because profits fall by the same proportion in both sectors, relative profitability is not affected. Consequently, the allocation of skilled labour between the two sectors remains unchanged. Similarly, a tax on R&D expenditures would not affect the relative incentives to engage in research in the two sectors and hence would have no effect on the relative rates of growth of the qualities of the two goods.

This policy ineffectiveness depends crucially on our assumption of two types of labour, one of which is used for production and the other for research. As we will see in the next subsection, a small modification of the model can restore the capacity of the social planner to use taxes in order to affect consumption when the status good cannot be identified.

4.2.1. *Slowing-down the rate of innovation.*

In our basic model both total output and total R&D expenditures are fixed by, respectively, the stock of unskilled and the stock of skilled labour. Consider now an alternative version of the model (it is explicitly solved in the Appendix). Suppose that there is only one type of labour, denoted L . Labour has four possible employments: in the production of either of the two goods, or in R&D in either of the two sectors. The labour market clearing condition is now given by

$$D^n(\alpha_t, w_t) + D^s(\alpha_t, w_t) + H^n(\alpha_t, w_t) + H^s(\alpha_t, w_t) = L, \quad (36)$$

where D_t^l is the number of workers employed in production and H_t^l is the number employed in research in sector l at time t .

It is now possible to substitute current production for R&D. In the appendix we show that the endogenous levels of production and research fluctuate around a constant level, the fluctuations being caused by the change in prices following an innovation. There is, however, no trend in the aggregate level of research employment, $H_t^n + H_t^s$, as α_t grows. Just as in our basic model, a higher quality of the status good raises profits from innovating in this sector, resulting in an increase in the demand for researchers in the status good sector. The only effect of increases in α_t is then to shift researchers from R&D in the normal good to R&D in the status good.

The substitutability between R&D and production allows for the use of taxes even if the two goods cannot be identified. A social planner can tax either consumption or R&D. Suppose that all research expenditures are taxed at a rate $\tau^{\text{R\&D}}$. The tax has two effects. First, by making research expenditures more costly it reduces the aggregate level of R&D in the economy. Second, there is an indirect effect through wages. The reduction in the demand for researchers reduces the equilibrium wage, and thus goods' prices. The demand for the normal good is unaffected by the lower prices, but that for the status good increases, raising the incentives to do status R&D. The overall impact of the tax on H_t^{*s} is then ambiguous: research employment is increased by the tax but a lower proportion of it is devoted to the status good. As α_t grows the second effect becomes weaker, and it eventually disappears. In the long-run all researchers are employed in the status sector, and the introduction of an R&D tax would result in a reduction in the level of employment in status research. The R&D tax thus, by shifting labour away from research and into production, slows down the rate of innovation, implying that utility will fall at a slower rate. Note that initially the reduction in R&D employment will reduce the rate of growth of both q_t and α_t . For low levels of H^s , this could reduce the rate of growth of utility. However, what is important is that because α_{t+1} is now lower than it would have been in the absence of the tax, the transfer of resources from normal-good research into status-good research is slower. That is, the tax will decrease the rate of negative utility growth.

The effect of a consumption tax will be exactly the opposite: it reduces H_t^* , but increases the fraction of these workers employed in status-good R&D. Although for small values of α_t it may reduce H_t^{*s} , in the long-run it will always

result in an increase in status R&D and would thus speed up the decline in utility. When the two types of goods cannot be identified, a tax on R&D would therefore be preferable to a tax on consumption, as the latter would actually increase the amount of status R&D undertaken.

4.2.2. *Distribution Effects.*

The evolution of utility over time can be affected by the distribution of income in the economy. Recall from (9) that an individual in peer group k consumed the status good only if her income were such that

$$m_t^k(N^k - 1) > \frac{Bp_t^s}{\alpha_t}. \quad (37)$$

In our previous analysis we had assumed that this condition was satisfied for all groups. In this case, all individuals spent on the normal good an amount which, although a function of N^k , did not depend on income. The aggregate expenditure share was simply

$$\Theta_t = p_t^s \frac{B}{\alpha_t} \sum_k \frac{N^k}{N^k - 1} \quad (38)$$

and the distribution of income across groups was irrelevant.

However, when condition (37) is not satisfied for all peer groups, individual incomes do affect aggregate expenditure shares. Those individuals who have high incomes and/or are in large groups will purchase the status good; those with low incomes and/or in small groups will not. Hence distribution matters. Let l denote all the peer groups for which condition (37) is not satisfied, and h denote those for which it is. Then, the aggregate expenditure share in the normal good is given by

$$\Theta_t = \sum_l m_t^l N^l + p_t^s \sum_h \frac{B}{\alpha_t} \sum_h \frac{N^h}{N^h - 1}. \quad (39)$$

For a given partition of individuals into peer groups, the larger the number of groups with an income high enough to satisfy condition (37), the greater the share of expenditure being devoted to the status good, $1 - \Theta_t$. This in turn will enhance the incentives to engage in status-good R&D, increase the rate of growth of the quality index α_t relative to q_t , and thus accelerate the rate of utility decline. Under this scenario, progressive income taxation, which transfers resources from richer to poorer agents, can have the effect of reducing the aggregate expenditure share devoted to the status good. What is needed is a transfer that reduces the income of some h -type groups enough to stop them from purchasing the status good, without increasing the income of l -type groups above that needed in order to buy x . This type of redistribution will diminish conspicuous consumption, hence reducing the incentives to do research for status innovations and slowing down the rate of negative utility growth.

Similarly, redistribution from individuals in large peer groups to those in

small ones will reduce the share spent in status consumption, $1 - \Theta_t$. Moreover, if there were a positive correlation between peer group size and income level—that is, richer individuals have larger peer groups than poorer individuals—redistribution would be particularly effective, as it would transfer income to individuals that already have little incentive to engage in conspicuous consumption because of their small N^k .

5. Conclusion

The model we have outlined above can explain why the observed increase in per capita income levels has not been necessarily associated with an increase in happiness. It has also highlighted structural variables that may help understand cross-country variations in happiness, such as preferences for conspicuous consumption, peer group size, the relative rates of innovation of the two types of good, and the distribution of income.

We have identified two sources of inefficiency: static and dynamic. Policy implications depend crucially on whether the status good can be identified by the policy maker. As far as taxes are concerned, there are two possibilities: a tax on consumption and a tax on R&D. When the status good can be identified a selective consumption tax is preferable, as it increases both the level and the rate of growth of utility, while an R&D tax affects only the latter. On the other hand, when it cannot be identified, taxes on R&D may be preferable. The reason for this difference is that since ‘unchecked’ innovation eventually leads to a fall in utility, the only feasible policy if relative prices cannot be affected is to slow down innovative activity.

Another possible policy is income redistribution. The threshold effect in status consumption, implies that redistribution from high-income individuals (who *are* purchasing the status good) to those with low incomes (who are not), will reduce the aggregate demand for the status good. There is also a second way in which redistribution may help. With the utility form studied in the main text, being in a larger peer group increases the incentives to spend resources on the status game. If this is true, then a tax system that redistributes income towards those with lower incomes and in smaller peer groups will also reduce the aggregate demand for the status good. A particularly important issue then arises: whether there is any correlation between peer group size and income. In general one would expect that higher income individuals have larger peer groups, hence redistribution to the poorer would reduce the speed of negative utility growth.

Our conclusion that the long-run rate of utility growth is always negative is extreme given that our choice of utility function means that expenditure share depends on the quality of the status good, but not on that of the normal good, q_t . Different utility functions (eg one in which the marginal utility to normal-good consumption was increasing in q_t) would result in expenditure share depending on both α_t and q_t . In this case, long-run utility growth would depend on the relative sizes of the quality improvements γ_n and γ_s . We would

get positive, zero or negative growth, depending on these parameter values—although the level of utility growth would always be sub-optimal.

Overall, we hope that the main point of the model as it stands is clear. That is, given a plausible specification of utility, status effects may result in technical change actually making people *less* happy. We believe that the incorporation of status goods into the above model captures some important features of change in capitalist economies that are missing in most treatments of growth. At the very least, it teaches us that a high rate of innovative activity in an economy is not necessarily a good thing.

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Appendix: A Model with One Type of Labour

Consider the model in Section 2 except that now there is only one type of labour, denoted L , which can be used either for production or research. The labour market clearing condition at t is now given by

$$D_t^n + D_t^s + H_t^n + H_t^s = L, \quad (\text{A.1})$$

where D_t^l is the number of workers employed in production and H_t^l is the number employed in research in sector l at time t . We denote the total production and research employment levels as $D_t = D_t^n + D_t^s$ and $H_t = H_t^n + H_t^s$, respectively. There is now only one wage, w_t .

As before, free entry into research in each sector implies

$$\frac{1}{\lambda + H_t^s} V_t^s = w_t = \frac{1}{\lambda + H_t^n} V_t^n. \quad (\text{A.2})$$

In order to determine the value of the innovation, we use the expression for expected profits in Table 1. For the status good sector, this is

$$V_t^s = \frac{\gamma_s - 1}{\gamma_s} \frac{H_t^n [1 - \Theta_{t+1}(\gamma_n, \gamma_s, \alpha_t)] + \lambda [1 - \Theta_{t+1}(1, \gamma_s, \alpha_t)]}{(1+r)(\lambda + H_t^n)}, \quad (\text{A.3})$$

while for the normal good sector expected profits are

$$V_t^n = \frac{\gamma_n - 1}{\gamma_n} \frac{H_t^s \Theta_{t+1}(\gamma_n, \gamma_s, \alpha_t) + \lambda \Theta_{t+1}(\gamma_n, 1, \alpha_t)}{(1+r)(\lambda + H_t^s)}. \quad (\text{A.4})$$

Substituting for (A.3) and (A.4) into (A.2) we can determine the demand for researchers in the normal good sector as a function of H_t^s ,

$$H_t^n = \frac{1}{\Gamma} \frac{H_t^s \Theta_{t+1}(\gamma_n, \gamma_s, \alpha_t) + \lambda \Theta_{t+1}(\gamma_n, 1, \alpha_t) - \Gamma \lambda [1 - \Theta_{t+1}(1, \gamma_s, \alpha_t)]}{1 - \Theta_{t+1}(\gamma_n, \gamma_s, \alpha_t)}. \quad (\text{A.5})$$

In order to find the wage, we first substitute the now endogenous D_t for the previously constant L in (16):

$$w_t(z_t^s, z_t^n, \alpha_t) = \frac{z_t^n \alpha_t}{D_t z_t^s z_t^n \alpha_t + (z_t^n - z_t^s) z_t^s B\kappa}. \tag{A.6}$$

Since aggregate savings, S , must be equal to total R&D expenditures, $w_t H_t$, we can also express the wage rate as $w_t = S/(L - D_t)$. These two equations determine D_t and w_t as functions of (z_t^s, z_t^n, α_t) . Solving them yields

$$D_t(z_t^s, z_t^n, \alpha_t) = \frac{z_t^n \alpha_t L - S(z_t^n - z_t^s) z_t^s B\kappa}{z_t^n \alpha_t (1 + z_t^s S)}, \tag{A.7}$$

$$w_t(z_t^s, z_t^n, \alpha_t) = \frac{z_t^n \alpha_t (1 + z_t^s S)}{z_t^s z_t^n \alpha_t L + (z_t^n - z_t^s) z_t^s B\kappa}. \tag{A.8}$$

Recall that the fraction of expenditure devoted to the normal good is given by $\Theta_t = B\kappa p_t^s/\alpha_t = B\kappa w_t/\alpha_{t-1}$, which substituting for the wage can be expressed as

$$\Theta_t(z_t^s, z_t^n, \alpha_{t-1}) = \frac{B\kappa z_t^n (1 + z_t^s S)}{z_t^s z_t^n \alpha_{t-1} L + (z_t^n - z_t^s) B\kappa}. \tag{A.9}$$

Using (A.5) to substitute for H_t^n into the labour market clearing condition $D_t + H_t^n + H_t^s = L$, we can express the level of status good R&D as

$$H_t^{*s}(z_t^s, z_t^n, \alpha_t) = \frac{\Gamma[1 - \Theta(\gamma_s, \gamma_n, \alpha_t)][L - D_t(z_t^s, z_t^n, \alpha_t)] - \lambda\{\Theta(1, \gamma_n, \alpha_t) - \Gamma[1 - \Theta(\gamma_s, 1, \alpha_t)]\}}{\Theta(\gamma_s, \gamma_n, \alpha_t) + \Gamma[1 - \Theta(\gamma_s, \gamma_n, \alpha_t)]}. \tag{A.10}$$

Equation (A.10), together with (A.7) and (A.9), determines the equilibrium level of research in the status good sector, H_t^{*s} .

An increase in α_t now has two effects. On the one hand, it shifts resources away from normal-good research into status-good research, as $\partial\Theta/\partial\alpha < 0$. On the other, it affects the amount of labour devoted to production. If we remove the innovation shocks, i.e. let $z_t^s = z_t^n = 1$, we have $D_t = L/(1 + S)$ which is independent of α_t . (In fact, the only effect of increases in α_t on D_t is to dampen the effect of innovation shocks on aggregate demand). The aggregate level of R&D, $H_t^* = L - D_t$, can then be expressed as $H_t^* = SL/(1 + S)$. That is, changes in α_t have no permanent effect on the level of aggregate research employment. As in the model in the main text, there is no trend in the aggregate level of research (though this level is now endogenous), and the only effect of increases in α_t is to shift researchers from normal to status good R&D.

Suppose now that taxes on R&D and on consumption are introduced, with both goods being taxed at the same rate. An innovator now pays $(1 + \tau^{\text{R\&D}})w_t$ for each researcher employed, while the consumption tax implies that prices are $p_t^l = (1 + \tau^{\text{cons}})z_t^l w_t$. With a research tax, the arbitrage equation implies

$$\frac{1}{1 + \tau^{\text{R\&D}}} \frac{1}{\lambda + H_t^s} V_t^s = \frac{1}{1 + \tau^{\text{R\&D}}} \frac{1}{\lambda + H_t^n} V_t^n, \tag{A.11}$$

which results in the demand for researchers in the normal good sector being still given by (A.5).

The research tax affects capital market equilibrium, which is given by the expression $(1 + \tau^{\text{R\&D}})w_t = S/(L - D_t)$. The demand for production labour is, in turn, shifted by the consumption tax,

$$D_t = \frac{z_t^s w_t}{z_t^n w_t} \frac{1 + \tau^{\text{cons}}}{1 + \tau^{\text{cons}}} \frac{B\kappa}{\alpha_t} + \frac{1}{z_t^s (1 + \tau^{\text{cons}}) w_t} - \frac{B\kappa}{\alpha_t}. \tag{A.12}$$

Solving these two equations together, we have

$$D_t(z_t^s, z_t^n, \alpha_t) = \frac{z_t^n \alpha_t L - (z_t^n - z_t^s) S z_t^s B \kappa (1 + \tau^{\text{cons}}) / (1 + \tau^{\text{R\&D}})}{z_t^n \alpha_t [1 + S z_t^s (1 + \tau^{\text{cons}}) / (1 + \tau^{\text{R\&D}})]}, \tag{A.13}$$

and

$$w_t(z_t^s, z_t^n, \alpha_t) = \frac{z_t^n \alpha_t [1 + S z_t^s (1 + \tau^{\text{cons}}) / (1 + \tau^{\text{R\&D}})]}{z_t^s (1 + \tau^{\text{cons}}) [z_t^n \alpha_t L + (z_t^n - z_t^s) B \kappa]}. \tag{A.14}$$

The expenditure share at time $t + 1$ given the market state and α_t is then given by:

$$\Theta_{t+1}(z_{t+1}^s, z_{t+1}^n, \alpha_t) = \frac{B \kappa z_{t+1}^n [1 + S z_{t+1}^s (1 + \tau^{\text{cons}}) / (1 + \tau^{\text{R\&D}})]}{[z_{t+1}^n z_{t+1}^s \alpha_t L + (z_{t+1}^n - z_{t+1}^s) B \kappa]}. \tag{A.15}$$

The equilibrium level of research in the status good sector, H_t^{*s} , is still defined by the solution to (A.10), with the values of D_t and Θ_{t+1} now being given by (A.13) and (A.15), respectively.

The two taxes affect the current values of Θ_{t+1} and D_t in an asymmetric way. Differentiating we have $\partial \Theta_{t+1} / \partial \tau^{\text{cons}} > 0$ and $\partial \Theta_{t+1} / \partial \tau^{\text{R\&D}} < 0$. The consumption tax increases the price of the status good, and thus reduces the share of expenditure devoted to conspicuous consumption. A research tax affects demand through the wage: the tax dampens the demand for research labour, lowers the wage and thus the price for the status good, which in turn increases demand for this good.

Consider now the effect through D_t . Differentiating we get

$$\frac{\partial D_t}{\partial \tau^{\text{cons}}} = - \frac{z_t^s S}{z_t^n \alpha_t (1 + \tau^{\text{R\&D}})} \frac{z_t^n \alpha_t L + B \kappa (z_t^n - z_t^s)}{[1 + S z_t^s (1 + \tau^{\text{cons}}) / (1 + \tau^{\text{R\&D}})]^2}$$

and $\partial D_t / \partial \tau^{\text{R\&D}} = - [(1 + \tau^{\text{cons}}) / (1 + \tau^{\text{R\&D}})] \partial D_t / \partial \tau^{\text{cons}}$. Our assumption that both commodities are consumed, $0 < \Theta_t(z_t^s, z_t^n, \alpha_{t-1}) < 1$, implies that $z_t^n \alpha_t L + B \kappa (z_t^n - z_t^s) > 0$ (see (A.13)). A tax on R&D thus increases production employment, while a consumption tax reduces it.

The taxes have no impact on the current level of utility. Current demand for the normal good, D_t^n , is independent of prices and remains unaffected, so that the entire change in D_t is absorbed by a change in D_t^s . But since in equilibrium status consumption does not affect the level of utility, u_t^{*h} remains unchanged.

Taxation does, however, have dynamic effects. First note that an R&D tax increases aggregate research employment, H_t^* . However, a research tax also has the effect of reducing the share of expenditure devoted to the status good hence tending to lower employment in status R&D. The overall impact of the tax on H_t^{*s} is then ambiguous: research employment is increased by the tax but a lower proportion of it is devoted to the status good. The effect of a consumption tax will be exactly the opposite: it reduces H_t^* , but increases the fraction of these workers employed in status-good R&D.

For small values of α_t , the effect through the expenditure share is likely to dominate, and a research (consumption) tax will increase (reduce) status R&D. However, as α_t grows this effect becomes weaker, and in the limit (as α_t tends to ∞ and Θ_t tends to 0) it disappears, and only the impact through D_t matters. In the long-run, all researchers are employed in the status sector, $H_t^{*s} = H_t^* = L - D_t$. Using the expression for D_t as $\alpha_t \rightarrow \infty$, we have

$$H_t^{*s} = L - \frac{L}{1 + S z_t^s (1 + \tau^{\text{cons}}) / (1 + \tau^{\text{R\&D}})}. \tag{A.16}$$

A tax on R&D would then reduce the level of employment in status research and thus

slow down the rate of negative utility growth, while a tax on consumption would speed up the decline in utility.

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