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# Inequality, Happiness and Relative Concerns: What Actually is their Relationship?

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**Abstract**

This paper briefly and informally surveys different theoretical models of relative concerns and their relation to inequality. Models of inequity aversion in common use in experimental economics imply a negative relation between inequality and happiness. In contrast, empirical studies on happiness typically employ models of relative concerns that assume that increases in others' income always have a negative effect on own happiness. However, in these latter models, the relation between inequality and happiness can be positive. One possible solution is a rivalry model where a distinction is made between endowment and reward inequality which have respectively a negative and positive effect on happiness. These different models and their contrasting results may clarify why the empirical relationship between inequality and happiness has been difficult to establish.

**Keywords:** inequality, relative position, social preferences, tournaments, evolution.

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# 1 Introduction

There is an increasing acceptance that the welfare of individuals is not solely determined by their material circumstances but also depends heavily on their relative position in society. One way to explain this would be to assume that people care directly about the consumption or utility levels of others, people have "social preferences". For example, if people have a strong preference for social status, it would not be surprising if a high ranking individual in a poor country could be happier and healthier than a low ranked individual in a rich country even if they have the same real income. Another is to attempt to explain such relative concerns as arising from the economic incentives that arise in tournament-like situations. Simply put, if life is a tournament where prizes are awarded to a society's winners, it would be rational to seek high social position.

Either way, the literature on relative concerns has enormous implications for the study of inequality. The Second Welfare Theorem apparently separates issues of equality and efficiency and has led several generations of economists to believe that the desirability or otherwise of greater equality is purely a question of subjective taste. However, the new evidence for the strength of relative concerns suggests not only that important externalities exist, but they are considerable in magnitude. This opens to the door to the possibility that changes in the distribution of income can have a significant effect on efficiency, that redistribution could be benefit even those who lose financially and that taxes have the potential to be Pareto-improving.

Data that supports the relative position hypothesis comes from at least three directions. First, the growing literature on the economics of happiness that analyses survey data on subjective wellbeing has given rise to the "Easterlin Paradox" (Easterlin (1974)). Average happiness scores do not rise or rise only slowly despite considerable growth in living standards. However, happiness scores in cross-section are increasing in income: at a given point in time, richer people are happier than poorer people.[1] Second, if one has the economist's traditional dislike of subjective data, there also seems to be a status gradient in a very material dimension, that of health. A number of studies have found that one's relative position, as well as one's absolute standard of living, is important in determining mortality (see Marmot (2004), Wilkinson and Pickett (2006) for overviews). Third, a wide range of choice experiments have provided support for the idea that people's decisions are influenced by relative income. Explicit models of social preferences have been fitted to this data by Fehr and Schmidt (1999) and others. There is now an extensive literature on the extent and importance of this phenomenon.[2]

[1] Since Easterlin's original work, similar patterns have been found by more recent research on subjective wellbeing. See Clark et al. (2007) for a detailed survey. Another survey of empirical research on happiness goes as far as to conclude that in determining happiness "It is not the absolute level of income that matters most but rather one's position relative to other individuals" (Frey and Stutzer, 2002, p411).

[2] The literature is too large to do more than note some of the prominent alternatives. Charness and Rabin (2002) argue that people care more about the intentions of others than over the distribution of income per se. List (2006) finds that social preference models do not predict behaviour well outside the laboratory.

More recently still, Fleissbach et al. (2007) find evidence of social comparison in reward processing centres of the human brain.

Some economists have made specific policy proposals based on the existence of relative concerns. Since relative concerns imply that Joneses' wealth or visible consumption may have a negative effect on the Smiths, standard microeconomic theory suggests that suitable taxes could improve welfare by correcting these negative externalities. Indeed, Robert Frank (1985, 1997) and Richard Layard (2005) have argued that, in this context, progressive taxation should be Pareto improving. Similarly, the main thrust of Marmot (2004) is that greater equality should improve health.

However, there is a hidden problem in much of the literature in this area. It is assumed that that if there is a status gradient in health or happiness, that is health and happiness are influenced by relative position, then *necessarily* health and happiness are decreasing in the level of inequality. This is a logical fallacy because there are plausible models of relative concerns in which social standing matters and hence there is a status gradient and yet welfare is *increasing* in inequality. For example, the most common reason advanced for inequality causing bad health is that low status causes high levels of stress. Yet when one looks at a formal model of status competition, as will be done in this essay, it turns out that greater inequality reduces competition and can make people better off. Of course, it may still be true empirically that inequality is bad for both health and happiness. However, the relationship between inequality and welfare under relative concerns remains less straightforward than is generally admitted.

One difficulty in clarifying the theoretical arguments is the number of existing different models. First, there are models where relative concerns are ordinal, individuals care about their rank, but also other models where concerns are cardinal, individuals care about how much higher or lower they are than other people. Second, in some models individuals have relative concerns over income or wealth, in others the concerns are over consumption. This makes a difference when consumption is a choice variable, as then relative concerns induce a strategic situation. Third, there is a crucial difference in the way different models treat an individual's concerns over incomes or consumption that are below her own. Specifically, while all such models presume that others having greater wealth lowers one's own utility, some assume others having less wealth raises one's utility, others assume that it lowers it. Thus, some models assume competitive or rivalrous preferences, while others assume what is called inequity aversion.

In this essay, I make three simple points. First, that the exact form of relative concerns is largely irrelevant in explaining the Easterlin paradox or the presence of a status gradient. That is, if one wants to explain why happiness is not growing in rich countries or why a high ranked individual in a poor country can have better health than a low ranked one in a rich country, it does not matter very much which model is used. Second, in contrast, the form of relative concerns matters very much for determining the effect of inequality. And I find that the relationship between relative concerns and inequality is driven by individuals' attitudes to those who have a lower income than themselves, and not other factors such as whether relative concerns are ordinal

or cardinal. Third, there is also a contrast in the form of relative concerns assumed in happiness research and in experimental economics. In the experimental literature, models that assume inequity aversion are more commonly used and have found some support in the data. In contrast, in the happiness literature, researchers have almost exclusively used the rivalrous types of preference where increases of income of those poorer than you have a negative effect. That is, implicitly they are using models that imply greater inequality would raise happiness.

Thus, the form of relative preferences should not be ignored by anyone interested in happiness, inequality or their intersection. Determining the appropriate form of relative concerns is not just a question for theorists. It also matters because current empirical studies have had difficulty establishing a robust relationship between inequality and health and between inequality and happiness.[3] A clearer theoretical picture would clarify the empirical hypotheses to be tested. This would lead to cleaner and clearer results and a better understanding of which policies to reduce inequality would actually enhance welfare.

Thus, to this end, this essay outlines the theoretical arguments that connect relative concerns and inequality. Section 2 summarises the basic models. Section 3 briefly surveys recent work on the underlying causes of relative concerns. Section 4 and 5 show that, while all models are capable of explaining the Easterlin paradox, they can imply quite different relationships between equality and happiness. Section 6 makes the argument that it is the attitude to those poorer than you that is making the difference. Section 7 shows that the relationship between inequality and happiness can further depend on the form of inequality assumed. Section 8 briefly considers policy issues. All this is done as simply and non-technically as possible. Thus, I hope this essay will help to clarify the very important relationship between relative concerns and inequality.

# 2 Models of Relative Concerns

In this section, I outline some simple models of relative concerns. I show that a variety of specifications have similar properties and are all capable of explaining the Easterlin paradox. Easterlin's original claim that economic growth has no effect on happiness does not seem to hold for poorer countries. But the finding that happiness increases in income more steeply in cross section than average happiness increases with average income seems to be very robust (see, for both claims, Clark et al. (2007)). In other words, an increase in happiness for an individual from an increase in income for her alone seems to be higher than from a similar increase in income for all agents. All models surveyed in this section capture such relative effects. We will later go on to show

[3]The conclusion of Deaton's (2003) survey is that there is no clear link between inequality and health. Wilkinson and Pickett (2006) claim that in fact the majority of studies support a negative relationship. Alesina et al. (2004) find a negative relationship between happiness and inequality in Europe and the US. Clark (2003) finds a positive relationship with UK data. Graham and Felton (2006) find a negative effect for the poor and a positive one for the rich in Latin America.

that these different specifications have very different implications for the relationship between inequality and welfare.

Taking a reduced form approach, a model of relative concerns assumes that an individual $i$ with income $z_i$ (or alternatively in some models, consumption) has utility of the form

$$U(z_i, z_{-i}) \tag{1}$$

where $z_{-i}$ represents the incomes of others, for example, given a population of $n$ individuals it would be a vector $(z_1, ..., z_{i-1}, z_{i+1}, ..., z_n)$. In contrast, the standard neoclassical assumption is that an individual's utility depends only on his own income.[4] But, like neoclassical models, these models of relative concerns assume that only allocations matter, not the method or process by which they arrive. Thus, this approach does not allow for considerations of justice or deservingness.[5]

Not surprisingly, the effect of one's own income $z_i$ on utility is assumed to be positive. However, generally it is assumed that the effect of an increase in income of someone who is richer than you is negative (i.e. $\partial U(z_i, z_{-i})/\partial z_j < 0$ for $z_j > z_i$). Following Friedman (2005), let us call this effect, "envy". However, on the effect of changes in income of those who are poorer, there is less consensus. Some assume that any improvement for others has a negative effect on you (i.e. $\partial U(z_i, z_{-i})/\partial z_j < 0$ for $z_j < z_i$). Friedman (2005) calls this "pride" (a better name might be "competitiveness" or "downward envy"). However, others assume that an improvement for those below you has a positive effect (i.e. $\partial U(z_i, z_{-i})/\partial z_j > 0$ for $z_j < z_i$). Call this "compassion". See Figure 1 for a simple representation of this.

For the moment, let us concentrate on models with pride. One very simple observation is that an increase in utility for one individual arising from an increase in her income will be larger than if her increase in income is accompanied by a similar increase in income for someone else. As we will see, this property can offer a simple explanation of the Easterlin paradox.

We can further divide relative models with both pride and envy into two categories on the basis of functional form. The first is often called the "keeping up with the Joneses" model but perhaps is better called a model of mean-dependence.[6] It assumes that utility is increasing in one's own absolute income $z_i$ but there is also a relative component where one's own income is compared with the average income of others $\bar{z}$,

[4] It is true that in a standard model of general equilibrium, it is possible that, for example, an increase in the income of some will raise the price of some good, hence decreasing the welfare of others. This is sometimes called a pecuniary externality. However, models of relative concerns assume an effect that holds even with constant prices. Another way for the distribution of income to have a direct effect on individual welfare is when individuals contribute to public goods. See Dasgupta and Kanbur (2007) for a recent treatment.

[5] Thus, this essay does not address these issues, even though they are undoubtedly important in considering inequality.

[6] As Clark and Oswald (1998) point out a model that is mean dependent may not imply a desire to "keep up" with others.

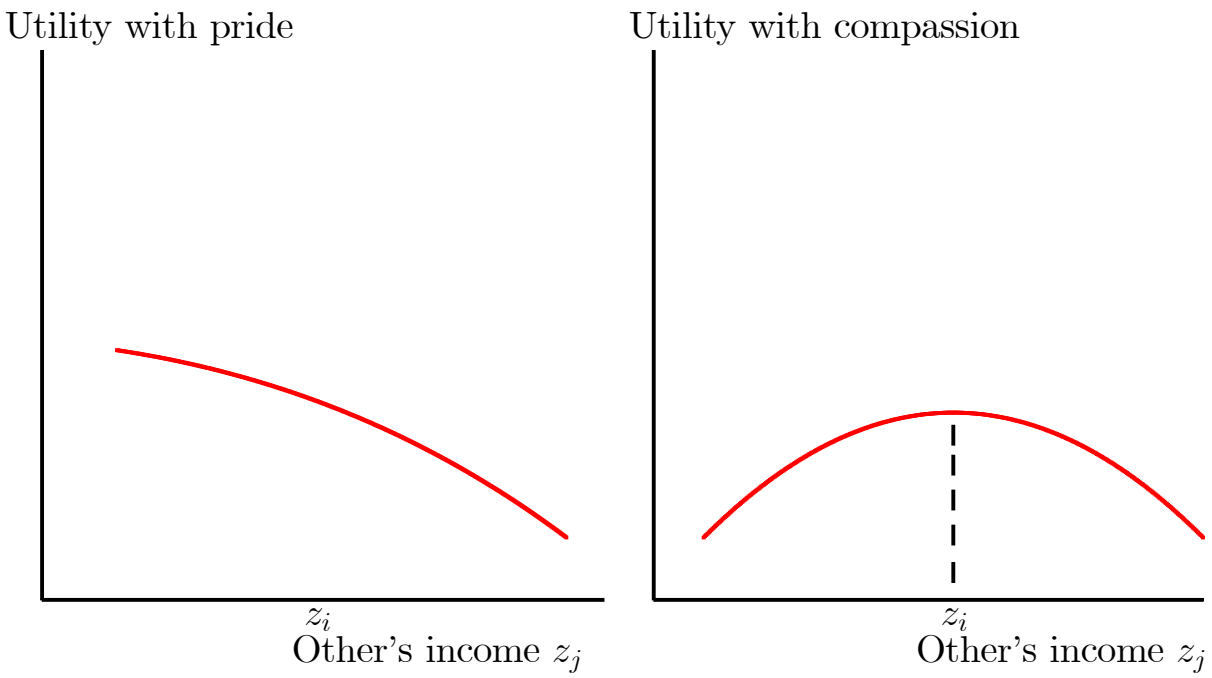


Figure 1: Preferences exhibiting pride and compassion respectively. For a fixed own income $z_i$, we vary other's income $z_j$.

for example,

$$U(z_i, z_{-i}) = U(z_i, z_i - \bar{z}) \tag{2}$$

(an alternative formulation of $U(z_i/\bar{z})$ is also popular). This formulation goes back to Duesenberry (1949) and has been used by many authors including Boskin and Sheshinski (1978), Abel (1990), Gali (1994), Harbaugh (1996), Clark and Oswald (1996, 1998) and Futagamia and Shibata (1998).

Even this simple specification captures some of the basic properties of the empirical stylized facts. For example, it produces a version of the Easterlin paradox. As happiness/welfare is increasing in own income $z_i$, it should be increasing in cross-section. However, happiness may not rise over time for any individual whose income rises no faster than average income. For example, if $U$ is linear, there is no absolute component to utility and the incomes of all rise at the same rate, average happiness will not rise.

**Example 1** *Suppose* $U(z_i - \bar{z}) = z_i - \bar{z} + 1$. *Then, if incomes are distributed uniformly on [0,1], utility ranges from 0.5 to 1.5 with an average of 1. That is, "happiness" increases with income in cross-section. Now, suppose incomes all rise by 0.5, so that the average income is now 1. The distribution of utility is unchanged and still ranges from 0.5 to 1.5. Happiness does not increase at all in response to a general increase in income.*

Further, if $U(\cdot)$ is concave then if the incomes of the rich rise faster than the those of the poor, then average happiness will fall. This is because the higher average income

brings down the happiness of the poor, but the happiness of the rich increases only slowly because they are in the relative flat area of the concave utility function.

**Example 2** *Suppose* $U(z_i - \bar{z}) = \sqrt{z_i - \bar{z} + 1}$. *Initially, income is uniformly distributed on [0,1] and average utility (i.e.* $\int_0^1 \sqrt{z_i - \bar{z} + 1}\ dz$*) is 0.989. Suppose now that those with above average incomes see a rise in income but those with below average income remain unchanged. Specifically, suppose that the new income density is 1 on [0,0.5] and 2/3 on the interval [0.5, 1.25]. Average income is now 0.5625 and no-one's income has fallen. Yet, one can calculate that average utility is now lower at 0.983. Clearly, this would not be possible under standard preferences.*

The second group of models is based on rank. This approach was pioneered by Layard (1980), Frank (1985) and Robson (1992). Given own income $z_i$ and and a distribution of income $F(\cdot)$, utility is of the form

$$U(z_i, z_{-i}) = U(z_i, F(z_i)) \tag{3}$$

One's utility or happiness is increasing in own income $z_i$ but also in the rank $F(z_i)$ one holds in income. This formulation has pride in the sense that, if a group of persons who are currently richer than you had their income reduced to a level below yours, your rank and hence your utility would increase.[7]

This form of utility function can also potentially explain the Easterlin paradox. For a fixed distribution of income, the utility of an individual is definitely increasing in income $z_i$, as both the direct effect $\partial U/\partial z_i$ and through the effect on rank $\partial U/\partial F \cdot f(z_i)$, where $f(z)$ is the density of $F(z)$, are both positive. An increase in income for a single individual raises his consumption and, keeping other incomes constant, raises his rank. Thus, happiness would be increasing in cross-section. However, when society as a whole becomes richer, average rank must remain constant.

**Example 3** *Suppose we have a large population all with the same preferences, the extreme case where* $U(z_i, z_{-i}) = F(z_i)$*, people only care about their relative position. Now, average happiness is always 1/2, irrespective of the distribution of income (see Kornienko (2004)) so that material progress has no influence on happiness. However, the richest always have a much higher utility than the poorest.*

In behavioural economics, there is now an extensive literature on social preferences. In contrast to the above models, it is generally assumed that individuals have "compassion". The inequity aversion model of Fehr and Schmidt (FS) (1999) is perhaps the best known. It assumes that utility depends positively on one's own income, but negatively

[7] There is a technical problem in that this rank based specification is discontinuous in others' incomes when the population has finite size $n$. For each individual whose income drops below yours, your rank jumps by $1/n$.

on the difference between one's own income and that of others. For an individual with income $z_i$ comparing herself with $n$ other people with income $z_{-i}$ this has the simple form

$$U(z_i, z_{-i}) = z_i - \frac{\alpha}{n-1} \sum_{z_j > z_i} (z_j - z_i) - \frac{\beta}{n-1} \sum_{z_j < z_i} (z_i - z_j) \tag{4}$$

where $\alpha$ is a weight on the average of incomes that are above yours and $\beta$ is a weight on the average of incomes below yours.

FS assume that $\alpha \geq \beta$ and that $\beta$ satisfies $1 > \beta \geq 0$. Given $\alpha$ is positive we have what we called envy, a dislike of others having more. If $\beta$ is positive, then low incomes for others reduce one's own utility, that is, there is "compassion". But if, contrary to FS's assumptions, $\beta$ were negative, then we have pride as then lower incomes for others raises an individual's utility. The relation between the FS model and a mean dependent model is illustrated by the following manipulation of (4)

$$U(z_i, z_{-i}) = z_i - \beta(z_i - \bar{z}_{-i}) - \frac{\alpha + \beta}{n-1} \sum_{z_j > z_i} (z_j - z_i) \tag{5}$$

where $\bar{z}_{-i}$ is the average of $z_{-i}$, incomes held by others apart from individual $i$. One can see that if $\beta$ is negative and equal to $-\alpha$, the FS model reduces to a mean dependent model such as (2). Or to put it another way, typical mean dependent models are the special case of the FS model where pride is as strong as envy and there is no compassion.

As we will see, the FS model predicts a negative relation between happiness and inequality. However, it is less successful at explaining the Easterlin paradox. This is simply because in its original formulation (4) it linear in own absolute income. Suppose all incomes are increased by the addition of $\$x$. Then, it is easy to calculate that the relative component of utility, the terms in $\alpha$ and $\beta$ in (4), will be unchanged, and consequently the change in utility will be determined by the first term in the utility function (4) which is simply $z_i$. So, utility for each individual would rise by $x$, the same amount as the increase in incomes. Thus, in contrast to the data on happiness, substantial rises in real incomes should lead to substantial increases in happiness.

The same problem can arise in the the mean dependent and rank models as well. For simplicity, Examples 1-3 assumed utility depends only on relative income. More plausibly, and to make a fairer comparison with the FS model, there should be an absolute income component in utility. For example, for the mean dependent model (2), one could add an absolute component to the formulation in Example 1 to obtain $U = z_i + \alpha(z_i - \bar{z} + 1)$ where again $\alpha > 0$ is used to weight the relative income component. In Example 1, an equal increase in income had no effect on happiness because it did not change the relative income component of utility. But now there is also an absolute income component, it is easy to see that such an increase in income this would lead to a general rise in happiness.

**Example 4** *Again suppose a large population of individuals have the same utility function* $U = z_i + \alpha(z_i - \bar{z} + 1)$ *with parameter value* $\alpha = 1/2$ *and initially incomes are*

*uniformly distributed on* $[0,1]$ *and so we have* $U_B(z) = 3z/2 + 1/4$ *and utility ranges on [1/4, 5/4]. We now raise incomes by 1/2 so that we have a uniform distribution on [1/2, 3/2]. Utility is now* $U_A(z) = 3z/2$ *and ranges on [3/4, 9/4]. Everyone's utility has been raised by 1/2. Suppose instead that the absolute income component to utility is concave so that for example, utility could be* $U = \log(z_i + k) + \alpha(z_i - \bar{z} + 1)$ *for some constant* $k \geq 1$*. It is easy to check that now increasing the incomes of all by some amount* $x$ *will raise all utilities but by less than* $x$*. For example, when* $k = 100$*, when all incomes rise by 1, average utility only rises by 0.01.*

That is, as the above example suggests, there is a relatively simple way to reconcile these models with the Easterlin paradox. Simply assume that utility is strictly concave rather than linear in own absolute income. For example, one can replace the original formulation (4) of the FS model with

$$U(z_i, z_{-i}) = v(z_i) - \frac{\alpha}{n-1} \sum_{z_j > z_i} (z_j - z_i) - \frac{\beta}{n-1} \sum_{z_j < z_i} (z_i - z_j) \tag{6}$$

where $v(\cdot)$ is an increasing but strictly concave function. Now, if the level of income is high enough, general increases in income will have less than a one-for-one effect on average happiness. Specifically, it is easy to verify that the relative component of the above utility function (the terms in $\alpha$ and $\beta$) is unchanged if everyone's income increases by the same amount. So, again we have the familiar story that an increase in own income keeping others' incomes constant will have a greater effect than from raising all incomes. Further, as the own income part of the utility function $v(\cdot)$ is concave, the effect of a general increase in income on utility could be quite small if incomes are already large. That is, economic growth in rich countries would have a smaller effect on happiness than a similar increase in incomes in a poor country. For an illustration of such a pattern, see, for example, Figure 4 in Clark et al. (2007).

Thus, one can capture some aspects of relative concerns either by dependence of utility on mean income or by dependence on one's rank in the income distribution or by a model of inequity aversion. However, this is not to say that the different formulations are identical. For example, consider the changes in the income distribution seen in the US over the past twenty years in which the very rich have become very much richer while many others have seen little increase in real income. Suppose the median individual has seen no change in real income, and by definition, still holds a rank of 1/2. Then, under the rank based formulation (3), her utility or happiness would be unchanged. However, under the mean based formulation (2), as mean income has risen, the same person would feel worse off when contemplating her unchanged real income. This effect would be stronger still under the FS model (4).

# 3 Why Do People Have Relative Concerns?

Concern for relative position seems deep rooted in human behaviour. An often repeated idea is that relative concerns have been selected by competition for relative position in our evolutionary past. The argument runs that men who were able to achieve high position were able to reproduce much faster than lowly ranked men (evolutionary explanations tend not to be gender-neutral). Thus, it became natural to care about relative position. This is a possibility. But in fact, there are at least three different evolutionary or psychological explanations that have recently been proposed. Further, there is an alternative hypothesis that relative concerns arise from current rather past social arrangements. It is the tournament-like nature of economic competition that gives individuals an incentive to make relative comparisons.

First, let us go back in time and imagine that you are a hunter-gatherer and some other member or members of your tribe have just been conspicuously successful. Maybe they just killed a mammoth. In any case, in response to their success you feel unhappy and worried. You are angry and argumentative.[8] Maybe, it is because you fear that the successful hunters will use their newfound prestige and assets (fresh meat) to dominate the tribe. Again, in this story, men should be particularly afraid about loss of access to women due to the success of other men. In any case, let us call this the *rivalry* story.

But there are other potential reasons for this unhappiness at the success of others. One recent alternative theory due to Samuelson (2004) and Rayo and Becker (2007) is roughly the following. The unhappiness is Nature telling you that you are pursuing the wrong strategy. If these others are having success from whatever it is they are doing, then maybe you should be doing it too. Evolutionary selection has given you concerns about others in order to give you an incentive to gather useful information about potentially profitable activities. Let us call this the *information* story.

Finally, there is a story that is perhaps even more basic. Standard utility theory assumes that preferences are complete. In practice, one could imagine that one has to construct preferences One way would be from direct consumption experience: for example, I prefer oranges to lemons as after tasting both I find oranges to be sweeter. More generally one could construct an index of sweetness, a form of utility function, by repeated sampling of foods. As a consequence, one's evaluation of an individual orange, for example, will depend on the overall distribution of oranges. This means of constructing preferences has been considered by Kornienko (2004) and Stewart, Chater and Brown (2006), following earlier work by Parducci (1965). But how does this relate to relative concerns? The answer is that when one applies this methodology to assess satisfaction with a level of income, then satisfaction should depend on that level of income's position within the distribution of incomes. That is, relative concerns arise because it is a fundamental psychological mechanism to evaluate objects, opportunities or incomes by means of relative comparisons. Let us call this the *perception* story.

[8] These negative responses to the success of neighbours are actually taken from contemporary society. See Luttmer (2005).

What do these stories tell us about relative concerns in contemporary society? Let us look first at the rivalry story. Competition for marriage partners has been formalised in a dynamic model by Cole et al. (1992). Let us sketch a simple, static version. There is a large population of equal numbers of men and women. Suppose each man has utility

$$U(z_i, x_i, s_i) = (z_i - x_i)s_i \tag{7}$$

where $z_i$ is initial endowment, $x_i$ is choice of visible investment, $z_i - x_i$ is residual consumption, and $s_i$ is the quality of wife with which he matches. Notice that these preferences are not "social". There are no relative concerns and utility does not depend on others' incomes or consumption.

Men have continuous wealth distribution $F(z)$ and women vary in perceived quality, for example, in their own wealth with continuous distribution $H(s)$. Let $\Phi(x)$ be the distribution of investment amongst men. Note that unlike the distribution of income, this distribution depends on men's choices and is thus endogenous. Women's preferences over husbands are simply increasing in $x$, the investment that a man makes. All women would therefore like to match with the man who chooses the highest investment. That man would prefer to match with the woman with the highest $s$. The only matching pattern that would be stable given such preferences is indeed where the highest ranked man matches with the highest ranked woman, the second ranked man matches with second ranked woman and so on.[9] This generalises to the relation $\Phi(x) = H(s)$, a man's rank in the distribution of investment $\Phi(\cdot)$ is equal to rank of his wife in the distribution of women.[10] But such assortative matching implies that, given a choice of investment $x$, a distribution of investment $\Phi(x)$, a man will match with a woman of quality $s = H^{-1}(\Phi(x))$ (to obtain this from $\Phi(x) = H(s)$ we just invert the function $H(s)$). Now, to simplify further, suppose women's quality is uniformly distributed so that $H(s) = s$ on [0,1], then we have $s = \Phi(x)$. Replacing that in the man's utility function (7), we have

$$U(z_i, x_i, s) = (z_i - x_i)\Phi(x_i) \tag{8}$$

where $\Phi(x)$, remember, is his rank in investment. That is, because of competition for marriage opportunities, the reduced form utility for men depends on their rank in the choices they make. We go on to solve a model of this form in Section 5. But the important message for now is that this form of tournament competition induces people to act as though they had competitive social preferences, even though they fundamentally only care about themselves. Social status is instrumental to material benefits.

This is an important insight but it throws up a problem for the current enquiry. One might hope that an evolutionary analysis would help in identifying the appropriate form of relative concerns. For example, the rivalry story might support rivalrous preferences. However, as argued by Cole et al. (1992) and Postlewaite (1998), it could be current

[9] Stability in matching problems means that there is no blocking pair: a man and a woman who would both prefer to match with each other instead of their current matches.

[10] Assumed implicitly here is that there are no ties in men's choices of investment. Such an outcome is consistent with equilibrium as we will see.

social arrangements, such as the way that marriage markets or the way that desirable opportunities are assigned, that determine relative concerns. Rather than such concerns being "hard-wired" by evolution, attitudes towards inequality, for example, could change in response to changes in society. Even the perception stories suggest that people's preferences respond to their environment and experiences. Certainly, Cole et al.'s instrumental story potentially would allow for different forms of concerns in different countries or in different social groups. Thus, there is no fundamental or fixed form of relative concern.

# 4 Models of Relative Concerns In Which Greater Equality is Welfare Improving

What we have seen is that models of relative concerns can provide simple explanations for phenomena such as the Easterlin paradox. However, to this point, we have not made a direct link between utility and inequality. We now see how a simple model of social preferences can imply that an increase in inequality can have a direct negative effect on individuals who see no change in their own material circumstances.

The Fehr-Schmidt model was introduced in Section 2 and assumes a utility function of the form (4). The equivalent in a large population with income distribution $F(\cdot)$ is for the an individual to have utility

$$U(z_i, z_{-i}) = z_i - \alpha \int_{z_i}^{\infty} (y - z_i) dF(y) - \beta \int_0^{z_i} (z_i - y) dF(y) = z_i + S(z_i, z_{-i}) \qquad (9)$$

Further, as Deaton (2003) notes, one can rewrite (9) above as

$$U(z_i, z_{-i}) = z_i - \beta(z_i - \bar{z}) - (\alpha + \beta) \int_{z_i}^{\infty} (y - z_i) dF(y) = z_i - \beta(z_i - \bar{z}) - (\alpha + \beta) R(z_i) \quad (10)$$

where again $\bar{z}$ is average income and $R(z_i) = \int_{z_i}^{\infty} 1 - F(y) dy$ is the measure of "relative deprivation" introduced by Yitzhaki (1979).

This implies that the FS model has the additional property that utility can be increasing in the degree of equality. It can be shown that if there are two distributions $F(z)$ and $G(z)$ that have the same mean and same support and if $F$ is more equal in the sense of second order stochastic dominance (equivalently generalised Lorenz dominance)[11] then $R(z)$ is lower at all income levels under $F$ than under $G$. Thus, if as FS assume $\alpha > \beta$, then, even keeping her own income constant, an individual will have higher utility in a more equal society. Note that this is a different and stronger result

[11] Actually, here, as the means are the same, generalised Lorenz dominance is the same as Lorenz dominance. If $F$ Lorenz dominates $G$ then the Lorenz curve associated with $F$ is always closer to the line of complete equality than that of $G$. Thus, it implies a lower Gini coefficient. See, for example, Thistle (1989) or Shaked and Shanthikumar (2007).

than in Example 2 which concerns only average utility and relies on a change in average income. With the FS model, it is possible for utility to fall at every level of income if income becomes less equally distributed around an unchanged mean.

**Example 5** *Suppose a large population of individuals have the same utility function (9) with parameter values $\alpha = 1/2$ and $\beta = 0$, but differ in their income. Specifically, suppose under distribution $F_B(z)$ incomes are uniformly distributed on $[0,1]$ then we have $U_B(z) = (-1 + 6z - z^2)/4$. We now make income more equally distributed, so that for example, $F_A(z) = 3z^2 - 2z^3$ which is a unimodal distribution on $[0,1]$ with the same mean 1/2 as our initial uniform distribution ($F_B$ is a mean preserving spread of $F_A$). Utility is now $U_A(z) = (-1 + 6z - 2z^3 + z^4)/4$. Note that $U_A(z) - U_B(z) = (-1+z)^2 z^2/4 > 0$ everywhere on (0,1). That is, utility is higher at almost every level of income in a society with the same average income but less inequality. This is illustrated in Figure 2 below.*

In summary, the FS model predicts a negative relation between happiness and inequality at a given level of own income. Further, this is something that is not present in rank or mean dependent models of relative concerns introduced in Section 2.

# 5 Models of Relative Concerns In Which Greater Inequality is Welfare Improving

We have seen in the previous section that relative concerns can lead to a negative relationship between inequality and happiness. This might seem to be a natural outcome. However, a simple observation is that the even the Fehr-Schmidt model implies that greater inequality will, in contrast, be welfare increasing if the coefficient $\beta$ is negative ("pride" or "downward envy" instead of "compassion") and sufficiently large in absolute size, specifically if $\beta < -\alpha$. This requires that individuals derive high utility from having greater income than the poor. If this is the case, given equation (10), when $\beta < -\alpha$, the welfare of an individual will be increasing in the level of inequality in terms of the relative deprivation. That is, individuals will prefer the incomes of others to be more unevenly distributed when pride is stronger than envy. Of course, Fehr and Schmidt themselves assume that, on the contrary, $\beta \geq 0$.

However, let us separate empirical and logical arguments. It is an empirical issue about which values of $\alpha$ and $\beta$ best fit actual behaviour, and thus in practice which is stronger, envy or pride. Indeed, it may be the case that for everyone $\beta$ is non-positive, there is no pride, only compassion.[12] On the other hand, the model with $\beta < -\alpha$ is internally coherent, and so one cannot rule out *a priori* this possibility. Indeed, most of

[12]Indeed, recent careful work by Blanco, Engelmann and Normann (2007) finds that all subjects in the experiments they consider have "compassion" and not "pride".

the literature on relative concerns, introduced here in Section 2, assume that $\beta = -\alpha$. That is, it is a possibility that in a population where everyone has relative concerns, it is nonetheless the case that greater inequality increases welfare.

This is not just a pedantic point. It is also possible to obtain similar results from a model that is somewhat more plausible. Consider, for example, this simplified version of the analysis of Hopkins and Kornienko (2004) which in turn is based on the model of Frank (1985). This model also is analysed by Becker et al. (2005).

This involves a different modelling approach to that used up to now. Suppose an individual does indeed care about his relative position. The question is, how does he know what it is? The Fehr-Schmidt model described in the previous section was developed to describe behaviour in laboratory experiments where information about what others receive is given to subjects. In social situations, however, wealth or incomes of others are not necessarily known. People often infer the wealth of others by their visible consumption choices, for example, the clothes they wear or what car they drive. Knowing this, there is the possibility of "conspicuous consumption", deliberate choice of consumption to improve one's apparent relative position.

To model this, we assume that a large population of agents all have relative concerns over their position in visible consumption rather than in the underlying distribution of income. Specifically, assume that there is some visible but otherwise worthless form of consumption, expenditure on which we denote $x$. Suppose an individual with income $z_i$ and visible consumption $x_i$ has utility

$$U(z_i, x_i, x_{-i}) = (z_i - x_i)\Phi(x_i) \tag{11}$$

where $\Phi(\cdot)$ is now the distribution of visible *consumption* in the population ($F(z)$ still denotes the distribution of income). There is a tradeoff for each individual, the greater the expenditure on $x_i$, the higher will be her relative position $\Phi(x_i)$, but the less income will be left for other consumption (her utility is increasing in this other consumption which equals $z_i - x_i$). Note that this model is formally equivalent to the rivalry model of Cole et al. (1992) introduced in Section 3.

This situation is strategic. An increase in consumption by one group of individuals can lower the relative position of another. This leads to a particular difficulty relative to the models considered in the previous section. Here, utility depends on a distribution $\Phi(x)$ which is endogenous and determined by the choices of other agents. As Hopkins and Kornienko (2004) point out, nonetheless, it is possible solve this problem by application of techniques from auction theory. Here, an explicit solution to this simple version of the model is given in the Appendix.

There are two main conclusions from this analysis. First, there exists an equilibrium in which conspicuous consumption is increasing in one's income. This means that the agent with the highest income will have the highest consumption, and more generally, each agent will have the same rank in consumption as in income. That is, in equilibrium $\Phi(x) = F(z)$. That is, while individuals compete in consumption in order

to improve their apparent rank, in equilibrium these efforts cancel themselves out and each maintains the same relative position.

Second, the amount of conspicuous consumption chosen by each agent and hence welfare depend on the distribution of income in society. To see this, note that in equilibrium the marginal cost of an increase in consumption must equal the marginal benefit in terms of potential gain in rank. This benefit is proportional to the income density $f(z_i)$. That is, the gain from greater consumption is higher when locally incomes are dense. Intuitively, when consumers are close together in terms of income, other things equal, it is easier to overtake others in consumption. Now, the point about this type of equilibrium is that no-one overtakes anyone else: one's rank in equilibrium is the same as in the underlying distribution of income, or $\Phi(x) = F(z)$. But in order for a pattern of consumption to be an equilibrium, consumption has to be high where the density of income high so that no-one has an incentive to break ranks. Thus, in this model of consumption rivalry, an increase in income equality increases competition.

This is crucial. Since greater competition leads to higher expenditure on conspicuous consumption, but in equilibrium everyone keeps the same rank, greater equality can make people worse off. Specifically, as shown in the Appendix, if incomes are more equal then, in this model, utility is lower at every level of income.[13] That is, for this simple strategic model, we have the polar opposite result compared to the Fehr-Schmidt model. Here, greater equality decreases happiness for a given income. There follows a simple example of this.

**Example 6** *Suppose initially the distribution of income $F(z)$ is uniform on [0, 1] so that $F_A(z) = z$ then by the solution (15) derived in the Appendix we have $x_A(z) = z/2$. All consumers spend exactly half of their income on conspicuous consumption. Equilibrium utility is $U_A(z) = z^2/2$. We now make income more equally distributed, so that for example, $F_B(z) = 3z^2 - 2z^3$ which is a unimodal distribution on [0,1] with mean 1/2. Now, we can calculate that, first, equilibriums consumption is higher and equilibrium utility is* ***lower****: equilibrium consumption is $x_B(z) = z(4 - 3z)/(6 - 4z)$ which is greater than $z/2$ on (0,1) and equilibrium utility is now $U_B(z) = z^3 - z^4/2$ which is strictly less than $U_A = z^2/2$ on (0,1). That is, we have exactly the opposite effect from greater equality to that of Example 5.*

# 6 Which Story Should We Believe?

We have seen that if people have Fehr-Schmidt (1999) preferences (with the appropriate parameter values) greater equality can increase welfare. In contrast, in the model of conspicuous consumption of the previous section, greater equality increased social

[13] The strength of this result does depend on this very simple formulation (11). Hopkins and Kornienko (2004) show that, in a more general formulation, utility will be lower at low income levels in a more equal distribution of income, but utility may be higher at high income levels.

competition and lowered utility at each income level. This raises at least two questions. First, what exact aspect of the different models is driving the different results? Second, if we can isolate this particular factor, is there empirical evidence to support one set of models over the other?

To address the first question, let us consider a model where people compete in terms of conspicuous consumption but have inequity aversion. That is, what happens if we blend the models of the previous two sections? Friedman (2005) has recently considered a strategic model which does just this. In the current notation, he analyses a model where an agent with income $z_i$ chooses consumption $x_i$ to maximise

$$U(z_i, x_i, x_{-i}) = \log(z_i - x_i) - \alpha \int_{x_i}^{\infty} (y - x_i) d\Phi(y) - \beta \int_{0}^{x_i} (x_i - y) d\Phi(y) \qquad (12)$$

where $\Phi(\cdot)$ is the distribution of consumption in the population. That is, utility depends on non-conspicuous consumption $z_i - x_i$ but also how one's conspicuous consumption compares to that of others. Relative concerns are modelled in the same way as Fehr and Schmidt (1999) but in terms of the strategic variable, consumption.

Friedman finds that the outcome heavily depends on whether "pride" is stronger than "envy" (that is, $\beta < -\alpha$) or vice versa. In the first case, we have a similar situation to that analysed by Hopkins and Kornienko (2004) (and summarised here in Section 5).[14] But perhaps the more interesting result concerns Fehr and Schmidt's preferred parameter values, that is when $-\alpha < \beta$ so that envy is stronger than pride. Here, Friedman finds that there are multiple equilibria in each of which all agents choose the same level of conspicuous consumption. The equilibrium where this level is zero Pareto-dominates the other equilibria that have positive levels of conspicuous consumption. Game theorists will recognise this pattern from games of coordination where multiple, Pareto-ranked equilibria are common. Agents neither like having more or less consumption than their neighbours so that there is conformity, they all choose the same. Thus, rather than consumption being driven by the level of equality as with rank-based preferences (11), conspicuous consumption is decided by convention.

This suggests that what is driving the difference in effect of inequality is not whether utility depends on rank as in (11) or differences in levels as in Friedman's version of the Fehr-Schmidt model. Nor is it important whether relative concerns are over an exogenous distribution of income as in the models of Section 2 or over a strategic variable such as conspicuous consumption, as in Section 5. Rather it is whether preferences exhibit pride or compassion. When there is compassion and hence, inequity aversion, greater equality raises utility, but when there are competitive preferences involving pride, greater inequality can make people better off.

What is the empirical evidence for the different forms of relative concerns? It is true that Fehr and Schmidt's (1999) original study and recent work by Blanco, Engelmann

[14] Friedman looks at the case where all agents have the same income, which means that the only equilibrium is in mixed strategies. However, I have done some preliminary calculations with income heterogeneity and find results that are qualitatively similar to those of Hopkins and Kornienko (2004).

and Normann (2007) find strong evidence for inequity aversion in the laboratory. But outside the laboratory, most studies find the effect of others' income is negative, for example, Luttmer (2005). However, such research typically does not distinguish the effect on happiness of changes in incomes of those who are richer from the effect of changes in income of those who are poorer. A partial exception is Blanchflower and Oswald (2004) who find in data from the US that the income of the richest fifth has the biggest impact on happiness of others. But the impact of the income of the poorest on others' happiness, though smaller in absolute size, has the opposite sign, giving some evidence for inequity aversion. The fact that many people give to charity is also suggestive that compassion is widespread. On the other hand, Brown et al. (2004) regress employee satisfaction against both the average wage in the firm and the employee's rank in wages. Rank is found to be more important in predicting satisfaction. This provides some support for rank based preferences over the average based alternative. Further, this is more supportive of rivalrous preferences than of inequity aversion. However, this question clearly requires more research.

# 7 A Model of Relative Concerns In Which Greater Equality Can Be Positive or Negative for Welfare

Relative concerns do not have to arise from social preferences. We saw already in Section 3, following Cole et al. (1992), that concern for rank can be generated by competitive situations. One advantage of this strategic approach is that by changing the nature of the game faced by the contestants one can change the nature of their relative concerns. This possibility is exploited by Hopkins and Kornienko (2007b) who note that inequality in a competitive setting can be thought of in two distinct ways. Further, these two different types of inequality will have completely different effects on behaviour and welfare.

Suppose contestants start with different initial endowments which they use to compete in order to obtain differing rewards. Therefore, there can inequality both in terms of *endowments* and in *rewards*. Furthermore, these are logically separate. For examples, individuals could differ widely in terms of ability, but rewards for high performance could be only slightly greater than for low. Or, rewards for success could be very much higher than for failure, even when individuals start with very similar endowments. Even more importantly, it is possible to show that these two different forms of inequality have very much opposing effects on welfare.

In effect, we generalise the analysis in Sections 3 and 5. As in the simple tournament model of Section 3, we assume that contestants have utility of form (7), that is, $U(z_i, x_i, s_i) = (z_i - x_i)s_i$ where $z_i$ is initial endowment, $x_i$ is choice of effort and $s_i$ is the value of reward that is obtained. Previously, it was assumed that the "rewards" were potential spouses, but we can think of other situations where rewards could be in cash or in terms of prestige. Assume again that there is a continuum of contestants with

endowments distributed according to $F(z)$ and there is a continuum of rewards with distribution $H(s)$. If rewards are assigned according to relative achievement, so that the rank of reward assigned is equal to one's rank in achievement in terms of performance $x$. If so, then we have the relation $H(s) = \Phi(x)$ or equivalently, $s = H^{-1}(\Phi(x))$, which gives a reduced form utility

$$U(z_i, x_i, s_i) = (z_i - x_i)H^{-1}(\Phi(x_i)). \tag{13}$$

That is, contestants face a very similar problem to that in the conspicuous consumption model analysed in Section 5. Again the solution is in the Appendix.

This more general framework allows for a new question to be asked. What is the effect of greater equality of rewards? It turns out the effect is the opposite to that of greater equality of endowments. If rewards become more equal, then the marginal benefit of raising one's rank decreases. There is less competition, effort falls, and utility rises at every endowment level.

**Example 7** *Suppose the distribution of endowments $F(z)$ is uniform on [0,1] and that the distribution of rewards $H_A(s)$ is uniform on [0,1]. By our results in the Appendix, equilibrium effort is $x_A(z) = z/2$ and utility is $U_A(z) = z^2/2$. We now make rewards more equally distributed, so that for example, they are uniform on [1/4,3/4] still with mean 1/2 or $H_B(s) = 2s - 1/2$. Now $S_B(z) = H_B^{-1}(F(z)) = z/2 + 1/4$ which means that, given the equilibrium strategy (17) derived in the Appendix, effort falls to $x_B(z) = z^2/(1+2z)$ which is lower than $x_A(z)$ everywhere on (0,1). Further, equilibrium utility is now $U_B(z) = (z+z^2)/4 > z^2/2 = U_A(z)$ on (0,1). Utility is higher at every endowment level under the more equal distribution of rewards. Since the distribution of endowments is unchanged, this implies that everyone is better off under the more equal distribution of rewards.*

We saw earlier in Section 5, that in tournament-like models greater equality can increase competition and make people worse off. Nonetheless, we now see that even in such models, greater equality, in the form of greater equality of rewards, can be beneficial.

# 8 Lessons for Policy

The point of this essay is that the relationship between relative concerns and inequality is less simple than is sometimes assumed. Therefore, it should not be too surprising if it is also difficult to extract policy prescriptions from what is a broad and nuanced theoretical literature. Nonetheless, there are some basic themes.

First, even the presence of inequity aversion amongst the whole population is generally not sufficient for redistribution to be Pareto improving. Significant redistribution

away from rich individuals to poorer ones will make the rich worse off even if they have what was described as "compassion" in Section 2. This is because models of relative concerns typically assume that individuals care about their own income as much as or more than they care about the incomes of others. Thus, it is unlikely that the increased equality will be sufficiently important to compensate for the loss of their own income. Equally, although we have seen that greater *inequality* reduces competitive pressures in the strategic model of Section 5, for similar reasons it is unlikely to generate a Pareto improvement. The only example of greater equality making all better off is an increase in the equality of rewards in the tournament model of Section 7.

However, in competitive models of the sort analysed in Section 5, the presence of relative concerns in making consumption choices means that those choices are typically distorted away from the levels that would be chosen in the absence of competition. For example, if individuals have to choose between spending on a conspicuous and on a non-conspicuous good, then in non-cooperative equilibrium, all could spend too much on the conspicuous good. Hence, a tax on the conspicuous good could make everyone better off. This idea is perhaps due to Duesenberry (1949), but see also Layard (1980), Frank (1985), Ireland (2001), Kanbur et al. (2006) and Weisbach (2007).

The major theme of this essay, that different forms of relative concerns have very different implications, also applies to these tax schemes. For example, as Hopkins and Kornienko (2004) point out, a tax could be Pareto improving, but it may or may not be progressive. In a rivalrous model, distortions will be largest, and therefore taxes should be highest, near the modal income which in most societies is relatively low.[15] In contrast, it is possible that if people competed in conspicuous consumption but had preferences that were of the inequality aversion type (as in the model in Section 6) that such corrective taxes would be progressive. However, at this stage, formal results of this type are still unknown.

There is one final but important point to be made about the importance of the form of relative concerns assumed. The type of expenditure that gives status can make an enormous difference in the conclusions reached. For example, Frank (1985, 1999) emphasises competition in terms of consumption. He, therefore, argues in favour of a consumption tax to encourage saving and raise growth. However, in contrast, in the classic work of Cole et al. (1992), social status can be found in capital accumulation. Growth will be higher than in the absence of competition and can even be excessive (Corneo and Jeanne (1997)). But there are others that have argued that competition for social position is in balance beneficial. Becker et al. (2005) argue that competition for status provides an incentive for the undertaking of risky activities such as entrepreneurship that otherwise would be under-provided. What is certainly true that one can obtain almost the opposite effects from social competition depending on whether status is found in conspicuous consumption or in saving (Corneo and Jeanne (1998)).

[15] A related point is made by Corneo (2002) who observes that the Scandinavian countries have both a relatively equal pre-tax income distribution and high taxes. He hypothesises that the high taxes may be necessary to correct the high levels of social competition induced by the narrow income distribution.

# 9 Conclusions

This essay started with the proposition that the presence of relative concerns does not necessarily lead to a negative relationship between inequality and utility or happiness. Indeed, in briefly surveying the recent theoretical literature, it became clear that there are plausible models of relative concerns where inequality is bad, where it is good and where different forms of inequality can have opposite effects.

However, this survey does suggest what is behind these different responses to inequality. These models of relative concerns, social or other regarding preferences, differ along several axes. They can be ordinal or cardinal, individuals can care about their rank or their distance from the mean in income or in consumption. However, what really seems to matter is the attitude assumed over those with incomes less than one's own. While all models surveyed have a form of "envy", others having more than you is bad, some assume "compassion", concern for those with less than oneself, while others "pride", satisfaction from others having less. It is the presence of compassion that seems to be at the basis of inequity aversion and it the presence of pride that permits a positive relationship between inequality and happiness in other models.

Even in these competitive models where pride dominates, one can make a distinction between "good" and "bad" inequality. Inequality in initial endowments has quite an opposing effect to inequality in final rewards. The first discourages competition and the second encourages it. Thus, greater equality of rewards can have as beneficial an effect in a model with pride, as greater equality of incomes can have in a model with compassion.

My main argument is therefore that in order to understand the relationship between inequality and happiness and health, researchers will have to be much more precise about the form of relative concerns they assume. In terms of empirical work, it would seem relatively simple to test, for example, whether higher incomes for the poor make the middle class more or less happy. However, while existing experimental results provide evidence for compassion over pride in the laboratory, I am not aware of an empirical test of this hypothesis using happiness data (with the partial exception of Blanchflower and Oswald (2004)). Therefore, to understand the role of inequality, researchers might do better by examining how the effect of others' income varies across the income distribution, rather than by simply regressing health or happiness on a single measure of inequality.

This importance of the type of relative concerns also suggests that both empirical researchers and theorists could do well to take greater account of heterogeneity. Casual observation suggests that while some people are highly competitive, others are conformist. In the terminology I have used here, rather than assuming everyone has pride or compassion, it is more likely that there is a mixture in the population. Hence, the relationship between inequality and happiness could be yet more complex. I hope that in pointing out these distinctions and in clarifying the mechanisms of social preferences

and status seeking behaviour, this might provide an impetus for this and other research.

# Appendix

In this Appendix, I sketch solutions to the strategic models introduced in Sections 5 and 7. Given all agents have utility (11) but differ in income distributed according to $F(z)$, suppose all agents adopt the same strictly increasing strategy $x(z)$, so that an agent with income $z_i$ chooses consumption $x_i = x(z_i)$. Let $\gamma(x)$ be the inverse of this strategy function so that $z_i = \gamma(x_i)$. Note that rank $\Phi(x_i)$ of the consumer $i$ is equal to the probability that consumer $i$ has higher consumption than another randomly chosen consumer $j$ or

$$\Phi(x_i) = \Pr[x_i > x_j] = \Pr[x_i > x(z_j)] = \Pr[\gamma(x_i) > z_j] = F(\gamma(x_i)).$$

Therefore, if all other consumers use the strategy $x(z)$ then consumer $i$ has expected utility $(z_i - x_i)F(\gamma(x_i))$. Differentiating with respect to $x_i$ gives a first order condition

$$-F(\gamma(x_i)) + (z_i - x_i)f(\gamma(x_i))\gamma'(x_i) = -F(z_i) + (z_i - x_i)\frac{f(z_i)}{x'(z_i)} = 0, \tag{14}$$

where $f(z)$ is the income density and the second formulation follows as if consumer $i$ also uses the strategy $x_i = x(z_i)$ then $\gamma(x_i) = z_i$ (and $\gamma'(x_i) = 1/x'(z_i)$).

This defines a differential equation in income $z$. From (14), we have $x'(z)F(z) + x(z)f(z) = zf(z)$. Integrating both sides we have $x(z)F(z) = \int_0^z tf(t)dt$. We can then obtain by integration by parts the following solution

$$x(z) = z - \frac{\int_0^z F(t)dt}{F(z)} \tag{15}$$

where $F(z)$ is the underlying distribution of income.

Now, put (15) into the utility function (11) and use $\Phi(x) = F(z)$ to obtain equilibrium utility

$$U(z) = \int_0^z F(t)\ dt. \tag{16}$$

Note that, the distribution $F_A(z)$ is more equal in terms of second order stochastic dominance (equivalently generalized Lorenz dominance) than another distribution $F_B(z)$ if and only if $\int_0^z F_A(t)\ dt \leq \int_0^z F_B(t)\ dt$ holds for all $z$. Thus, in a more equal society, utility will be lower at every level of income.

Given the slight modified model (13), it is not too difficult to use the above methods to determine that there is an equilibrium strategy in strictly increasing strategies of the form

$$x(z) = z - \frac{\int_0^z S(t)dt}{S(z)} \tag{17}$$

where $S(z) = H^{-1}(F(z))$. This gives equilibrium utility of the form

$$U(z) = \int_0^z S(t)\ dt. \tag{18}$$

The parallels to the earlier results, (15) and (16), are clear. Indeed, greater equality of endowments will have a similarly negative effect as in the earlier, simpler strategic model.

Greater equality of rewards, however, will have the opposite effect. Thistle (1989) shows that the distribution $F_A(z)$ is more equal in terms of second order stochastic dominance (equivalently generalized Lorenz dominance) than another distribution $F_B(z)$ if and only if $\int_0^r F_A^{-1}(t)\ dt \geq \int_0^r F_B^{-1}(t)\ dt$ holds for all $r$ in $[0, 1]$. For simplicity, assume $F(z) = z$ endowments are uniformly distributed. Then, if rewards are more equally distributed in terms of second order stochastic dominance, it follows that equilibrium utility (18) will be higher under the more equal distribution at every level of income.

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