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ABSTRACT

Status, Happiness, and Relative Income*

Models of status based on Frank's (1985) count of the number of people with lower conspicuous consumption are inconsistent with the extensive empirical literature on happiness and well-being. The alternative approach to consumption interaction which uses some form of relative income has been developed in various contexts. These predict that a representative agent's well-being will increase with real income or consumption. However, this is again inconsistent with the time-series evidence for advanced economies. In this paper we combine a simple model of relative income with a distribution of ability that correctly predicts both time series results of near constant utility, and the positive, concave cross-sectional relation between income, working time and happiness.

JEL Classification: D01, D31, D6

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It remains a serious blot on modern economics, which prides itself as a science, that the relative income theory is rarely taken seriously, despite providing fruitful explanations for human behaviour and despite never having been empirically refuted (Green,F., Demanding Work, Princeton University Press, 2006, p.152)

1. Introduction

In 1899 Veblen emphasized the importance for an individual's well-being of comparison and status. However, it was half a century before this was formalised: in Duesenberry's (1949) relative income hypothesis. Still, it was another quarter century before Easterlin (1974) discovered that economic growth in advanced economies did not appear to increase happiness or life satisfaction. Since then numerous empirical studies have confirmed Easterlin's findings, and there has been a recent explosion of the literature on happiness, reviewed by Layard (2005, 2006), Di Tella and MacCulloch (2006), and Clark *et al* (2006).

The role of status was featured in the work of Hirsch (1976) who argued that forms of conspicuous consumption (what he termed the consumption of "positional goods") conferred status. Examples of goods of this sort are homes in exclusive residential areas or antiques. However, what gives these goods their status value is that their supply is limited. Thus though average incomes might rise, so does the price of such goods and the distribution of status remains constant as a consequence.

A formal model of status in which there is over-consumption of the status good (and hence a negative externality) was presented by Frank (1985). This approach has been developed in more mathematical detail by Robson (1992) and most recently by Hopkins and Kornienko (2004). In this work status depends on the essentially unobservable number of people with lower conspicuous consumption (rank). However, since utility depends on absolute consumption as well as rank, such models predict that average utility will increase with per capita income and economic growth. However, this is contradicted by the empirical evidence on well-being over time.

Taking the time-series evidence for a start, a recent poll conducted for the BBC, for example, found that "the proportion of people in the UK saying they are 'very happy' has fallen from 52% in 1957 to just 36% today", a period in which real incomes have doubled (BBC (2006). In Japan, despite a five-fold increase in income over a similar period, happiness scores are no higher than they were at the outset. Blanchflower and Oswald (2004) find that happiness has declined for white females in the US. Similar stories emerge from the data for Belgium and Germany, though in some continental European countries there have been small increases (Layard (2005)). Similar results hold for life-satisfaction and other measures of subjective well-being (SWB).

A more mixed picture emerges from cross-sectional data. For example, there is no cross-country correlation between SWB and PPP-adjusted per capita GDP in the group of advanced economies whose per capita GDP exceeds $15000-$20000 (Layard (2005)). By contrast, in poorer countries where many lack the basic necessities of life, there is a strong correlation between SWB and income, in accord with the conventional theory. On the other hand, in all countries there is a modest positive relationship between individual incomes and happiness in cross-section data, though the correlation is very much weaker for incomes above the median. (Kahneman et al, 2006)

However, it is important to point out that sociological and individual-specific variables such as social capital, relationships, and employment are generally more important as explanatory variables than even relative income, when trying to explain empirically differences in happiness and life-satisfaction both across countries and individuals, and over time. For example, Helliwell (2006) can explain most of the variance of both happiness and its opposite (suicide) across a large sample of countries using just six such explanatory variables – and using the same specification for each of these dependent variables.

Recently there has been a growing body of research pointing to the crucial role of relative income in explaining SWB (Clark and Oswald (1996), McBride (2001), van Praag and Ferrer-i-Carbonell (2004), Ferrer-i-Carbonell (2005), Helliwell and Huang (2006) and Luttmer (2005), Clark *et al* (2006)). This is based on the idea that people form aspirations based on comparison of their own situation with an appropriate reference group (such as neighbours). As neighbours, say, become richer, the aspirations gap will grow and this reduces happiness by as much as a similar growth in own household income relative to the reference group will raise it.[1]

As Clark *et al* (2006) discuss, theoretical models of utility depending on relative income have been used to study savings, taxation, asset pricing and related issues, but have not been related to the happiness literature. They also include absolute income in some form, so they share with models of status the counterfactual prediction that SWB grows with income.[2] Use of a representative agent means that cross – sectional relationships cannot be explored. Clark *et al* (2006) suggest a simple utility or happiness function for cross – country comparison where the marginal effect of absolute income in one country is positive but tends to zero as income becomes infinite, while relative income has a larger effect (Fig. 4). However this does not capture declining (or constant) happiness over time in rich countries. Relative and absolute income and taxation in a model with a distribution of ability was considered by Boskin and Sheshinski (1978), but they assumed fixed labour supply, (though education was endogenous), and did not discuss the happiness findings of Easterlin (1974) and others.

What we present in this paper is, to our knowledge, the first disaggregated heterogeneous agent model of relative income, and an environmental externality, that is consistent both with the time-series and cross-sectional evidence on SWB. Heterogeneity in this model comes through the distribution of ability. As a further contrast to status models, income, labour supply and unemployment are endogenously determined in our simple general equilibrium framework that incorporates second-best taxation and a public sector. Thus we may claim to be making a rudimentary start to Layard's (2005) programme for reformulating public economics based on more realistic micro-foundations. In our framework an income tax initially reduces the 'consumption externality' as well as increasing the supply of public goods, and is thus Pareto-improving up to the point at which these benefits are balanced by rising unemployment.

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[1] Though we should note that, working with German data, Ferrer-i-Carbonell (2005) finds evidence of some asymmetry in this relationship.

[2] See e.g. Abel (1990, 1999, 2005), Campbell and Cochrane (1999), Ljungqvist and Uhlig (2000), Choudhary and Levine (2006).

The paper is structured as follows: in Section 2 we start with a discussion of status models. This is followed by a review of the evidence for the importance of relative income in Section 3. Section 4 develops our model and its implications and we present numerical simulations in Section 5. Section 6 concludes.

2. Models of Status

Since Frank (1985), an individual's status has been defined essentially as the number of people with lower conspicuous consumption. While initially plausible, this variable cannot be directly observed by the agent. Without access to sophisticated statistical data it would be difficult for many people in a modern society to know even their approximate ranking in any such distribution. Moreover, given the fixed price and unlimited supply of positional goods in such models, the excessive conspicuous consumption result is not surprising.[3] We entirely agree with Frank (1985, 1999) and others that expenditure on status seeking and positional goods is likely to be excessive in the absence of 'luxury taxes'. However we note that this wasteful expenditure is, according to much recent research, actually driven by aspirations based on reference groups such as neighbours' conspicuous and other consumption.

The most recent, and mathematically sophisticated, model of status in the literature is that by Hopkins and Kornienko (2004).[4] They comment that "a more affluent society will have a lower utility at each income level" (p.1099). In their paper, a more affluent society is one in which, given a fixed interval of support, the change in the distribution of exogenous income satisfies first-order stochastic dominance. This analytical result is argued to offer one explanation for Easterlin's empirical finding that "average happiness scores seem to change more slowly than average income."

One point that we would mention in passing is that the empirically relevant definition of 'more affluent' is a growth in everyone's real income. That is, the interval of support is shifted to the right rather than remaining unchanged. This is what has

[3] Though presumably endogenizing the supply and price of such goods would lead to consumers spending an excessive share of their income on them in the chase for status.
[4] Henceforth HK.

happened in most of the countries where average SWB has declined or remained constant (though exceptionally in the US, the real wages of the less skilled have stagnated for decades). Given its distribution, when all incomes grow in the Frank-HK model, so too will both positional and other consumption. Thus the distribution of the former will follow the distribution of income in equilibrium and utility will actually increase for everyone even though excessive positional consumption will continue to inflict a negative externality. Indeed Lemma 1 in HK (page 1090) demonstrates that the utility of the lowest income group is an increasing function of the level of the lowest income. A more natural interpretation of economic growth would thus be a rightward shift in the interval of support for the distribution of income.

The only alternative would be for conspicuous consumption to increase so rapidly with income, and non-conspicuous consumption to decline so much, that everyone became worse off, despite incomes being higher. This is clearly not plausible given the limited supply of the kinds of goods that might be classified as 'positional'. Indeed, as Helliwell and Putnam (2004) point out, the decline in SWB in some countries seems to be the result of declining social capital in its various forms, such as trust and community involvement. Such variables are not included in models of status.

In motivating their definition of status as depending with positive weight on the number of people with strictly lower conspicuous consumption, HK (page 1089) point out that starting from an equal distribution, any increase in conspicuous consumption by one individual will generate a finite status gain. However, an implication of this would seem to be that the marginal utility of conspicuous consumption is thus infinite when starting from such an initial position, something that appears counter-intuitive. While this avoids the problems of multiple equilibria in Frank's original specification (HK, fn.17, p. 1092), the central idea of status as being 'downward looking' in the sense of the number of poorer people (who have lower consumption of both kinds) does not seem to fit with the most recent empirical research. Of course, this does not mean that conspicuous consumption is unimportant, just that the models of status reviewed here are no more help in explaining the robust empirical findings on the behaviour of SWB than conventional growth models.

In contrast to the notion of status and utility depending on a 'poverty count', most of the psychological research reviewed by Layard (2005) and Frey and Stutzer (2002), but neglected by HK, points in the opposite direction and is framed in terms of directly observable consumption or wealth indicators. As Stutzer (2004, p. 93) explains, "People look upward when making comparisons. Aspirations thus tend to be above the level already reached. Wealthier people impose a negative externality on poorer people but not *vice versa*." Thus people compare themselves with a 'reference group' of similarly or better-off individuals, and form aspirations based on characteristics of the reference group such as indicators of status, income or consumption. It is the gap between one's current situation and aspirations based on the reference group that is then a major determinant of unhappiness. Furthermore, as Stutzer (2004) has shown directly, reference groups and aspirations are not static, but adapt with changing circumstances, including rising income.

An approach that generates negative utility growth is that of Cooper et al (2001), who consider endogenous growth with excessive resources devoted to status goods, where utility depends on the difference in status consumption from members of one's peer group. However labour supply is exogenous, there is no unemployment, and only two skill classes.

Thus there is strong evidence from a variety of sources - ranging from macroeconomic time series to laboratory experiments - that utility functions of the Frank-HK sort may be not be wholly appropriate and that an alternative approach which postulates dependence of utility on relative income may offer a better approximation to the complexity of interdependent preferences. Thus it is to this that we now turn and, in the next two sections, develop an alternative model.

3. Relative Income

The most striking direct empirical evidence in support of the relative income hypothesis is very recent. With US data, Luttmer (2005, p.990) reports that "an increase in neighbors' earnings and a similarly sized decrease in own income each have roughly the same negative effect on well-being". Ferrer-i-Carbonell (2005) has obtained similar results with German data (but using quite different reference groups in terms of similar education), as have Helliwell and Huang (2005) with Canadian data. The consistency of these findings in the presence of numerous controls and robustness checks is remarkable and they are compatible with both the failure of average happiness to increase with average real income over time, and with the positive cross-sectional relationship between income and happiness. However Helliwell and Putnam (2005, p.446) also report "diminishing returns to relative income above median levels, especially for those living in OECD countries", and Kahneman et al (2006) argue that even these effects may be exaggerated by "focussing illusions". And as noted above, the representative – agent models of relative income reviewed by Clark *et al* (2006) are, (like models of status), generally inconsistent with the finding of basically constant levels of happiness in spite of growth in consumption.[5]

Although they do discuss some of the literature on happiness, Brekke and Howarth (2002), and Brekke, Howarth and Nyborg (2003) also adopt utility functions of relative income in ratio form that allow positive utility growth. Surprisingly, they do not offer any discussion of the striking contradiction between their specification and the empirical evidence of constant happiness over time in rich countries. Instead they rely on two hypothetical questionnaire surveys of small samples of students, which appear to support their specification, and which they incorrectly claim "are broadly consistent with the…links between personal income and subjective well-being that we discussed earlier…" (Brekke and Howarth, 2002, p.42).

4. A Model of Relative Income

In this section, we explore the implications of a utility function to represent SWB or happiness that depends on both relative income (rather than the distinction between positional and non-positional goods)[6], an environmental externality, and also on endogenous leisure, where work effort depends on ability. The empirical evidence

[5] Of course, they focus on different issues which they do help to explain – see the discussion preceding fn.2

[6] The empirical meaning of the distinction is unclear in the HK model with unlimited supply, which also ignores the obvious complementarities between 'conspicuous' and other consumption.

reviewed above suggests that various measures can proxy for the complex psychology of aspirations and comparison with a reference group that will also vary across individuals. To keep the model simple, we just use equilibrium income of each individual's ability class as reference income, though we indicate how alternatives can generate similar results. This is very close to the empirical specification of Ferrer-i-Carbonell (2005), who uses the average income of those with similar educational qualifications as reference income. Our model thus generalises both previous attempts to include relative income in representative agent models, and the exogenous income distribution assumed by HK, as well as including unemployment and a public sector. We do not include the important issues of adaptation to changing income, which would require a dynamic model.

Most importantly, our results are consistent with several key stylised facts about happiness and labour supply that are contradicted or excluded by the previous approaches. Firstly we find that equilibrium SWB or utility (of consumption and working time) is independent of aggregate productivity (or real wages). Secondly, individual welfare is a concave increasing function of ability and individual real income, and finally, individual work time increases with ability and income. Thus we can explain not only the divergent time series and cross sectional results from empirical studies of happiness, but also the equally puzzling cross sectional correlation between wages and hours, and the very slow changes in average working time over long periods in advanced economies such as the UK and US.[7]

Finally it should be emphasized that the dominant role of relative income clearly depends upon absolute income exceeding levels of poverty at which basic necessities are lacking. In other words our model implicitly requires that minimal income or unemployment benefits are high enough to maintain a basic standard of living.

We shall assume that individuals differ in terms of their ability $a \in [0,1]$ and the density is $f(a)$, with $F(1) = 1$. If e is effort or working time, the effective labour supply of someone with ability a is ae and, if productivity is p, their output will be

[7] Many European countries experienced large reductions in standard working hours from high post-war levels, and more recently in politically motivated attempts to reduce persistent long -term unemployment, though without obvious success.

$q = pae$ with a linear technology. p may thus be thought of as the basic wage per unit of effective labour[8].

If someone is employed, utility is assumed to be quasi-linear in leisure, and to depend on the ratio of own income to the *equilibrium* income of individuals with the same ability, with an exponent $\beta \leq 1$. Furthermore we assume that economic growth, as summarised by the productivity factor *p*, imposes the negative externalities that have been documented by authors from Mishan (1960) to Lane (2001), Offer (2006) and Putnam (2004)[9]. These externalities include congestion and loss of social capital, the breakdown of community and family, and the rapid rise of youth suicide, crime, mental illness and clinical depression in the last half Century. While we do not develop an explicit growth model, our productivity factor allows for comparison of different levels of aggregate consumption, and our static utility could be embedded in a growth model.
For simplicity we set the externality equal to the productivity factor, and choose the simplest specification of utility that is consistent with the survey results on approximately constant happiness summarized above. Thus

1. $$U_{em} = U\left(\frac{y}{p^{1-\beta} y^{*\beta}}\right) - e + V\left(G/p\right)$$

.

where utility, *U,* is concave and increasing, and *y* is the individual's net income or consumption when the price of output is normalised to unity: $y = pae(1-t)$. Clearly the exponents in the denominator need not sum to unity, and will depend upon the institutions of a society, so cases of declining or increasing happiness with economic growth could be accommodated. Equilibrium income is $y^* = pae^*\left(1-t\right)$, where $e^* = e^*(a,t)$ is equilibrium effort for those with ability *a*, who face a proportional tax on their earned income at a rate t , and the tax revenue provides for the provision of public goods and/or social security. The value of government expenditure, *G,* on

[8] Clearly, those with zero ability cannot supply labour, but we could introduce a positive lower bound on ability without fundamentally changing the results.
[9] It is interesting to note that Switzerland and Scandanavian countries that top the international happiness ranking score highly on measures of social capital, suggesting that institutions can be structured to mitigate the negative externalities of growth.

public goods is represented by the concave, increasing function $V(G/p)$, with expenditure being deflated by the wage rate so as to provide a measure of public sector employment or other service provision. Concavity captures both decreasing returns in the technology of provision as well as diminishing marginal utility of the good or service.

If someone is unemployed they will receive a benefit B. For analytical purposes we can treat this as a fraction of the reference wage p (per unit effort), that is earned by the top ability group a=1, so that $B = \theta p$, where θ is the 'replacement rate', a policy variable[10]. It must be emphasized that this is defined quite differently from the usual ratio of unemployment benefits to minimum or 'low' wages, in order to avoid some arbitrary choice. Since our ability variable goes down to zero for those who are unable to work, the lowest wage earned by individuals working may be a small fraction of the highest wage. Thus our 'replacement rate' as a share of the maximum wage, can be an even smaller fraction. The reference income in the relative income term is just the benefit received by other unemployed people, with the same exponent as before. Since there is ample empirical evidence on the stigma of unemployment, we allow for this by letting the utility of consumption of the private good be subject to scale and level reductions.[11] Thus the utility of someone who is unemployed is given by

2. $$U_{un} = \delta U\left(\frac{\theta p}{p^{1-\beta}\left(\theta p\right)^{\beta}}\right) - \varepsilon + V\left(G/p\right) = \delta U\left(\theta^{1-\beta}\right) - \varepsilon + V\left(G/p\right),$$

where $0 \le \delta \le 1$ and $\varepsilon > 0$. Thus utility of the unemployed increases with the replacement rate or their relative income, but not with overall productivity, so the

[10] For tractability, we make the extreme assumption here that all benefits are withdrawn for any level of labour supply, but there are no constraints on the choice between receiving the given benefit (without working), or supplying individually optimal effort and income. In practice, most welfare systems do subject low skill workers to very high marginal rates of taxation as benefits are withdrawn after some minimal threshold. However, work – related benefits for low – wage workers have become common in the UK and US.

[11] For example, R. Moffitt (1983) used scale and level effects to explain US data on low-income individuals entitled to benefit. A model incorporating these effects found them significant factors in explaining non-take-up. Stigma has also been amply demonstrated in the sociological literature on interviews with social welfare recipients. Layard (2005, 2006) summarises this and more recent research showing unemployment to be a major cause of unhappiness, comparable to divorce or bereavement.

(un)happiness of the unemployed does not change with economic growth when the replacement rate is given.

These utility functions follow the tradition of using relative income/consumption discussed above. Similar results follow from using mean income in the whole economy as reference income, though this adds some unnecessary complication. Alternatively, with 'upward looking' comparisons, using the income of the highest earners as the reference income for aspirations also preserves the essential results. Furthermore, we could define a sequence of ability subgroups, with the maximum income in each as the reference income for the subgroup. Then we obtain similar results for each subgroup, with equilibrium functions differing only by constants, and we avoid the extreme case of the poorest groups in society forming aspirations based on the highest incomes, in favour of more local comparisons.

Those who are employed will choose equilibrium effort so as to maximise utility. As this is a large economy and agents are small, they will take the equilibrium level of income of those with the same ability as given in choosing their own optimal effort. This yields the first-order condition for optimal effort, e^*, and income, y^*, from (1) as

3. $$\frac{pa(1-t)}{p^{1-\beta}y^{*\beta}}U'\left(\frac{y^*}{p^{1-\beta}y^{*\beta}}\right)=1.$$

Rearranging and writing $x \equiv a(1-t)$, so $y^* \equiv pxe^*$, we obtain

4. $$x^{1-\beta}U'\left(\left(xe^*\right)^{1-\beta}\right)=e^{*\beta}$$

as the defining equation for equilibrium effort, which is now obviously a function of *x*. It is thus clear that equilibrium effort does not depend on productivity, and by substitution into (1), the same holds for equilibrium utility, as required. It should also be obvious that this result does not depend on the quasi – linearity of our utility function, but holds quite generally with our version of the relative income hypothesis. Any specification of utility with relative income and an externality that is linearly related to productivity as in (1) is thus consistent with the time series evidence on approximately constant happiness in developed countries. The weighting of relative income by the exponent, β, is in principle subject to empirical testing, with some cross – sectional results, as mentioned above, suggesting a value close to one.

Simplifying (4), we write the defining equation for equilibrium earnings in terms of ability and taxes as

5. $$xU'\left(y^{*1-\beta}\right) = y^{*\beta}$$

By differentiating (5) we can obtain the response of earnings to change in ability or taxation:

6. $$\frac{dy^*}{dx} = \frac{y^{*\beta}}{x\left\{\beta y^{*\beta-1} - (1-\beta)xy^{*-\beta}U''\left(y^{*1-\beta}\right)\right\}}$$

which is positive by concavity. Thus, as expected, earnings increase with ability, and fall as the tax rises. However, it turns out that the response of effort cannot be signed unambiguously, due essentially to conflicting income and substitution effects. From the positive earnings response it does follow that the elasticity of effort must exceed minus one, where the effort elasticity is $\eta \equiv \frac{x}{e^*}\frac{de^*}{dx} > -1$. More surprisingly, equilibrium utility does necessarily increase with *x*, though this becomes increasingly likely as the weighting of relative income, β, approaches one.

To obtain monotonic responses and numerical simulations we shall continue with a constant – elasticity utility as follows:

7. $$U_{em} = \frac{1}{1-1/\gamma}\left(\frac{pae(1-t)}{p^{1-\beta}y^{*\beta}}\right)^{1-1/\gamma} - e + V\left(G/p\right)$$

with $\gamma > 1$. From the FOC we obtain equilibrium effort as a simple, monotonic increasing function:

8. $$e^* = x^{\alpha-1}, \text{where } \alpha - 1 \equiv \frac{(1-\beta)(\gamma-1)}{1+\beta(\gamma-1)} > 0, \text{ and } \alpha = \frac{\gamma}{1+\beta(\gamma-1)}$$

Note that $\alpha - 1 < \gamma - 1$, and α decreases from γ to one as β increases from zero to one. The latter case must thus be excluded to obtain equilibrium effort that increases with ability and declines as the tax rate rises, as both casual observation and empirical results indicate. Equilibrium net earnings are $y^* = pae^*(1-t) = px^\alpha$, and utility for *x*, (or individual a facing tax t), then follows by substituting (8) into (7), so

9. $$U_{em}^*(x) = \frac{1}{\gamma - 1} x^{\alpha - 1} + V(G/p)$$

In our linear – production economy, government surplus spending on public goods other than benefits is proportional to productivity, so the 'deflated' expenditure on the RHS of (9) is independent of p, as we show formally below.

Next we determine the lowest employed – or highest unemployed – ability, say $\underline{a}$, with $\underline{x} \equiv \underline{a}(1-t)$. Individuals with this level of ability are indifferent between work and unemployment, so

10. $$U_{em}^*(\underline{x}) = U_{un}(\underline{x}) \Rightarrow \underline{x}^{\alpha-1} = \delta U(\theta^{1-\beta}) - \varepsilon$$

It follows that the marginal ability is given by:

11. $$\underline{a} = \frac{1}{1-t}\left\{(\gamma - 1)\left(\delta U(\theta^{1-\beta}) - \varepsilon\right)\right\}^{\frac{1}{\alpha-1}}$$

so unemployment, $F(\underline{a})$, increases with both the tax and replacement rates as expected, but is independent of productivity - in agreement with the time-series evidence. From (8) we see that the effort elasticity becomes arbitrarily small as β approaches one, so the observed low labour supply elasticities of at least full – time male workers with respect to taxes and wages suggests a 'high' weighting (close to one) of the reference income in utility (1). By contrast, (11) shows a unit tax elasticity of the participation or marginal ability, in accordance with much higher responsiveness of the (particularly female) participation rate to wages and taxes found empirically.

The public sector

Government revenue, *R*, from the tax on income is

12. $$\begin{aligned} R &\equiv \frac{t}{1-t}\int_{\underline{a}}^{1} y^{*} f(a)da = \frac{t}{1-t}\int_{\underline{a}}^{1} pa^{\alpha}(1-t)^{\alpha} f(a)da \\ &= pt(1-t)^{\alpha-1}\int_{\underline{a}}^{1} a^{\alpha} f(a)da \end{aligned}.$$

Clearly a rising tax will ultimately reduce revenue from existing employment, as well as raising the participation ability and hence unemployment.

With a balanced budget, revenue has to meet unemployment benefit costs $BF(\underline{a})$ and any other spending on public goods, so $R = BF\left(\underline{a}\right) + G$. Dividing by productivity we find from (12) that

13. $$\frac{R}{p} = \theta F\left(\underline{a}\right) + \frac{G}{p}$$

The LHS is independent of the productivity level by (12), so the 'deflated' value of public good expenditure on the RHS of (13) and in the equilibrium utility function (9) is likewise independent of productivity. This completes the argument for the consistency of our model with the basic constancy of average happiness scores over long periods of real economic growth.

Of course, if some public expenditure was on goods with falling real prices relative to wages, due to rising productivity, then utility from a constant share of public expenditure could increase over time. However, due to the negative externalities of congestion, and declining natural and social capital as consequences of growth, the combination of these two effects allows for the small positive or negative trends in life satisfaction or happiness over time that are observed in a few countries. Finally, since raising the tax always raises expenditure on benefits for more unemployed households, the tax that maximises *G* will be smaller than the revenue maximising tax. We continue with some numerical simulations of taxation and welfare to give examples of optimal (linear) taxes.

5. Optimal Public Finance

In this section we want to use the model to look at the issue of optimal public finance and to examine how that varies as the various parameters in our model change. If we were to assume that ability was uniformly distributed on the [0,1] interval, we could certainly establish some analytical results. However we wish to consider more general ability distributions than the uniform, and in such cases analytical results are very difficult to establish. For this reason we have numerically solved our model and explored the sensitivity of our results to variations in the underlying structural parameters.[12]

As we wish to explore the implications of variations in the shape of the ability distribution we have used the Beta distribution.[13] This is the obvious candidate as it is defined on [0,1] and has the great advantage that, by varying its two parameters, we can explore a wide range of cases.[14]

The policy variables that we solve for are the tax rate (t) and the replacement rate (θ). In calculating the optimum values for these we check to ensure that the public finances are feasible, i.e. that the tax revenue raised is at least as large as public expenditure. As a preliminary, we note that in this model government revenue initially rises with the tax rate, and subsequently declines in a standard Laffer curve. In addition, the supply of the public good initially increases with the tax rate, which

[12] Mathcad13 was used to carry out the simulations. The relevant code is available on request from the authors.

[13] It is a two-parameter distribution with the density given by $f(a) = \dfrac{\Gamma(\upsilon_1 + \upsilon_2)}{\Gamma(\upsilon_1)\Gamma(\upsilon_2)} a^{\upsilon_1 - 1}(1-a)^{\upsilon_2 - 1}$,

usually denoted as $B(\upsilon_1, \upsilon_2)$. Its mean is $\mu = \dfrac{\upsilon_1}{\upsilon_1 + \upsilon_2}$, and its variance is

$\sigma^2 = \dfrac{\upsilon_1 \upsilon_2}{(\upsilon_1 + \upsilon_2)^2 (\upsilon_1 + \upsilon_2 + 1)}$.

[14] Thus $B(1,1)$ is the uniform distribution. By varying the two parameters one can change the peakedness and the skewness of the distribution.

raises the welfare of all, but as taxes rise further, increasing expenditure on benefits for the growing number of unemployed reduces the residual revenue available for public goods. This is illustrated in Figure 1.

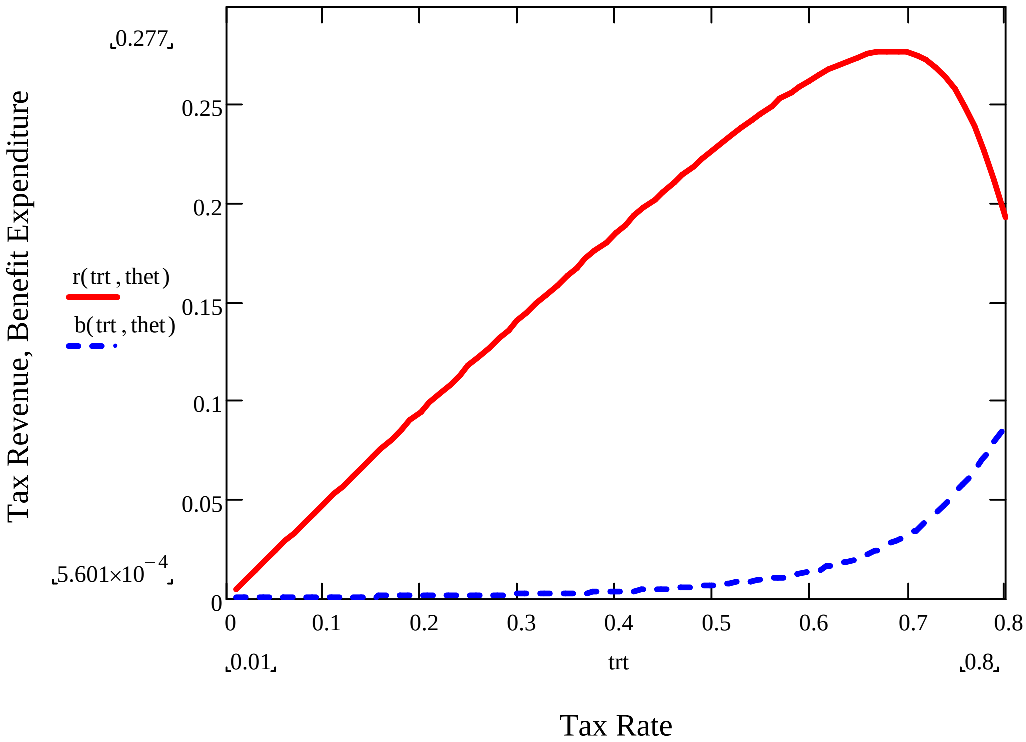

Figure 1: The Laffer Curve and Benefit Expenditure

The Benchmark Case

For our base case we have chosen a distribution that is symmetric about 0.5 and set $\upsilon_1 = \upsilon_2 = 4$. For our stigma effect we let $\delta = 0.8$ and $\varepsilon = 0.1$. The elasticity of utility with respect to income (γ) is set at 1.25 and the parameter on relative income (β) at 0.7. In the theoretical section, we did not specify a specific functional form for the utility from public goods. Since we require this for numerical analysis, we need to do so now. We allow for diminishing marginal utility of the public good and let the sub-utility function be $\left(\frac{G}{p}\right)^{\rho}$, where $0 < \rho \leq 1$ is the elasticity of utility with respect to the level of public good consumption.[15] In our base scenario we set $\rho = 0.4$.

[15] In all our simulations we set $p = 1$. This is simply a normalisation and our numerical results are invariant to p.

The social welfare function to be maximised is that of Atkinson and Stiglitz (1980):

$$W^*(t) = \frac{1}{1-\zeta}\int_0^1 \left(\left(U^*(a,t,\theta)\right)^{1-\zeta} - 1 \right) f(a)da \ ,$$

where $U^*(a,t,\theta)$ reflects the equilibrium choice made by someone of ability a facing the tax rate t and replacement rate θ.[16] ζ is a parameter allows us to control for inequality aversion: the Benthamite (strict utilitarian) case is $\zeta = 0$ and the Rawlsian case is the limit as $\zeta \to \infty$.

We start with the utilitarian case as a benchmark and then see how the optimum changes as the structural parameters change. The results for the utilitarian case are set out in Table 1 below.

[16] The relevant functions are given by equations 2 and 9.

Case	Optimum Tax Rate	Optimum Replacement Rate
Benchmark	0.466	0.028
Distribution less peaked $\upsilon_1=\upsilon_2=3$	0.467	0.037
Distribution Positive skew $\upsilon_1=3,\ \upsilon_2=4$	0.451	0.033
Distribution Negative skew $\upsilon_1=4,\ \upsilon_2=3$	0.481	0.03
Gamma higher (=1.3)	0.475	0.023
Gamma lower (=1.2)	0.457	0.035
Delta higher (=0.85)	0.466	0.02
Delta lower (=0.75)	0.466	0.028
Epsilon higher (=0.15)	0.466	0.028
Epsilon lower (=0.05)	0.466	0.026
Beta higher (=0.8)	0.591	0.022
Beta lower (=0.6)	0.374	0.034
Rho higher (=0.5)	0.488	0.026
Rho lower (=0.3)	0.428	0.032

Table 1: The Optimal Tax and Replacement Rates (Utilitarian)

In the benchmark case, the optimal tax rate is 46.6% and the optimal replacement rate is 2.8%, which as emphasized in Section 4 above is a fraction of the maximum wage, rather than the usual reference to a minimum or low wage. However, it is worth noting that while the social welfare function is quite strongly concave in the tax rate (for any given replacement rate), the concavity, over quite a range of replacement rates – and particularly those that feature in the optimum calculations, is quite limited. This can be seen in Figures 2 and 3 below, which show how social welfare varies around the optimum. As might be expected with a utilitarian objective that does not include distributional considerations, unemployment is very low, though of course the zero - ability or disabled cannot supply labour, so we have essentially full employment.

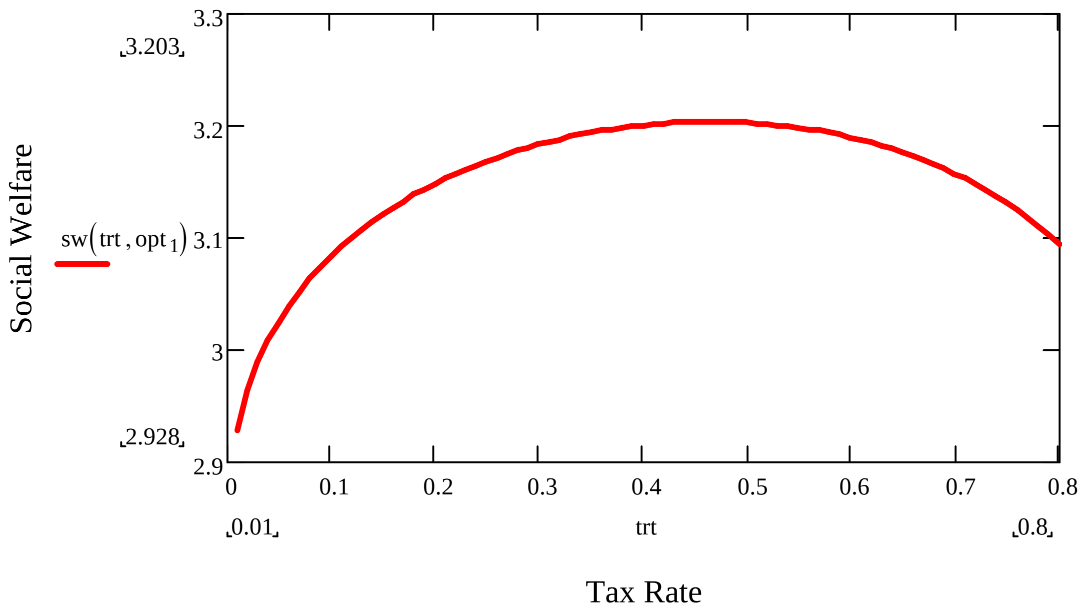

Figure 2: Social Welfare as a function of the Tax Rate

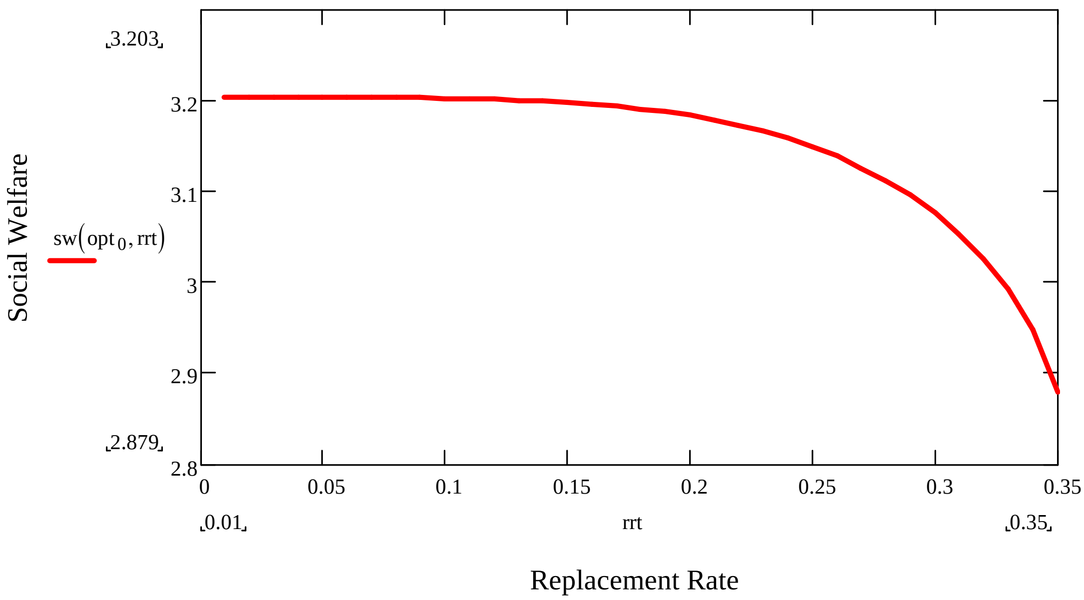

Figure 3: Social Welfare as a function of the Replacement Rate

While it is not appropriate to compare the utilitarian optimal replacement rate with what one would expect to be able to sustain in the real political world where distribution matters, it is worth noting that should the political economy of this 2.8% rate be seen as problematic, the flatness of the function in Figure 3 suggests that much higher rates can be attained with a relatively small loss in aggregate welfare. For example at a rate of 30%, social welfare at the original optimal tax rate is still almost 98% of its globally optimal level – though it is starting to drop away quite rapidly above that. Of course, at a replacement rate of 30%, the optimal tax rate is different: 32%. Moreover at this point the unemployment rate is almost 14%. This indicates that in this model there are some potentially important political economy tradeoffs.

As the equilibrium income of the employed is an increasing (and convex) function in ability, a more peaked distribution reduces the potential income base[17] and leads to a lower tax revenue potential (at any tax rate). The same is the case when the distribution is skewed positively, so that there are more people in the lower half of the ability distribution. On the other hand, skewing the ability distribution negatively puts more people in its upper half and raises the potential tax base. However, as Table 1 shows, while such changes have only a relatively modest impact on the optimal tax rate, there is rather more volatility in the optimal replacement rate. The biggest jump comes when the distribution becomes less peaked. In this case one has increased the numbers in the upper <u>and</u> lower tails of the distribution. Since there is little change to the potential tax base, and hence potential tax revenue, you might intuitively expect to see a greater focus on the use of tax revenue for the provision of public goods (which <u>all</u> benefit from) and less being used to provide income support (which benefits a relatively small minority). Nevertheless, again we find that were we to deem a replacement rate of 30% as politically more feasible, social welfare would still be 97% of its globally optimal level.

Skewing the distribution so that there are more people in the lower tail (positive skew) lowers the potential income base. Since one wants to keep as many of these in employment in order to raise the revenue to provide the public good (as this adds

[17] "Potential income base" means the aggregate equilibrium income if the entire labour force were to work.

relatively more to the utility to the poor), the optimal tax rate is lower. Again one finds that one can raise the replacement rate by a significant amount and have a relatively limited impact on welfare. Thus at 30%, the optimal tax rate would be lower at around 28%.[18] At that rate social welfare would be 94% of its globally optimal level.

A negative skew means we have a more able society with greater income earning ability and so higher tax rates can be supported for any given unemployment rate. This replacement rate is lower but this is because there are relatively fewer people in the bottom part of the ability distribution. Here again we can significantly raise the replacement rate without having a major impact on welfare. So at 30%, the optimal tax rate is 37% and one achieves almost as much welfare as the global maximum: 99% of the optimal level.

A higher value for gamma raises both the utility and the marginal utility of private consumption. In particular it increases the utility derived from the existing level of the replacement rate. Since this makes unemployment less unattractive, the replacement rate needs to fall to compensate for this. However, the negative effects of this are offset by a rise in the tax rate and an increase in public good provision. The opposite is the case when gamma is lower than the benchmark level: the optimal tax rate falls and the replacement rate rises.

Stigma is captured by the scale parameter δ and the level parameter ε. Interestingly, varying δ has no impact on the optimal tax rate, but does have an impact on the optimal replacement rate. A higher (resp. lower) δ reduces (resp. increases) the stigma of unemployment and that is countered by a reduction (resp. increase) in the benefit rate. The same stigma effects are also in operation for ε.

Raising β raises the importance of relative income comparisons in the model. As can be seen from equation (8), a rise in β reduces the equilibrium level of effort and so requires a higher rate of tax to support expenditure on social benefit and on public

[18] This lower rate is to maintain the incentive to choose employment so that as to ensure there is sufficient revenue to cover public expenditure.

goods. Reducing β has the opposite effect. Changing this parameter also has a much larger impact on the tax rate than on the replacement rate.

The impact of changes in ρ are as one might intuitively expect. A rise in ρ raises the value of public goods and so the tax rate rises in order to finance this higher level of public spending whereas lowering ρ has the opposite effect.

The Impact of Inequality Aversion

The final exercise is to see what happens as we increase inequality aversion. We can do this by raising the value of ζ from the benchmark Benthamite case of $\zeta = 0$. Table 2 below shows that as aversion increases, so do both the optimal rates. This is what one would intuitively expect to happen. In the limit, as ζ goes to infinity the social welfare function is Rawlsian: one seeks to maximise the welfare of the least well off, the group at the bottom of the ability distribution. As expected, the optimal tax is higher, though not spectacularly so, but the optimal replacement rate is about seven times the benchmark utilitarian case. The price for this egalitarian move is then that unemployment rises to 16%. Note however that our ‘unemployed’ include the inactive, so we still have a respectable employment rate of 84%.

Case	**Optimal Tax Rate**	**Optimal Replacement Rate**
$\zeta = 2$	0.467	0.037
$\zeta = 4$	0.467	0.046
$\zeta = 8$	0.468	0.069
…	…	…
$\zeta = \infty$	0.545	0.209

Table 2: Optimal Tax and Replacement Rates and Inequality Aversion

This completes our analysis and discussion of the numerical analysis of the model.

6. Conclusions

Combining a simple model of utility depending on relative consumption with a continuum of ability types gives general equilibrium results that are consistent with both cross – sectional and time – series evidence, thus resolving the inconsistencies that have plagued previous specifications of relative income in macro-models, or conventional labour supply. We include voluntary unemployment with a categorical benefit that is lost when any labour is supplied – at least a rough approximation to most existing systems that impose high marginal tax rates on low earners as unemployment benefits are lost. While standard models of labour supply assume that unemployment increases utility at constant income due to the always positive marginal utility of leisure, much recent research shows unemployment to be a major cause of unhappiness, comparable to divorce or close bereavement. Thus we incorporate the welfare loss or 'stigma' of unemployment in the model and simulations.

In general equilibrium, effort increases with individual ability and wages, as universally observed in modern advanced economies, while both utility or SWB and labour supply are independent of aggregate productivity (which we interpret as being consistent with the results for growth in real income). Taxes in equilibrium primarily affect the participation decision, while the effect on welfare or labour supply of the employed declines as the weight on relative income in utility approaches one. Government revenue initially rises with the tax rate, and subsequently declines in a standard Laffer curve. The supply of the public good initially increases with the tax rate, which raises the welfare of all, but as taxes rise further, increasing expenditure on benefits for the growing number of unemployed reduces residual revenue for public goods.

Since further comparative – static results of parameter variation are difficult to derive analytically, we explore some of the most salient with numerical simulations using the convenient beta distribution of ability. Budget feasibility or non – negative expenditure on public goods, imposes restrictions on parameters, which are also chosen to yield 'reasonable' tax and unemployment rates. Public finances are illustrated, optimal taxes under different welfare goals are derived, and their sensitivity to parameter changes is tabulated. The key result is both intuitive and consistent with previous findings in more restricted models: the optimal tax increases with the weighting of relative income so as to counteract the rising externality imposed by individual earnings.

Though our model is basically simple and stylized, the systematic incorporation of relative income in individual utility with varying ability generates a series of results that are consistent with a large body of empirical evidence, and avoids the obvious but neglected conflicts with well – established facts that characterise much previous work on relative income and status.

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