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On the cultural transmission of preferences for social status

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Abstract

We study the formation of preferences for 'social status' as the result of intergenerational transmission of cultural traits. We characterize the behavior of parents with preferences for status in terms of socialization of their children to this particular cultural trait. We show that degenerate distributions of the population (whereby agents have either all status preferences or all non-status preferences) are dynamically unstable. Moreover, under some conditions, there exists a unique stationary distribution which is non-degenerate (in which both status and non-status preferences co-exist in the population), and this distribution is locally stable. Finally, we study the dependence of the stable stationary distribution of status preferences on institutional, technological and policy parameters which affect agents' economic conditions.

Keywords: Cultural transmission; Social status; Socialization

1. Introduction

Concepts like 'conspicuous consumption', 'habit formation', 'snob effects', 'social status' have been recently revitalized and studied in detail, building on insights in Duesenberry (1949); Leibenstein (1950); Arrow (1974); Stigler and Becker (1977); Akerlof (1984); Frank (1985) and many others. The reason for this interest comes from an increased recognition that economic theory has difficulties explaining a number of socio-economic phenomena without acknowledging the importance of interdependence of preferences.

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In particular the role of preferences for social status has been studied, relative to their effect *i*) on the allocation of resources (Fersthman and Weiss, 1993), *ii*) on savings and the accumulation of human capital (Cole et al., 1992; Fersthman et al., 1996), and relatively to their effect *iii*) on endogenous growth models (Corneo and Jeanne, 1996 and Rauscher, 1996).

In this literature the structure of social interdependence in preferences is assumed as given. More precisely, individuals are supposed to have two preference components: a private utility component and a social utility component (e.g. a taste for social recognition). Interesting implications of this preference structure on various aspects of socio-economic behavior are then derived. Natural questions arise though regarding the circumstances under which such social interdependencies in preferences will exist, and be stable over time. In other words, one would like to have a framework allowing an endogenous analysis of the formation and stability of social preferences.[1]

The first paper addressing this issue is Gruner (1995). It considers a general equilibrium model in which individuals derive utility from economic decisions and social interactions. Social norms are supposed to evolve according to a simple selection mechanism depending on past performances, and in such a setting status-seeking behavior emerge under favorable conditions of the economy. The purpose of the present paper is to go further in this direction, analyzing the dynamic determinants of the formation of status-seeking behavior. More precisely, we consider the formation of preferences for status as the result of intergenerational transmission of cultural traits. In order to do this, we extend to the case of preferences for social status a simple framework that we have developed to analyze the transmission of cultural traits (Bisin and Verdier, 1996). This framework, which builds on and extends the cultural anthropology and population dynamics literature (Cavalli-Sforza and Feldman, 1981 and Boyd and Richerson, 1985), is characterized by: *i*) parents acting consciously to socialize their offsprings to particular cultural traits; *ii*) children acquiring preferences by imitation of individual actions from the family but mediated by the social environment (in particular by the distribution of cultural traits across the population).

By modelling explicitly the process of cultural transmission, we provide microfoundations for the selective forces on interdependence of preferences. This allows us to consider precisely the forces tending in the long run towards existence and stability of preferences for social status or conformity.[2]

Concentrating on cultural traits represented by status vs. non-status preferences,

[1]More generally, endogeneity of preferences is also a topic that has been recently revitalized: cf. e.g. Frank (1985); Becker and Mulligan (1997); Rogers (1994); Bisin and Verdier (1996), and the volume by Becker (1996).

[2]An alternative and complementary route is to consider that socially interdependent preferences are biologically determined and selected by some replicator dynamics (Fersthman and Weiss, 1996 and Kockesen et al., 1997).

we show that *i*) the socio-economic choices of agents with status preferences are self-enforcing, in the sense that e.g. consumption of status goods by agents with preferences for status depends positively from the prevalence of agents with preference for status in the population; *ii*) both status and non-status agents perceive greater gains from socialization (and hence socialize more intensely their children) when they represent relative minorities in the population; and also *iii*) both status and non-status parents perceive greater gains from socialization when they expect status behavior to be predominant in the future.

These pattern of socio-economic choices and socialization gains generate interesting implications for the dynamics of preferences for status in the population:

degenerate distributions (whereby agents have either all status preferences or all non-status preferences) are dynamically unstable;

under some conditions, there exists a unique stationary distribution which is nondegenerate (both status and non-status preferences co-exist in the population), and moreover this distribution is locally stable

The set-up constructed in this paper to analyze the dynamics of preferences for status allows us also to study the dependence of the stable stationary distribution of status preferences from various institutional and policy changes. In particular, our comparative statics exercises can be interpreted to analyze the stationary state effects (on the predominance of status preferences) of e.g. *i*) changes in social institution or organizations that modify the 'production' of status and the determinants of 'social recognition', *ii*) taxation of 'status' and 'non-status goods', *iii*) subsidies to 'status occupations', *iv*) changes in agents' wealth.

The plan of the paper is the following. Section 2 introduces briefly the issue of transmission of preferences in general terms. Section 3 considers more formally the case of transmission of preferences for social status. Section 4 collects all results on socialization to preferences for status, on the dynamics of preferences for status, and on comparative statics on the stationary distribution of the population over preference traits. Finally Section 5 concludes.

2. Transmission of preferences

Before studying in detail the dynamics of the distribution in the population of preferences for social status, it is useful to introduce and discuss our approach to the problem of transmission and diffusion of preferences and cultural traits (Bisin and Verdier, 1996).

We model the transmission of cultural traits and preferences as occurring through social learning. Children are born 'naive', i.e. with not-well-defined preferences and cultural traits. They acquire preferences through observation, imitation and adoption of cultural models with which they are matched. In particular children are first matched with their family ('vertical transmission'), and then with the population at large, e.g. teachers, role models etc. ('oblique transmission'). We also identify socialization as an economic choice (mostly of parents).[3] In other words, parents purposefully attempt at socializing their children to a particular trait.[4]

The motivation for a parent to socialize his child (even though socialization is costly) comes from the fact that each parent is altruistic. But, we assume, parents can perceive the welfare of their children only through the filter of their own (the parents') preferences. This particular form of myopia (which we call 'imperfect empathy') is quite crucial in the analysis. In the set-up of this paper it has the important implication that parents always want to socialize their children to their own preferences and cultural traits (because children with preferences and cultural traits different than their parents' would choose actions that do maximize their own and not their parents' preferences).[5]

While a direct empirical analysis of cultural transmission mechanisms has never been pursued to the best of our knowledge, 'imperfect empathy' is consistent with both the study of several cultural traits in a sample of the population of Stanford students by Cavalli-Sforza and Feldman (1981) and the study of church contributions by Iannaccone (1995).[6]

[3]Both the terminology of 'vertical' and 'oblique' transmission and the transmission mechanism itself are consistent with the literature in 'cultural anthropology': cf. e.g. Cavalli-Sforza and Feldman (1981) and Boyd and Richerson (1985), and the literatures in socio-psychology and child development, cf. e.g. Bandura and Walters (1963) and Baumrind (1967). The analysis of socialization as an economic choice is in line with the literature on endogenous preferences; cf. e.g. Becker (1996).

[4]While socialization may occur as the unintended by-product of some economic activity, cf. e.g. Coleman (1990), socialization is often in fact the result of resources invested purposefully by individuals and institutions: parents devote energy and money choosing the type of school and social environment in which to put their children; voters are ready to pay taxes for specific institutions preserving their cultural identities; governments allocate significant funds into programs promoting socialization to certain type of social behavior.

[5]This is not true in general, but only in the case of 'pure cultural traits', which do not affect the real side of the economy. If one particular trait for instance enlarges substantially the economic opportunities of the children, the parents might want to socialize them to this particular trait even if different than their own. We concentrate here on the 'pure' cultural distinction between status and non-status preferences. In other words we do not consider e.g. the effects that status-seeking behaviour might have on the labour market opportunities of an agent.

[6]Moreover (admittedly anecdotal or indirect) evidence can be cited for the 'imperfect empathy' e.g. of families trying to have children *i*) marry in their own ethnic or religious group (Todd, 1994), *ii*) carry on the 'family trade'. Also, the Catholic Church (e.g. in the recurrent words of Cardinal Carlo Maria Martini) laments the drop of status associated to vocational occupations, and attributes it to the prevailing cultural attitudes at the level of the family. Finally, 'imperfect empathy' is in line with both 'non-idealistic' philosophical thought (cf. Masson, 1995) and especially with theoretical and empirical work in psychology and cognitive sciences (cf. e.g. Osherson and Smith, 1990; Yates, 1990). Also, it is related to formal bounded rationality theory (cf. e.g. Rubinstein, 1996); Thaler, 1991), and to case-based decision theory (cf. Gilboa and Schmeidler, 1994).

It is our contention that this approach is very fit for the analysis of transmission of preferences for social status: we see parents' actively and purposefully attempting to socialize their children to their own vision about different life-styles.

3. Transmission of status preferences

We introduce here the set-up we use to study inter-generational transmission of preferences for status. Consider an overlapping generation structure. In each generation there is a continuum of agents. An individual lives for two periods, as a child and as an adult. Moreover he has one offspring. (Hence population is stationary and normalized to 1).

Preferences. There are two possible types (a and b) of preferences in the population. Agents with preferences of type a are the status agents. Their preferences are represented by the utility function $u^a(x, \bar{x})$, where x represents consumption of a 'status good', and $\bar{x}$ represents the average consumption of the status good in the population. We assume that x belongs to a closed convex compact set $X = [0, x^{\max}]$, and $u^a(x, \bar{x})$ is twice continuously differentiable and strictly concave in both arguments. Moreover, to guarantee interior solutions of the agents' choices, we make the regularity assumptions that $(\partial/\partial x)u^a(x^{\max}, \bar{x}) < 0$, and $(\partial/\partial x)u^a(0, \bar{x}) > 0$, for all $\bar{x}$.

(Different examples can be illustrated with this general formulation: x could for instance represent i) effort or education level (cf. e.g. Fersthman and Weiss, 1993), or ii) savings affecting the accumulation of assets (cf. e.g. Cole et al., 1992; Corneo and Jeanne, 1996), or else iii) conspicuous consumption signalling the income ranking in society (cf. e.g. Bernheim, 1994).

The non-status agent (with preferences of type b) has utility function $u^b(x)$, where for symmetry we assume $u^b(x) = u^a(x, x)$, so that the two agent types just differ in their preference for status.[7] Other assumptions on preferences are collected in the following.

Assumption 1. Agents' preferences satisfy:

1. $\dfrac{\partial}{\partial \bar{x}} u^a(x, \bar{x}) < 0, \; \dfrac{\partial^2}{\partial x \partial \bar{x}} u^a(x, \bar{x}) > 0$

2. $\left| \dfrac{\partial^2}{\partial x \partial \bar{x}} u^a(x, \bar{x}) \right| < \left| \dfrac{\partial^2}{\partial x \partial x} u^a(x, \bar{x}) \right|$

Assumption 1.1 characterizes our definition of preferences for status: an increase

[7]The assumptions on prefences are consistent with $u^a(x, \bar{x})$, $u^b(x)$ representing the indirect utility of consumption choice over one 'status good', x, and other 'non-status' goods.

in the average consumption of the status good, $\bar{x}$, for a given x, decreases the utility of the agent[8] and increases the marginal utility for the status good x. It directly implies that the optimal choice of x for the status agent increases with $\bar{x}$. Assumption 1.2 requires greater 'sensibility' of the marginal utility of x to changes in x than to changes in $\bar{x}$.

Let us now introduce the analysis of the socio-economic interaction between status and non-status agents, as well as of the socialization choice of parents.

The Socio-Economic Problem. Each adult non-status agent b solves[9]

$$\max_{x \in X} u^b(x)$$

We denote the solution with x_0.

The choice problem for the adult status agent at time t, given $\bar{x}$, is:

$$\max_{x \in X} u^a(x, \bar{x})$$

This defines a continuous function $x^a(\bar{x})$ mapping X into X. Let q_t be the fraction of status agents (type a) in the population at time t. The equilibrium level of the status variable $\bar{x}$ by definition is the average consumption of x. Hence it solves the fixed point:

$$\bar{x} = q_t x^a(\bar{x}) + (1 - q_t)x_0$$

Given $x^a(\bar{x})$, the solution of the fixed point is represented by a mapping $\bar{x}(q_t)$. We may then construct the composite mapping $x^a(\bar{x}(q_t))$.

Socialization. The socialization of a naive individual occurs in two steps. First the naive child is exposed to the parent model (type a or b) and adopts his parents' preferences with a certain probability τ^i, $i \in \{a, b\}$. With probability $1 - \tau^i$ the child is matched randomly with an individual of the old generation and adopts then the preferences of that individual.

More precisely as q_t denotes the fraction at time t of individuals of the old generation which are of type a, transition probabilities P_t^{ij} that a parent of type i has a child adopting a preference of type j are given by:

$$P_t^{aa} = \tau^a + (1 - \tau^a)q_t; \quad P_t^{ab} = (1 - \tau^a)(1 - q_t) \tag{1}$$

$$P_t^{bb} = \tau^b + (1 - \tau^b)(1 - q_t); \quad P_t^{ba} = (1 - \tau^b)q_t \tag{2}$$

[8] The first assumption differentiates status preferences from preferences for conformism: preferences for conformism would rather be characterized by $(\partial/\partial\bar{x})u^a(x, \bar{x}) > (<)\ 0$ when $x > (<) \bar{x}$ as individuals concerned with conformity would always like to be close to the average behavior $\bar{x}$ in society.

[9] Cf. the appendix for a formal analysis of the agents' optimization problems introduced in the text, and for the proofs of the propositions.

Given the transition probabilities P_t^{ij}, the fraction q_{t+1} of adult individuals of type a in period $t+1$ is easily calculated to be:

$$q_{t+1} = q_t + q_t(1-q_t)[\tau^a - \tau^b] \tag{3}$$

The Socialization Problem. There are many dimensions along which it is costly for parents to socialize their children to a certain preference pattern (cf. footnote 4). Here we simple denote with $H(\tau^i)$ the cost of socialization effort τ^i. We assume it is twice continuously differentiable, strictly increasing and strictly convex. We assume also that $H(0)=0$ and $(\mathrm{d}/\mathrm{d}\tau^i)H(0)=0$. Formally, each parent with preferences of type $i \in \{a, b\}$ at time t chooses τ^i to maximize

$$\beta[P_t^{ii}V^{ii}(q_{t+1}) + P_t^{ij}V^{ij}(q_{t+1})] - H(\tau^i) \tag{4}$$

where[10] β is the discount rate; P_t^{ii} and P_t^{ij} are the transition probabilities of the parent's cultural trait to the child (which, as defined above in Eq. (1)–2), depend on τ^i and q_t); $V^{ii}(q_{t+1})$ (resp. $V^{ij}(q_{t+1})$) denotes the utility from the economic action of a child of type i (resp. j) as perceived by a parent of type i.[11] More precisely,

$$V^{aa}(q_{t+1}) = u^a(x^a(q_{t+1}, \bar{x}(q_{t+1})) \quad V^{ab}(q_{t+1}) = u^a(x_0, \bar{x}(q_{t+1}))$$
$$V^{bb}(q_{t+1}) = u^b(x_0) \qquad V^{ba}(q_{t+1}) = u^b(x^a(q_{t+1})$$

Note that this definition of $V^{ij}(q_{t+1})$, for $i, j \in \{a, b\}$, embodies 'imperfect empathy': it clearly implies that $V^{aa}(q_{t+1}) \geq V^{ab}(q_{t+1})$ and $V^{bb}(q_{t+1}) \geq V^{ba}(q_{t+1})$ and hence parents like to socialize their children to their own preference trait.[12]

Let $\tau^a(q_t, q_{t+1})$ and $\tau^b(q_t, q_{t+1})$ denote the solution of the socialization problem respectively for agents a and b.

4. Socialization and dynamics of preferences for status

We first characterize the socio-economic problem of status agents. This is done in proposition 1 and 2.

Proposition 1. *If preferences satisfy assumption 1, then*

[10] Note that $H(\tau^i)$ must be convex enough so that the solution of the socialization problem is $\tau^i < 1$.

[11] We can separate the socio-economic and the socialization problem because we assume socialization cost enters separately into preferences. This is just for simplicity.

[12] In the socialization problem then, without loss of generality, we allow each agent i to socialize children only to trait i.

- $x^a(\bar{x})$ *is a monotonically increasing continuous function*
- $x^a(\bar{x}(q_t))$ *is also a monotonically increasing and continuous function in* q_t

Agents with preferences for status increase their consumption of the status good with the average consumption of the status good in the population. This is because an increase in $\bar{x}$ increases the marginal utility of x for status agents (by assumption 1.1). And since the average consumption of the status good increases with the fraction of status agents in the population ($\bar{x}(q_t)$ is a monotonically increasing continuous function), individual consumption also increases with the fraction of status agents.

Proposition 2. $\tau^a(q_t, q_{t+1})$ *and* $\tau^b(q_t, q_{t+1})$ *are increasing in* q_{t+1}; *while* $\tau^a(q_t, q_{t+1})$ (*resp.* $\tau^b(q_t, q_{t+1})$) *is decreasing* (*resp. increasing*) *in* q_t.

The socialization effort of parents with status preferences, $\tau^a(q_t, q_{t+1})$, is decreasing in the fraction of status preferences in the population, q_t: the larger the fraction of status preferences, the better children are socialized to the status trait by the outside cultural and social environment (i.e. 'obliquely', independently on parents' effort τ^a. Symmetrically, non-status parents' effort, τ^b, depends negatively on the fraction of non-status preferences, $1-q_t$ (hence positively on q_t).

The analysis of the dependence of socialization effort on the future prevalence of cultural traits is more complex (and interesting). Parents' socialization effort depends positively on the relative gains they perceive from children with their own cultural trait: $\Delta V^a(q_{t+1})=V^{aa}(q_{t+1})-V^{ab}(q_{t+1})$ and $\Delta V^b(q_{t+1})=V^{bb}(q_{t+1})-V^{ba}(q_{t+1})$. For the non-status agents, then, when q_{t+1} increases, all agents expect that the future social equilibrium $\bar{x}(q_{t+1})$ will be larger and conversely that the optimal action of social status agents $x^a(\bar{x}(q_{t+1}))$ will also be larger. Hence non-status parents perceive an increased cost to have their child different from them as the deviation of the optimal choice of status agents from their own optimal choice, x_0, is increased. Hence $\Delta V^b(q_{t+1})$ is increasing in q_{t+1}.

For parents with status preferences, an increase in $\bar{x}(q_{t+1})$ has two effects. On one hand it reduces the perceived benefit for a social status parent to have his child sharing the same preferences (this is because an increase in $\bar{x}$ induces status agents to increase x at the optimum, but this is costly since status agents consume at a point where $u^a(x, x)$ is decreasing in x). On the other hand it also increases the cost for a social status parent to see his child being a non-status agent, as clearly $V^{ab}(q_{t+1})$ is decreasing in the average behavior $\bar{x}(q_{t+1})$. Assumptions 1.1 and 1.2 guarantee that the second effect is stronger than the first one. Therefore the incentives for status parents to transmit their preferences for social status are increasing with their expectations about the predominance of preferences for status in the population.

The dynamics of the distribution of preferences for status in the population are derived by substituting $\tau^i(q_t, q_{t+1})$ into Eq. (3)):

$$q_{t+1} - q_t = q_t(1 - q_t)[\tau^a(q_t, q_{t+1}) - \tau^b(q_t, q_{t+1})] \tag{5}$$

We have then:

Proposition 3. *The degenerate stationary states of the dynamics of the distribution of preferences for status*, $q=0$ *and* $q=1$, *are locally unstable*.

This result crucially depends on the fact that $\tau^a(q_t, q_{t+1})$ (resp. $\tau^b(q_t, q_{t+1})$) is decreasing (resp. increasing) in q_t (proposition 2), and holds more generally when this property holds. Intuitively, since minorities value socialization to their own trait more than majorities, they produce higher socialization efforts, which counteracts their tendency to disappear (due to the fact that the outside cultural environment is biased towards socialization to the majority's trait). Note that this property is driven by the fact that socialization effort is chosen optimally by parents (the property would not hold with exogenous τ^i, as in Cavalli-Sforza and Feldman, 1981 or Boyd and Richerson, 1985).[13]

While more general results are possible at a notational cost, we prefer here to proceed by specializing the form of the preferences for status.

Assume that the cost of socialization by parents has a quadratic form $H(\tau^i) = (\tau^i)^2/2K$.[14] Preferences for the status agents are specialized to:

$$u^a(x, \bar{x}) = u(x) + Jf(x, \bar{x}) \text{ where } f(x, \bar{x}) = \begin{cases} (x - \bar{x}) & \text{if} \quad x - \bar{x} < S \\ S & \text{otherwise} \end{cases}$$

where J is a parameter reflecting the intensity of preferences for social status. To get rid of trivial agents' choices, we also make the regularity assumptions that $u(x)$ is twice continuously differentiable, strictly concave, and satisfies $(d/dx)u(0) > 0$, $(d/dx)u(x^{\max}) < J$, $u(x_0 + S) + J > 0$ and $u(x^{\max} + S) + J < 0$. Also, since we assumed $u^b(x) = u^a(x, x)$, we have $u^b(x) = u(x)$.

Note that this specification does not satisfy the differentiability assumptions imposed in the previous section. The sense in which this is a particular case of the set-up introduced in Section 3 is clarified by noticing that $u(x) + Jf(x, \bar{x})$ can be

[13] This property also differentiates socialization mechanisms from evolutionary mechanisms based on replicator dynamics and genetic fitness. With genetic fitness the dynamics of q_t depends on whether increasing the variable x beyond some point induces a positive or negative shift in fertility rates of individuals with social status preferences. Clearly in a long term model considering the co-evolution of genetic and cultural selection processes, the stationary state structure of preferences will depend both on biological as well as social factors.

[14] The parameter K must be chosen small enough so that in equilibrium $\tau^i < 1$, $i = a, b$ (cf. footnote 10).

approximated arbitrarily well by a continuously differentiable concave function which satisfies assumption 1.[15]

For this specification of preferences we can derive a simple closed form characterization of equilibrium and dynamics (cf. Appendix). In particular, there exist a value of $q \in (0, 1)$, let it be denoted $\bar{q}$, such that:

if $q_t \leq \bar{q}$, agents with status preferences choose $x^a = \bar{x} + S$, i.e. they increase their consumption of the status good one-to-one with increases in average consumption of the status good; otherwise,

if $q_t > \bar{q}$, $\bar{x}$ is high enough that increases in $\bar{x}$ have no more effects on status agents' utility, and hence their choice of x^a is independent from $\bar{x}$.

Moreover, with this specification of status preferences it is straightforward to complete the characterization of the dynamics of the distribution of preferences given by Proposition 1:

Proposition 3. (bis) *The dynamical system for q_t has three stationary states*: $q=0$, $q=1$ *which are locally unstable; and a unique interior stationary state q_s given by*:

$$q_s = 1 - \frac{u(x_0) - u\left(\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J)\right)}{J\left[\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J) - x_0\right]} \quad \text{if} \quad JS > \left[u(x_0) - u\left(\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J)\right)\right]$$

$$q_s = 1 - \frac{S}{u^{-1}[u(x_0) - JS] - x_0} \quad \text{if} \quad JS \leq \left[u(x_0) - u\left(\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J)\right)\right]$$

which is locally stable for K small enough.[16]

[15] We thank Efe Ok for providing us with a simple proof of this fact. The proof is available upon request from the authors. The results of Propositions 1–3 hold for the special model we study here. This is also directly shown in the proof of Proposition 3 (bis) and after the proof of Lemma 1 in the appendix. Actually for the results which follow to hold qualitatively what is effectively required is: *i*) the separation of preferences for good x (represented in this specification by $u(x)$) from preferences for status (represented by $f(x, \bar{x})$), *ii*) preferences for status f to be a function of $(x - \bar{x})$, and *iii*) enough concavity on preferences for status.

[16] When socialization costs are not convex enough (i.e. K not small enough), then the dynamics of the system may exhibit complicated orbits around q_s.

4.1. Comparative statics

An interesting implication of our framework is the fact that parameters of the individual objective function as well as social status function of the agents have an influence on the long run pattern of the distribution of preferences in the population.

The following proposition studies the effect of the parameter J on the long run distribution of social status preferences. In our set-up J may represent the intensity both of preferences for and production of social status (e.g. the importance of social networks and organizations in the population, since social status is produced and possibly enjoyed via social networks and organizations).

Proposition 4. (*Social Status Effects*). *If* $q_s \leq \bar{q}$[17] *then* q_s *is increasing in* J. *When* $q_s > \bar{q}$ *then* q_s *is increasing* (*resp. decreasing*) *in* J *if the following function*

$$\epsilon(x) = \frac{\mathrm{dlog}[u(x_0) - u(x)]}{\mathrm{dlog}[x - x_0]}$$

is increasing (*resp. decreasing*) in x.

Status preferences generating at the margin more benefits in terms of social distinction or putting more weight to social interdependencies (i.e. a higher J), other things being equal, may be more successful from a cultural selection point of view against non-status preferences. The intuition is as follows.

When $q_s \leq \bar{q}$, the stationary state q_s is such that the associated choice of status agents and average socio-economic behavior, x^a and $\bar{x}$, are in the regime in which $x^a = \bar{x} + S$. If instead $q_s > \bar{q}$, then x^a is independent of $\bar{x}$. Inside each region of the parameters, an increase of J pushes up the benefits perceived by 'social status' parents of having their offspring sharing their own preferences. In the region of parameters corresponding to $q_s \leq \bar{q}$ the optimal socio-economic choice of status agents, $x^a(\bar{x}(q_s))$, does not change with J and a shift of this parameter does not affect the socialization incentives of non-status parents. Hence for this configuration of parameters, one gets larger incentives to socialization to social status preferences than to non-status ones and therefore a larger stationary state of individuals sharing these social preferences. In the other parameter region (corresponding to $q_s > \bar{q}$), an increase in J increases $x^a(\bar{x}(q_s))$ and consequently also increases the benefits for non-status parents to have children like them. The whole effect on the long run stationary state q_s is therefore *a priori* ambiguous. When the elasticity $\epsilon(x)$ of the difference $u(x_0) - u(x)$ with respect to the difference $x - x_0$ is monotonic in x, we are able to say which socialization incentives (status versus non-status) increases proportionately faster than the other and hence to sign

[17] In terms of the primitives of the model, this occurs for $J \leq [u(x_0) - u((\mathrm{d}/\mathrm{d}x)u^{-1}(-J))]$.

the implication for the long run stationary state q_s. For example when $\epsilon(x)$ is increasing in $x > x_0$, then the incentives for status parents increase faster in proportion than those of non-status parents which in turn implies a larger fraction of individuals sharing preferences for social status.[18]

Changes in the private objective function may also affect the long run distribution of social status preferences. To analyze this case we rewrite preferences for good x, $u(x)$, as $u(x, \theta)$. We also assume:

$$\frac{\partial^2 u(x, \theta)}{\partial x \partial \theta} > 0 \tag{6}$$

This condition guarantees that the marginal return of the socio-economic action x is affected positively by an increase in θ. Thus the privately optimal action $x_0(\theta)$ is increasing in θ.

This general formulation includes many different contexts. For example if x corresponds to an educational or effort choice, then θ might capture returns to education net of taxation; alternatively, if x represents savings or wealth accumulation, θ might capture returns to capital net of taxes. Finally, if x represents conspicuous consumption, θ might capture the relative price of the status good net of consumption tax. All these cases are studied as examples of the following proposition which identifies general conditions under which an increase in θ tends to promote in the long run social status preferences.

Proposition 5. (*Economic and Policy Effects*). *Assume that $u(x, \theta)$ satisfies (6) and also the following condition:*

$$-\frac{\dfrac{\partial^2 u(x, \theta)}{\partial x \partial \theta}}{\dfrac{\partial^2 u(x, \theta)}{\partial x^2}} \text{ is monotonic in } x \tag{7}$$

Then for $q_s < \bar{q}$:

$$\frac{\partial q_s}{\partial \theta} > (<) 0, \text{ when } -\frac{\dfrac{\partial^2 u(x, \theta)}{\partial x \partial \theta}}{\dfrac{\partial^2 u(x, \theta)}{\partial x^2}} \text{ is increasing (decreasing) in } x$$

Condition 7) in the proposition is a monotonicity condition on the slope of the marginal private benefit isocurves, defined by $(\partial/\partial x)u(x, \theta) = \text{constant}$. When it is satisfied, one can show that the incentives for parents of type a and b to socialize

[18]When the utility function $u(.)$ is quadratic, this elasticity $\epsilon(x)$ is equal to 1 and $q_s = 1/2$ is independent from J. When the utility function is Cobb–Douglas: $u(x) = x^{\alpha}((x_0/\alpha) - x)^{1-\alpha}$, then this elasticity $\epsilon(x)$ is decreasing in $x > x_0$ and q_s is decreasing in J.

their child are shifted in opposite direction by a change of θ. Hence a nonambiguous change of the long run stationary state q_s. While it is difficult to interpret this proposition intuitively, one may get sense of what it means by looking at specific examples:

Example 1. *Effort or Occupation*: $u(x, \theta)=\theta x+F(1-x)$ with $(\mathrm{d}/\mathrm{d}x)\, F(x)\geq 0$ and $(\mathrm{d}^2/\mathrm{d}x^2)\, F(x)<0$. An interpretation of this formulation is that each individual has one unit of time which he allocates to one 'status sector' with constant returns to scale and another sector with decreasing returns. The parameter θ can be interpreted as the return to the 'status sector'. Alternatively it can be interpreted as a measure of a specific subsidy to that sector. Then it is easy to check that:

$$-\frac{\dfrac{\partial^2 u(x,\theta)}{\partial x \partial \theta}}{\dfrac{\partial^2 u(x,\theta)}{\partial x^2}} = \frac{-1}{\dfrac{\mathrm{d}^2}{\mathrm{d}x^2} F(1-x)}$$

Hence from Proposition 5), $q_s(\theta)$ is increasing (decreasing) in θ when the marginal return to the non-status sector $(\mathrm{d}/\mathrm{d}x)F(x)$ is convex (concave). In the case of a Cobb Douglas technology $F(1-x)=(1-x)^\alpha$ with $0<\alpha<1$, $(\mathrm{d}/\mathrm{d}x)F(.)$ is concave and therefore $q_s(\theta)$ is decreasing in θ.

Example 2. *Wealth and Savings*: $u(x, \theta)=\log(\theta-x)+\rho\ \log(x)$. This specification is a very common one used for example in overlapping generation models where θ could be interpreted as the income of the young and x their saving decision. In this case:

$$-\frac{\dfrac{\partial^2 u(x,\theta)}{\partial x \partial \theta}}{\dfrac{\partial^2 u(x,\theta)}{\partial x^2}} = \frac{1}{1+\rho\left[\dfrac{\theta-x}{x}\right]^2}$$

which is increasing in x. Hence in this case, an increase in θ implies an increase in q_s.

Example 3. *Conspicuous Consumption*: utility is Cobb–Douglas over two goods, a status good x and the numeraire, c_n: $u(x, c_n)=\beta\ \log(x)+(1-\beta)\ \log(c_n)$. All agents have the same endowment ω. The relative price of the status good is θ. Given the budget constraint $\theta x+c_n=\omega$, the reduced form of private utility $u(x, \theta)$ can be written as: $u(x, \theta)=\beta\ \log(x)+(1-\beta)\log(\omega-\theta x)$. In this case:

$$-\frac{\frac{\partial^2 u(x,\theta)}{\partial x \partial \theta}}{\frac{\partial^2 u(x,\theta)}{\partial x^2}} = \frac{-(1-\beta)\omega}{(1-\beta)\theta^2 + \beta\left[\frac{\omega - \theta x}{x}\right]^2}$$

which is decreasing in x. Hence taxing consumption of the status good (i.e. increasing θ) implies a reduction of the long run fraction q_s of individuals with status preferences.

We stress that the results of Proposition 5) can be seen from two different and complementary perspectives depending on weather θ is interpreted as a parameter reflecting 'supply side' fundamentals of the economy like technology, factor endowments, institutions, or else as a fiscal policy variable.

5. Conclusion

The quest for social status is a pervasive phenomenon is human societies. Most of the economic literature on the subject has taken the route of assuming the existence of preferences for status and to derive the consequences of this structure on production, growth, technologies and institutions. Building on recent work on evolutionary anthropology and cultural transmission, the present paper concentrates on issues related to the formation and stability of such preferences. In our set-up standard economic 'supply side' fundamentals, like technologies or endowments or policy instruments, have also effects on the structure and stability of long run social values. From a policy point of view, this aspect may be of relevance when studying the regulation of the education sector or the labor market, inasmuch as policies promoting investments in certain types of education or particular professional occupations may have significant long run effects on the status role perceived by individuals for this types of education or occupations.

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Appendix

Proof of Proposition 1. The optimization problem $\max_{x \in X} u(x, \bar{x})$ is a well defined concave problem on a compact choice set. Its argmax, $x^a(\bar{x})$, is then a continuous function. Moreover, by the implicit function theorem on the first order condition, $(\partial/\partial x)u^a(x, \bar{x})=0$, and using Assumption 1.1, $x^a(\bar{x})$ is increasing in its argument.

$\bar{x}(q_t)$ is the solution of the fixed point problem: $\bar{x}=q_t x^a(\bar{x})+(1-q_t)x_0$. Hence $\bar{x}(q_t)$ is a function iff the fixed point is unique for any $q_t \in [0, 1]$. Uniqueness of the fixed point follows by the contraction mapping theorem if

$$\frac{\mathrm{d}}{\mathrm{d}\bar{x}}[q_t x^a(\bar{x}) + (1-q_t)x_0] < 1, \ \forall q_t \in [0, 1]$$

which is satisfied under Assumption 1.2.

Finally the implicit function theorem on $\bar{x}-q_t x^a(\bar{x})+(1-q_t)x_0=0$ implies that $\bar{x}(q_t)$ is increasing. It then follows trivially that $x^a(q_t)=x^a(\bar{x}(q_t))$ is increasing and continuous in q_t. QED

Proof of Proposition 2. The solutions of the agents' Socialization Problems (introduced in Section 3) satisfy:

$$\frac{\partial \tau^a}{\partial q_t} = \beta \frac{V^{aa}(q_{t+1}) - V^{ab}(q_{t+1})}{\frac{\partial^2}{\partial \tau^2} H(\tau^a)} < 0, \text{ and } \frac{\partial \tau^b}{\partial q_t} = \beta \frac{V^{bb}(q_{t+1}) - V^{ba}(q_{t+1})}{\frac{\partial^2}{\partial \tau^2} H(\tau^b)} > 0$$

Also, clearly sign $(\partial \tau^i/\partial q_{t+1})=\text{sign }(\mathrm{d}\Delta V^i/\mathrm{d}q_{t+1})$.

Using the envelope theorem,

$$\frac{\mathrm{d}\Delta V^a}{\mathrm{d}q_{t+1}} = \frac{\partial}{\partial \bar{x}} u^a(x^a(q_{t+1}), \bar{x}(q_{t+1})) \frac{\mathrm{d}\bar{x}}{\mathrm{d}q_{t+1}} - \frac{\partial}{\partial \bar{x}} u^a(x_0, \bar{x}(q_{t+1})) \frac{\mathrm{d}\bar{x}}{\mathrm{d}q_{t+1}} > 0,$$

because $\mathrm{d}\bar{x}/\mathrm{d}q_{t+1}>0$; and $(\partial/\partial\bar{x})\ u^a(x^a(\bar{x}(q_{t+1})), \bar{x}(q_{t+1}))>(\partial/\partial\bar{x})\ u^a(x_0, \bar{x}(q_{t+1}))$ since $x_0<x^a(\bar{x}(q_{t+1}))$ (using Assumption 1.1).

Similarly

$$\frac{\mathrm{d}\Delta V^b}{\mathrm{d}q_{t+1}} = -\frac{\mathrm{d}}{\mathrm{d}x} u^b(x^a(\bar{x}(q_{t+1}))) \frac{\mathrm{d}x^a(\bar{x}(q_{t+1}))}{\mathrm{d}q_{t+1}} > 0$$

again because $(\mathrm{d}/\mathrm{d}q_{t+1})(x^a(\bar{x}(q_{t+1}))$ and $(\mathrm{d}/\mathrm{d}x)\ u^b(x^a(\bar{x}(q_{t+1})))<0$ (since $x_0< x^a(\bar{x}(q_{t+1}))$). QED.

Proof of Proposition 3. It is sufficient to prove that:

$$\frac{\mathrm{d}q_{t+1}}{\mathrm{d}q_t}\Big|_{q_t=q_{t+1}=0} > 1, \frac{\mathrm{d}q_{t+1}}{\mathrm{d}q_t}\Big|_{q_t=q_{t+1}=1} > 1$$

By the implicit function theorem on Eq. (3)), $(\mathrm{d}q_{t+1}/\mathrm{d}q_t)\big|_{q_t=q_{t+1}=0}=1+$

$(\tau^a(0, 0) - \tau^b(0, 0))$ and $(\mathrm{d}q_{t+1}/\mathrm{d}q_t)|_{q_t=q_{t+1}=1} = 1 + (\tau^b(1, 1) - \tau^a(1, 1))$. But $\tau^a(0, 0) = 0$ and $\tau^b(1, 1) = 0$; and moreover, by Proposition 2:

$$\frac{\partial \tau^a}{\partial q_t} < 0, \text{ and } \frac{\partial \tau^b}{\partial q_t} > 0$$

As a consequence $\tau^a(1, 1) < \tau^b(1, 1)$ and $\tau^a(0, 0) > \tau^b(0, 0)$, which imply that, respectively, $q = 1$ and $q = 0$ are locally unstable. QED

The Specialized Model: Closed Form Solution.

We study now the model specialized to:

$$H(\tau^i) = \frac{(\tau^i)^2}{2K}$$

$$u^a(x, \bar{x}) = u(x) + Jf(x, \bar{x})$$

$$\text{where } f(x, \bar{x}) = \begin{Bmatrix} (x - \bar{x}) & \text{if} & x - \bar{x} < S \\ S & \text{otherwise} & \end{Bmatrix}$$

Lemma 1. *There exists* $\bar{q} \in (0, 1)$ *such that for any* $q_t \in [0, 1]$, *the population average of the status action*, $\bar{x}(q_t)$, *and the status agents' action*, $x^a(\bar{x}(q_t))$, *are continuous functions of* q_t, *determined by*

$$\bar{x}(q_t) = \begin{cases} \dfrac{q_t}{1 - q_t} S + x_0 \text{ when } q_t \leq \bar{q} \\ q_t \dfrac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J) + (1 - q_t)x_0 \text{ when } q_t > \bar{q} \end{cases}$$

$$x^a(\bar{x}(q_t)) = \begin{cases} \dfrac{1}{1 - q_t} S + x_0 \text{ when } q_t \leq \bar{q} \\ \dfrac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J) \text{ when } q_t > \bar{q} \end{cases}$$

Proof of Lemma 1. The solution of the status agents' problem, given $\bar{x}$, is simply:

$$x^a = \bar{x} + S \text{ if } \frac{\mathrm{d}}{\mathrm{d}x} u(\bar{x} + S) + J \geq 0$$

$$x^a = \frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J) \text{ if } \frac{\mathrm{d}}{\mathrm{d}x} u(\bar{x} + S) + J < 0$$

The fixed point problem for $\bar{x}$, given $q_t = q$, can then be written $\bar{x} + S = qx^a(\bar{x}) + (1 - q)x_0 + S$. Substituting x^a above gives:

$$\bar{x} = \begin{cases} \dfrac{q}{1 - q} S + x_0 \quad \text{if} \quad \dfrac{\mathrm{d}}{\mathrm{d}x} u\left(\dfrac{S}{1 - q} + x_0\right) + J \geq 0 \\ q \dfrac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J) + (1 - q)x_0 \quad \text{if} \quad \dfrac{\mathrm{d}}{\mathrm{d}x} u\left(\dfrac{S}{1 - q} + x_0\right) + J < 0 \end{cases}$$

The function $\Omega(q)=(\mathrm{d}/\mathrm{d}x)u((S/1-q)+x_0)+J$ is decreasing in q and, since we assumed for regularity that $(\mathrm{d}/\mathrm{d}x)\,u(x_0+S)+J>0$ and $(\mathrm{d}/\mathrm{d}x)u(x^{\max}+S)+J<0$, it has the property that $\Omega(0)>0$ and $\Omega(1)<0$. Hence there exists a unique $\bar{q}\in(0, 1)$ such that

$$\frac{\mathrm{d}}{\mathrm{d}x}u\left(\frac{S}{1-\bar{q}}+x_0\right)+J=0$$

As the continuity of $\bar{x}$ and x^a as functions of q_t is straightforward, the statement in Lemma 1 is proved for such a $\bar{q}$. QED.

Note that $x^a(\bar{x})$ and $x^a(\bar{x}(q_t))$ are increasing function as in the general case in Proposition 1.

One may also derive easily the incentives for parents to transmit their preferences. They are given by the following first order conditions:

$$\tau^a=\beta K(1-q_t)\Delta V^a(q_{t+1}) \text{ and } \tau^b=\beta K q_t \Delta V^b(q_{t+1}) \tag{8}$$

with

$$\Delta V^a(q_{t+1})=\begin{cases} u\left(\frac{1}{1-q_{t+1}}S+x_0\right)-u(x_0)+J\frac{1}{1-q_{t+1}}S \text{ when } q_{t+1}\leq\bar{q} \\ u\left(\frac{\mathrm{d}}{\mathrm{d}x}u^{-1}(-J)\right)-u(x_0)+J\left[\frac{\mathrm{d}}{\mathrm{d}x}u^{-1}(-J)-x_0\right] \text{ otherwise}\end{cases} \tag{9}$$

$$\Delta V^b(q_{t+1})=\begin{cases} u(x_0)-u\left(\frac{1}{1-q_{t+1}}S+x_0\right) \text{ when } q_{t+1}\leq\bar{q} \\ u(x_0)-u\left(\frac{\mathrm{d}}{\mathrm{d}x}u^{-1}(-J)\right) \text{ otherwise}\end{cases} \tag{10}$$

Note that $\tau^i(q_t, q_{t+1})$, $i\in\{a, b\}$, have the same properties derived for the general case in Proposition 2.

It is now possible to prove Proposition 3 bis) by solving directly for q_s.

Proof of Proposition 3. (bis) *i*) Following the proof of Proposition 3, to show that $q=0$ and $q=1$ are locally unstable stationary states, we must show that

$$\tau^a(0, 0)-\tau^b(0, 0)>0 \text{ and } \tau^a(1, 1)-\tau^b(1, 1)<0$$

(note that this uses the implicit function theorem on Eq. (3)) in a neighborhood of $q=0$ and $q=1$; which is possible since the nondifferentiablity of τ^i, $i\in\{a, b\}$, occurs at some $\bar{q}$ in (0, 1)). Given Eq. (8), we must check respectively that

1. $\Delta V^a(0)>0$ (since $\tau^b(0, 0)=0$)

2. $\Delta V^b(1)>0$ (since $\tau^a(1, 1)=0$)

From Eq. (9), taking $0=q_{t+1}$ and using $0<\bar{q}$, we have $\Delta V^a(q_{t+1})=u((1/1-q_{t+1})\ S+x_0)-u(x_0)+J(1/1-q_{t+1})\ S$. Point 1) is then proved if $u(x_0+S)+JS>u(x_0)$. To show that this is true, note that *i*) the left hand side of this inequality is the maximum of $u(x)+J(x-\bar{x})$; *ii*) the right hand side is $u(x)+J(x-\bar{x})$ evaluated at $x=x_0$ and $q_{t+1}=0$; and *iii*) the argmax of $u(x)+J(x-\bar{x})$ is different from x_0 for $q_{t+1}<\bar{q}$.

From (10), taking $q_{t+1}=1$ and using $\bar{q}<1$, point 2) is proved if $u(x_0)>u((\mathrm{d}/\mathrm{d}x)u^{-1}(-J))$, which is true as x_0 is different from $(\mathrm{d}/\mathrm{d}x)u^{-1}(-J)=(S/1-\bar{q})+x_0$ and $u(x)$ has a maximum at x_0.

ii) The unique interior stationary state q_s solves $\tau^a(q_s, q_s)=\tau^b(q_s, q_s)$, which by Eq. (8)) gives:

$$\frac{\Delta V^a(q_s)}{\Delta V^b(q_s)}=\frac{q_s}{1-q_s}$$

or more conveniently:

$$1+\frac{\Delta V^a(q_s)}{\Delta V^b(q_s)}=\frac{1}{1-q_s} \tag{11}$$

Using (9) and (10), it is a simple matter to see that the function $\Lambda(q)=1+(\Delta V^a(q)/\Delta V^b(q))$ is continuous in q. Moreover, using the concavity of $u(.)$, one can see that it is decreasing in the range $q\leq\bar{q}$ and equal to the constant $\lambda=(J[(\mathrm{d}/\mathrm{d}x)u^{-1}(-J)-x_0]/u(x_0)-u((\mathrm{d}/\mathrm{d}x)u^{-1}(-J)))>1$, for $q\geq\bar{q}$. On the other hand, the function $d(q)=(1/1-q)$ is increasing in q with $d(0)=1$ and $d(1)=+\infty$. Hence there exists a unique interior solution $q_s\in(0, 1)$ satisfying Eq. (11). One may then compute explicitly this solution q_s after substitution and some algebra.

More precisely if $JS\leq u(x_0)-u((\mathrm{d}/\mathrm{d}x)u^{-1}(-J))$, q_s is determined by:

$$\frac{J\dfrac{S}{1-q}}{u(x_0)-u\left(\dfrac{S}{1-q}+x_0\right)}=\frac{1}{1-q}$$

which gives:

$$q_s=1-\frac{S}{\dfrac{\mathrm{d}}{\mathrm{d}x}u^{-1}(u(x_0)-JS)-x_0}$$

Similarly, if $JS>u(x_0)-u((\mathrm{d}/\mathrm{d}x)\ u^{-1}(-J))$,

$$q_s = 1 - \frac{u(x_0) - u\left(\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J)\right)}{J\left(\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J) - x_0\right)}$$

This gives

$$q_s = \begin{cases} 1 - \dfrac{u(x_0) - u\left(\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J)\right)}{J\left[\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J) - x_0\right]} & \text{if} \quad JS > \left[u(x_0) - u\left(\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J)\right)\right] \\ 1 - \dfrac{S}{u^{-1}[u(x_0) - JS] - x_0} & \text{if} \quad JS \le \left[u(x_0) - u\left(\frac{\mathrm{d}}{\mathrm{d}x} u^{-1}(-J)\right)\right] \end{cases}$$

iii) To prove the local stability of q_s, we must check that for K small enough:

$$-1 < \left| \frac{\mathrm{d}q_{t+1}}{\mathrm{d}q_t} \right|_{q_t = q_{t+1} = q_s} < 1$$

Differentiating Eq. (3)) and evaluating the derivative at $q = q_s$ (i.e. at $\Delta\tau = \tau^a - \tau^b = 0$), one gets[19]

$$\frac{\mathrm{d}q_{t+1}}{\mathrm{d}q_t}\Big|_{q_t = q_{t+1} = q_s} = \frac{1 + q_s(1 - q_s)\dfrac{\partial \Delta\tau}{\partial q_t}}{1 - q_s(1 - q_s)\dfrac{\partial \Delta\tau}{\partial q_{t+1}}} \tag{12}$$

with $(\partial\Delta\tau/\partial q_t) = -\beta \mathrm{K}[\Delta V^a + \Delta V^b]$ and $(\partial\Delta\tau/\partial q_{t+1}) = \beta \mathrm{K}[(1 - q_s)\,(\partial\Delta V^a/\partial q_{t+1} - q_s\,(\partial\Delta V^b/\partial q_{t+1}]$.

Clearly q_s does not depend on K, and neither do $(\partial\Delta V^a/\partial q_{t+1})$ and $(\partial\Delta V^b/\partial q_{t+1})$. Hence, one may always choose K small enough such that $1 - q_s(1 - q_s)(\partial\Delta\tau/\partial q_{t+1}) > 0$. Moreover, using the fact that $(\Delta V^a(q_s)/\Delta V^b(q_s)) = (q_s/1 - q_s)$, after some algebra, one gets:

$$\frac{\partial\Delta\tau}{\partial q_t} + \frac{\partial\Delta\tau}{\partial q_{t+1}} = \beta K(1 - q_s)\Delta V^a(q_s)\left[\left(\frac{1}{\Delta V^a}\frac{\partial \Delta V^a}{\partial q_{t+1}} - \frac{1}{\Delta V^b}\frac{\partial \Delta V^b}{\partial q_{t+1}}\right) - \frac{1}{1 - q_s} - \frac{1}{q_s}\right]$$

the expression is negative as the term $(1/\Delta V^a)\,(\partial\Delta V^a/\partial q_{t+1}) - (1/\Delta V^b)\,(\partial\Delta V^b/\partial q_{t+1})$ is non-positive (since $(\Delta V^a(q_{t+1})/\Delta V^b(q_{t+1}))$ is non-increasing in q_{t+1})

[19] The terms $(\partial\Delta\tau/\partial q_t)$, $(\partial\Delta\tau/\partial q_{t+1})$, ΔV^i, $(\partial\Delta V^i/\partial q_{t+1})$ must be considered as evaluated at $q_t = q_{t+1} = q_s$. We avoid for simplicity to point this out in the notation.

from Eq. (9)) and 10). From this and the positivity of $1-q_s(1-q_s)\ (\partial\Delta\tau/\partial q_{t+1})$, it follows that $(dq_{t+1}/dq_t)\ |_{q_{t+1}=q_t=q_s}<1$.

Also, $(\partial\Delta\tau/\partial q_{t+1})-(\partial\Delta\tau/\partial q_t)=\beta K[(1-q_s)\ (\partial\Delta V^a/\partial q_{t+1})+\Delta V^a-q_s\ (\partial\Delta V^b/\partial q_{t+1})+\Delta V^b]$. One again can choose K small enough such that $|(\partial\Delta\tau/\partial q_{t+1})-(\partial\Delta\tau/\partial q_t|<8$. From this $q_s(1-q_s)\ [(\partial\Delta\tau/\partial q_{t+1})-(\partial\Delta\tau/\partial q_t)]<\frac{1}{4}8=2$. Hence $(dq_{t+1}/dq_t)\ |_{q_{t+1}=q_t=q_s}>-1$; which concludes the proof of the local stability of q_s. QED.

Proof of Proposition 4. As q_s is determined by Eq. (11)), in order to do the comparative statics, we need to see how the functions $\Delta V^a(q)$ and $\Delta V^b(q)$ change with J. Defining $x^a(J)=(d/dx)u^{-1}(-J)$ we get

$$\frac{\partial\Delta V^a(q)}{\partial J}=\frac{1}{1-q}S \text{ when } q\leq\bar{q}$$

$$\frac{\partial\Delta V^a(q)}{\partial J}=\frac{d}{dx}u^{-1}(-J) \text{ when } q>\bar{q}$$

$$\frac{\partial\Delta V^b(q)}{\partial J}=0 \text{ when } q\leq\bar{q}$$

$$\frac{\partial\Delta V^b(q)}{\partial J}=J\frac{-1}{\frac{d^2}{dx^2}u\left(\frac{d}{dx}u^{-1}(-J)\right)} \text{ when } q>\bar{q}$$

Consider first the regime $JS\leq[u(x_0)-u((d/dx)\ u^{-1}(-J))]$ (i.e. $q_s\leq\bar{q}$). In this case an increase in J shifts up $\Delta V^a(q)$ but does not change $\Delta V^b(q)$. Hence the ratio $(\Delta V^a(q)/\Delta V^b(q))$ is shifted up and $(\partial q_s/\partial J)>0$.

In the regime $JS>[u(x_0)-u((d/dx)\ u^{-1}(-J))]$ (i.e. $q_s>\bar{q}$), both $\Delta V^a(q)$ and $\Delta V^b(q)$ are shifted up by an increase in J. However:

$$1+\frac{\Delta V^a(q_s)}{\Delta V^b(q_s)}=\frac{-\frac{d}{dx}u(x^a)(x^a-x_0)}{u(x_0)-u(x^a)}$$

As $x^a(J)=(d/dx)\ u^{-1}(-J)$ is increasing in J, it is easy to see that the left hand side of that equation is shifted up (down) with J if $\epsilon(x)$ is increasing (decreasing) in x. QED

Proof of Proposition 5. We consider how $\Delta V^a(q)$ and $\Delta V^b(q)$ change with θ when $q<\bar{q}$. We have then:

$$\frac{\partial \Delta V^a(q)}{\partial \theta} = \frac{\partial}{\partial \theta} u\left(\frac{S}{1-q} + x_0, \theta\right) - \frac{\partial}{\partial \theta} u(x_0, \theta) + \frac{\partial}{\partial x} u\left(\frac{S}{1-q} + x_0, \theta\right) \frac{\mathrm{d}x_0}{\mathrm{d}\theta} \text{ when } q \leq \bar{q}$$

$$\frac{\partial \Delta V^b(q)}{\partial \theta} = \frac{\partial}{\partial \theta} u(x_0, \theta) - \frac{\partial}{\partial \theta} u\left(\frac{S}{1-q} + x_0, \theta\right) - \frac{\partial}{\partial x} u\left(\frac{S}{1-q} + x_0, \theta\right) \frac{\mathrm{d}x_0}{\mathrm{d}\theta} \quad \text{when } q \leq \bar{q}$$

From this we see immediately that $\Delta V^a(q)$ and $\Delta V^b(q)$ vary in opposite direction with θ when 7) is satisfied. Noting that

$$\frac{\mathrm{d}x_0}{\mathrm{d}\theta} = \left(\frac{-\frac{\partial^2}{\partial \theta \partial x} u(x_0, \theta)}{\frac{\partial^2}{\partial x^2} u(x_0, \theta)} \right),$$

we can define the following function for $h > 0$:

$$\Psi(h) = \frac{\partial}{\partial \theta} u(x_0, \theta) - \frac{\partial}{\partial \theta} u(x_0 + h, \theta) - \frac{\partial}{\partial x} u(x_0 + h, \theta) \left(\frac{-\frac{\partial^2}{\partial \theta \partial x} u(x_0, \theta)}{\frac{\partial^2}{\partial x^2} u(x_0, \theta)} \right)$$

The function $\Psi(h)$ is such that

$$\frac{\mathrm{d}}{\mathrm{d}h} \Psi(h) = -\frac{\partial^2}{\partial \theta \partial x} u(x_0 + h, \theta) - \frac{\partial^2}{\partial x^2} u(x_0 + h, \theta) \left(\frac{-\frac{\partial^2}{\partial \theta \partial x} u(x_0, \theta)}{\frac{\partial^2}{\partial x^2} u(x_0, \theta)} \right)$$

Therefore for $h > 0$: $(\mathrm{d}/\mathrm{d}h)\ \Psi(h) <$ (resp. $>$) 0 when $-(\partial^2 u(x, \theta)/\partial x \partial \theta)/(\partial^2 u(x, \theta)/\partial x^2)$ is increasing (resp. decreasing) in x.

Hence given that $\Psi(0) = 0$, $\Psi(h) <$ (resp. $>$) 0 when $-(\partial^2 u(x, \theta)/\partial x \partial \theta)/(\partial^2 u(x, \theta)/\partial x^2)$ is increasing (resp. decreasing) in x.

Noting then that

$$\frac{\partial \Delta V^a(q)}{\partial \theta} = -\frac{\partial \Delta V^b(q)}{\partial \theta} = -\Psi(x^a - x_0)$$

we conclude that the ratio $\Delta V^a(q)/\Delta V^b(q)$ is shifted up (resp. down) with an increase in θ when

$$-\frac{\dfrac{\partial^2 u(x,\theta)}{\partial x \partial \theta}}{\dfrac{\partial^2 u(x,\theta)}{\partial x^2}} \text{ is increasing (decreasing) in } x$$

Hence the consequence for q_s as stated in the proposition. QED

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