



Department of Economics

Keeping up with the Medici!

Three Essays on Social Comparison, Consumption and Risk

Oege Dijk

Thesis submitted for assessment with a view to obtaining the degree of
Doctor of Economics of the European University Institute

Florence, April 2012

EUROPEAN UNIVERSITY INSTITUTE
Department of Economics

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Abstract

This thesis investigates the influence of social comparison (i.e. comparing ones outcomes with others such as neighbours, colleagues, etc) on consumption and risk-taking.

The first essay (joint with Robert H. Frank and Adam S. Levine) shows how income growth of the top ranks of the income distribution can decrease overall saving rates through a so-called expenditure cascade. As the higher incomes increase their consumption, those ranked below them also increase their consumption in order not to fall behind too much, which causes those ranked below them to increase consumption as well, etc. These consumption cascades can thus lower saving rates throughout the income distribution. We provide empirical evidence for this phenomenon by showing that several proxies related to financial distress (bankruptcy rates, divorce rates, commute times) are positively associated with increases in inequality.

The second essay argues shows that social comparison can induce risk-taking. It shows that with comparison-convex preferences social comparison would induce both more risk-taking and a preference for negatively correlated gambles. With a laboratory experiment we show that although only a third of subjects display the preference for negatively correlated outcomes typical of comparison-convex utility, those subjects take a lot more risks in a social setting, resulting in significantly higher overall risk-taking. This would both explain the puzzling amount of portfolio under-diversification among households, as well as excessive risk-taking among financial professionals in the run-up to the financial crisis.

Finally, the third essay experimentally investigates whether subjects focus on rank or social distance when comparing their outcomes. In the theoretical literature both specifications have been used. No support for a social rank effect is found, but a higher social reference point is found to be positively associated with more risky choices, thus lending credibility to the social distance utility hypothesis.

Dedication

This thesis is dedicated to my grandfathers, Pake Fean, who always told me “Kloekloekleare! Wat yn dyn holle sit nimt nimmen fan dy ôf”, and Pake Burgum who told me “Goed dyn best dwaan op skoalle, jong!”.

Acknowledgements

As always, this thesis did not just jump out of my fingers one cold January morning. It is the product of many years of stimulation, correction, reflection, support, challenge, more support, distraction, arbitrary deadlines and inspiration given by many, many people.

First of all and most of all I must thank Pascal. Foremost for allowing my research take me wherever it might, without regard for traditional boundaries of the discipline. But also for many hours of discussion and feedback that after long discursions into the realms of Buddhist insights, the joy of meditation or just life in general, would inevitably circle back to the issue at hand: this little bundle of papers. I feel I gained not just an academic mentor, but a friend as well.

Furthermore I would like to thank Bob Frank. It is quite something when one's intellectual hero tells you out of the blue "we should write a paper together". Not many people would have taken this chance with a young academic from the Tuscan hills. And give him the opportunity to explore the rolling hills and gorgeous gorges of Ithaca in full Indian summer display to boot. Another great aid to single out is Jeff Butler, who did so much to teach me the ropes of experimental economics, and allowed me the use of the facilities at EIEF. Then a deep word of thank to Massimo Marinacci who was so kind to provide the ERC funding without which much of thesis would have literally been impossible. (This would probably be a good place to thank all the good boys and girls working at the European Research Council in general.)

This thesis also immensely benefited from the discussions with Debrah Meloso, Luigi Guiso, Eric S. Schoenberg, Ori Heffetz, Joep Sonnemans, Jona Linde, Gary Charness, David K. Levine, Olof Johansson-Stenman, Peter Martinsson as well as many guests to the EUI Economics department and seminar participants at the Cornell LabMeeting, the University of Amsterdam, the Max Planck Institute for Economics in Jena, the University of Gothenburg and Bilgi University. Lorenzo Magnolfi is thanked for his excellent research assistance.

Yet this thesis is not just a product of office, library, seminar and lab hours, but I daresay it would not have been possible without the necessary hours of blowing

off steam every now and then. To that end my hearty thanks to the fine bar personnel at Angie's, Blob, Bar Fiasco, Caffè Santambrogio and Teatr(in)o, who made sure these hours never ended too early, as well as to my many partners in crime. Your names will be withheld to protect your reputations, but you know who you are.

Finally I would like to thank my family, both for their readiness to act as lender of last resort, as well as their continual support and encouragement to try out new challenges, experience new cultures, and go wherever my heart would guide me. It's easy to make risky jumps when you've got a sturdy net to fall back on.

Also, I would like to thank Gunnar Bardsen and Mark Le Quement who helped straighten out the numbering problems with the theorem-like environments.

Introduction

Keeping up with the Medici. This simple phrase sums up a lot of what this thesis is about. First of all, and maybe the most obvious connection, this thesis was mostly written in the splendid renaissance surroundings of Florence, Italy, and the standard phrase of “keeping up with the jones” rings hollow here as there are not that many Jones’ around here to keep up with. Rossi’s, Bianchi’s, Bartolini’s, and Manetti’s, yes, but Jones’ not so much. So as a nod to the amazing four years that I spent among Florence’s stupendous palazzo’s and piazza’s it seems fitting to name the thesis after it’s most prodigious family.

Secondly it fits in with the message of the first chapter of this thesis: that the incomes, lifestyles and expenditures of the richest members of society can have an important trickle-down effect on the rest of society. In Florence the artistic output that emerged as other families tried to rival the Medici in conspicuous displays was a happy byproduct for those who come to admire the city today, but often the passions aroused by social competition are not channeled as productively. And as the Pitti family can attest: trying to outdo your rivals in architectural display can easily result in financial ruin.

Finally, the Medici were a family of bankers, and natural risk-takers, which fits in with the second chapter of how social comparison can affect risky decision-making. Indeed one of the factors that lead to the rise of the Medici is the collapse of the Bardi, Peruzzi and Acciaiuoli banking empires as a result of all three families taking too much risk with large sovereign loans in a bid to to outdo each other.

So the overall theme of this thesis is how social comparison can affect decision-making in the economic sphere. Humans are social animals and that we have a natural tendency to compare our outcomes is obvious to anybody that has ever watched siblings fight over who would get the larger piece of cake. However, most of standard textbook economics does not take this social dimension into account and models economic agents as solely self-concerned utility-maximizers.

Relaxing this strong assumption and investigating the consequences is what this thesis sets out to do.

The first chapter looks at how social comparison could affect decisions on consumption and leisure, and especially how this could interact with rising levels of inequality. Even when we only compare ourselves with those who are similar to us, this would still imply that large increases in consumption in the highest echelons of society would trickle down as each strata of society increases their displays of consumption in order to keep up with those slightly better off.

The second chapter investigates through an experiment how social comparison can influence risk-taking decisions. This turns out to depend a lot on the relative strength of two opposite social emotions: envy and gloating. Those who really enjoy outdoing other (as opposed to mainly fear doing worse than others), are the most likely to take more risk when being able to compare outcomes.

Finally the third chapter tries to adjudicate whether social comparison centers mainly on rank (i.e. being first or second, no matter by how much), or on the size of the difference (i.e. is being first by a landslide much better than by scraping in by an inch?). Tentatively it seems that experimental subjects are more influenced by the size of the difference instead of rank per se.

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Expenditure Cascades

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ABSTRACT

Prevailing economic models of consumer behavior completely ignore the well-documented link between context and evaluation. We propose and test a theory that explicitly incorporates this link. Changes in one group's spending shift the frame of reference that defines consumption standards for others just below them on the income scale, giving rise to expenditure cascades. Our model, a descendant of James Duesenberry's relative income hypothesis, predicts the observed ways in which individual savings rates respond to changes in both own and others' permanent income, as well as numerous other stylized fact patterns that are difficult to reconcile with prevailing models.

Introduction

Evaluative judgments are known to depend heavily on context. For example, the same car that would have been experienced as having brisk acceleration in 1950 would seem sluggish to most drivers today. Similarly, a house of given size is more likely to be viewed as adequate the larger it is relative to other houses in the same local environment. And an effective interview suit is one that compares favorably with those worn by other applicants for the same job.

Although the link between context and evaluation is uncontroversial among behavioral scientists, the reigning economic models of consumer behavior completely ignore it. These models assume that each person's consumption spending is completely independent of the spending of others.

In contrast, James Duesenberry's relative income hypothesis—once a staple in economics textbooks—explicitly acknowledged the link between context and evaluation.¹ In this paper we employ a variant of his model to explore the relationship between context and spending patterns. In this effort, we exploit data that allow us to quantify the effects of substantial increases in income inequality that have occurred in recent decades. According to the life-cycle and permanent income hypotheses, these increases should have no effect on individual spending decisions. In contrast, the relative income hypothesis predicts a substantial change in spending patterns in response to these changes. From statistical analysis of U.S. Census data for the 50 states and 100 most populous counties, we find evidence that rapid income growth concentrated among top earners in recent decades has stimulated a cascade of additional expenditure by those with lower earnings.

1. Expenditure Cascades

Milton Friedman's permanent income hypothesis continues to provide the foundation that underlies modern economic analysis of spending and savings.² According to this model, a family spends a constant proportion of its permanent

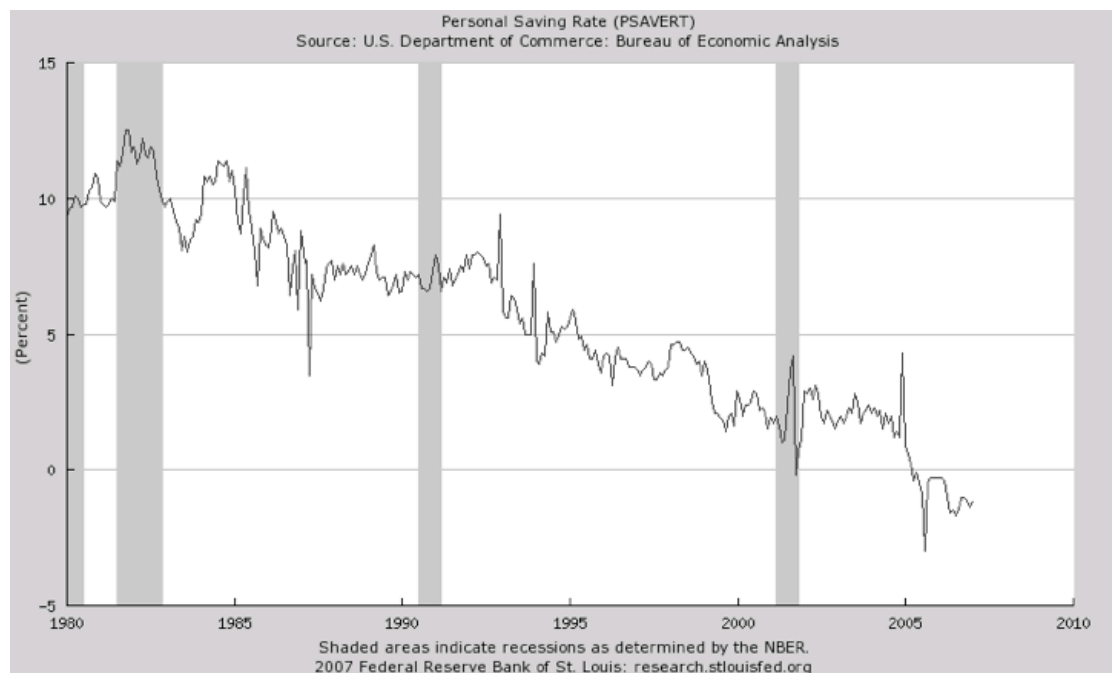
¹ Duesenberry, 1949.

² Friedman, 1957.

income, rich or poor. The model thus predicts that savings rates should be independent of household income and should remain stable over time.

Both predictions are at odds with experience. It has long been shown, for example, that savings rates rise sharply with permanent income in cross-section data.³ Savings rates have also shown substantial variation over time. According to U.S. Department of Commerce estimates shown in Figure 1, the aggregate personal savings rate has fallen from an average of roughly 10 percent in the mid-1970s to below zero in the years immediately before the economic downturn of 2008.

Figure 1. The Personal Savings Rate in the United States



Source: Federal Reserve Bank of St. Louis

The recent experience of middle-income families also casts doubt on Friedman's portrayal of the relationship between household income and spending. In 1980, the median size of a newly constructed house in the United States was approximately 1,600 square feet. By 2001, however, the corresponding figure

³ See, for example, Mayer, 1972. Mayer rejects Friedman's original conjecture that this pattern is explained by the unresponsiveness of spending to transitory income changes, arguing that it cannot explain why people in high-income occupations save at higher rates than people in low-income occupations.

had grown to over 2,100 square feet—more than twice the corresponding growth in median family earnings.⁴ During the same period, the median household experienced substantial growth in consumer debt. One in five American households currently has zero or negative net worth.⁵

Why has consumption expenditure grown so much more rapidly than predicted by traditional economic models? We use the term *expenditure cascade* to describe a process whereby increased expenditure by some people leads others just below them on the income scale to spend more as well, in turn leading others just below the second group to spend more, and so on. Our expenditure cascade hypothesis is that a pervasive pattern of growing income inequality in the United States has led to the observed decline in savings rates.

2. An Illustrative Model

Consider an economy with N consumers arranged in ascending order with respect to their permanent incomes. According to the permanent income hypothesis, individual i 's current consumption, c_i , is proportional to his permanent income, Y_i :

$$c_i = \gamma Y_i, i = 1, \dots, N, \quad (1)$$

where γ is a parameter unrelated to permanent income level or rank. According to this model, each consumer's spending is independent of all income levels other than his own:

$$\frac{dc_i}{dY_j} = 0, \forall i \neq j. \quad (2)$$

⁴ Median house size growth: <http://www.census.gov/prod/2003pubs/02statab/construct.pdf>; <http://www.census.gov/hhes/income/histinc/f03.html>. Income growth rates: Center on Budget and Policy Priorities, 2003.

⁵ Wolff, 2002.

Thus, according to the permanent income hypothesis, changes in the distribution of income should have no effect on individual spending levels. If someone's income does not change, her spending will remain the same, even if the income and spending levels of others change substantially.

A simple version of the baseline model, and the one we build on in this paper, is to assume that individuals have preferences over current consumption and future consumption and can transfer consumption from the present to the future by saving and borrowing decisions. Let utility be increasing and concave in consumption, and future consumption discounted by a factor $\beta \in (0,1)$, then the objective function that an individual maximizes is given by:

$$U(c1, c2) = u(c1) + \beta u(c2), \quad (3)$$

In contrast to this baseline model, we consider the following model in which others' consumption does play a role.⁶ Suppose each individual i compares her consumption to the consumption levels of a set of neighbors $N(i)$. We let $\hat{c} = \frac{1}{|N(i)|} \sum_{j \in N(i)} c_j$ represent the average consumption level of the people in this set. We further assume that the consumption of others presents a negative externality and thus enters negatively into the utility function. The strength of this negative externality is given by parameters $\alpha_1, \alpha_2 \in (0,1)$.

$$U_i(c1, c2) = u(c1 - \alpha_1 \hat{c}) + \beta u(c2 - \alpha_2 \hat{c}). \quad (4)$$

Now we solve for the optimization problem given incomes y_1 and y_2 in period 1 and period 2 respectively, and a given interest rate R on savings s .

$$\begin{aligned} & \max_{\{c1, c2\}} u(c1 - \alpha_1 \hat{c}) + \beta u(c2 - \alpha_2 \hat{c}) \\ & s.t. \\ & c1 + s = y1 \\ & c2 = sR + y2 \end{aligned} \quad (5)$$

⁶ This setup borrows on the asset trading model of Ghiglino and Goyal, 2010.

After writing down the Lagrangian for this problem, we find the intertemporal first order condition, called the Euler equation:

$$u'(c_1 - \alpha_1 \hat{c}) = \beta R u'(c_2 - \alpha_2 \hat{c}) \quad (6)$$

We define lifetime income by $Y = Ry_1 + y_2$ and rewrite second period consumption as $c_2 = Y - Rc_1$. We then proceed by total differentiating and rearranging equation (6) and find that⁷:

$$\frac{dc_1}{d\hat{c}} = \frac{\alpha_1 u''(c_1 - \alpha_1 \hat{c}) - \alpha_2 \beta R u''(c_2 - \alpha_2 \hat{c})}{u''(c_1 - \alpha_1 \hat{c}) + \beta R^2 u''(c_2 - \alpha_2 \hat{c})} \quad (7)$$

Given our assumption of concavity of the utility function, present consumption is increasing in the reference income as long as α_1 is sufficiently larger than α_2 , that is as long as an individual is sufficiently myopic with respect to relative consumption in the future.

Putting in a bit more structure we assume utility is given by a standard CRRA utility function: $u(x) = \frac{x^{1-\sigma}}{1-\sigma}$. We can then solve the resulting Euler equation for c_1 :

$$c_1 = \frac{1}{1 + \beta^{1/\sigma} R^{1/\sigma}} Y + \frac{\alpha_1 \beta^{1/\sigma} R^{1/\sigma} - \alpha_2}{1 + \beta^{1/\sigma} R^{1/\sigma}} \hat{c} \quad (8)$$

The first part of this equation corresponds to the standard Permanent Income Hypothesis: when relative consumption does not play a role (i.e. $\alpha_1 = \alpha_2 = 0$), consumption in period 1 is a constant fraction of permanent income Y , depending only on the real interest rate and the discount rate. However when relative consumption does play a role, and an individual is sufficiently myopic

⁷ Applying the fact that lifetime income is independent of the reference income, thus $\frac{dY}{d\hat{c}} = 0$.

with respect to relative consumption (i.e. $\alpha_1 > \frac{\alpha_2}{\beta^{1/\sigma} R^{1/\sigma}}$), then present consumption is increasing in the average consumption of the reference group \hat{c} .

Yet the story doesn't end there. Because individual i not only has a reference group, she is also part of the reference group of other people. So as individual i increases her consumption, her neighbors in turn will increase their consumption after which their neighbors will increase theirs', etc. So each individual's saving and consumption decision in the end affects every other individual with which she is connected in a finite number of steps.

In the appendix we show how to solve for the equilibrium decision for any given social network. Here we will just give the result. Let C_1 be the vector of first period consumption decisions of all individuals in a given network, and Y the vector of corresponding permanent incomes. We then define two constants

$\gamma_1 = \frac{1}{1 + \beta^{1/\sigma} R^{1/\sigma}}$ and $\gamma_2 = \frac{\alpha_1 \beta^{1/\sigma} R^{1/\sigma} - \alpha_2}{1 + \beta^{1/\sigma} R^{1/\sigma}}$, and show that:

$$C_1 = (I - \gamma_2 G^N)^{-1} \gamma_1 Y \quad (9)$$

The matrix G^N is the adjacency matrix where entry $G_{i,j}^N$ is equal to $\frac{1}{|N(i)|}$ if individual j is in the reference group of individual i . The inverse matrix $(I - \gamma_2 G^N)^{-1}$ is known as the Bonacich centrality measure. The Bonacich centrality of a node in a network is the number of paths through the network that end on that node, discounted for the length of the path.

Now we are ready to go back to our economy N consumers arranged in ascending order with respect to their permanent incomes. Let the first entry in the permanent income vector Y be the income of the consumer on the bottom of the income ladder, and the last entry that of the consumer at the top of the income ladder. Now assume that each consumer acts as the reference group for the consumer just below her on the income ladder. In a crude way, this model

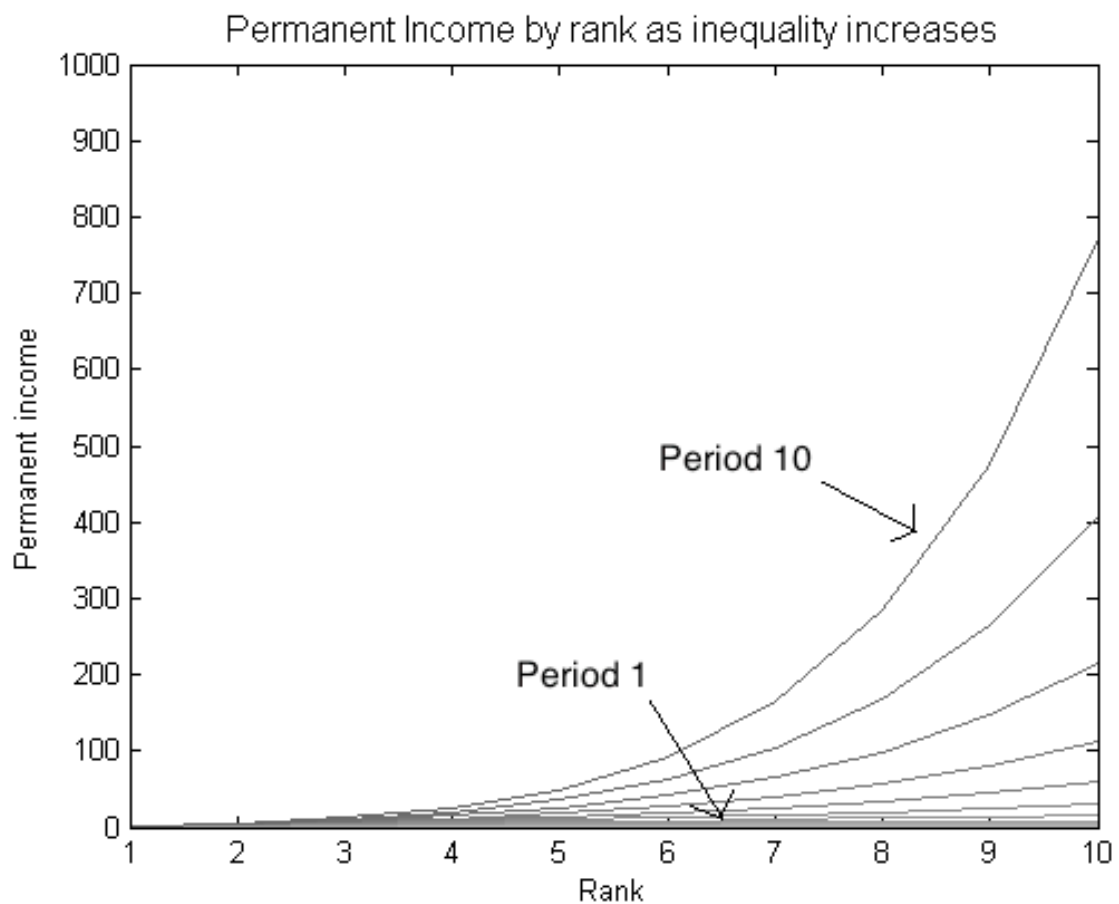
captures what are perhaps the two most robust findings from the behavioral literature on demonstration effects: 1) the comparisons that matter most are highly localized in time and space; and 2) people generally look to others above them on the income scale rather than to those below.⁸

When we examine the Bonacich matrix $(I - \gamma_2 G^N)^{-1}$ of such a network we find an upper triangular matrix with all ones on the diagonal, all zeros below the diagonal and all entries positive and less than one above the diagonal. What this means is that the consumption decision by a consumer is affected by the incomes of all those above her on the income ladder. The top consumer's consumption decision affect the decision by the person just below, whose increased consumption affects the person just below her, etc. It is through such an expenditure cascade of consumption adjustments that increased inequality can lower the overall saving rate.

To showcase the effects increasing inequality can lower saving rates through such an expenditure cascade, we run a simple but demonstrative simulation. Our economy is populated by 10 consumers, ranked from 1 to 10, with each consumer acting as the reference group for the consumer below on the income ladder. For our simulations, we assume parameter values $\beta = 0.95$, $R = 1.4$, $\sigma = 0.5$, $\alpha_1 = 0.1$, and $\alpha_2 = 0.05$. We increase inequality from period 1 to period 10, such that the income of a consumer with rank r at time t is given by $y_t^r = y_1^r (1 + \frac{r-1}{10})^t$, $r=1,..10$.

⁸ For a survey of the relevant literature, see Frank, 1985, chapter 2.

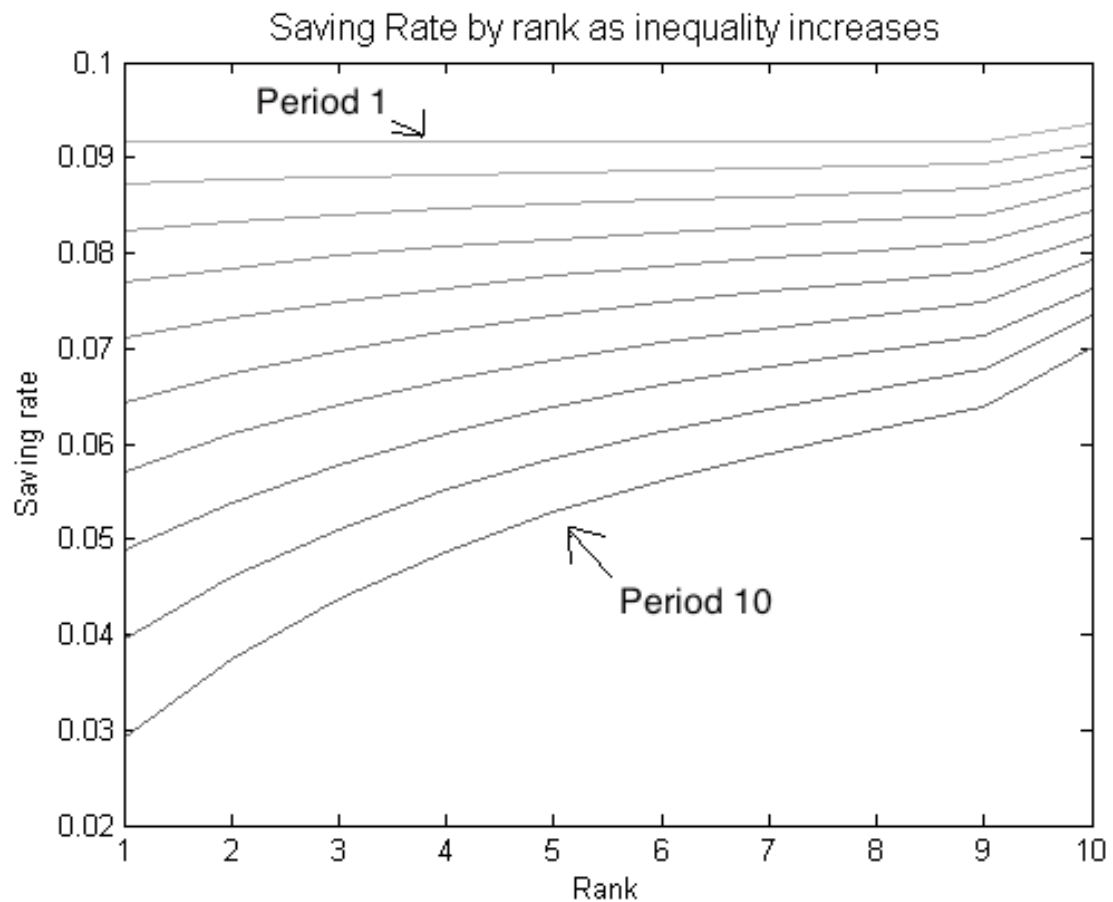
Fig 2. Permanent income by rank as inequality increases.



The increasingly unequal income distribution can be seen in Fig 2. On the horizontal axis are the 10 individuals in the economy ordered by rank. The vertical axis shows their permanent incomes $Ry_1 + y_2$.

In response to the increase in income disparities, households adjust their saving and consumption decisions in order to keep up with the increased consumption of the households ranked above them (see figure 3).

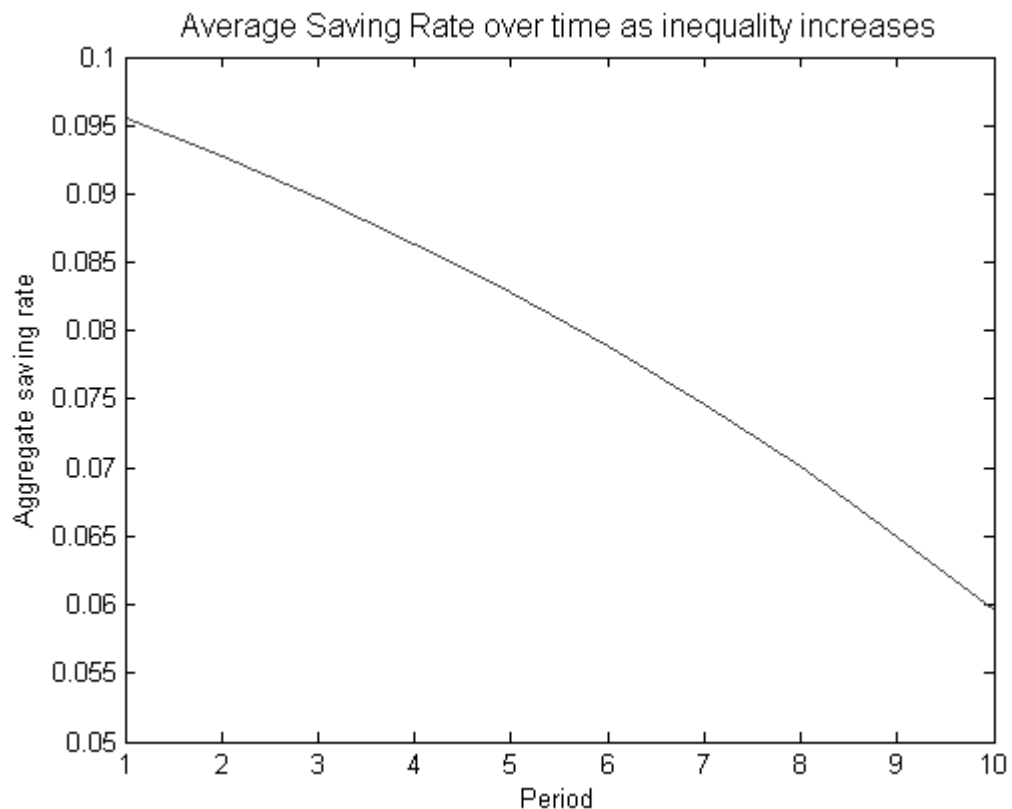
Fig 3. Saving rates by rank from Period 1 to 10



As consumers are trying to keep up with those ranked above them, increasing inequality causes expenditure cascades lowering saving rates. The lower consumers are ranked, the more they are affected by the cascade. The lower saving-rates by the poor match data that show that saving rates are increasing by income group⁹, and is something that is not easily explained by the Permanent Income Hypothesis. With saving rates falling for all income groups, average saving rates are falling with increased inequality as well (see Figure 4).

⁹ Dynan et al, 2004.

Fig 4. Average saving from period 1 to 10.



Some economists may object that concerns about relative consumption can affect savings rates in the manner described only if consumers are myopic. After all, if a consumer is induced to spend more today because of higher current spending by others, she will have even lower relative consumption in the future. Perhaps so. Yet it may still be rational to be responsive to community consumption standards.

Consider, for example, the fact that in most communities, the median family on the earnings scale now pays much more for housing, in real terms, than its counterpart in 1980. This family would find it easier to live within its means if it simply spent less on housing than others in the same income bracket. But because the quality of public schools in the United States is closely linked to local property taxes, which in turn depend on local real estate prices, this family

would then end up having to send its children to below-average schools.¹⁰ In the same vein, a job seeker could live more comfortably for the time being by refusing to match the increased expenditures of others on interview suits. Yet doing so would entail a reduced likelihood of landing the best job for which he was qualified. It is thus clear that being influenced by community consumption standards need not imply myopia. On the contrary, it may be a perfectly rational response on the part of consumers in pursuit of widely recognized goals.

On the other hand, there is considerable evidence that myopia is a salient feature of human psychology.¹¹ The pain of enduring lower relative living standards today can be experienced directly. In contrast, the pain of enduring lower relative standards in the future can only be imagined. So even though expenditure cascades can exist in the absence of myopia, they are undoubtedly strengthened by it.

In any event, if individual spending is influenced by the spending of others in the manner assumed in our simple model, an increase in income inequality will give rise to a reduction in savings rates. In the next section we examine how the increase in inequality assumed in our illustration compares with the actual recent growth in inequality.

3. Changing Patterns of Income Growth

In the United States, income growth from 1945 until the end of 1970s was well-described by the famous picket fence chart shown in Figure 3. Incomes grew at about the same rate for all income classes during that period, a little under three percent per year.

¹⁰ In light of evidence that any given student's achievement level rises with the average socio-economic status of his or her classmates, property values and school quality will be positively linked even in jurisdictions in which school budgets are largely independent of local property values.

¹¹ Pigou, 1929, and more recently, Ainslie, 1992; Laibson, 1998; and O'Donoghue and Rabin, 1999.

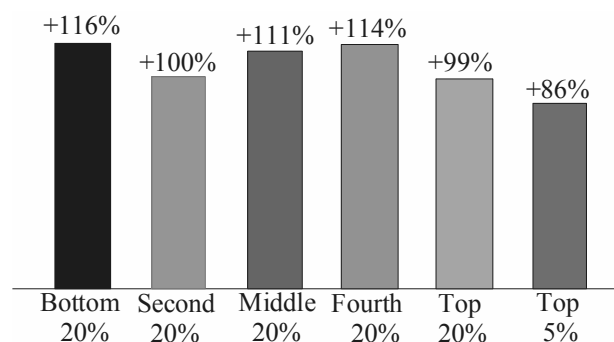


Figure 5. Changes in Before-Tax Household Incomes, 1949-1979.

Source: <http://www.census.gov/hhes/income/histinc/f03.html>

That pattern began to change at some point during the 1970s. During the 24-year period shown in Figure 4, the real pre-tax income of people at the bottom income distribution remained essentially unchanged, and gains throughout the middle of the income distribution were extremely small. For example, median family earnings were only 12.6 percent higher at the end of that period than at the beginning. Income gains for families in the top quintile were substantially larger, and were larger still for those in the top five percent. Yet even for these groups, income growth was not as great as during the earlier period. The later period was thus a period of both slower growth and much more uneven growth.

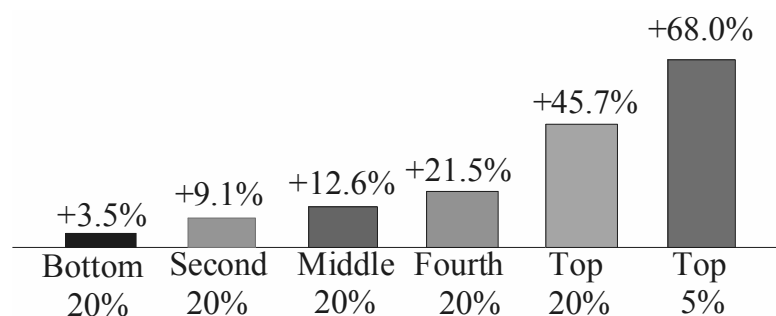


Figure 6. Changes in Before-tax Incomes, 1979-2003.

<http://www.census.gov/hhes/income/histinc/h03ar.html>

Income inequality has also increased in two important ways not portrayed in Figures 3 and 4. One is that changes in the income-tax structure during the Ronald Reagan presidency significantly shifted real after-tax purchasing power in favor of those atop the economic ladder, a change that was reinforced by additional tax cuts targeted toward high-income families during the first term of

George W. Bush. A second change not reflected in Figures 1 and 2 is the magnitude of the earnings gains recorded by those at the very top of the income ladder.

Figure 5 portrays some of the results of these two additional effects. Note that the bottom 20 percent of earners (net of both tax and transfer payments) gained slightly more ground than in Figure 4, which showed pre-tax incomes (net of transfer payments). Note also that the gains accruing to the top one percent in Figure 5 are almost three times as large the corresponding pre-tax gains experienced by the top five percent. For people in the middle quintile, however, growth in after-tax incomes occurred at essentially the same modest pace as growth in pre-tax incomes.

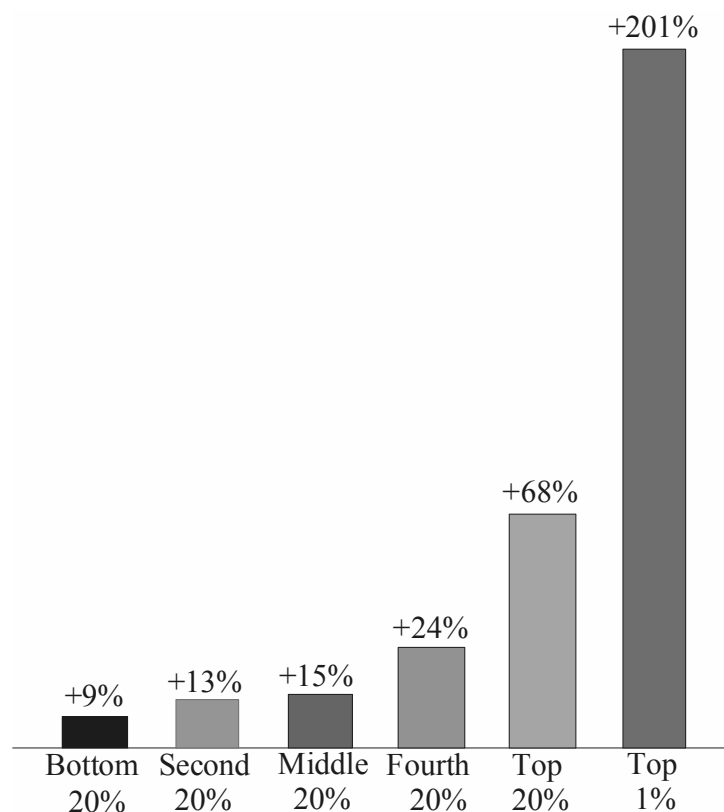


Figure 7. Change in After-Tax Household Income, 1979-2000

Source: Center on Budget and Policy Priorities, "The New, Definitive CBO Data on Income and Tax Trends," Sept. 23, 2003

For present purposes, an important feature of recent experience is that the aggregate pattern of income changes repeats itself in virtually every income subgroup. Thus, if we look at the top quintile of the earnings distribution,

earnings growth has been relatively small near the bottom of that group and only slightly larger in the middle, but much larger among the top one percent. We see the same pattern again among the top one percent. In this group, the lion's share of income gains have accrued to the top tenth of one percent.

Only fragmentary data exist for people that high up in the income distribution. But a few snapshots are available. For more than 25 years, for example, *Business Week* has conducted an annual survey of the earnings of CEOs of the largest U.S. corporations. In 1980, these executives earned 42 times as much as the average American worker, a ratio that is larger than the corresponding ratios in countries like Japan and Germany even today. But by 2001, the American CEOs were earning 531 times the average worker's salary. There is evidence that the gains have been even more pronounced for those who stand higher than CEOs on the income ladder.¹²

A similar pattern of inequality growth is observed when we look within occupations and educational groups. It shows up, for example, among college graduates, dentists, real estate agents and high school graduates.¹³ *The upshot is that almost irrespective of the identities of the members of a person's personal reference group, income inequality within that group is likely to have grown sharply in recent decades.* Even for the wealthiest reference groups, for which average incomes have risen most sharply, most members are thus likely to have seen their incomes decline relative to those of their most prosperous associates.

4. Three Specific Hypotheses

In its simplest form, the expenditure cascade hypothesis is that increasing income inequality within any reference group leads to a reduction in the average savings rate for that group. Our attempts to test this hypothesis are grounded on the observation that income growth patterns for most population subgroups in the United States in recent decades are roughly like the one shown for the population as a whole in Figure 5. Within most groups, people at the top have

¹² See, for example, Krugman, 2002. As Wolff, 2002, has shown, the distribution of household net worth has also become more right-skewed in recent decades.

¹³ See Frank and Cook, 1995, chapter 5.

enjoyed robust earnings growth, while others have seen their incomes grow much more slowly. Our claim is that the new context created by higher spending at the top of each group has caused others within the group to save a smaller proportion of their incomes.

An ideal test of this claim would examine how an individual's spending responds when other members of his or her personal reference group alter their spending. But because we cannot identify the specific persons who constitute any individual's personal reference group, we are forced to rely on crude proxies.

We begin by assuming that the amount of income inequality within a person's personal reference group varies directly with the amount of inequality in the geographic area in which that group is embedded. This assumption is more palatable for narrowly defined geographic areas than for broad ones. Thus, for example, the within-reference-group level of inequality for an individual is likely to correspond more closely to the degree of inequality in the city in which he lives than to the degree of inequality in his home country. In one version of our study, we employ samples of persons segregated by state of residence. In another, we employ samples from the 100 most densely populated counties. Our inequality measures for both sets of jurisdictions come from the 1990 and 2000 installments of the United States Census.

Do people who live in high-inequality jurisdictions in fact save at lower rates than those who live in low-inequality jurisdictions? Unfortunately, the Census does not record information that would enable us to construct reliable estimates of household savings rates by state or county.¹⁴ We are thus forced to examine alternative restatements of the hypothesis that are amenable to testing with available data.

A more general statement of the hypothesis is that families living in high-inequality areas will find it harder to live within their means than their

¹⁴ We also looked into other data sources, such as the Bureau of Economic Analysis. Unfortunately we were unable to locate any savings rate data at a geographic level that made sense for our theory.

counterparts in low-inequality areas. This observation suggests that the expenditure cascade hypothesis can be tested by examining the relationships between various measures of financial distress and measures of income inequality.

Families respond to financial distress in multiple ways, some of which leave clear footprints in data available from the Census or other sources. Beyond saving at lower rates, for example, they tend to carry higher levels of consumer debt, which increases their likelihood of filing for bankruptcy. In addition, families who cannot afford to carry the mortgage payments for houses in conveniently located neighborhoods with good schools often respond by moving to cheaper, more remote neighborhoods, thus increasing their average commute times. And like other forms of distress, financial distress may increase the level of stress in personal relationships, thus increasing the likelihood of marriages ending in divorce. We have found that for both state and county data, growth in inequality between 1990 and 2000 is positively linked with growth in each of these three measures of financial distress. But because the narrower county level data are preferable from the perspective of our theory, we report only the results of our analyses of those data. Our decision to focus on the most populous counties was driven in part by Thorstein Veblen's observation that "...consumption claims a relatively larger portion of the income of the urban than of the rural population... [because] the serviceability of consumption as a means of repute is at its best...where the human contact of the individual is widest and the mobility of the population is greatest."¹⁵

5. Empirical Results

In this section, we present the results of empirical studies of the link between inequality and the likelihood of filing for bankruptcy, between inequality and the likelihood of filing for divorce, and between inequality and commute times.

We calculated two measures of income inequality in household incomes. The first was the ratio of the 90th percentile household income to 50th percentile

¹⁵ Veblen, 1899, p. 66.

household income (P9050).¹⁶ The second is the Gini coefficient, a number between zero and one that indicates the level of inequality across the entire income distribution of an area.¹⁷ For present purposes, the Gini coefficient is the preferred inequality measure, because it is Lorenz consistent¹⁸ and accounts for the real income loss experienced by those in the lower reaches of the income distribution between 1990 and 2000, the specific time frame covered by our data. In the results we report below, we thus confine our attention to regressions in which our inequality measure was based on the Gini coefficient. (Results for regressions using the P9050 measures were qualitatively similar.)

To control for unobserved heterogeneity across states and counties, we ran all our regressions in first-difference form. In our bankruptcy regressions, for example, the value of the dependent variable for each area is the difference between that area's bankruptcy filings in 2000 and the corresponding number for 1990. Similarly, the area inequality variable we used was the difference between its Gini coefficient in 2000 and the corresponding measure in 1990.¹⁹ Because both years were at approximately the same point in the business cycle, we do not expect this external influence to bias our results.

Our first-difference regression models thus take the following general form:

$$\Delta dep_i = a + b\Delta ineq_i + c\Delta x_i + \Delta u_i, \quad (6)$$

¹⁶ P9050 ratios for states were calculated using 1-percent microdata samples provided by the Decennial U.S. Census. The ratios for counties were estimated using income brackets. For 1990, these brackets came from 1990 Census Summary File 3, tables P80 and P80A. For 2000, see 2000 Census Summary File 3, tables P52 and P53.

¹⁷ We used a program provided by the U.S. Bureau of the Census to calculate Gini coefficients.

¹⁸ An inequality measure is Lorenz consistent if and only if it is simultaneously consistent with the anonymity principle (permutations among people do not matter for inequality judgments), population principle (cloning the entire population and their incomes does not alter inequality), relative income principle (only relative, and not absolute, income matters), and Dalton principle (regressive transfers from poor to rich increase inequality).

¹⁹ Some Decennial Census data, such as income, are for the year prior to the year of the census. In order to match income data with financial distress, we use non-business bankruptcies for 1989 and 1999. Welfare data used in the divorce rate regressions are from 1990 and 2000.

where $\Delta dep_i = dep_{2000i} - dep_{1990i}$, the change in the dependent variable for area i , $\Delta ineq_i = ineq_{2000} - ineq_{1990}$, the change in the Gini coefficient for area i , Δx_i is a vector of the corresponding changes in other possible exogenous influences on the dependent variable (with \mathbf{c} its vector of response coefficients), and Δu_i is an error term, assumed i.i.d.²⁰ The list of exogenous variables is recorded separately for each regression.

5.1 Bankruptcy

Individuals and married couples may file for non-business bankruptcy under Chapters 7, 11, or 13.²¹ To assess whether increases in inequality increase the likelihood of such filings, we use the total number of non-business bankruptcies under any of these three chapters as the basis for constructing our dependent variable.²²

In addition to DGini, exogenous variables for our bankruptcy regressions include a mix of economic and socio-demographic characteristics employed by authors in the bankruptcy literature, all translated into first-difference form.²³ Economic factors include the change in the twentieth percentile household's nominal income (DNomP20),²⁴ the change in the proportion of total households in which both husband and wife work (DTwoWorker), and the change in the unemployment rate (DUnemploy). Socio-demographic characteristics include the change in average household size (DHHsize), the change in the proportion of total population black (DBlack), the change in the proportion of total population Asian and Pacific Islander (DAsian), the change in the proportion of total population ages 18-29 (DAge1829), and the change in the proportion of total

²⁰ To test for heteroskedasticity, we used a special form of White's test that regresses the squared residuals of the original regression on the predicted values and the squares of the predicted values. We reject the null hypothesis of homoskedasticity if the F-test on the two independent variables is significant. Instead of reporting the results of this test in every regression, homoskedasticity is assumed unless otherwise stated.

²¹ The majority of cases were filed under Chapter 7 during the time period of our data. Only a handful of individuals and married couples filed in a different way.

²² All bankruptcy data come from the American Bankruptcy Institute website <<http://www.abiworld.org/stats/stats.html>>.

²³ See, for example, White 2007; Fay et al., 2002; Summers and Carroll, 1987; and Hermann, 1966.

²⁴ Lacking price index data at the county level, we were forced to use nominal income. But since the 1990s was a period of relatively low inflation, the change in nominal income for a county ought to be a good approximation for the corresponding change in real income.

population ages 15 and older divorced (DDivorce). In addition, since the number of people filing for bankruptcy in a county is population-sensitive, we include the change in the total county population aged 18 and over as an independent variable (DAdultPopulation). Finally, we include the change in population per square mile (DDensity). Only the last of these variables, DDensity, does not appear in standard bankruptcy studies. We added it to control for the possibility that it might be correlated with social forces that influence the likelihood of filing for bankruptcy.²⁵

At the outset, we had no prior views about what functional form would best capture the relationship between income inequality and financial distress. Simple linear regressions of the change in non-business bankruptcies on the change in income inequality revealed a positive, significant relationship in both our state and most populous county samples. But the goodness of fit was generally better in regressions involving the logarithms of the changes in bankruptcy and inequality measures. Also, this specification was robust across our state and county samples and facilitated easily-interpretable results in terms of elasticities. In Table 1, we report the results for the $\Delta \ln \text{Gini}$ measures for the 100 most populous counties.

The coefficient for $\Delta \ln \text{Gini}$ suggests that, as hypothesized, changes in income inequality are positively and significantly associated with changes in the number of non-business bankruptcy filings in our sample of the 100 most populous counties. A one percent increase in the Gini coefficient is associated with an 8.73 percent rise in the number of non-business bankruptcies. This is a remarkably strong effect. For our sample of the 100 most populous counties, the Gini coefficients increased by an average of 4.41 percent between 1990 and 2000.

²⁵ We do not expect legislation to skew the results, because most bankruptcy law occurs at the federal level, and there was no major change to federal bankruptcy law over the time period of our data (the most recent large-scale changes occurred in 1978 and 2005). One notable exception concerns what property may be considered exempt. Under the Bankruptcy Reform Act of 1978, Congress adopted a uniform federal bankruptcy exemption but allowed the states the option of setting their own exemption levels. By the time our dataset began, all states had taken this option, though some have allowed filers the option to choose either the federal or state exemption level. As noted by Fay et al. 2002, states only rarely change their exemption levels, and most changes are designed to simply preserve the real values of these levels.

Our estimate thus implies that increased inequality in these counties was associated with an almost 40 percent increase in bankruptcy filings between 1990 and 2000. This estimate seems reasonable given that, on average, non-business bankruptcies increased 148 percent in our sample.

Table 1. The Relationship between Inequality and the Likelihood of Bankruptcy

	Bankruptcy likelihood (1)
Constant	0.724*** (0.183)
$\Delta \ln \text{Gini}$	8.732*** (2.338)
ΔNomp20	-0.00008686*** (0.00002439)
$\Delta \text{Density}$	0.00003352 (0.00002577)
$\Delta \ln \text{AdultPopulation}$	1.431*** (0.434)
ΔBlack	-0.883 (0.1672)
ΔAsian	-2.595 (2.745)
$\Delta \text{TwoWorker}$	11.339*** (4.167)
$\Delta \text{Unemploy}$	2.771 (3.585)
$\Delta \text{Age1829}$	-8.311** (3.170)
$\Delta \text{Divorce}$	11.172 (7.577)
ΔHHSize	-1.490* (0.752)
R2	0.5173

Dependent Variable: Change in the natural logarithm of the number of non-business bankruptcies. Sample: 100 Most Populous Counties. Standard errors given in parentheses.

Note also in Table 1 that changes in the absolute income of the 20th percentile household are negatively and significantly associated with changes in bankruptcy filings. This finding is consistent with the traditional view that households with more money should be better able to meet their financial

obligations. But the effect is small, and does not rule out the notion that a household's desired consumption may increase hand in hand with income. Although the Δ Density variable is not statistically significant at conventional levels, this may reflect the existence of threshold effects, since density is extremely high in most of the 100 most populous counties.

5.2 Divorce Rates

The dependent variable in our divorce regressions is the change in the proportion of the total area population aged 15 and over that is divorced. In these regressions, too, we include the standard economic and socio-demographic factors discussed by other authors in the relevant literature.²⁶ The main economic factor is the change in the log of the maximum state welfare benefit for a family of three, which captures the impact of the 1996 welfare reform that gave states greater latitude in distributing welfare benefits (DlnWelfare). The socio-demographic factors include the change in the proportion of total population aged 25 and over with at least a bachelor's degree (DEdu), the change in the proportion of women aged 16 and over in the labor force (DWomenLF), the change in the proportion of total households receiving retirement income (DRetInc), and the change in the average household size (DHHSIZE).²⁷

Table 2 reports our results for the DlnGini specification for the 100 most populous counties.

Note in Table 2 that a one percent rise in the Gini coefficient is associated with a 1.21 percent increase in the proportion of divorced persons in highly populated counties. Given that the average change in the Gini coefficient between 1990 and 2000 was 4.41 percent for counties in our sample, the estimate implies that increased inequality was associated with a 5.34 percent increase in the number of divorces during this period.

²⁶ See, for example, Friedberg 1998, Stevenson and Wolfers 2006, 2007.

²⁷ We do not expect differences in state divorce legislation to skew these results, as the largest change in divorce laws in recent times—the adoption of unilateral divorce and no-fault divorce—occurred prior to the start of our dataset. The bulk of these changes occurred in the 1970s, which means that they had been in place for over one decade by the time our dataset began.

Table 2. The Relationship between Inequality and Divorce Rates

	Divorce Rate (1)
Constant	0.080*** (0.018)
$\Delta \ln \text{Gini}$	1.207*** (0.277)
$\Delta \ln \text{Welfare}$	0.049 (0.066)
ΔEdu	-0.700** (0.289)
$\Delta \text{WomenLF}$	1.283*** (0.379)
ΔRetInc	1.322* (0.694)
ΔHHSize	-0.502*** (0.104)
R2	0.54

Dependent Variable: Change in the natural logarithm of the proportion of total population ages 15 and over divorced. Sample: 100 Most Populous U.S. Counties. Standard errors given in parentheses.

5.3 Travel Time to Work

In these regressions, our dependent variable is the change in the proportion of all workers aged 16 and over whose daily commute is one hour or more. Here again we include a variety of economic and demographic characteristics that are known to affect our dependent variable.²⁸ We include changes in the median household income (DNomP50). Because of studies finding a positive relationship between race and commute time, particularly for African-Americans, we control for racial characteristics by including the change in the proportion of total population white (DWhite) and the change in the proportion of total population black (DBlack). We also include the change in the density of the population (DDensity), this time to control for changes in congestion on the roads and in the public transit systems. Finally, we include the change in the proportion of total population receiving retirement income (DRetInc), to control for the portion of the population that is older and probably not commuting.

²⁸ See, for example, Levinson and Kumar 2006, Khattak et al., 2000.

Again the results for the state and county regressions were broadly similar. Unlike the earlier regressions, however, we found that DGini provided a somewhat tighter fit than DlnGini in these regressions and was more robust across our state and county samples. Table 3 reports our results for that specification for the 100 most populous counties.

Table 3. The Relationship between Inequality and Commuting Time

	Commute Time (1)
Constant	-2.261e-5 (0.00576)
Δ Gini	0.403** (0.160)
Δ nomP50	8.920e-7** (3.727e-7)
Δ white	-0.041 (0.49)
Δ black	0.156** (0.066)
Δ density	-1.917e-7 (1.01e-6)
Δ retinc	-0.340*
R2	0.2344

Dependent Variable: Change in the proportion of total workers ages 16 and over with one hour or longer daily commute. Sample: 100 Most Populous Counties. Standard errors given in parentheses.

The estimated coefficient for DGini suggests that, as hypothesized, increases in income inequality are positively associated with changes in financial distress, as manifested in this instance by decisions to buy cheaper, but less conveniently located, housing. For counties in our sample, the Gini coefficient went up by an average of 0.018 between 1990 and 2000. Our estimate thus implies that increased inequality is on average associated with an increase of 0.0073 in the proportion of adults with commutes longer than one hour. For a county that began with the average value of that proportion in 2000 (0.09), increased inequality is thus associated with a rise of almost 8 percent in the number of adults with long commutes. For Fairfax County, Virginia, in which the proportion of adults with long commutes in 2000 was 0.097, and which had the largest growth in inequality during the decade (DGini= 0.038), our estimate suggests

that approximately 16 percent more adults in the county had long commutes in 2000 than if inequality had not grown.

6. Our Findings in Context

For our three specific measures of financial distress, our findings are consistent with the expenditure cascade hypothesis and at odds with the permanent income hypothesis. Economists seldom change their views about the efficacy of conventional models on the basis of isolated regression findings, nor should they. It is important to recognize, however, that our findings are part of a broader fabric of theoretical and empirical research that conveys a consistent message.

On the theoretical side, our best current understanding of the conditions that molded human nervous systems lends no support to models in which individuals care only about absolute resource holdings. No serious scientist disputes the Darwinian view that animal drives were selected for their capacity to motivate behaviors that contribute to reproductive success. In the Darwinian framework, reproductive success is all about relative resource holdings.

For example, frequent famines were an important challenge in early human societies, but even in the most severe famines, there was always some food. Those with relatively high rank got fed, while others often starved. On the plausible assumption that individuals with the strongest concerns about relative resource holdings were most inclined to expend the effort necessary to achieve high rank, such individuals would have been more likely than others to survive food shortages.

Relative resource holdings were also important in implicit markets for marriage partners. In most early human societies, high-ranking males took multiple wives, leaving many low-ranking males with none.²⁹ So here, too, theory predicts that natural selection will favor individuals with the strongest concerns about relative resource holdings. The motivational structure expected on the basis of theoretical considerations is thus consistent with the expenditure cascade

²⁹ Konner, 1982.

hypothesis but inconsistent with models in which only absolute consumption matters.

On the empirical side, our findings on the link between inequality and various measures of financial distress complement similar findings by other researchers. Using OECD data across countries and over time, for example, Bowles and Park found that total hours worked were positively associated with higher inequality, both as measured by the 90/50 ratio and the Gini coefficient.³⁰ Using specially constructed 2000 Census data for a sample of 200 school districts in the United States, Ostvik-White found that median house prices were substantially higher in school districts with higher levels of income inequality, as measured by the 95/50 ratio, even after controlling for median income.³¹

The expenditure cascade hypothesis is also consistent with detailed patterns in cross-section data that are not predicted by the permanent income or life-cycle hypotheses. For example, as James Duesenberry observed in his 1949 book, a black family with a given absolute income would have had higher relative income in the segregated neighborhoods of the era than a white family with the same absolute income. And as Duesenberry predicted, the savings rates of black families with a given income level were higher than those of white families with the same income. The permanent income hypothesis and the life cycle hypothesis, both of which disavow any role for context in consumption decisions, predict that families will save at the same rate irrespective of where they stand in their respective local distributions of income.

The expenditure cascade hypothesis is also consistent with observed patterns in international savings rates that are not predicted by traditional consumption theories. The aggregate savings rate, for example, was lower in the United States than in Europe in 1980, and the gap has grown larger during the ensuing years. One could invoke cultural differences to explain the initial gap, but the prevailing view is that cultures have grown more similar to each other with globalization,

³⁰ Bowles and Park, 2002.

³¹ Ostvik-White, 2003.

which leaves growth in the savings gap unexplained. The expenditure cascade hypothesis suggests, more parsimoniously, that the observed patterns in the savings data should mirror the corresponding patterns in the inequality data. It thus suggests that Americans saved less than the Europeans in 1980 because inequality was much higher in the United States than it was in Europe. And it suggests that the savings gap has grown wider because income inequality has been growing faster in the United States than in Europe in the years since then.³²

Finally, the expenditure cascade hypothesis suggests a plausible answer to the question of why aggregate savings rates have fallen even though income gains have been largely concentrated in the hands of consumers with the highest incomes. As noted earlier, formal versions of the permanent income and life-cycle hypotheses predict no link between aggregate savings rates and differential rates of income growth across income classes. As a practical matter, however, modern specifications of these models have been forced to accommodate the fact that savings rates rise sharply with permanent incomes in cross-section data. If we take that fact as given, the observed pattern of income growth in recent decades would seem to imply a secular upward trend in aggregate savings rates. After all, the lion's share of all recent income gains have accrued to prosperous families with the highest savings rates. And yet, as noted, aggregate savings rates have fallen sharply.

The expenditure cascade hypothesis suggests that the apparent contradiction may stem from the fact that the patterns of income change within wealthy groups have mimicked those we observe for the population as a whole. As noted earlier, available evidence suggests that no matter how we partition the population, income gains are highly concentrated among top earners within each group. Again, the expenditure cascade hypothesis stresses that local comparisons matter most. So even though more income is now flowing to members of prosperous groups, most members of such groups have been losing ground relative to their most prosperous peers. If it is relative income that

³² Smeeding, 2001.

drives the bequest motive and if local context is what really matters, the observed decline in aggregate savings rates is not anomalous.

7. Concluding Remarks

Although persuasive theoretical and empirical evidence suggests that evaluations of consumption goods depend on context, prevailing economic models of consumption disavow any link between spending and context. This disavowal has become increasingly difficult to justify. Prevailing models predict that savings rates will not vary with permanent income; and that savings rates at all levels—individual, local, or national—should be insensitive to changes in the distribution of income. Prevailing models also predict that changes in income inequality should not influence either the number of hours people choose to work or the median price of housing where they live. Each of these predictions is contradicted by experience.

Economists have generally responded by incorporating ad hoc modifications into traditional theories—as, for example, by positing a bequest motive for wealthy consumers to accommodate the fact that savings rates rise sharply with permanent income in cross-section data. Such moves, however, generally raise more questions than they answer. Why, for example, should only the wealthy wish to leave bequests to their children?

Our claim is that existing fact patterns and theoretical constraints can be accommodated parsimoniously by simple variants of James Duesenberry's relative income hypothesis. We have argued that a simple model incorporating context-dependence predicts a clear link between income inequality and observed savings rates. Such a model predicts, for example, that the savings rate of any reference group will decline when income inequality within that group rises. This prediction is consistent with observed patterns in U.S. Census data for the 50 states and the 100 most populous counties between 1990 and 2000, a period during which income inequality was rising rapidly. It is also consistent with links found by other authors between inequality and hours worked. It is consistent as well with links found by other authors between inequality and

median house prices. Finally, it is consistent with numerous observed patterns in cross-national savings data.

On the strength of available theoretical and empirical evidence, Mr. Duesenberry's relative income hypothesis clearly merits a closer look.

Appendix A: A Network Model of Relative Income Effects

In this appendix, we describe a model in which relative income effects emerge in a network that can be characterized by an adjacency matrix G .

First we observe that the consumption game that individuals play on the network exhibits strategic complementarities: when individual i increases consumption, this increases the marginal utility of consumption of all of i 's neighbours. When i 's neighbours then increase consumption, then the marginal utility of consumption of i 's 2nd order neighbours increases as well. These increasing differences make the game super-modular, a set of games for which pure strategy nash equilibria always exist.³³ Furthermore, since utility is concave in own consumption the equilibrium is unique.³⁴

The structure of the network of connections is can be represented by an adjacency matrix G . For an economy with N individuals the element G_{ij} is set equal to one if individual j is in the reference group of individual i , and equal to zero otherwise. Thus G_i is a row vector of zeros and ones, with a one for every neighbor of i .

Recalling the solution to first order condition from before:

$$c1 = \frac{1}{1 + \beta^{1/\sigma} R^{1/\sigma}} Y + \frac{\alpha_1 \beta^{1/\sigma} R^{1/\sigma} - \alpha_2}{1 + \beta^{1/\sigma} R^{1/\sigma}} \hat{c}. \quad (A1)$$

We then define two constants γ_1 and γ_2 :

$$\begin{aligned} \gamma_1 &= \frac{1}{1 + \beta^{1/\sigma} R^{1/\sigma}} \\ \gamma_2 &= \frac{\alpha_1 \beta^{1/\sigma} R^{1/\sigma} - \alpha_2}{1 + \beta^{1/\sigma} R^{1/\sigma}} \end{aligned} \quad (A2)$$

³³ Milgrom and Roberts, 1990.

³⁴ Ballester et al, 2006.

Recalling the definition of $\hat{c} = \frac{1}{|N(i)|} \sum_{j \in N(i)} c_j$ and defining $n_i = |N(i)|$ as the number of neighbors of node i , and C_1 as the vector of first-period consumption decisions by all nodes in the network, we rewrite the first order condition as follows:

$$c1_i = \gamma_1 Y_i + \frac{\gamma_2}{n_i} G_i C_1 \quad (A3)$$

We then normalize the adjacency matrix G by dividing every entry by n_i , corresponding to it's row i . Using the resultant normalized matrix G^N we solve for the equilibrium consumption decision in the network:

$$\begin{aligned} c1_i &= \gamma_1 Y_i + \gamma_2 G_i^N C_1 \\ C_1 &= \gamma_1 Y + \gamma_2 G^N C_1 \\ C_1 &= (I - \gamma_2 G^N)^{-1} \gamma_1 Y \end{aligned} \quad (A4)$$

Given an empty network (i.e. nobody belonging to anybody else's reference group), the result coincided with the standard permanent income result and consumption is simply a constant fraction of permanent income: $C_1 = \gamma_1 Y$. When the network is non-empty than the standard solution gets pre-multiplied by the matrix $(I - \gamma_2 G^N)^{-1}$, which corresponds to a measure of network centrality developed by Bonacich (1987).

When γ_2 is smaller than the inverse of the modulo of the largest eigenvalue of G^N then the inverse $[I - \alpha \pi G^N]^{-1} (I - \alpha \pi G_N)^{-1}$ can be expressed as:

$$[I - \gamma_2 G^N]^{-1} = \sum_{s=0}^{\infty} (\gamma_2 G^N)^s \quad (A5)$$

By the Perron-Frobinus theorem the largest eigenvalue of G^N is smaller than the maximum sum across rows. Since by definition every row of G^N sums up to one, and γ_2 is smaller than one by construction, the condition for the inverse is always satisfied. Examining an individual element (i,j) in the matrix, we see that:

$$\{[I - \gamma_2 G^N]^{-1}\}_{(i,j)} = \sum_{s=0}^{\infty} (\gamma_2)^s \{(G^N)^s\}_{(i,j)}$$

One of the properties of the adjacency matrix is that $(G)_{(i,j)}^s$ counts the number of paths of length s starting in j and ending in i . Hence $(\gamma_2)^s \{(G^N)^s\}_{(i,j)}$ counts the number of paths from consumer j to consumer i of length s , weighted by the degree of each node and discounted for the length of the path by $(\gamma_2)^s$. Thus $(I - \gamma_2 G^N)^{-1}$ keeps track of how all the consumption externalities ripple through the network as each consumer reacts to the consumption patterns of its neighbors.

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Risky Competition

Does social comparison induce risk-taking?

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ABSTRACT

A highly competitive 'bonus culture' has been blamed for the excessive risk-taking by financial professionals in the run-up to the latest financial crisis. We show that when gloating is stronger than envy (i.e. when utility is comparison-convex) then social comparison induces risk-seeking. Another implication of comparison-convexity is a preference for negatively correlated outcomes. We test these propositions with an investment game with and without the possibility of social comparison. We find a bit more than a third of subjects prefer negatively correlated outcomes and social comparison induces 50% higher risky investment among those subjects. Those subjects that prefer positively correlated outcomes do not significantly increase their risky investments when social comparison is possible.

JEL: C91; D01, D14, D81

1. Introduction.

In the popular press the excessive risk-taking by banks in the run-up to the latest financial crisis is often blamed on a 'bonus culture' among financial professionals. The habit of comparing the size of their annual bonuses with that of their colleagues would have induced Wall Street bankers to engage in highly leveraged and risky bets in order to outperform their peers. And indeed in a recent survey among risk and compliance officers at financial services firms 72% of respondents said the bonus culture had led to "uncontrollable risk-taking".³⁵ Recently, Demarzo, Kaniel and Kremer (2008) showed that such relative concerns can in fact lead to asset bubbles.

And it may not just be greedy bankers who take on more risk in order to outperform their peers. There is some suggestive evidence that Mr. and Mrs. Jones could be vulnerable to the impulse as well. Stock market participation has been found to be increasing in the amount of social interaction of a household (Hong et al., 2004), and in the average stock market participation of the neighborhood (Brown et al, 2008). The more you associate with your neighbors, the more opportunities there are to compare your financial position, and the more you could be induced to gamble on the stock market in order to keep up.³⁶

Also within firms, social emotions such as envy and gloating could affect the kind of projects managers undertake. It has been shown that career concerns can induce excessive risk taking by managers (Hermalin, 1993; DeMarzo and Duffie, 1995). The same goes for explicit tournament rewards (Hvide, 2002; Taylor, 2003). Indeed it seems that high-tech firms with more risk taking flexibility are less likely to base executive compensation on relative performance (Fung, 2009). In all of the above models the performance of others directly affects your own potential payoff through explicit incentives. But what if people care about other people's outcomes even when that's not the case? Then social comparison in itself could induce risk taking. This would be especially the case when explicit

³⁵ Brooke Masters, "Bonus measures fail to reform risk takers.", *Financial Times*, January 11, 2010.

³⁶ The fact that many people see the stock market as a form of gambling is illustrated by the negative correlation between lottery prizes and stock market participation found by Kumar (2009) and Gao and Lin (2010).

incentives are quite weak, such as in the case of CEO's (Jensen and Murphy, 1990). So far however, the study of social preferences and performance has mainly focused on effort provision (Fershtman et al, 2004; Goel and Thakor, 2005; Dur and Glazer, 2007).

There are a few theoretical papers that study the effect of social comparison and the concern for social status on risk-taking. Robson (1992) shows that when utility is convex in relative wealth individuals will engage in risky gambles until a stable income distribution is reached where all fair gambles are rejected. Becker et al (2005) extend the analysis and show that even with concave utility over both wealth and status individuals could rationally accept fair gambles. Furthermore risk taking is shown to be increasing in the equality of initial endowments. Hopkins (2010) recently extended the analysis and shows that while risk-taking is decreasing in the inequality of initial endowments it is increasing in the inequality in rewards to status.

As it is extremely difficult to study the effects of social comparison in the field³⁷, in this paper we examine the influence of social comparison on risk preferences experimentally. We do this by eliciting choices over risky prospects both in isolation and in a context where social comparison is possible.

In the same way that choices over risky gambles reflect the shape and curvature of a utility function over monetary outcomes, risky gambles in a social context would reflect the shape and curvature of the social comparison function. One of the central aspects of this social comparison function is whether it is convex or concave (Clark and Oswald, 1997), or put another way whether social gains loom larger than social losses or the reverse (Maccheroni, Marinacci and Rustichini, 2009). This distinction has surprisingly large implications. Clark and Oswald show that comparison-concave preferences lead to emulation and herding behaviour, whereas comparison-convex preferences give rise to deviance and diversity. Maccheroni et al. show that these results hold broadly and only depend

³⁷ One would need reliable data on whom people compare themselves with, their own choices and these others' choices, and then control for endogeneity effects. This problem is known as the reflection problem (Manski, 1993.)

on the convexity of the kink around the reference point. We show that the distinction also affects preferences over positively or negatively correlated outcomes in gambles. With comparison-concave preferences, individuals would prefer positively correlated gambles (if you win I win, and when you lose I lose). With comparison-convex preferences individuals would prefer negatively correlated outcomes (when I win you lose, and vice versa). Furthermore with comparison-convex preferences social comparison induces more risk taking. The latter would be the mechanism that explains why social comparison could lead to more risky trading in financial firms, more stock market participation the more you interact with your neighbours, and overly risky decisions by managers in a firm.

That social comparison can influence behavior is an old and by now established idea in the social sciences. By now its implications have been studied in many terrains. Veblen (1899) looked at how consumption is used to signal social class. Duesenberry (1949) studies how relative income affects saving. Hirsch (1976) and Frank (1985) looked at demand for positional and non-positional goods. Relative preferences have been linked to wage compression within firms (Frank 1984), excessive consumption of status goods (Ireland 1998; Hopkins and Kornienko, 2004), economic growth (Corneo and Jeanne, 1996; Cooper et al, 2001), happiness (Luttmer, 2004), the Easterlin paradox (Clark et al, 2008) and wage satisfaction (Clark et al. 2009). Furthermore the existence of relative preferences would have implications for public good provision and taxation (Aronsson and Johansson-Stenman, 2008; Ireland, 2001), environmental policy (Wendner, 2005) and even stabilization policy (Ljunqvist and Uhlig, 2000). It should be noted that most of the conclusions of these papers follow from the assumption of comparison-concave preferences. With comparison-concave utility in consumption or social status, those that fall behind experience increased marginal utility of consumption and thus increase their expenditure on conspicuous or status goods, leading to inefficient outcomes where everybody is running to stay in the same place. Furthermore, when social losses loom larger than social gains, a mutual comparison would result in a net utility loss. Thus optimal policy would seek to reduce differences in income and status. With

comparison-convex preferences by contrast policy should be geared towards increasing these.

Only recently have people started studying social preferences using risky choices, although so far only in laboratory contexts. Bault et al (2008) elicited subjects' subjective emotional response to the outcomes of lotteries on a 100-point scale from "extremely negative" to "extremely positive". They also measured more objective physiological reactions such as heart rates and skin conductance. They find that when subjects can observe both their own outcomes and the outcomes of another subject, they react more strongly to social gains than to social losses. Linde and Sonnemans (2009) find that people are more risk-seeking when outcomes are contextualized as social gains than as social losses. Schoenberg and Haruvy (2010) show that larger asset bubbles occur when subjects learn about the wealth of the leading trader than when they learn about the wealth of the laggard.

We add to this literature in several ways. First of all we allow subjects to choose either positively correlated or negatively correlated outcomes, thereby testing the findings of Bault et al. Their conclusion that social gains loom larger than social losses was based on self-reported satisfaction with outcomes and on physiological reactions such as heart rate and skin conductance. Our setup directly tests behavioral predictions based on their findings. Second, in our setup subjects can choose among a continuous range of risk taking, instead of binary choices between lotteries. This allows us to study the second prediction that comparison-convex preferences induce more risk taking. We will also further explore the effect of inequality on risk-taking.

2. Theory.

Suppose that a person has a standard (increasing, concave) utility $u(x_0)$ over own outcome x_0 , and an additive comparison utility $v(x_0, x_1)$ over the difference with someone else's outcome x_1 .³⁸

$$U(x_0, x_1) = u(x_0) + v(x_0, x_1) \quad (1)$$

We then assume a piecewise linear function for $v(x_0, x_1)$ as in Fehr and Schmidt.³⁹ The linearity keeps the analysis simple and as Macheroni et al. (2009) showed, the results would carry through for more complicated specifications as long as there is a kink around the reference point.

$$v(x_0, x_1) = \alpha \max\{x_0 - x_1, 0\} - \beta \max\{x_1 - x_0, 0\} \quad (2)$$

The first part of this specification reflects the feeling of gloating: enjoying positive utility from having a better outcome than your peer. The second part reflects the feeling of envy: suffering negative utility having a worse outcome than your peer. Social gains are multiplied by the coefficient α , and social losses by the coefficient β . This specification parsimoniously fits the several theories for social preferences. With parameters $\alpha = \beta = 0$, social comparison does not play a role at all. When gloating is stronger than envy ($\alpha > \beta$) utility is comparison-convex: social gains loom larger than social losses, in line with the findings of Bault et al. For parameter values $0 < \alpha < \beta$, utility is comparison-concave: envy is stronger than gloating and social losses loom larger than social gains. Finally, when $\alpha < 0$ individuals are inequity-averse, that is they both get disutility from disadvantageous inequality and advantageous inequality. We will now derive two implications of such utility.

³⁸ For the purpose of this paper we restrict the analysis to the case of a single social reference point. For a more extended treatment that allows for multiple reference points we refer the reader to Maccheroni et al (2009).

³⁹ Although note that compared to the Fehr-Schmidt specification we switched the parameters α and β to reflect the primacy of the gloating in our paper.

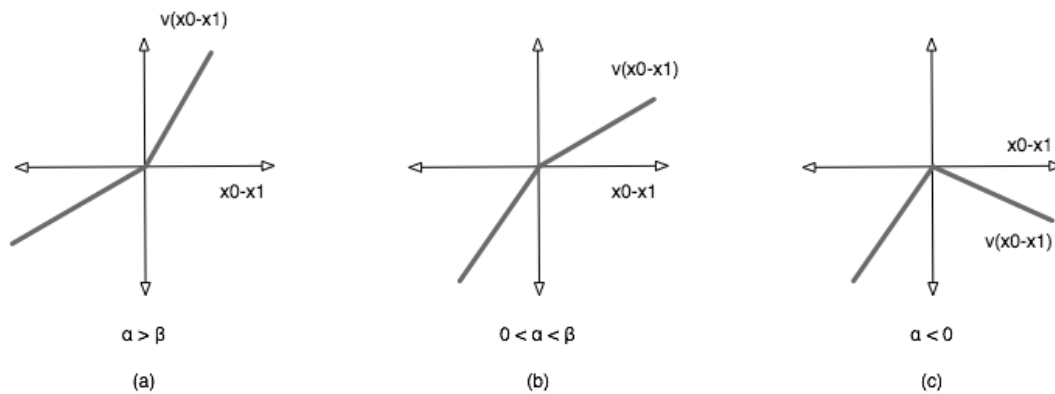


Figure 1. Three different specifications of the social comparison value functions. On the left comparison-convex utility, in the middle comparison-concave utility and on the right inequality averse utility.

The first implication is a derivative of the Clark and Oswald (1996) conclusions applied to risky outcomes. As comparison-concave utility yields a preference for emulation, it also implies a preference for positively correlated outcomes. Likewise as comparison-convex utility yields a preference for diversity it also implies a preference for negatively correlated outcomes.⁴⁰

As an example take a situation where both you and your peer engage in a simple heads/tail coin lottery with earnings of E10,- for guessing the right coin side and E0,- for guessing the wrong side. When gambling on the outcome of a single coin toss, by picking the same coin side your outcomes will also be the same, so your outcomes will be positively correlated and your comparison utility will equal zero. When picking the opposite coin side your outcomes are negatively correlated and your comparison utility will be either $v(0,10)$ or $v(10,0)$. When $\alpha > \beta$ then $(1/2)v(10,0) + (1/2)v(0,10) > 0$ and thus you would pick the opposite coin side as your opponent. When $\alpha < \beta$ then $(1/2)v(10,0) + (1/2)v(0,10) < 0$ and thus you would prefer the positively correlated outcomes from picking the same coin side.⁴¹

⁴⁰ This is similar to Roussanov's (2010) argument that those who are mainly concerned by getting ahead of the Jones' (as opposed to catching up), should *underdiversify* their portfolio's.

⁴¹ Note that in this example, as in the experiment, both the expected value and the variance is the same for both the positively and the negatively correlated gamble. In a more general setting individuals with comparison-convex utility would be willing accept lower expected value investments with higher variance in order to get negative correlation with others' outcomes. This could explain why still a lot of people engage in buying individual stocks instead of investing in index funds.

Proposition 1: Subjects will prefer negatively correlated gambles iff their utility function is comparison-convex ($\alpha > \beta$). Conversely subjects will prefer positively correlated gambles iff their utility is comparison-concave ($\alpha < \beta$). Subjects are indifferent between positively and negatively correlated gambles iff they do not have social preferences ($\alpha = \beta = 0$) or their comparison utility is linear ($\alpha = \beta$).

Proof: See appendix B.

The second implications derived from the convexity of the social comparison function when $\alpha > \beta$. As convex utility over own outcomes implies risk seeking in individual risky choice, so does adding a convex comparison term to the utility function decrease risk aversion when social comparison is possible

Proposition 2. When utility is comparison-convex ($\alpha > \beta$), individuals prefer bigger investments in risky gambles when social comparison is possible.

Proof: See appendix B.

3. Experimental Setup

In order to test the validity of Proposition 1 and Proposition 2, we designed an experiment where subjects made a continuous risk taking decision with a simple mechanism for choosing either positively or negatively correlated outcomes.

Every round subjects are given an endowment and can invest a part of their endowment in a lottery described as follows:

You have a one-half chance (50%) to lose the amount X you bet and a one-half chance (50%) to win one-and-a-half times the amount ($1.5X$) you bet.

As the expected value of the gamble is equal to $1.25X$ a risk neutral subject would invest the entire endowment. More risk averse subjects would invest only a part of their endowment. This mechanism was first introduced by Gneezy and Potters

(1997), and is getting used more often recently, see e.g. Charness and Gneezy (2010).

In order to investigate the impact of social comparison we ran two kinds of treatments: the Comparison treatment (C) and the No Comparison treatment (NC).

In the Comparison treatment subjects are matched with their direct physical neighbour in the laboratory (called the NEIGHBOUR) and while they make their own investment decision on the screen they simultaneously see the decision made by NEIGHBOUR (both gamble amount X and winning coin side).⁴² At the end of the round they are informed both of their own payoff and the payoff of NEIGHBOUR.

Subjects participate in the lottery by betting on the outcome of a coin toss: Heads or Tail. Usually one of the subjects will have the winning coin side assigned to them by the computer, e.g. “Your winnings coin side this rounds will be Heads”. The neighbouring subject is then informed that the NEIGHBOUR has a winning coin side of Heads, and is then asked to select her own winning coin side, either Heads or Tail. By choosing the same coin side as their NEIGHBOUR, payoffs will be positively correlated, and by choosing a different coin side as NEIGHBOUR payoffs will be negatively correlated.

Out of twelve rounds on average subjects made a coin side choice four times, while their NEIGHBOUR also made four coin side choices, and four times the coin side would be assigned to both subjects.⁴³ At the start of the experiments subjects were asked to briefly shake hands with their neighbour and wish each other luck. At the end of every round subjects are asked to rate their subjective satisfaction with the outcome on a scale from “Extremely Negative” to “Extremely Positive”.

⁴² Subjects were able to continuously update their decisions throughout each 40 second decision period.

⁴³ The double assignment of coin choices in a third of the rounds was to ensure that we would collect observations on both positively correlated and negatively correlated outcomes for all subjects.

In the No Comparison treatment subjects made their decisions in isolation: they only saw their own decision and outcomes, and not those of their NEIGHBOUR. Half the time their winning coin side was assigned, and half the time they were asked to choose their own winning coin side. Screenshots are shown in Appendix C.

In the first 12 rounds of the experiment the initial endowment was held constant at E8,-. In the second stage of the experiment initial endowments were randomized according to a uniform distribution between E2,- and E14,-. Subjects were informed at the beginning of each round of their endowment that round. In the Comparison treatment subjects were shown both their own endowment and their NEIGHBOUR's endowment.

After all stages had been completed a questionnaire was administered. Besides the usual questions about age, gender and university department, three additional measures were included. The first was a similarity question. Subjects were asked to rate their NEIGHBOUR on a 10-point similarity scale from 1 ("The person at this university least similar to me") to 10 ("The person at this university most similar to me"). This question is motivated by the finding in the psychology literature that emotions related to social comparison are most salient with those whom we consider similar to us. Also included was an 8-item Dispositional Envy Scale questionnaire developed by Smith et al (1999), that purports to measure the enviousness of a respondent. And finally we included a 14-item Competitiveness Index developed by Houston (2009). After the questionnaire was completed, one of the 24 rounds was randomly selected for payoff and subjects were informed about their final earnings for the experiment.

In December 2010, and April 2011⁴⁴, a total of six experimental sessions were deployed at the Center for Research in Experimental Economics and Political Decision making (CREED) at the Universiteit van Amsterdam. Out of 138 subjects, 48 subjects participated in the No Comparison treatment and 90 subjects participated in the Comparison treatment. Average payments were E14,50- including a E5,- show-up fee.

Subjects were seated behind computer screens and divided by separators such that they could not see the screens of other participants. Subjects were given five minutes to read the instructions, after which the experimenter went through the instructions and cleared up any questions that arose.

For the comparison treatment subjects were matched with their physical neighbour in the lab. The lab was arranged in rows of four, with computer labels Ax, Bx, Cx and Dx, where x corresponds to the row number. All A subjects were matched with B subjects and C subjects were matched with D subjects. In the instruction subjects were informed that they would be seeing feedback on their neighbour during the experiment and were invited to briefly shake hands and wish each other luck before the start of the session.⁴⁵

The experimental setup was programmed with the help of the experimental software z-Tree (Fischbacher, 2007).

4. Hypotheses

Assuming a significant proportion of subjects with comparison-concave preferences, we can make the following hypotheses:

H1: Average gambles are higher in the Comparison treatment than in the No Comparison treatment.

⁴⁴ In the first three sessions females were undersampled, making up only one-third of the subjects. To investigate potentially interesting gender effects, additional sessions were run in april where females were oversampled.

⁴⁵ Introducing the subjects to each other could potentially have lead to risk-sharing behavior among subjects. However given the impossibility of communicating otherwise throughout the treatment, and the unenforceability of any agreement we do not believe this could have played a role.

H2: The stronger a subject's preference for negatively correlated gambles, the more a subject will gamble in the Comparison treatment.

5. Results

First we will look at the first part of the experiment where initial endowments were equal, so ex-ante inequality should play no role. Here, out of a maximum gamble of E8.00, subjects invested on average E4.16 (52% of endowment) in the No Comparison treatment and E5.59 (70%) in the Comparison treatment.⁴⁶ Thus gambles are on average about 30% higher in the Comparison treatment, in line with H1.

Table 1. H1: Average gambles are higher in the Comparison treatment

	Mean Gamble	SD
Comparison Treatment	5.59***	2.74
No Comparison Treatment	4.16	2.73

In the No Comparison the distribution of gamble decisions shows two significant modes, one at investing the entire endowment, and one at investing slightly less than half the endowment (see fig. A3 in Appendix A). Only 25% of all gamble decisions involve the entire endowment. By contrast in the Comparison treatment 47% of gambles are equal to the entire endowment. Furthermore, average gamble sizes are quite stable over time (see fig. A4 in Appendix A).

In the comparison treatment subjects made a decision about their winning coin side between three and five times during the twelve rounds. Out of 354 coin decisions made in the Comparison treatment, there were 179 (51%) decisions for the opposite coins side as NEIGHBOUR. These choices resulted in negatively correlated outcomes. While 175 (49%) choices were for the same coin side, resulting in positively correlated outcomes. These results could be interpreted in two ways: either subjects did not take into account whether outcomes would

⁴⁶ Wilcoxon test for difference in average gamble: $p < 0.001$.

be positively or negatively correlated and chose their coin side randomly, or the social comparison function is on average linear across subjects.

Table 2. H2: Subjects with a preference for negatively correlated outcomes gamble more.

	Mean Gamble	SD
No Comparison Treatment	4.16	2.73
Comparison Treatment	6.30***	2.41
Opposite side >50% of the time		
Comparison Treatment	4.97	2.81
Same side > 50% of the time		

While 41% of subjects chose the same coin side more than half the time, 36% of subjects chose the opposite coin side over half the time, and 23% of subjects chose the same and opposite coins side the same amount of times. We compare the gambles of those subjects that chose the opposite coin side more than half the time with those that chose the same coin side over half the time in table 2. Those with a preference for the opposite coin side gamble significantly more (Average gamble is E6.30, 79% of endowment, and 50% more than the average in the no comparison treatment) than those who prefer the same coin side (average gamble is E4.97, 62% of endowment).⁴⁷ In fact the gambles of those who have a preference for the same coin side are not significantly different from the No Comparison treatment⁴⁸, while the difference is highly significant for those with opposite coin preferences.⁴⁹

The test for the robustness of the above finding we construct a measure OppositeCoin which is defined by the number of opposite coin choices out of total number of coin choices made. Thus OppositeCoin varies from 0 for subjects that always chose positively correlated gambles, to 1 for subjects that always

⁴⁷ Wilcoxon test for difference in average gamble: $p=0.03$

⁴⁸ Wilcoxon test for difference in average gamble: $p>0.10$.

⁴⁹ Wilcoxon test for difference in average gamble: $p<0.001$.

chose negatively correlated gambles. In a way OppositeCoin proxies for the ratio between α and β where a value higher than 0.5 corresponds to $\alpha > \beta$. The results are shown in table A1 of the appendix.

Under all specifications the coefficient for OppositeCoin is positive and significant. Those who prefer negatively correlated gambles on average gamble more than two euro more than those that prefer positively correlated gambles. Thus a revealed preference for negatively correlated outcomes is indeed associated with more risk-taking as H2 predicted.

There are also a few other interesting patterns in the data. Own average past payoffs and fraction of rounds won so far do not seem to matter in and of themselves, but only in the way they relate to the neighbour's payoffs and winnings. Gamble size is decreasing in the log of the ratio of own payoffs over the neighbour's payoffs, so the further you are ahead, the less you gamble. However having won more rounds than the neighbor so far, actually increases the Gamble size. Thus the overall effect of relative past performance is somewhat ambiguous.

As usual we find a gender effect where males choose bigger gamble sizes than females (see Croson and Gneezy, 2010; Eckel and Grossman, 2008), however the gender of the neighbour does not seem to play a role here.⁵⁰ Out of the measure constructed from questionnaire at the end of the experiment, only the Enjoyment of Competition measure significantly affects gambling size. Neither Dispositional Envy, nor the reported similarity of the neighbor show up as significant. The effect of enjoyment of competition is rather sizeable though: increasing this measure from the lowest to the highest level is associated with an increase in gamble size of more than two Euro, a similar effect size as the OppositeCoin Measure.

Interestingly, although we find the implications of the Bault et al. findings, we do not replicate their result. They found a stronger subjective emotional response

⁵⁰ However as we will see the neighbour's gender effect does turn out significant in the unequal endowment treatment.

for social gains than for social losses. We find little influence of the neighbour's outcome on emotional response (see fig. A5 in appendix A). One possible explanation could be that in their experiment subjects were more willing to truthfully reveal gloating when the neighbour lost because subjects were attached to heart rate and skin conductance monitors. In effect subjects were attached to lie detectors. Another explanation would be that in their experiment subjects were choosing between options with different risk and payoff profiles. In our setup expected payoffs were the same whether you choose heads or tails. Thus subjects maybe experience less regret and envy when choosing the wrong coin side, and less relief and gloating when choosing the right coin side.

We will now look at the second part where endowments were unequal. As initial endowments for the subjects and their neighbours were drawn from independent uniform distributions, every round started with an inequality in endowments. The average percentages of initial endowment gambled were broadly similar in the inequality and fixed endowment treatments (72% vs 70% in the comparison treatment and 51% vs 53% in the no comparison treatment).

We investigate the effect of unequal relative endowments on risk-taking by regressing the gamble percentage on a number of measures including the log of the endowment ratio, and a dummy variable for having the bigger initial endowment (see table 2 in Appendix A). The measure *OppositeCoin* is still a significant predictor of gamble sizes (although more marginally significant than before). The percentage of the endowment that is gambled is declining in the size of the initial endowment, consistent with Increasing Relative Risk Aversion (Holt and Laury, 2002).

However none of the relative measure of initial endowment show up as significant in the estimation. Neither the log of the initial endowment ratio, nor the dummy variable for the higher initial endowment show up as significant in any of the specifications. This is a somewhat surprising result. Especially given that the measures of past relative performance do show up as (marginally) significant.

Interestingly, in contrast to the analysis of the first twelve rounds, the gender of the neighbor does seem to matter here. The average gamble when the neighbor is male is 77% of endowment while the average gamble with a female neighbor is 66% of endowment, although the difference is only marginally significant with a Wilcoxon test.⁵¹

6. Discussion and Conclusion

This paper has investigated the effect of social comparison on risk-taking. The two main results are that 1) Increasing the potential for social comparison with a neighbor increases the amount of financial risk taken by subjects and 2) subjects that prefer negatively correlated outcomes invest significantly more in a risky lottery when social comparison is possible.

These results point to the fact that most individuals have competitive preferences: they enjoy having better outcomes than others. This goes against the recent literature on fairness preferences and inequality aversion (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000) that assumes that people are adverse to even advantageous inequality. However these inequality-averse preferences are usually found in zero-sum experiments where subjects can only make themselves better off by making someone else worse off.⁵² Indeed it has recently been found that (perceived) intentions matter a great deal in these kind of games (Falk et al, 2008) and that behaviour in dictator games and trust games is largely determined by dispositional guilt-aversion and reciprocity (Regner and Harth, 2010). These setups are thus not good environments to test preferences over outcomes when guilt is not a psychological factor at play, such as when outcomes are the result of individual risky decisions. As inequality-averse preferences are strongly comparison-convex they would have predicted a strong preference for positively correlated outcomes.

⁵¹ Wilcoxon test for the difference in average gamble: $p=0.10$.

⁵² An exception would be the generosity game by Guth (2010), where increasing the other's payoff does not reduce the decider's payoff. However even in that game the only way in which a decider can increase their *relative* outcomes is by decreasing the outcomes of the other.

The second important point to note is that it seems that the standard findings of prospect theory do not map onto social reference points one-by-one. In prospect theory losses loom larger than gains (Kahneman and Tversky, 1979), whereas we show that for a significant part of the subject population social gains loom larger than social losses. Earlier Linde and Sonnemans (2009) have shown that when it comes to social reference points subjects are risk seeking in social gains instead of losses as predicted by standard prospect theory. Taken together with the findings of Bault et al (2008) it thus seems that people react very differently to social reference points than to private ones. This is an issue worthy of further investigation.

Our results also have some important other implications. First of all it would provide an additional explanation for the finding that people with more social interaction invest more in the stock market. Second, it implies that for professions where people have significant latitude in determining the riskiness of their strategies, such as financial traders or high level managers, social competition could lead to increased risk-taking. But besides influencing the amount of risk taken, social comparison could also influence the kinds of risk taken and lead people to choose highly idiosyncratic strategies for their investment portfolios in a search for negatively correlated investments.

Finally the results have implications for the theoretical literature on social comparison that relies on comparison-concave preferences. Most of the literature on optimal taxation and relative consumption derive their results from comparison-concave preferences (Aronsson and Johansson-Stenman, 2008, 2010; Wendner 2004; See also Graafland, 2010 and references therein). Their conclusion would be reversed when utility is actually comparison-convex.

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Appendix A: Tables and figures.

We regress the gamble size in the first twelve periods on a number of factors including OppositeCoin using GLS estimation. Given that gamble sizes for neighbouring subjects could be correlated for other reasons than social comparison preferences (herding, for example), one needs to control for the neighbour's gamble size. However, a simple OLS system of equations would not work as the independent variable for one equation would show up as a dependent variable in the next, and vice-versa.⁵³

Instead, we assume that the error terms are spatially correlated for neighboring subjects:

$$Y_1 = \alpha + \beta X + u_1$$

$$Y_2 = \alpha + \beta X + u_2$$

$$E[u \ u] = \Sigma = \begin{bmatrix} \sigma^2 & \rho & 0 & & 0 & 0 & 0 \\ \rho & \sigma^2 & \rho & \cdots & 0 & 0 & 0 \\ 0 & \rho & \sigma^2 & & 0 & 0 & 0 \\ & \vdots & & \ddots & \vdots & & \\ 0 & 0 & 0 & & \sigma^2 & \rho & 0 \\ 0 & 0 & 0 & \cdots & \rho & \sigma^2 & \rho \\ 0 & 0 & 0 & & 0 & \rho & \sigma^2 \end{bmatrix}$$

Furthermore, we allow for gamble sizes to be correlated over time for each subject, and estimate the system of equation with GLS.⁵⁴

⁵³ Resulting in estimating equations $Y_1 = \alpha + \beta_1 Y_2 + \beta X_1 + u_1$, $Y_2 = \alpha + \beta_1 Y_1 + \beta X_2 + u_2$, etc. To prevent this from influencing the results, we control for the correlation between the independent variables through the error term.

⁵⁴ In particular, we used the R function `gls` with a linear spatial correlation structure `corLin` and a symmetric time correlation structure `corSymm`.

Table A1. Determinants of gamble size for Comparison treatment in period 1-12.

Dependent Variable	Gamble (1)	Gamble (2)	Gamble (3)	Gamble (4)
OppositeCoin	2.14** (0.90)	2.09** (0.90)	2.17** (0.90)	2.43** (0.84)
Past Payoffs	0.01 (0.04)	0.001 (0.03)		
Past Wins	-0.73 (0.49)	-0.42 (0.47)		
Log Payoff Ratio	-0.28 (0.20)		-0.35* (0.18)	-0.36** (0.18)
Leading in Payoffs	-0.09 (0.15)		-0.09 (0.15)	-0.12 (0.15)
Log Win Ratio	0.21 (0.22)		0.15 (0.20)	0.12 (0.20)
Leading in Wins	0.44*** (0.17)		0.38** (0.16)	0.39** (0.16)
Win Previous Round	-0.06 (0.10)	-0.05 (0.09)	-0.14* (0.09)	
Male	0.96 (0.72)	1.02 (0.71)	0.99 (0.72)	1.10** (0.46)
Neighbour Male	0.18 (0.71)	0.22 (0.69)	0.32 (0.70)	
Male * Neighbour Male	0.22 (1.00)	0.13 (0.98)	0.18 (1.00)	
Neighbour Win Previous Round	0.01 (0.08)	-0.02 (0.08)	-0.02 (0.09)	
Similarity	0.67 (1.17)	0.71 (1.16)	0.69 (1.17)	
Enjoy Competition	2.14* (1.28)	2.16* (1.27)	2.17* (1.27)	2.15* (1.24)
Dispositional Envy	-0.16 (0.85)	-0.18 (0.84)	-0.12 (0.84)	
Period	0.01 (0.01)			
AIC	4219.608	4211.796	4210.149	4201.456

*Estimated with GLS with spatially and temporally correlated error terms. Standard errors are given in parentheses. Numbers with * are significant at the 10-percent level. Numbers with ** are significant at the 5-percent level. Numbers with *** are significant at the 1-percent level. Number of observations: 1080. Number of subjects: 90.*

Table A2. Determinants of gamble fraction in Comparison treatment with unequal initial endowments, period 13-24.

Dependent Variable	Gamble Percentage (1)	Gamble Percentage (2)	Gamble Percentage (3)	Gamble Percentage (4)
OppositeCoin	16.7* (9.0)	15.6* (9.0)	16.1* (9.0)	17.2* (9.3)
Initial Endowment	-0.79*** (0.22)	-0.80*** (0.22)	-0.89*** (0.21)	-0.88*** (0.22)
Log Endowment Ratio	0.73 (4.8)	0.90 (4.78)	1.5 (2.4)	1.4 (4.8)
Larger Endowment	-1.73 (1.81)	-1.75 (1.82)		-1.6 1.8
Log Endowment Ratio* Larger Endowment	4.5 (6.3)	4.5 (6.4)		4.5 (6.3)
Log Payoff Ratio	-3.6* (1.9)	-3.6* (1.9)	-3.4* (1.9)	
Leading in Payoffs	3.1* (1.9)	2.4 (1.8)	2.6 (1.8)	
Log Win Ratio	5.4* (3.0)	5.9** (2.9)	5.2* (2.8)	
Leading in Wins	-5.7*** (2.1)	-6.0***	-5.4***	
Win Previous Round	-1.7 (1.2)			
Neighbour Win Previous Round	-0.5 (1.3)			
Male	20.8*** (8.0)	20.9*** (8.0)	20.4** (8.0)	19.2** (7.9)
Neighbour Male	16.3** (7.6)	16.3** (7.6)	16.5** (7.6)	15.8** (7.9)
Male * Neighbour Male	-20.0* (11.3)	-20.0* (11.4)	-19.1* (11.3)	-10.7 (10.9)
Similarity	29.9** (12.9)	29.9** (12.9)	28.2** (12.7)	
Enjoy Competition	31.9** (14.5)	31.8** (14.6)	30.7** (14.4)	
Dispositional Envy	7.5 (10.2)	7.3 (10.3)		
Period	0.2 (0.2)	0.16 (0.18)		
AIC	9811.073	9813.793	9821.725	9847.005

*Estimated with GLS with spatially and temporally correlated error terms. Standard errors are given in parentheses. Numbers with * are significant at the 10-percent level. Numbers with ** are significant at the 5-percent level. Numbers with *** are significant at the 1-percent level. Number of observations: 1080. Number of subjects: 90.*

Figure A3. Distribution of gambles.

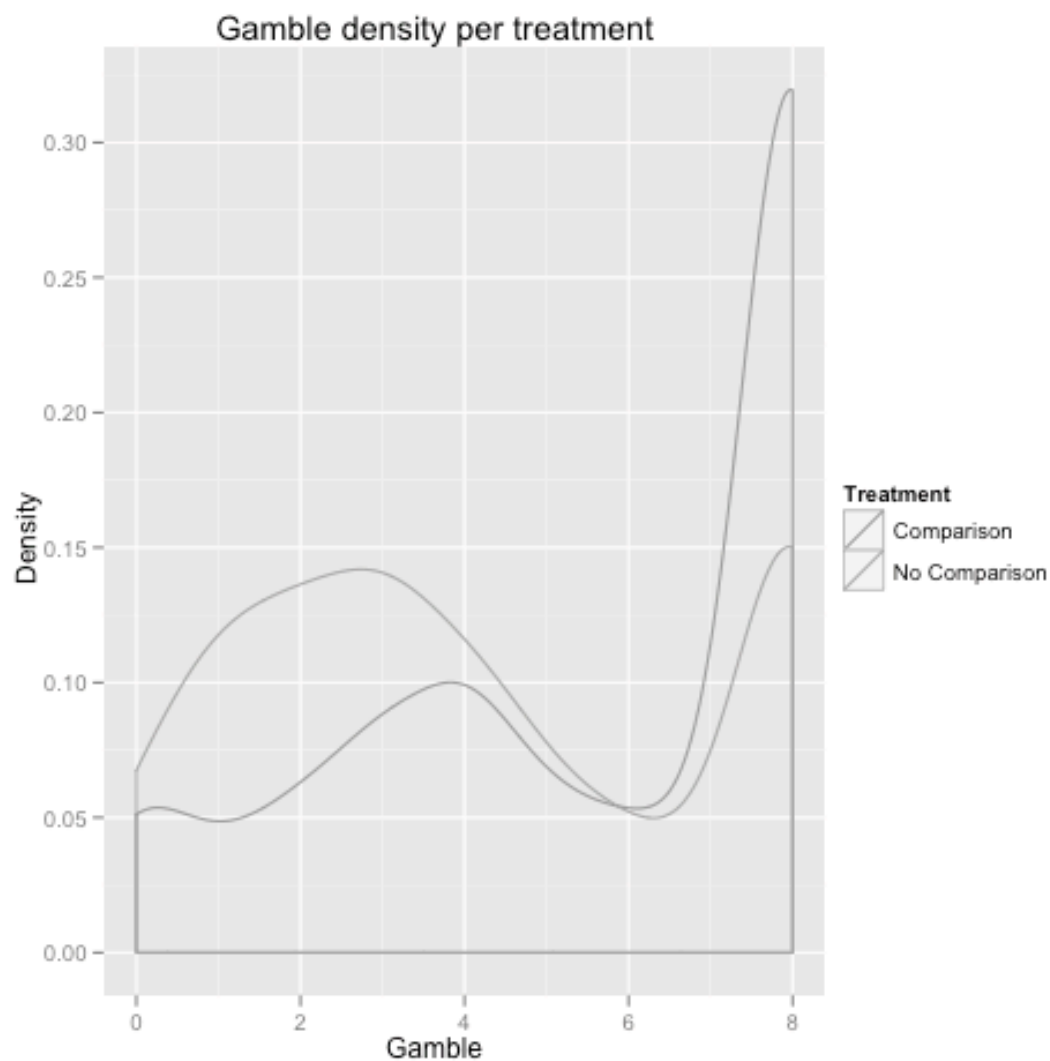


Figure A3. Comparing the distributions of gambles in the two treatments. In the No Comparison treatment, there is one mode at gambling slightly less than half the endowment, and one mode at gambling the entire endowment. In the comparison treatment there is a large shift to investing the entire endowment.

Figure A4. Gambles over time.

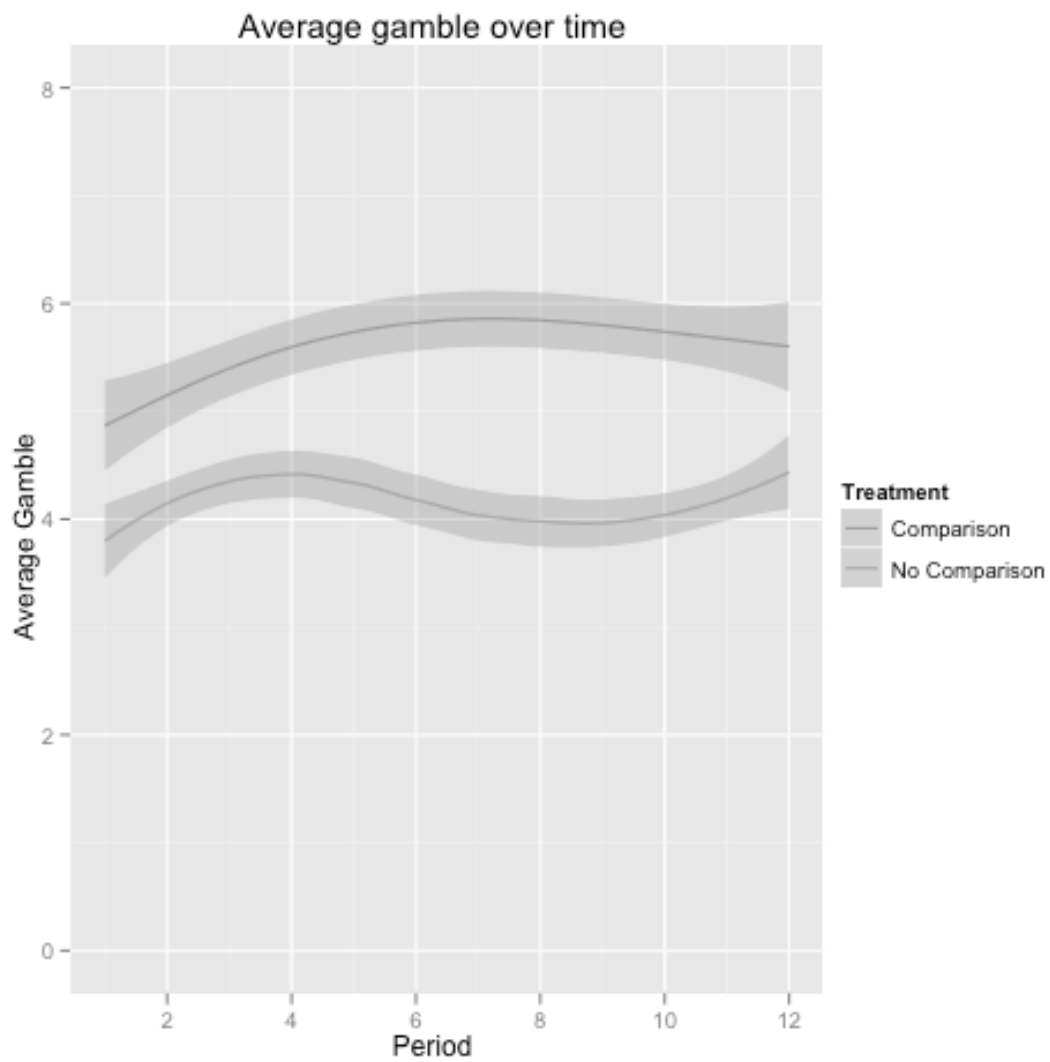


Figure A4. Average gambles in part one of the experiment.

Figure A5. Subjective rating of outcomes.

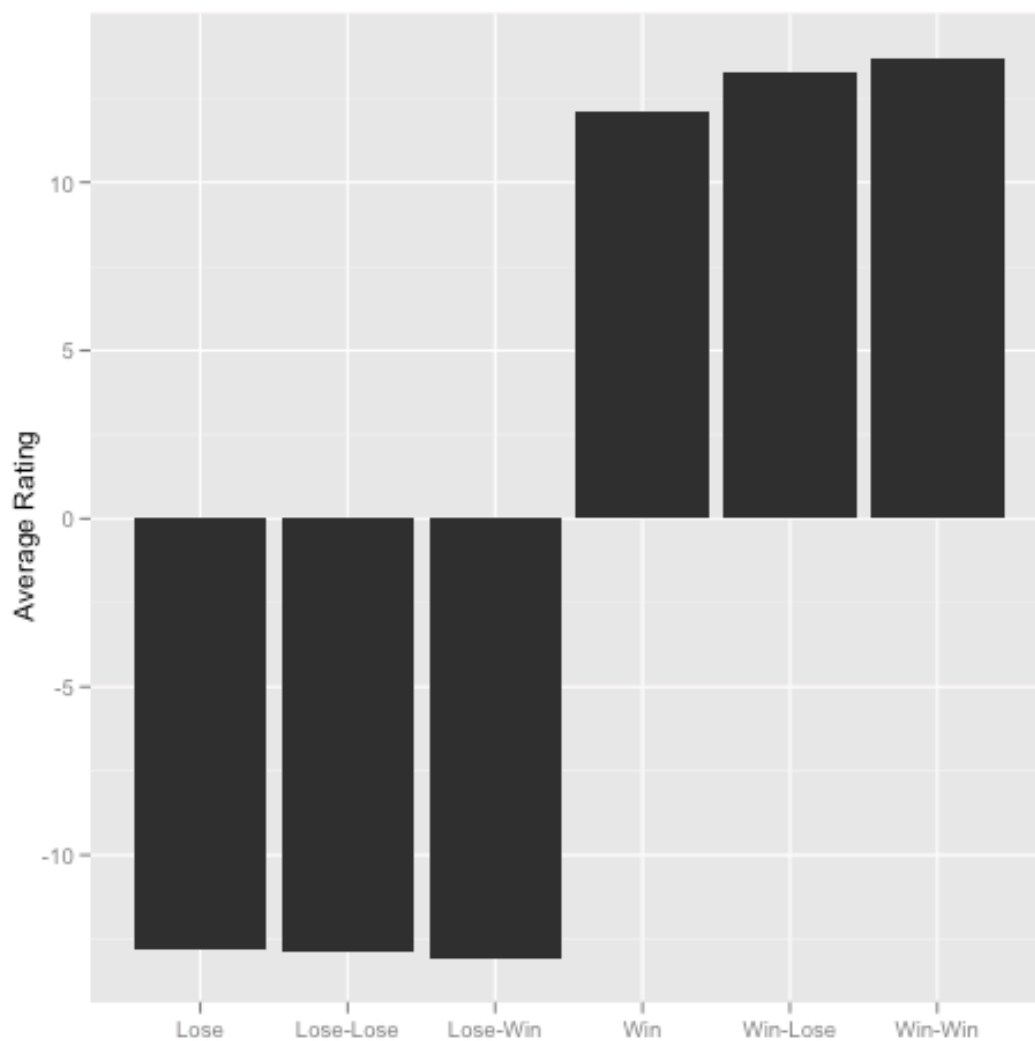


Figure 3 Emotional rating on a scale from -20 (extremely negative) to +20 (extremely positive). The outcomes for the No Comparison treatment are shown under “Lose” and “Win” respectively. The outcomes for the Comparison treatment are shown under “Lose-Lose”, “Lose-Win”, etc.

APPENDIX B: PROOFS

Proposition 1: Subjects will prefer negatively correlated gambles iff their utility function is comparison-convex ($\alpha > \beta$). Conversely subjects will prefer positively correlated gambles iff their utility is comparison-concave ($0 < \alpha < \beta$). Subjects are indifferent between positively and negatively correlated gambles iff they do not have social preferences ($\alpha = \beta = 0$) or their comparison utility is linear ($\alpha = \beta$).

Proof:

In our setup given an initial endowment of Y , and given a gross return of R on winning the gamble, a gamble of size g_0 will result in payoffs $x_0 \in \{Y - g_0, Y + Rg_0\}$ both with 0.5 probability. A gamble of size g_1 by the neighbour will result in payoffs $x_1 \in \{Y - g_1, Y + Rg_1\}$ for neighbour. The expected utility of a gamble g_0 given a gamble g_1 by the neighbour is thus given by:

$$EU(g_0, g_1) = E \{ u(x_0) + \alpha \max\{x_0 - x_1, 0\} - \beta \max\{x_1 - x_0, 0\} \mid g_0, g_1 \} \quad (\text{B.1})$$

However the expected utility of the comparison term depends on the correlation between outcomes. Let $EU_{POS}(g_0, g_1)$ be the expected utility of a gamble g_0 , given the other's gamble g_1 with positively correlated outcomes. That is:

$(x_0, x_1) \in \{(Y - g_0, Y - g_1), (Y + Rg_0, Y + Rg_1)\}$. Conversely let $EU_{NEG}(g_0, g_1)$ be the expected utility of a gamble g_0 , given the other's gamble g_1 , while choosing the opposite coin side as the other player. Thus possible outcomes are:

$(x_0, x_1) \in \{(Y - g_0, Y + Rg_1), (Y + Rg_0, Y - g_1)\}$. We will show that

$EU_{NEG}(g_0, g_1) > EU_{POS}(g_0, g_1)$ iff $\alpha > \beta$, for $\forall g_0, g_1$.

For the negatively correlated gamble there are two possible outcomes: Win-Loose and Loose-Lose. For the positively correlated gamble there are again two possible outcomes: Loose-Lose and Win-Win.

Since the utility of the positively correlated gamble depends on whether you gamble more than the other or less, we will examine both cases separately.

First we write down both expressions fully:

$$EU_{NEG}(g_0, g_1) > EU_{POS}(g_0, g_1) \quad (B.2)$$

When $g_0 < g_1$, inequality B.2 expands to:

$$\begin{aligned} & \frac{1}{2}u(Y - g_0) + \frac{1}{2}u(Y + Rg_0) + \frac{1}{2}\alpha(Rg_0 + g_1) + \frac{1}{2}\beta(-g_0 + Rg_1) > \\ & \frac{1}{2}u(Y - g_0) + \frac{1}{2}u(8 + Rg_0) + \frac{1}{2}\alpha(-g_0 + g_1) + \frac{1}{2}\beta(Rg_0 + Rg_1) \end{aligned} \quad (B.3)$$

Which readily reduces to $\alpha > \beta$.

With $g_0 > g_1$, the inequality B.2 expands to

$$\begin{aligned} & \frac{1}{2}u(Y - g_0) + \frac{1}{2}u(Y + Rg_0) + \frac{1}{2}\alpha(Rg_0 + g_1) + \frac{1}{2}\beta(-g_0 + Rg_1) > \\ & \frac{1}{2}u(Y - g_0) + \frac{1}{2}u(Y + Rg_0) + \frac{1}{2}\beta(-g_0 + g_1) + \frac{1}{2}\alpha(Rg_0 - Rg_1) \end{aligned} \quad (B.4)$$

Which again reduces to $\alpha > \beta$.

Thus the $EU_{NEG}(g_0, g_1) > EU_{POS}(g_0, g_1)$ iff $\alpha > \beta$, for $\forall g_0, g_1$.

Thus individuals with comparison-convex utility prefer negatively correlated outcomes.

Proposition 2. When utility is comparison-convex ($\alpha > \beta$), individuals prefer bigger investments in risky gambles when social comparison is possible.

Proof:

We will show that $\alpha > \beta$ implies a higher marginal expected utility for gamble size under social comparison than in isolation. We already know through Proposition 1 that $\alpha > \beta$ implies a strict preference for negatively correlated gambles. Therefore we can proceed by simply writing down expected utility for negatively correlated gambles and inspecting the first order condition.

When choosing a different coin side, expected utility is given by:

$$EU_{NEG}(g_0, g_1) = \frac{1}{2}u(Y - g_0) + \frac{1}{2}u(Y + Rg_0) + \frac{1}{2}\alpha(Rg_0 + g_1) + \frac{1}{2}\beta(-g_0 + Rg_1)$$

(B.5)

Taking the first-order-condition:

$$\frac{\partial EU_{NEG}(g_0, g_1)}{\partial g_0} = -\frac{1}{2}u'(Y - g_0) + \frac{R}{2}u'(Y + Rg_0) + \frac{1}{2}(R\alpha - \beta) \quad (B.6)$$

When utility is comparison convex ($\alpha > \beta$) then marginal utility from comparison of increasing the gamble size g_0 is positive, increasing in α , and decreasing in β .

Although also with comparison-convex utility as long as $\alpha > \frac{1}{R}\beta$ social comparison would induce bigger gambles due to the positive expected value of the gamble. Running the experiment with fair gambles however would have resulted in most subjects not investing in the lottery at all, thus rendering the choice between positively and negatively correlated gambles moot.

For positively correlated gambles the predictions of comparison utility are a bit more complicated. The same general principle applies: comparison-concavity predicts emulating behaviour and comparison-convexity predicts a preference for diversity. Since outcomes are correlated emulation and diversity can only be realized through varying the gamble size depending on the gamble size of the opponent. Specifically, the increase or decrease of marginal utility of gamble size due to social comparison depends on whether the gamble is smaller or larger than the other's gamble. When the gamble g_0 is larger than g_1 marginal utility is affected in the same manner as with negatively correlated outcomes: the optimal gamble is increasing in α and decreasing in β :

$$\frac{\partial EU_{POS}(g_0, g_1)}{\partial g_0} = -\frac{1}{2}u'(Y - g_0) + \frac{R}{2}u'(Y + Rg_0) + \frac{1}{2}(R\alpha - \beta), g_0 > g_1$$

(B.7)

For gambles smaller than the other ($g_0 < g_1$), the opposite holds: the optimal gamble is decreasing in α and increasing in β :

$$\frac{\partial EU_{NEG}(g_0, g_1)}{\partial g_0} = -\frac{1}{2}u'(Y - g_0) + \frac{R}{2}u'(Y + Rg_0) - \frac{1}{2}(\alpha - R\beta), g_0 < g_1 \quad (B.8)$$

Thus for positively correlated outcomes the optimal gamble strategy for people with comparison-concave utility is copying the other's gambling strategy. For

people with comparison-convex utility the optimal strategy lies in doing the opposite of the other: gamble a little when the other gambles a lot, and gamble a lot when the other gamble a little. This endogeneity makes it difficult to make predictions for decisions with positively correlated outcomes and social comparison.

Bault et al (2008) solved the endogeneity issue by simulating either a very risk averse (prudent) or risk-seeking (bold) opponent while the subjects thought they were facing a human subject. They indeed found more risk averse choices in the bold treatment than in the prudent treatment.

APPENDIX C: Screenshots

C1. The decision screen for the No Comparison treatment.

Period: TRIAL1 out of 1 Time Remaining: 46

Size of gamble (max E8.00): E

Your Decision:

Gamble: **E5.00**

Coin side: **HEADS**

If you win, you will earn:

$E8.00 + 1.5 \times E5.00 =$ **E15.50**

If you loose, you will earn:

$E8.00 - E5.00 =$ **E3.00**

C2. The decision screen for the comparison (C) treatment.

Period: TRIAL1 out of 1 Time Remaining: 41

Size of gamble (max E8.00): E

Your Decision:

Gamble: **E6.00**

Coin side: **TAIL**

If you win, you will earn:

$E8.00 + 1.5 \times E6.00 =$ **E17.00**

If you loose, you will earn:

$E8.00 - E6.00 =$ **E2.00**

NEIGHBOURS's Decision:

Gamble: **E7.00**

Coin side: **TAIL**

If NEIGHBOUR wins, he/she earns:

$E8.00 + 1.5 \times E7.00 =$ **E18.50**

If NEIGHBOUR loses, he/she earns:

$E8.00 - E7.00 =$ **E1.00**

C3. The outcome screen for the No Comparison treatment.

Period	Time Remaining: 1
<p>The coin landed:</p> <h1 style="text-align: center; margin-top: 20px;">HEADS</h1>	
<div style="border: 1px solid black; padding: 20px; text-align: center; margin: 10px auto; width: fit-content;"> <p>Your coin side:</p> <h2 style="margin: 0;">HEADS</h2> <hr style="border: 1px solid black; margin: 20px 0;"/> <p>Your earnings this round:</p> <h1 style="margin: 0;">E15.50</h1> </div>	
<p>How would you rate this outcome?</p> <div style="display: flex; align-items: center; justify-content: space-between;"> Extremely negative Extremely Positive </div>	
<input type="button" value="Next Round"/>	

C4. The outcome screen for the Comparison treatment.

Period	TRIAL1 out of 1	Time Remaining: 10
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The coin landed: TAILS

Your coin side:

TAILS

Your earnings this round:

E17.00

NEIGHBOUR's coin side:

TAILS

NEIGHBOUR's earnings this round:

E18.50

How would you rate this outcome?

Extremely negative
○
○
Extremely Positive

APPENDIX D: Experimental Instructions

Welcome to our experimental study of decision-making. The experiment will last about an hour and a half. The instructions for the experiment are simple, and if you follow them carefully, you can earn a considerable amount of money. The money you earn is yours to keep, and will be paid to you immediately after the experiment.

The experiment will consist of three parts. After all three parts have finished, one of them will be randomly selected for payment.

Part One of the experiment consists of twelve successive rounds. In each round you will start with an amount of E8.00. You must decide which part of this amount (between E0.00 and E8.00) you wish to bet in the following lottery:

You have a 50% chance to lose the amount you bet and a 50% chance to win one-and-a-half (1.5) times what you bet.

The lottery is executed by a coin flip (Heads or Tail). Some rounds you will be assigned a coin side, and some rounds you will be asked to submit a coin side at the beginning of the round.

At the end of every round, the computer tosses a fair coin, landing either Heads or Tail. You win in the lottery if your coin side matches the computer toss. Since there are only two sides to a coin, the chance of winning in the lottery is one-half (50%) and the chance of losing is one-half (50%).

Thus, your earnings in the lottery are determined as follows. If you have decided to put an amount of X cents in the lottery, then your earnings in the lottery for the round are equal to $E8.00 - X$ cents if the computer coin does not match your coin side (you lose the amount bet) and equal to $E8.00 + 1.5X$ cents if the computer coin matches your coin side. Your potential earnings will be shown on the screen.

Each round will last for one minute, with the remaining time shown on the screen. You can change your decision as many times as you want during the round.

[***COMPARISON TREATMENT ONLY***]

During this experiment you will be connected with the subject sitting next to you, designated your NEIGHBOUR. During the experiment your screen will show both the decision that your NEIGHBOUR is making as well as your NEIGHBOUR's outcomes. The computer coin drawn will be the same for you and your NEIGHBOUR. Thus if you both have the same coin side, you will both win or both lose. If you have a different coin side, one of you will win and the other will lose.

If Part One gets selected for payoff, one of the twelve rounds will be randomly selected for payment for both you and your NEIGHBOUR. GOOD LUCK!

Do people have Usain Bolt Preferences?

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ABSTRACT

There is a large literature suggesting that comparison with outcomes of others can affect preferences. We conducted an experiment to dissect whether this comparison centers on one's social rank with respect to others, or on the social distance from other. The Social Rank Utility (SRU) hypothesis states that individuals care about having more than other people, but do not care about how much more. The Social Distance Utility (SDU) hypothesis states that individuals do care about how much more than other's they receive, but being ahead or behind per se does not matter. We find no evidence supporting the Social Rank Utility hypothesis, but do find a significant Social Distance effect.

JEL: C91, D01, D31, D81

1. Introduction

Usain Bolt famously won the 2008 Olympic 100m sprint with remarkable ease. So much so that at the 80 meter mark he stopped racing, thrust his hands into the air and leisurely paced towards his victory. Experts thought he could have easily broken the world record had he continued exerting himself for those last couple of strides. However this seemed to matter little to Bolt, who was content just to beat the number two, by whatever distance.

Professional sprinting is not the only human endeavor where people care about who is ahead and who is behind. Indeed there is hardly any activity where at least some measure of competitiveness enters the equation, economics not excepted. Whether it comes to your colleagues salaries or office size, the size of your neighbor's house and car, or even your siblings success people tend to compare their own outcomes with others and seem to enjoy having more than others (see for example Clark et al, 2008). Therefore finding out how exactly people compare themselves with others could have important implications for optimal remuneration policy, tax policy and others.

The question we are interested in is: Do people have preferences like Usain Bolt?⁵⁵ That is, do people only care about being first or second, or does the distance between you and your competitors matter to people?

Both approaches are in fact used the theoretical literature on social preferences. Frank (1985), Robson (1992) and Hopkins and Kornienko (2004) are examples of papers deploying a rank based specification. For example in Frank (1985) utility is specified as

$$U_i = U(x_i, y_i, R(x_i)); R(x_i) = \int_{x_0}^{x_i} f(x) dx \quad (1)$$

⁵⁵ To be clear: there are many tournament-style situations where Usain Bolt-like behavior makes sense. What we are interested in in this paper is whether people have innate rank-based preferences, even in the absence of explicit tournament incentives.

Where the utility of agent x depend upon the consumption of a positional good x , the consumption of a non-positional good y , and the rank of x in the reference distribution $F(x)$. Thus in such a specification only your rank in the income distribution matters, not how far below or how far ahead you stand with respect to others.

Others like Rauscher (1993), Mui (1995) and Cooper et al (2001) let concern for relative consumption enter the model through difference with average consumption. In Rauscher's paper utility depends upon absolute consumption and status, where status is a continuous function of own consumption and average consumption:

$$U_i = u(x_i) + v(s_i); s_i = f(x_i, \frac{1}{N} \sum_j x_j) \quad (2)$$

In this specification it's not your rank in the consumption distribution that matters but how far ahead or behind your from the average level of consumption.

3. Social Difference vs Social Rank

In order to test for the existence of Social Rank Utility (SRU) we focus on two particular features of such preferences: discontinuity and rank-dependent indifference.

Social Difference Utility (SDU) predicts continuity around the reference point. Being behind by a little or ahead by little should give about the same utility. SRU however predicts a discontinuous jump. Under SRU being first is much better than being second, even if you beat the other by just a little. Thus SRU posits that social comparison has a kind of implied tournament structure: you get a big (utility) prize when finishing first and nothing when you finish second.

Rank-dependent indifference means that, as long as your rank in a group is held constant, your utility is independent of other's outcomes. Whether you are first

by a landslide by the smallest margin, your satisfaction from being first is the same.

Suppose an individual gets an outcome x_0 and compares himself to one other individual with outcome x_1 . With social preferences utility can then be specified by a two part additive utility function given by a standard (increasing, concave) own-utility function $u(x_0)$ over own outcomes and a comparison-utility function $v(x_0 - x_1)$ over the difference in outcomes:

$$U(x_0, x_1) = u(x_0) + v(x_0 - x_1) \quad (3)$$

The difference between SDU and SRU is shown in the figure below.⁵⁶ With SDU the function $v(x_0 - x_1)$ is continuous around the reference point x_1 . With SRU there is a jump in utility when you make the transition from $x_0 < x_1$ to $x_0 > x_1$. Furthermore, with SRU comparison utility is flat on either side of the reference outcome x_1 due to rank-dependent indifference.

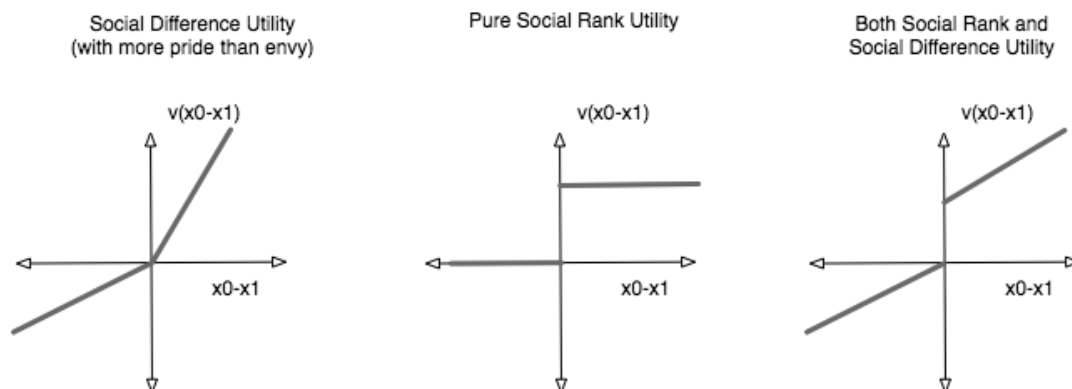


Figure 2 A representation of Social Difference Utility and Social Rank Utility. The horizontal axis represents the difference between own and reference outcome, where x_1 is the outcome of the social referent, and x_0 is own outcome. The social utility is given by a function $v(x_0 - x_1)$. SDU is continuous around the reference point $x_0 - x_1 = 0$, whereas SRU predicts a discontinuous jump.

⁵⁶ In this example the SDU function is piecewise linear and weakly convex. This is just an example, the function could also be curved and concave. The important thing is that the function is continuous around the reference point.

Our experimental setup is geared towards falsifying the two properties of SRU preferences.

4. Experimental setup.

The first paper to look into the question of whether people exhibit social rank or social difference based preferences is Rohde and Rohde (2009). Unfortunately, their setup is not geared towards falsifying the discontinuity and rank dependent flatness characteristics and the authors are unable to reject either of these specifications. In this paper we improve on their design.

In the beginning of the experiment we anonymously match each subject with another subject, the OTHER. The subjects are then asked to make a series of decisions between two options, with consequences for the payoff of both the subject itself and the OTHER.

Subjects are informed that after the experiment one of the questions will randomly be chosen, and the payoff of both themselves and the OTHER will depend on their decision for that question. This randomized payoff mechanism prevents income effects and allows us to use relatively high stakes questions (Cubitt et al, 1998).

Subjects were asked to make twenty decisions between an option A and an option B. Payoffs for self and OTHER could be different between options. Both the order of the questions and the position of the options (i.e. left or right) are randomized. Out of the twenty questions twelve were used for the experiment, and eight were filler questions in order to obfuscate somewhat the purpose of the design.

The structure of our setup is such that in every instance there is a choice between a risk-free fixed payoff A, and a risky lottery B.⁵⁷ There are three different combinations of a fixed payoff A and a risky lottery B, and we ask each combination with four different fixed payoffs for the OTHER. The four different fixed payoffs for the OTHER constitute a within-subject design. In order to distinguish between SRU and SDU we make use of two distinguishing features of

⁵⁷ The value of the lotteries and risk-free options were roughly chosen such that a person with a standard CRRA utility function with risk aversion parameter $\sigma=0.5$ would be indifferent between the two options.

SRU preferences discussed earlier: the discontinuity around the reference point and the flatness of the utility function on either side of the reference point.

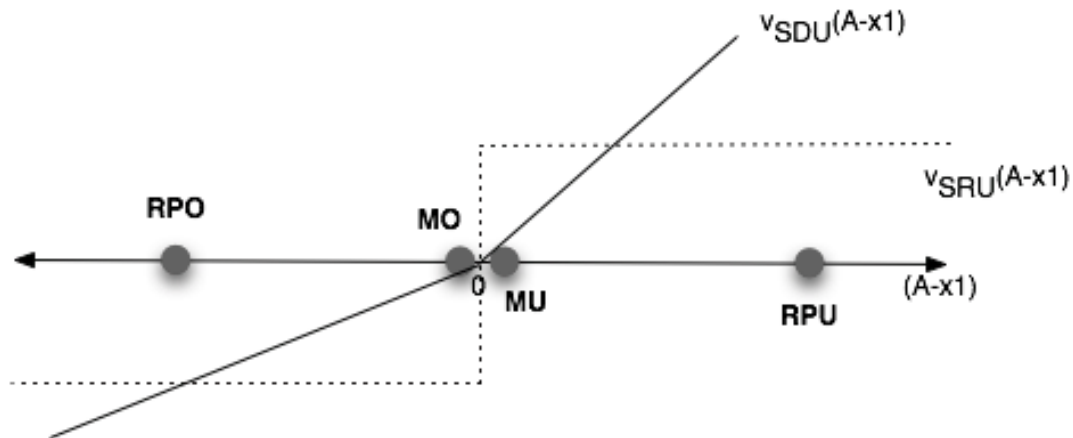


Figure 3 A graphical depiction of the different question types. The horizontal axis depicts the difference between the safe option A and the other's payoff x_1 . In the MO question the other's payoff is just above this safe option (thus $A-x_1$ is marginally negative) and in the MU question just below (thus $A-x_1$ is marginally positive). Similarly for the RPO and RPU questions. As can be gleamed from the graph, with SDU the utility obtained from choosing option A is more or less the same for both the MO and the MU questions, while for SRU there is a large jump. Similarly with SDU option A gives more utility for the RPU than for the MU question, whereas under SRU they give the same utility.

To test for the discontinuity we have a pair of reference payoffs Marginally Under (MU) and Marginally Over (MO) the fixed payoff A. In our case the margin is fifty cents. As an example question 1-4 the fixed payoff option is E5,50. Thus in the MU question the payoff for the OTHER is equal to E5,00 and in the MO question the payoff for the OTHER is equal to E6,00.

And in order to test for rank preserving indifference we have a pair of reference payoffs labeled Rank Preserving Under (RPU) and Rank Preserving Over (RPO). The RPU payoff is marginally above the lowest outcome of the lottery, and thus has the same expected rank as the MU payoff. The RPO payoff is marginally below the highest outcome of the lottery, and thus has the same expected rank as the MO payoff.

With the MU-type questions a subject will always earn more than the OTHER by selecting option A, whereas with the lottery option B she can earn either more or less than the OTHER, depending on the outcome of the lottery. With the MO-type questions a subject will always earn *less* than OTHER by selecting option A, but by choosing option B will have the same probability of earning more than OTHER as with the MU-type.

Table 1. Overview of relevant the decisions problems.

Series	Question number	Fixed Payoff A	Lottery Low	Lottery High	Win %	OTHER Payoff	Type
I	1	€5.50	€0	€20	50%	€0.50	RPU
	2	€5.50	€0	€20	50%	€5.00	MU
	3	€5.50	€0	€20	50%	€6.00	MO
	4	€5.50	€0	€20	50%	€19.50	RPO
II	5	€9.50	€5	€25	50%	€5.50	RPU
	6	€9.50	€5	€25	50%	€9.00	MU
	7	€9.50	€5	€25	50%	€10.00	MO
	8	€9.50	€5	€25	50%	€24.50	RPO
III	9	€7.50	€0	€18	66%	€0.50	RPU
	10	€7.50	€0	€18	66%	€7.00	MU
	11	€7.50	€0	€18	66%	€8.00	MO
	12	€7.50	€0	€18	66%	€17.50	RPO

5. Predictions

Prediction 1: *Subjects with SRU preferences are more likely to choose the risky lottery option B in the MO treatment than in the MU treatment.*

To test for the flatness of utility on either side of the reference point we have a Rank Preserving Under (RPU) and a Rank Preserving Over (RPO) payoff for the other. The reason they are called rank preserving is that the expected rank of both options, that is the probability of getting a higher payoff, are the same for both the MO (MU) and the RPO (RPU) questions.

Consider the first four questions with a choice between a fixed payoff of €5,50 (option A) or a lottery with a 50% chance of winning €20,- and a 50% chance of winning €0,- (option B). With the MO question the payoff for OTHER is equal to

€6,- and thus the probability of having higher payoff than OTHER is 0% for option A and 50% for option B. Now look at the RPO treatment where the OTHER will receive a payoff of €19,50. Again the probability of having a higher payoff than OTHER is 0% for option A and 50% for option B. This is what we mean when we say that the expected ranks are the same for both questions. The same reasoning goes for the MU and RPU treatments.

Since an individual with SRU preferences only cares about rank, she should not change choices between treatment MO and RPO, or between MU and RPU.

Prediction 2: *Subjects with SRU preferences should not change decisions between MO and RPO treatments and between MU and RPU treatments.*

In summary we would reject SDU when we find a significant difference between MO and MU but none between RPO and MO or RPU and MU. We would reject SRU when we find no significant difference between MO and MU, but do find differences between RPO and MO or RPU and MU.

5. Results.

On June 21, 22 and 23 2010 five experimental sessions were deployed at the Einaudi Institute for Economics and Finance (EIEF) in Rome, Italy. Subjects were recruited with emails and posters on universities in Rome, and via the website of EIEF. Over all five sessions 64 subjects showed up.

Participants were given some minutes to read the instructions, after which the experimenter went through the instructions line by line and answered any remaining questions. Subjects were paid a show-up fee of E5,- plus the outcome of one of the 20 decisions, selected at random at the end of the experiment.

Subjects were seated behind computer screens and were unable to see the screens of other participants. The experimental setup was programmed with the experimental software z-Tree (Fischbacher, 2007).

Result 1. *The propensity to choose the risky lottery option is increasing in the payoff of the OTHER.*

As can be seen in Table 3, the propensity to choose the risky lottery B is increasing in the payoff of the OTHER.⁵⁸ When the payoff of the OTHER is very low (RPU) only 40% of subject choose the lottery, whereas 57% choose the lottery when the payoff to the other is high (RPO).⁵⁹ The MU and the MO questions fall in between. A probit regression confirms this result as significant (see Appendix).

Table 3. Percentage choosing risky lottery by questions type.

Question Type	Percentage of subjects that choose risky lottery B
RPU	40%
MU	45%
MO	43%
RPO	57%

A probit regression shown in table 4 confirms this result as significant.

Table 4 Probability of Choosing Lottery increasing with OTHER's payoff.

Dependent Variable	Chose lottery B (1)	Chose Lottery B (2)	Chose Lottery B (3)
OtherFraction	0.57*** (0.10)	0.59*** (0.10)	0.59*** (0.10)
Male		0.44*** (0.17)	0.43*** (0.16)
Age			0.02* (0.01)
Pseudo R ²	0.02	0.04	0.04

*Estimated with a probit regression, with standard errors clustered on subject. Standard errors are given in parentheses. Numbers with * are significant at the 10-percent level. Numbers with ** are significant at the 5-percent level. Numbers with *** are significant at the 1-percent level. Number of observations: 832. Number of subjects: 64.*

⁵⁸ Interestingly, this goes against the results of Linde and Sonnemans (2009), who found higher risk taking in a social gain treatment (similar to our RPU) than in a social loss treatment (similar to our RPO).

⁵⁹ This difference between the RPU and RPO treatments is highly significant: Wilcoxon rank sum test: W = 28832, p-value = 0.0003.

Result 2. *Expected rank does not affect the propensity to choose the lottery option B when the differences are small.*

SRU preferences would predict a higher propensity to choose the lottery in the MO questions than in the MU questions. In fact, the fraction of subject that choose the lottery is even slightly lower in the MO (43%) than in the MU treatment (45%). This difference however is not statistically significant. (Wilcoxon test, $p=0.61$)

Result 3. *Keeping expected rank for both options constant, the propensity to choose the lottery option B is not independent of the payoff of the OTHER.*

The fraction of subjects that choose the lottery in the RPO question (57%) is higher than in the MO treatment (43%). Furthermore this difference is significant (Wilcoxon test, $p= 0.002$). The difference between the fraction of subjects that chose the lottery in the RPU questions (40%) and in the MU questions (45%) is smaller and indeed not significant (Wilcoxon rank sum test, $W= 19392$, $p= 0.30$).

7. Discussion and conclusion

In our experiment we find no evidence that subjects are motivated by a concern for rank when making a decision on risky prospects. We do find evidence that the height of other's payoffs matters, and the higher the other's payoff, the more willing people are to take risky gambles.

What this seems to point to is that there are two different pathways through which social comparison affects us. On the one hand, we use the outcomes of others as a reference to evaluate our own outcomes. As suggested by Corricelli and Rustichini (2009) emotions such as regret and envy could aid us in learning about the optimality of our own behaviour. Small differences however would provide little information.

On the other hand we strive for social recognition and we like to be seen to by others to be outdoing our peers, maybe even if by small margins. However this pathway is only relevant when others can observe our outcomes. Conducting a similar experiment where payments are rewarded in public to both subjects at the same time may yield different results.

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Appendix A Instructions

(Italian version of instructions available upon request)

This part of the experiment consists of 20 successive rounds. In each round you will have to make a choice between an option A and an option B. You will be matched with a random other subject, the OTHER. Your decision will affect both your own earning and those of the OTHER.

The options can either be sure payoffs or lotteries. In the case of a sure payoff you will receive that amount for sure. In the case of the lottery you will be shown the probability of winning a High Amount and the probability of winning a Low Amount.

If this part is chosen for payoff, then one of the rounds will be randomly selected and that round will be played out. Your payoff will depend either on your own decision or on the OTHER's decision.

Below you see an example of the choice situation you will face. Note however that this example will not be used.

The screenshot shows a choice experiment interface. At the top, it indicates 'Period 1 out of 16' and 'Remaining Time 0'. Below this, there are two columns for 'Opzione A' and 'Opzione B'. Each column lists two outcomes with their probabilities and payoffs. For Opzione A, the outcomes are: 50% chance of 7.00 and 50% chance of 14.00, and 50% chance of 2.00 and 50% chance of 21.00. For Opzione B, the outcomes are: 66% chance of 1.00 and 34% chance of 13.00, and 100% chance of 11.00. At the bottom, there are radio buttons for 'Opzione A' and 'Opzione B', with 'Opzione A' selected. An 'OK' button is in the bottom right corner.

Opzione	Probabilità	Guadagno
Opzione A	50%	7.00
	50%	14.00
	50%	2.00
	50%	21.00
Opzione B	66%	1.00
	34%	13.00
	100%	11.00

