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# Social Interaction and Effort in a Success-at-Work Augmented Utility Model

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# Social Interaction and Effort in a Success-at-Work Augmented Utility Model

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### Abstract

This paper examines how *success-at-work*, interpreted by both *subjective* and *relative* criteria, can motivate individuals to enhance their effort and utility. We employ a general specification utility function and show that the final effect of technological growth on individuals' effort and utility depends, respectively, on the assumptions we make about their nature with regard to their effort strategies (i.e. *conformists, deviants* or *neutrals*) and to their utility preferences (i.e. *altruistic* or *envious*). We show that these effects are determined largely by individuals' personal *success-consciousness* at-work, as well as their competition strategies towards *relative success* and status.

*Keywords*: Success-at-work; Effort; Happiness; Productivity.

*JEL classification*: D10, D60, D62, J24.

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# 1. Introduction

In conventional economic theory, a household's' utility is usually measured in terms of absolute level of income (largely consumption), whereas work and effort generate disutility. Although, there is a positive relationship between absolute levels of income and happiness, a number of recent papers, supported by surveys, suggest that an individual's subjective utility is more closely related to relative rather than absolute income, (Easterlin 1995, Solnick and Hemenway 1998, Alpizar, Carlsson, Johansson-Stenman 2005). Yet, there is a large literature that questions the extent to which, in relative terms higher income increases utility (i.e. Easterlin 1974, Frank 1985, Oswald, 1997, Easterlin 2001, Frey and Stutzer 2001, 2002, Stutzer, 2004); or whether people are becoming happier over time as economic growth increases (Blanchflower and Oswald 2000, Easterlin, 1995).

More interestingly, statistical evidence in industrialized countries appears to question whether work generates disutility. In general, evidence supports three findings relating to utility from work, (a) unemployed people are less happy than employed people (Clark, and Oswald 1994, Oswald 1997, Di Tella , MacCulloch, and Oswald, 2001); (b) white-collar workers are relatively happier than manual workers; (c) most people asked in surveys say that they would keep working even if they had sufficient income or won a lottery. Findings (a) and (b) may at first glance look consistent with the standard economic theory; the former for example, may be explained because of lack of income, whereas the latter because of the implied differences in income. However (c) suggests that work itself derives some source of 'joy' that is not substitutable for income. This also questions whether findings (a) and (b) are purely income related. Psychologists for example find that unemployment makes people unhappy even when they control for differences in income and that large increases in peoples' incomes cannot adequately compensate them for remaining without a job. Frey and Stutzer (2001), for example, show that subjective happiness does depend on absolute and relative income but only up to a point, above which increases in average income per head contribute little to well being. Alpizar, Carlsson and Johansson-Stenman (2005), find that although both absolute and relative income and consumption matter to individuals, people may care for certain goods that are not seen traditionally as 'positional' goods.[1]

The above findings tend to suggest two further misconceptions in the so-called *representative* utility function. First, that even in relative terms higher income does not necessary imply higher utility and second that work is not only a source of disutility, as traditionally assumed in conventional economic theory. The former of these effects, has already attracted some attention, but whether people work also because of personal satisfaction, rather than pure rivalry or "envy" among their colleagues, is a question that has received much less attention.

In general, as pointed out by Hirsch (1976), when utility depends on relative (rather than absolute) income, competition becomes "positional". Positional concerns imply that agents compare themselves with a reference level of income, consumption, or effort. We can generalise this literature by assuming the following utility form,

$$u = V(\alpha, A) - \beta\alpha$$

Where $\alpha$ represents an individual's own variable (usually income, consumption, or effort) and *A* is a reference level of that variable. The bulk of the literature then assumes that, $V_\alpha > 0$, $V_{\alpha\alpha} < 0$ and usually $V_{\alpha A} > 0$ (i.e. Clark and Oswald 1998, Gali 1994, Al-Nowaihi and Stracca 2005). The latter effect implies that there is a complementarity between $\alpha$ and *A*, which by assumption implies that agents prefer relative to absolute levels of income, consumption or effort. This, combined with the assumption, $u_V > 0$, as usually assumed by the literature, implies that individual effort is mainly driven by rivalry or 'envy'.[2] Perhaps a more important implication of the above assumptions is that 'status' in most studies becomes synonymous with 'relative income'. So for example, a scientist or an academic would have a lower 'status' and be less happy than, say a broker or a plumper, if the latter two earn

[1] In their study these non-positional goods included vacation and insurance.
[2] In Clark et al (1998), this comparison to the reference level is modelled directly as $V(\alpha\text{-}A)$ or $V(\alpha/A^*)$; hence, $V'(.)>0$ and $V''(.)<0$ implies that agents are *envious*.

more relative income. Similarly, the theory would imply that a teacher or an artist would happily exchange their professions with either a dentist or a banker if the latter two earned more relative income than the former two.

In this paper we attempt to re-examine some of the above effects by employing a general utility specification that assumes away some of the restrictive assumption in the literature. We allow the model to capture a number of observations that are also supported by surveys. First, individuals, derive utility from both absolute and relative income. Second, work but also success at work may be a source of joy for many individuals, rather than just a source of disutility. Third, 'status' and 'relative income' are not synonymous in this model. For each individual, success-at-work depends on both a *subjective* evaluation of personal success (i.e. how individuals rate their personal satisfaction from their nature of their job, regardless of income or consumption) but also on a *relative* or *objective* evaluation of success-at-work (i.e. in relation to the success of others within the same professional group). It is the latter of these, -i.e. *relative success* - that is closer to the definition of 'status' in the literature. Yet, although effort of individuals may be driven by *relative success-at-work* the latter is not necessarily synonymous to relative income, as 'effort', 'success' and 'consumption' are not identical concepts in this model. Finally, we relax the widely used assumption of an exogenously given reference standard. In this paper the reference level of success is given as the aggregation of all agents' individual levels of success. So without imposing the assumption that an individual's success level increases only in relation to some exogenous reference level of success, our definition of the latter allows higher levels of effort and success by some individuals to endogenously raise the success standards. This however does not make any presumption about each individual's behaviour. Our utility is such that does not explicitly impose convexity or concavity assumptions, and so it allows for many different combinations: i.e. *altruistic-conformists*, *altruistic-deviants*, *envious-conformist* and *envious-deviants.*

## 2. A Success-at-Work Augmented Utility Model

Consider an economy populated by a continuum of agents uniformly distributed on [0, 1], and are indexed by $i \in [0,1]$. In addition to consumption and effort each type of agents derives satisfaction from their degree of success-at-work. Agents are identical in all respects except their degree of success-consciousness. Without loss of generality, we assume that agents are ranked by their degree of success-consciousness, such that agent $i$ is characterised by a specific value of $\phi(i)$, where $\phi(i) \geq \phi(j)$, if $i > j$. We also assume that $\phi(0) \geq 0$, so that the value of $\phi(i)$ is non-negative for all agents.

Moreover, the notion of success-at-work entails an element of comparison. It is usually those agents whose achievement exceeds some commonly recognized standard that are regarded as successful. On this basis, we assume that satisfaction derived from success potentially depends also on some reference success level, $\overline{s}$ .[3] The utility function of agent $i$ takes the following form,

(1) $$Z^i(c^i, s^i, \overline{s}, e^i) = U(c^i) + \phi(i)V(s^i, \overline{s}) - \beta e^i$$

where $c^i$ , $e^i$ and $s^i$ denote respectively the levels of, consumption, effort, and success-at-work, of agent $i$. The amount of consumption available for an agent is dependent on a combination of the agent's own effort and the general level of productivity, $c^i = c\left(e^i, A\right)$, where $c_1, c_2 > 0$. Similarly, the amount of success achieved by each agent is, $s^i = s\left(e^i, A\right)$, where $s_1, s_2 > 0$. Agents have equal access to productivity, *A*, which is initially assume to be fixed. We assume that the reference success level is determined endogenously as the average success level of all agents, hence

[3] Intuitively, the 'economy' here is better interpreted as a single profession, or a group of professions that are close substitutes, to the effect that each agent compares themselves with everyone else in the economy, such that the 'economy' effectively becomes one closed unit of social interaction (see also Frank 1985b).

$\bar{s} = \int s^i di = \int s\left(e^i, A\right) di$.[4] This natural way of endogenising reference standards, serves to create a mechanism by which the self-enhancement of even a few individuals raises the reference standards and motivates our notion of *relative success*.

From equation (1), the utility function of the *success-conscious* agents can be decomposed into two parts. The first part, $U\left(c^i\right) - \beta e^i$, where $U_1 > 0$ , $U_{11} < 0$ and $\beta > 0$ is independent of success and corresponds to the family of standard utility functions that include consumption and leisure (negative of effort).[5] The second part, $\phi(i)V\left(s^i, \bar{s}\right)$, is dependent on the degree of success-at-work. We assume that $\phi(i)$ >0 which captures the idea that individuals in different professions, or indeed different individuals among the same profession, may have a subjective preference for what they enjoy doing and they may be characterised by different levels of success-consciousness.[6] However, we also allow success to be derived in *relative* terms (i.e. *objectively*) by assuming that the value of *V* also depends on the relative success of individuals, measured in relation to the average success level ( $\bar{s}$ ). The latter is captured by the assumption that $V\left(s^i, \bar{s}\right) > 0 \quad \forall\ s^i, \bar{s} > 0$; the combination of $V_1 \equiv \partial V / \partial s^i > 0$, where $\bar{s} = \int s\left(e^i, A\right) di$, together with the assumption that success is not independent of effort, $\partial s^i / \partial e^i > 0$, provides a platform for competition for *relative success*. However, the latter does not describe the behaviour of all individuals, as we do not impose conditions of *conformity* and *envy* in this model. As we show in section 2.1, depending on the shape of the $V(.,.)$ function, agents may have tendency either to conform to, or deviate from the average success level.

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[4] The bulk of the literature assumes that reference standards are exogenously determined. For some recent papers that examine the effects of endogenising reference standards see Falk and Knell (2004) and Al-Nowaihi and Stracca (2005).

[5] Note that is with most of this literature we assume a constant marginal disutility of effort, which is excludes excessive levels of effort (see Ljungqvist and Uhlig 2000, Al-Nowaihi and Stracca 2005).

[6] Note that if individuals exhibit zero success-consciousness, $\forall\, i : \phi(i) = 0$, our utility function collapses to the conventional utility specifications.

In theory, it would also be possible to allow the utility of consumption, as well as disutility of effort, to be dependent on relative terms. However, to simplify the analysis, in this model we assume that effort as well as consumption of each agent are much less observable to other agents than success is, such that only the utility of success is dependent on a reference level.

### 2.1 A Nash Equilibrium

Each agent $i$ chooses effort level $e^i$ to maximize their utility function in (1), taking the value [Deleted: s of $\bar{s}$ and] of $A$ as given. To simplify notation, let $u\left(e^i, A\right) \equiv U\left(c^i\left(e^i, A\right)\right)$ and $v\left(e^i, \bar{s}, A\right) \equiv V\left(s\left(e^i, A\right), \bar{s}\right)$, so that,

(2) $$Z^i = u\left(e^i, A\right) + \phi(i) v\left(e^i, \bar{s}, A\right) - \beta e^i.$$

The first order condition for the maximization of $e^i$ given (2) is,

$$u_1\left(e^i, A\right) + \phi(i) v_1\left(e^i, \bar{s}, A\right) + \phi(i) v_2\left(e^i, \bar{s}, A\right)\frac{d\bar{s}}{de^i} - \beta = 0$$

Where the population is large, the effect of each agent's action on the average level of success is negligible, as the value of $\frac{d\bar{s}}{de^i}$ tends to zero.[7] Consequently, the equation above becomes

(3) $$u_1\left(e^i, A\right) + \phi(i) v_1\left(e^i, \bar{s}, A\right) - \beta = 0.$$

Assuming that the second order condition $u_{11} + \phi(i) v_{11} < 0$ holds $\forall\ e^i, \bar{s}, A \geq 0$, then in general the solution to (3) is,

(4) $$e^i = e\left(\phi(i), \bar{s}, A,\right).$$

[7] With social interaction taking place between many individuals, where the influence of each individual on the social outcome is very small, the Nash equilibrium is analytically equivalent to a competitive equilibrium were agents takes the value of $\bar{s}$ as given. In the Appendix, we extend our analysis to allow for interactions in smaller groups, where individuals have positive weights. It will be shown that, with appropriate changes to notations, allowing individuals to have positive weights does not affect any results in this paper.

From equation (4), we can show that unlike the conventional theory, here individual effort depends on the subjective preference for satisfaction from work $\phi(i)$ as well as the reference success level $\bar{s}$, which itself is a function of $s^i$.[8] The effect of the average success level ($\bar{s}$), on the effort level of each individual is obtained by taking the total derivative of $e^i$ and $\bar{s}$ in the first order condition (3), and rearranging as,

$$\frac{de^i}{d\bar{s}} = -\frac{\phi(i)v_{12}}{u_{11} + \phi(i)v_{11}}$$

On the right hand side of the equation, the denominator is negative when the second order condition is satisfied; therefore for any $\phi(i)>0$, the expression $de^i / d\bar{s}$ has the same sign as $v_{12}$. An increase in the average success level $\bar{s}$ causes agents to exert a greater amount of effort if $v_{12} > 0$, and less effort if $v_{12} < 0$. We therefore introduce the following definitions:[9]

Definition 1: If $v_{12}(e, \bar{s}, A) > 0 \ \ \forall \ e, \bar{s}, A > 0$, then $de^i / d\bar{s} > 0$ and individuals are *conformists*. If $v_{12}(e, \bar{s}, A) < 0 \ \ \forall \ e, \bar{s}, A > 0$, then $de^i / d\bar{s} < 0$ and individuals are *deviants*. If $v_{12}(e, \bar{s}, A) = 0$ $\forall \ e, \bar{s}, A > 0$, then $de^i / d\bar{s} = 0$ and individuals are *neutrals*.

In addition, similarly to Clark and Oswald (1998), we also introduce two further concepts, here relating to *success*.

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[8] As the reference success level $\bar{s}$ is itself is a function of $s^i$, strictly speaking, it cannot be treated as an exogenous variable. To analyze the effect on the effort supply of an individual from other individuals, it would be necessary to define $\bar{s}_{-i} \equiv \bar{s} - \gamma^i s^i$, where $\gamma^i$ is the weight of individual *i*, and to carry out the analysis in terms of $\bar{s}_{-i}$. However, as the weight of each individual in our analysis is practically zero, the value of $\bar{s}_{-i}$ would be identical $\bar{s}$, in the following analysis, we economize the use of notation by focusing on $\bar{s}$.

[9] Alternatively, these effects can be interpreted as *strategic complementarity* for $v_{12}(e, \bar{s}, A) > 0$ and *strategic substitutability* for $v_{12}(e, \bar{s}, A) < 0$, (see Cooper and John, 1988)

Definition 2: Individuals are said to be *altruistic* if their utility increases with the reference success level, (i.e. if $v_2 > 0 \;\; \forall \; e, \bar{s}, A > 0$). Conversely, individuals are *envious* if their utility falls following a rise in the reference success level, (i.e. if $v_2 < 0 \;\; \forall \; e, \bar{s}, A > 0$).

The general specifications of our utility do not restrict the relationship between the sign of $v_{12}$ and $v_2$. In general, $v_{12}$ < 0 can be consistent with both $v_2$ >0 and $v_2$ <0. In the same way, $v_{12}$ <0 can be consistent with both $v_2$ >0 and $v_2$ <0. This enables the preferences of agents to be characterized by any of the following combinations: *altruistic-conformists*, *altruistic-deviants*, *altruistic-neutrals, envious-conformist envious-deviants* and *envious-neutrals*.

The average success level, $\bar{s} = \int s\left(e^i, A\right) di$, is determined by the success level of all individual agents, which in turn is optimally chosen based on the average success level. Consequently, a Nash equilibrium exists if there exists an average success level, $\bar{s}$, such that all agents choose effort level according to (4), and the following condition holds,

(5) $$\bar{s} = \int s\left[e\left(\bar{s}, A, \phi\left(i\right)\right), A\right] di .$$

Proposition 1: *Let* $Z^i = u\left(e^i, A\right) + \phi(i) v\left(e^i, \bar{s}, A\right) - \beta e^i$ *represent the general form of a success-augmented utility function. Let* $e*$ *denote the effort level that satisfies the first order condition of a conventional utility function, (i.e.* $\forall \, i : \phi(i) = 0$*). Then we can show that at an existing Nash equilibrium, the effort level chosen by all agents in our success-augmented utility model weakly exceeds that of the conventional model, hence* $e^i \geq e^*$, $\forall \, i : \phi(i) > 0$.

Proof: *The first order condition of the conventional utility function is,* $u_1\left(e^*, A\right) = \beta$, $\forall i : \phi(i) = 0$ *in equation (3). Then since,* $v_1\left(e^i, \bar{s}, A\right) = V_s s_1 > 0$, $\forall i : e^i, \bar{s}, A \geq 0$, *it follows that* $u_1\left(e^*, A\right) + \phi(i) v_1\left(e^*, \bar{s}, A\right) \geq u_1\left(e^*, A\right) = \beta$, *for* $\forall i : \phi(i) > 0$. *Since,* $u_{11} + \phi(i) v_{11} < 0$, $\forall i : e^i, \bar{s}, A \geq 0$, *and the value of* $e^i$ *satisfies the first order condition in equation (3), it follows that* $e^i \geq e^*$.

This proposition shows that compared with the conventional model, success consciousness generates an additional incentive for exerting effort. Moreover, for any value of $\phi(i) > 0$, this result is true and independent of whether agents are *conformists, neutrals* or *deviants*. The implications of this effect on consumption can be shown as follows.

Corollary 1: *If* $\bar{c}\left(\bar{s}\right) = \int c\left[e\left(\bar{s}, A, \phi\left(i\right)\right), A\right] di$ *is the average consumption level associated with a Nash equilibrium for a reference success level* $\bar{s}$ *and* $c^* \equiv \int c(e^*, A) di = c(e^*, A)$ *is the average consumption level of the conventional economy, then we can show that for any value,* $\phi(i) > 0$, $\bar{c}\left(\bar{s}\right) \geq c^*$.

Proof: *From Proposition 1,* $e^i \geq e^*$ *for all agents,* $0 \leq i \leq 1$ *that are success-conscious,* $\phi(i) > 0$. *From this and* $c_1 > 0$, *it follows,* $c\left[e(\bar{s}, A, \phi(i)), A\right] \geq c(e^*, A)$, *and hence that,* $\bar{c}\left(\bar{s}\right) = \int c\left[e\left(\bar{s}, A, \phi\left(i\right)\right), A\right] di \geq \int c\left(e^*, A\right) di = c^*$.

Proposition 2: *Within a Nash equilibrium, the level of effort that an agent chooses to exert depends on the degree of personal success-consciousness, so that if,* $\phi(j) > \phi(i)$ *then* $e^j > e^i$.

Proof*: From the definition of* $e^i$ *and* $e^j$*, it follows that* $u_1\left(e^i, A\right) + \phi(i)v_1\left(e^i, \overline{s}, A\right) - \beta = 0$ *and* $u_1\left(e^j, A\right) + \phi(j)v_1\left(e^j, \overline{s}, A\right) - \beta = 0$. *Since* $v_1\left(e^i, \overline{s}, A\right) = V_s s_1 > 0$, $u_1\left(e^i, A\right) + \phi(j)v_1\left(e^i, \overline{s}, A\right) > u_1\left(e^i, A\right) + \phi(i)v_1\left(e^i, \overline{s}, A\right) = \beta$ *and since* $u_{11} + \phi(i)v_{11} < 0$ *holds* $\forall\, i : e^i, \overline{s}, A \geq 0$*, it also follows that* $e^j > e^i$ *for* $\phi(i) < \phi(j)$.

This proposition states that the higher is a households subjective preference for utility from success (as determined by $\phi(j)$) the higher will be the level of effort that this household chooses to devote to work, in relation to that implied by a cooperative equilibrium where all effort is directed towards output production and consumption. Higher effort therefore may be the outcome of personal satisfaction (i.e. *subjective* success-at-work) even if individuals, as we show below, do not conform to competing for *relative* success-at-work (i.e. status). Yet subconsciously, the higher effort from personal satisfaction at work will also result in higher level of consumption.

Corollary 2: *Within a Nash equilibrium, agents with higher degree of success-consciousness, exert higher effort and as a result have a higher level of success at work and a greater level of consumption.*

Proof: *This follows directly from Proposition 2, according to which, the value of* $e^i$ *is non-decreasing in i. As* $c_1 > 0$ *and* $s_1 > 0$*, it follows that* $c^i$ *and* $e^i$ *are non-decreasing in i.*

Proposition 3: *Within a Nash equilibrium, agents with a higher degree of success-consciousness obtain a higher level of utility.*

Proof: *Substitute* $e^i = e(\bar{s}, A, \phi(i))$ *into the utility function in (1), and differentiate with respect to* $\phi(i)$*, gives* $\frac{\partial Z}{\partial \phi(i)} = \frac{\partial Z}{\partial e^i}\frac{de^i}{d\phi(i)} + V$*. As the first order condition implies that* $\frac{\partial Z}{\partial e^i} = 0$*, it follows that* $\frac{\partial Z}{\partial \phi(i)} = V > 0$*.*

In principle, an increase in the degree of success-consciousness has two channels through which it affects the level of utility. First, individuals choose their optimal effort level and second, individuals give different weights to success in terms of utility. As in the envelope theorem, in an optimizing environment the first channel of effect is negligible and therefore the total effect is entirely dependent on the second channel. Thus, since here the second channel is positive, individuals with a higher degree of success-consciousness obtain a higher level of utility.

It is possible to interpret our model as a one of work ethics,[10] with work ethics being represented by the value of $\bar{s}$. With this interpretation, the level of work ethics affects the decision of effort supply by each individual in the economy; on the other hand, the particular level of work ethics is itself endogenous determined, depending on both the level of technology as well as the effort supply of all agents.

Interestingly, none of the results obtained in this section are dependent on the competition strategies or preference characterization of agents, and so whether they are *conformist/deviants*, or *altruistic/envious*. For any combination of these possible characteristics, the existence of success-consciousness enhances effort level, consumption, and utility in the Nash equilibrium. In the next

[10] We are grateful to an anonymous referee for this observation.

section however, we show that how productivity growth affects effort and utility does depend on social interaction and competition for relative success and hence whether individuals are *conformists/deviants*, or *altruistic/envious*.

# 3. Effects of Productivity Growth on Effort and Utility

## 3.1 Exogenous Productivity Growth

In this section we consider the effects of an exogenous increase in the level of productivity. Analysis in the previous section may give the impression that, exogenous rises in the value of *A* would unambiguously increase the effort level of all individuals. This, however, is not the case in general. Changes in productivity (*A*) typically affect the reference success level, $\overline{s}(s^i)$, as they raise all individuals' success levels, $s^i(e^i, A)$. However, as higher productivity raises the success standards, individuals are not by assumption conform to rivalry in this model. They may choose to be 'envy' motivated as in other models and amplify their effort, but they may also choose to retain the same level of effort as before or even reduce the level of effort as they become discouraged by the rising standards. At this stage, to obtain clear results we need to impose additional restrictions on the utility function.

We substitute the optimal choice of effort in (4) into the first order condition (3), and take the total derivative with respect to $e^i$ and *A* and rearrange to obtain,

(6) $$\frac{de^i}{dA} = -\frac{u_{12} + \phi(i)v_{12}\frac{d\overline{s}}{dA} + \phi(i)v_{13}}{u_{11} + \phi(i)v_{11}}$$

As the second order condition holds, $u_{11} + \phi(i)v_{11} < 0$. In the numerator, $u_{12} = U_1 c_2 > 0$ is the effect of productivity growth on the marginal benefit of effort in obtaining the consumption good. The term $v_{13} = V_1 s_2 > 0$ is the effect of productivity growth on the marginal benefit of effort in securing success. The term $v_{12}$ could be positive, zero, or negative, depending on whether agents are *conformists, neutrals* or *deviants*.

To analyse the value of $d\bar{s}/dA$ at the neighbourhood of a Nash equilibrium, we use equation (5) to define the function,

(7) $$h(\bar{s}, A) = \int s\left[e\left(\bar{s}, A, \phi(i)\right), A\right]di\,.$$

Based on equation (7), the reference success level in a Nash equilibrium can be interpreted as the fixed point that satisfies, $\bar{s} = h(\bar{s}, A)$. Figure 1 plots a possible reaction function $\bar{s} = h(\bar{s}, A)$ against $\bar{s}$, the equilibrium (fixed point) is where the curve $h(\bar{s}, A)$ intersects with the 45 degree line. For the equilibrium to be locally stable, the reaction function $h(\bar{s}, A)$ needs to be flatter than the 45 degree line, hence, confining ourselves to situations where the function $h(\bar{s}, A)$ is continuously differentiable, we require the condition, $h_1 < 1$. Given that the equilibrium condition,

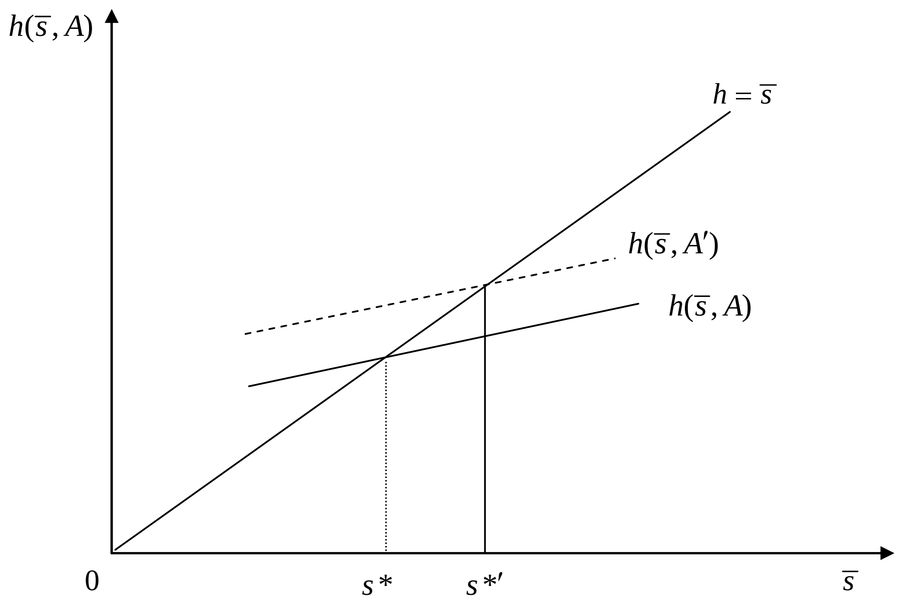


**Fig. 1 An increase in productivity with locally stable equilibria**

$h_1 < 1$ is satisfied locally, then for any small perturbation to the value of $\bar{s}$ around the equilibrium level, the economy will return to the original equilibrium. In Figure 1, an increase in productivity A shifts the curve $h(\bar{s}, A)$ upwards. If $h_1 < 1$, then the curve $h(\bar{s}, A)$ intersects the 45 degree line from above, and when $h(\bar{s}, A)$ shifts up, the fixed point moves to the right. On the other hand, if $h_1 > 1$, then the curve $h(\bar{s}, A)$ intersects the 45 degree line from below, and when $h(\bar{s}, A)$ shifts up, the fixed point moves to the left.

Definition: *A Nash equilibrium is stable if the reference level of success associated with it satisfies the condition,* $h_1(\bar{s}, A) = \int s_1\left(e^i, A\right) e_1\left(\bar{s}, A, \phi(i)\right) di < 1$.

Lemma 1*: In the neighbourhood of a stable Nash equilibrium, an increase in productivity increases the reference success level,* $\bar{s}$ *, hence* $d\bar{s} / dA > 0$.

Proof: *Derive the total derivative of* $\bar{s} = h(\bar{s}, A)$ *with respect to* $\bar{s}$ *and A, and rearranging we obtain,* $\dfrac{d\bar{s}}{dA} = \dfrac{h_2}{1 - h_1}$. *As the Nash equilibrium is stable,* $h_1 < 1$ hence $1 - h_1 > 0$, *and* $h_2 = \int s_1\left(e^i, A\right) e_2\left(\bar{s}, A, \phi(i)\right) di$ *, where* $s_1 > 0$*. Differentiate along the first order condition in (3), and using the second order condition, we obtain* $e_2\left(\bar{s}, A, \phi(i)\right) = -\dfrac{\phi(i) v_{13}}{u_{11} + \phi(i) v_{11}} > 0$*. Therefore as* $s_1 > 0$ *and* $e_2\left(\bar{s}, A, \phi(i)\right) > 0$*, we also obtain,* $h_2 > 0$ *and from this it follows that,* $d\bar{s}/dA > 0$*.*

Proposition 4: *If all agents are conformists or neutrals, then an exogenous increase in productivity in the neighbourhood of a stable Nash equilibrium increases the effort level of all agents. If agents are deviants, the final effect on effort of an exogenous increase in productivity is ambiguous.*

Proof: *When all agents are conformists,* $v_{12} > 0$*. Lemma 1 shows that in the neighbourhood of a stable Nash equilibrium,* $d\bar{s}/dA > 0$*. Therefore, using equation (6), and the earlier results,* $u_{11} + \phi v_{11} <$ 0 and $u_{12}, v_{13} > 0$, it follows that, $de^i/dA > 0$, *for all* $0 \le i \le 1$*. When all agents are neutrals,* $v_{12} = 0$, but since $u_{12}, v_{13} > 0$ it also follows that, $de^i/dA > 0$. Finally, when *agents are deviants,* $v_{12} < 0$ and so *the value of* $de^i / dA$ *can be positive, zero, or negative*, *depending on the size of* $u_{12}$ *and* $v_{13}$.

As Lemma 1 holds, it follows that, $d\bar{s}/dA > 0$, which implies that the average success level increases directly as the result of the common productivity. The final effect however, that a change in productivity has on the on the effort chosen by individuals, is ambiguous and will be determined crucially on whether agents are *conformists, neutrals* or *deviants*. When people are *conformists* an increase in productivity will increase all individual agents' efforts. In this model, this is because a higher productivity raises the average level of success. *Conformists* will always want to adjust their own success level in relation to that of the average success ($\bar{s}$) and so they will increase their effort following an increase in productivity which raises average success. This effect is similar to the 'rat race' effect, because by providing a higher individual effort, *conformists* push the average level of success to a higher Nash equilibrium (i.e. here endogenously through the effect that a higher A has on $e^i$). This result however only holds when all agents are conformists.

Interestingly, in the case of *neutrals*, ($v_{12} = 0$), $de^i / dA > 0$, hence higher productivity increases effort even when individuals do not seek to further enhance their success as a response to higher standards. This is because of the effects productivity growth has on both the marginal benefit of effort in obtaining the consumption good, which is always positive ($u_{12}$>0), but also through the element of personal satisfaction at work, which is $v_{13} = V_1 s_2 > 0$ for any $\phi(i) > 0$. The latter effect indicates that given a higher productivity, individuals may intensify their effort out of personal satisfaction from work, even when they do not wish to conform to competition for *relative success* (since $v_{12} = 0$).

If individuals are *deviants* ($v_{12} < 0$), the final effect depends on the size of the effects, $u_{12}, v_{13} > 0$ and the subjective preferences of agents, $\phi(i)$; and so it is possible for the value of $de^i / dA$ to be even negative for some individuals who decide to decrease their effort as they are discouraged by higher standard.

How effort levels react to technological growth is independent of whether agents are *altruistic* or *envious*. However, these characteristics can determine the way agents' utility levels are affected by growth. Substituting the optimal effort level in (4) into the utility function in (2), and taking the total derivative, gives

(8) $$dZ^i = Z_e de^i + \left[ u_2 + \phi(i) v_3 \right] dA + \phi(i) v_2 d\bar{s} \,,$$

where, $Z_e = u_1(e^i, A) + \phi(i) v_1(e^i, \bar{s}, A) - \beta = 0$, $u_2 = U_1 c_2 > 0$ and $v_3 = V_1 s_2 > 0$. From definition 2, individuals are *altruistic* if $v_2 > 0$ and *envious* if $v_2 < 0$.

Proposition 5: *If all agents are altruistic, then in the neighbourhood of a stable Nash equilibrium, a rise in productivity unambiguously increases the utility of all agents. If all individuals are envious, then the effect of a rise in productivity on the utility of all agents is ambiguous.*

Proof: *Rewrite equation (8) as,* $\frac{dZ^i}{dA} = \left[u_2 + \phi(i) v_3\right] + \phi(i) v_2 \frac{d\bar{s}}{dA}$, *where* $u_2 + \phi(i) v_3 > 0$. *Using Lemma 1,* $d\bar{s}/dA > 0$ *in the neighbourhood of a stable Nash equilibrium. Thus, if all agents are altruistic,* ($v_2 > 0$), *then* $\frac{dZ^i}{dA} > 0$, $\forall i \in [0,1]$. *If however all agents are envious,* ($v_2 < 0$), *then the value of* $dZ^i/dA$ *can be positive or negative, depending on the value of* $u_2 + \phi(i) v_3$.

Intuitively, an increase in productivity will have a twofold effect, (i) it increases the marginal product of effort in producing consumption goods and so it increases, $U(c^i(e^i, A))$, which is the conventional part of the utility function; (ii) it increases the average level of success ($\bar{s}$) pushing all agents' status to a higher level and this also increases utility, through $\phi(i) V\left(s^i\left(e^i, A\right), \bar{s}\right)$ and subject to the *success-consciousness* of individuals $\phi(i)$. However, as both $U(.)$ and $V(.)$ are functions of the individual effort ($e^i$), the final effect of an increased productivity will depend on $v_2$ and hence on the effect that the raised reference success $\bar{s}$ (due to an overall higher productivity) has on the individual levels of efforts towards individual success. It follows that when the utility function is characterized by '*envy*', individuals may exhibit very different attitudes toward technological growth. However, if the utility function is characterized by '*altruism*', all agents benefit from technological growth.

To sum up, the way effort levels respond to technological growth is dependent on whether agents are *conformist, neutrals*, or *deviants*. On the other hand, how levels of utility are affected by growth is dependent on whether agents are *envious* or *altruistic*. As these two aspects are independent of each other, effort and utility can respond to technological growth in any direction. For example, for *envious-conformists*, productivity growth may lead to both effort increase and utility reduction; for *altruistic-deviants*, growth can lead to effort reduction and utility growth; while *altruistic-conformists* expend more effort and obtain higher utility as the result of growth.

## 3.2 Endogenous Productivity Growth

The results obtained in the previous section can be easily extended to allow for endogenous productivity growth. Previous studies on the joint determination of economic growth and social interaction include Cole, et al. (1992) and Fershtman et al. (1996). Of these two papers, Cole et al. focuses on the endogeneity of social norms, While in Fershtman et al. individuals are assumed to have given reference for social status. On the other hand, Cole et al. use an a-k type production technology, and therefore productivity growth is not explicitly modelled, while Fershtman et al. allows for endogeneity of productivity growth. In particular, Fershtman et al. studies the effects of changing level of status-preference on the endogenously determined rate of productivity growth, through the interaction of agents who are heterogeneous in both innate ability and initial endowments. In these respects, our model is closer to Fershtman et al., both in allowing for the endogeneity of productivity growth, as well as in using innate preference for status/success as a starting point for analysis. In addition, our model allows the aspects in the success-preference that are relevant for growth to be identified, in a way that Fershtman et al. do not.

To illustrate the potential applications of introducing endogenous productivity growth in our model, we employ an assumption that is similar to the one used in Fershtman et al, that productivity grows as a result of some learning-by-doing process. In particular, assume that the rate of productivity growth is given by

$$A_{t+1} - A_t = A_t \int_0^1 g\left(e^i\right) di \, .$$

where $g(.)$ is assumed to be a non-decreasing function of its arguments. Using Proposition 4, it follows that the effect of rising value of *A* on the rate of productivity growth is dependent on whether agents are conformists or deviants. In particular, focusing on the stable Nash equilibrium, it follows that *when all agents are conformists or neutrals, sustained productivity growth is ensured. On the other hand, if agents are deviants, the rate of productivity growth may slow down or even stop as the level of productivity increases.*[11] In other words, our analysis highlights the fact, that it is whether agents are conformists/deviants, and not whether they are altruistic/envious, that might plays an important role in endogenously determining the rate of productivity growth.

Similarly, Using Proposition 5, it follows that *when individuals are envious, then our model's prediction on the path of utility growth is consistent with the well-documented finding in the literature that productivity growth does not always lead to unambiguous utility growth.* In other words, our analysis identifies the feature of 'envy', and not whether agents are conformists/deviants, for potentially giving rise to ambiguity in the direction of utility growth.

## 4. Concluding Remarks

This paper suggests that *success-at-work*, interpreted by both *subjective* and *relative* criteria, may motivate individuals to enhance their effort and utility. To examine this, we use a general specification utility function, which does not predetermine that people' efforts our motivated by rivalry, i.e. towards a higher *status*. In this model, an increase in productivity growth raises the reference level of success. This places pressure on people to intensify their individual level of effort, but whether individuals conform to this pressure is determined by each individual's characteristics. In general we show that *conformists* will intensify their effort as they are motivated by both *subjective* and *relative* criteria of

[11] This might be the case when, for example, $g(e^i) = \max[0, e^i - a]$ where $a > 0$ is a positive constant.

success-at-work. *Neutrals* do not care about rivalry but they too intensify their efforts because of personal success-consciousness at work (*subjective criteria*). For *deviants* however the effect is ambiguous and may even result in individuals lowering their effort discouraged by the potential 'rat-race' effect that follows. Moreover, we show that when agents are *altruistic*, growth always enhances utility, whereas if agents are *envious*, technological growth may end up reducing utility.

Given this, the model can explain a number of combinational effects on effort, growth, and utility, all of which can be plausible depending on the nature of individuals and particularly on the degree of their personal *success-consciousness* at-work as well as their competition strategies towards *relative success* and status.

## Appendix: Individuals with Positive Weights

In this appendix, we show that it is entirely possible to modifying the model by allowing the number of individuals in the ecnomy to be small, without affecting the results of analysis.

In particular, assume the economy is populated by *n* individuals, indexed by $i = 1,...n$. The degree of success-consciousness of individual *i* is given by $\phi(i)$, where $\phi(i) \geq \phi(j)$, if $i > j$. The reference success level is now defined as $\bar{s} = \sum_{i=1}^{n} \frac{s(e^i, A)}{n}$. Other aspects of the model remain unchanged, in particular, the utility function of agent *i* still takes the form of (1).

When the number of individuals is small, the effect of an individual's effort on the reference success level may not be trivial. Fortunately, with slight changes in notations, all the analysis presented in the paper remains unaffected. In particular, we introduce a new variable $\bar{s}_{-i} = \sum_{j \neq i} \frac{s(e^j, A)}{n}$, it then follows that $\bar{s} = \bar{s}_{-i} + s(e^i, A)/n$. In a Nash equilibrium, each player takes the value of $\bar{s}_{-i}$ as being given. Using this variable, and define

$$\hat{v}\left(e^i, \bar{s}_{-i}, A\right) \equiv V\left( s\left(e^i, A\right), \bar{s}_{-1} + \frac{s\left(e^i, A\right)}{n} \right) = V\left(s^i, \bar{s}\right),$$

then equation (2) can be written as

$$Z^i = u\left(e^i, A\right) + \phi(i)\hat{v}\left(e^i, \bar{s}_{-i}, A\right) - \beta e^i,$$

From this point onwards, only two changes are necessary. (1) Replace $\bar{s}$ by $\bar{s}_{-i}$ in the all maximization problems of the individuals, and (2) replace the function $v(.,.,.)$ by $\hat{v}(.,.,.)$. After these changes, all subsequent analysis and results remains unaffected.

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