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Article — Manuscript Version (Preprint)

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The Journal of Socio-Economics

Suggested Citation: Bratsiotis, George J.; Peng, Baochun (2008) : Social Interaction and Effort in a Success-at-Work Augmented Utility Model, The Journal of Socio-Economics, ISSN 1053-5357, Elsevier, Amsterdam, Vol. 37, Iss. 4, pp. 1309-1318,
<https://doi.org/10.1016/j.socec.2007.08.005> ,
<http://www.sciencedirect.com/science/article/pii/S1053535707001801>

This Version is available at:

<https://hdl.handle.net/10419/171340>

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

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First submitted: 16 January 2006

This version: 21 February 2007

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 α 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 α and A , which by assumption implies that agents

¹ In their study these non-positional goods included vacation and insurance.

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 plumber, if the latter two earn 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

² In Clark et al (1998), this comparison to the reference level is modelled directly as $V(\alpha A)$ or $V(\alpha/A^*)$; hence, $V'(\cdot) > 0$ and $V''(\cdot) < 0$ implies that agents are *envious*.

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 uniformly distributed agents 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, \bar{s} .³

The utility function of agent i takes the following form,

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

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, $c^i = c(e^i, A)$, where $c_1, c_2 > 0$.⁴ Similarly, the amount of success achieved by each agent is, $s^i = s(e^i, A)$, 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 by the average success level of all agents, hence $\bar{s} = \int s^i di = \int s(e^i, A) di$. 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*.⁵

From equation (1), the utility function of the *success-conscious* agents can be decomposed into two parts. The first part, $U(c^i) - \beta e^i$, 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).⁶

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).

⁴ x_1 and x_2 denote the partial derivatives with respect to the first and second arguments of $x(\cdot)$, respectively.

⁵ 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).

⁶ Note that is with most of this literature we assume a constant marginal disutility of effort, which excludes excessive levels of effort (see Ljungqvist and Uhlig 2000, Al-Nowaihi and Stracca 2005).

The second part, $\phi(i)V(s^i, \bar{s})$, 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.⁷ 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 $V(s^i, \bar{s}) > 0 \forall s^i, \bar{s} > 0$; the combination of $V_1 \equiv \partial V / \partial s^i > 0$, where $\bar{s} = \int s(e^i, A) di$, 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 restrict the model to comply with conditions of *conformity* and *envy*.

Note also, that our model does not assume an explicit cost associated with ‘relative effort’ or the psychological discomfort due to cognitive dissonance.⁸ Within our general utility specification such a cost could, for example, enter as a negative argument in the utility coming from success, i.e. $\phi(i)V(s^i, \bar{s}, \gamma)$ where $V_\gamma < 0$, (see also Oxoby 2004). However, as we show below, the exclusion of an explicit cost of psychological discomfort does not imply that costs associated with ‘relative effort’

⁷ Note that if individuals exhibit zero success-consciousness, $\forall i: \phi(i) = 0$, our utility function collapses to the conventional utility specifications.

⁸ According to psychologists, individuals tend to choose a subjective measure of “status” which is usually based on their social position and relative ability within their social group. This implies that individuals’ preferences may be affected by the pressure to compete for the perceived status norm. However, according to the theory of “cognitive dissonance” this latter pressure may alienate some individuals who find it hard to compete within mainstream methods, causing them psychological discomfort or even forcing them to abandon society’s norms, (for a recent paper see Oxoby 2004)

are neglected in this paper. In our model this comes from the fact that success is also measured in relative terms (i.e. in relation to \bar{s}). The latter is given by the sum of all efforts in the economy and so as effort rises, so does the reference level of success, \bar{s} , pushing the success norm to higher standards. As we show in section 2.1, depending on the assumption about the shape of the $V(.,.)$ function, agents may have tendency either to conform to, or deviate from the average success level. In particular, in the case where individuals are *deviants* the final effect of an increase in productivity on an individual's effort is ambiguous and depending on the utility specifications (i.e. on the effects, $u_{12}, v_{13} > 0$ and the subjective preferences of agents, $\phi(i)$) it can be negative, implying that individuals may decide to decrease their effort as they are discouraged by higher productivity standard; a result that is very reminiscent of those reached in the *cognitive dissonance* literature. So although our model does not explicitly assumes differentials in relative consumption and effort levels or an explicit cost associated with "cognitive dissonance", our general utility specification allows for intuitively similar results.

2.1 A Nash Equilibrium

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. We follow Cooper and John (1988), in that we too consider a symmetric case where there is only one type of agent across players and any player's best response is a function of the average action of his opponents (\bar{s}) and the action (type) of each agent, (s^i) , is common knowledge. In effect, we assume that agents are involved in a symmetric complete information game. As Cooper and John (1988)

show, in such a set up an increased desirability of an action can result, through strategic complementarities, into higher equilibrium actions.⁹

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

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

The first order condition for the maximization of e^i given (2) is,¹⁰

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

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

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

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} . Equation (4) can be viewed as a ‘reaction function’ where the optimal effort level of individual i is dependent on the effort level of all other agents, through the term \bar{s} . To calculate the ‘slope’ of this reaction function, (i.e. how the choice of e^i is affected by the value of \bar{s}), we use the implicit function theorem on the first order condition, equation (3), to obtain the effect of the average

⁹ More recently a number of papers have also focused on local heterogeneity that can be the product of incomplete information, random matching or local interaction. In such models agents are not identical, so that players are no longer sure of their opponent’s action. This tends to smooth out the best response function, reducing the possibility of multiple equilibria (see Carlsson and van Damme 1993 and Morris and Shin 1998, Glaeser and Scheinkman 2003 etc).

¹⁰ Note that the latter is, $u_1(e^i, A) + \phi(i)v_1(e^i, \bar{s}, A) + \phi(i)v_2(e^i, \bar{s}, A)d\bar{s}/de^i - \beta = 0$, but since we consider *success-at-work* in large environments, the effect of each individual agent’s action on the average level of success is negligible, hence $d\bar{s}/de^i \rightarrow 0$.

success level (\bar{s}), on the effort level of each individual ¹¹

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

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:¹²

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*.

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 $v_2 < 0 \ \forall e, \bar{s}, A > 0$).

¹¹ Note this is the partial effect of how individuals choose their effort level following an infinitesimally increase in the average success level.

¹² 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). Further developments of this approach are used in Glaeser, and Scheinkman (2003) and Vives (2005).

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, $\bar{s} = \int s(e^i, A) di$, 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,

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

Proposition 1: *Let $Z^i = u(e^i, A) + \phi(i)v(e^i, \bar{s}, A) - \beta e^i$ 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, $u_1(e^*, A) = \beta, \forall i : \phi(i) = 0$ in equation (3). Then since, $v_1(e^i, \bar{s}, A) = V_s s_1 > 0, \forall i : e^i, \bar{s}, A \geq 0$, it follows that $u_1(e^*, A) + \phi(i)v_1(e^*, \bar{s}, A) \geq u_1(e^*, A) = \beta$, 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 $\bar{c}(\bar{s}) = \int c[e(\bar{s}, A, \phi(i)), A] di$ 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, $\phi(i) > 0$, $\bar{c}(\bar{s}) \geq c^*$.

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, $c[e(\bar{s}, A, \phi(i)), A] \geq c(e^*, A)$, and hence that, $\bar{c}(\bar{s}) = \int c[e(\bar{s}, A, \phi(i)), A] di \geq \int c(e^*, A) di = c^*$.

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

This proposition states that at equilibrium, agents with different levels of success-consciousness typically behave differently.¹³ In particular, the higher is a household's 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.¹⁴

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.*

¹³ Note that to gain insight into the effects of the norm when that latter is endogenously determined we assume the conventional assumption of continuity in preferences (see Bernheim 1994). However, it would be possible to assume that utility changes discontinuously when an agent departs from the norm. With this type of assumption, for example, it would be possible to obtain an equilibrium where agents behave in an identical manner according to the norm and agents who deviate from that norm are punished (i.e. Akerlof, 1980).

¹⁴ Note that it is possible to interpret some of the features of our model, in a similar fashion to those of ‘work ethics’ (we are grateful to an anonymous referee for this observation). The latter literature usually distinguishes between two kinds of “work ethics”. First there is the ‘internal’ work ethic, which is part of the normative characteristics that make some individuals relatively more inclined to work harder; in our model this is similar to the subjective preferences of individuals. Second, there is a ‘cultural’ work ethic driven by ‘status’; in our model this is similar to the utility derived from ‘relative success’, driven by the value of \bar{s} . In general, work ethics imply moral and economic externalities that affect individuals’ decisions about their effort supply.

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.

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 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. The Effects of Productivity Growth

In this section we consider the effects of an exogenous increase in the level of productivity.¹⁵ 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, $\bar{s}(s^i)$, 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,

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

¹⁵ Note that in models with heterogeneous agents, the assumption of endogenous growth has been shown to produce interesting results. For example, by using two heterogeneous agent-types, (managers and laborers, with two sources of heterogeneity: non-wage income and ability), Fershtman, Murphy, and Weiss, (1996), show that changes in the distribution between these two types can make the quest for 'status' counterproductive in terms of economics growth. Note that our paper is not aimed to explain economic growth nor does it assume heterogeneous agents, as a result, we expect the effects of endogenous growth on effort to produce similar result to those of an exogenous increase in productivity and hence to be largely determined by the assumptions we employ about the curvature of an agent's utility function.

Since 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,

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

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, $h_1 < 1$ 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.

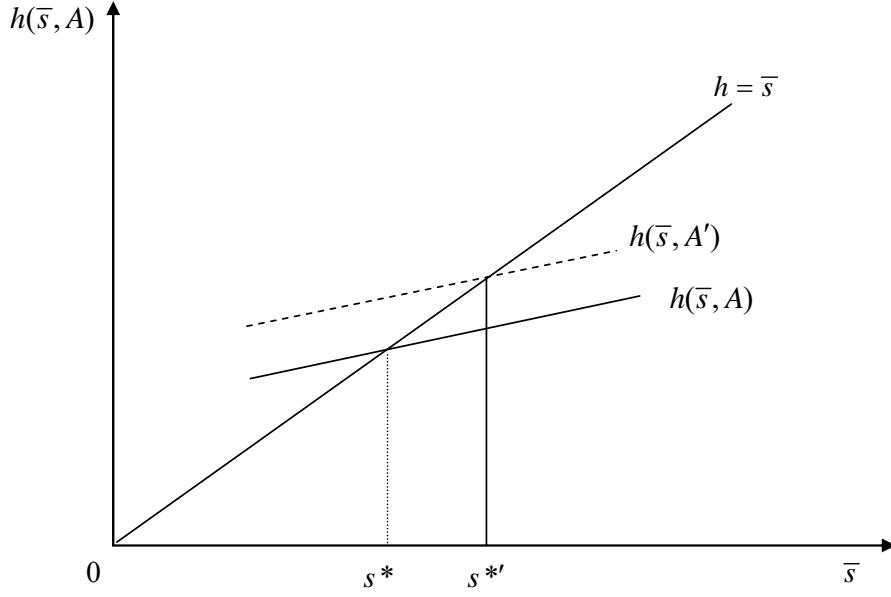


Fig. 1 An increase in productivity with locally stable equilibria

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

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, $\frac{d\bar{s}}{dA} = \frac{h_2}{1 - h_1}$. As the Nash equilibrium is stable, $h_1 < 1$

hence $1 - h_1 > 0$, and $h_2 = \int s_1(e^i, A) e_2(\bar{s}, A, \phi(i)) di$, where $s_1 > 0$.

Differentiate along the first order condition in (3), and using the second order condition, we obtain $e_2(\bar{s}, A, \phi(i)) = -\frac{\phi(i) v_{13}}{u_{11} + \phi(i) v_{11}} > 0$. Therefore as $s_1 > 0$

and $e_2(\bar{s}, A, \phi(i)) > 0$, 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 $0 \leq i \leq 1$. 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 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

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

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, $\frac{dZ^i}{dA} = [u_2 + \phi(i)v_3] + \phi(i)v_2 \frac{d\bar{s}}{dA}$, 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 $dZ^i/dA > 0$, $\forall i \in [0,1]$. 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 $\phi(i)V(s^i(e^i, A), \bar{s})$ and subject to the *success-consciousness* of individuals $\phi(i)$. However, as both $U(\cdot)$ and $V(\cdot)$ 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.

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’s efforts are 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 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.

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