Consumption Comparisons and Happiness: A Calibration Study*

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Abstract. Does it make us unhappier when we compare our consumption with that of the Joneses or our own past achievements? This paper tries an answer by bringing together two disparate literatures: the macro (growth) theory on habit formation and the applied literature related to the Easterlin paradox. Using the association of happiness and family income in the U.S. it calibrates a simple model of economic growth and estimates how much individual welfare (happiness) is affected by unexpected losses (e.g. following a financial crises) and gains of wealth. The results are compared with those obtained for a counterfactual economy where everything is the same besides that consumers are not comparing their achievements. Avoiding interpersonal utility comparisons, it is shown that positive and negative shocks affect welfare not markedly differently in both economies. The hypothesis that the comparing attitude as such makes people markedly unhappier is thus rejected.

Keywords: habit formation, happiness, welfare, economic growth

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1. Introduction

In evaluating our well-being we are continuously comparing our status quo with our past achievements and with others. While this fact was for some time mainly discussed among psychologists and sociologists it is by now also acknowledged and verified by many economists (see, for example, Easterlin, 1974, 2001, Oswald, 1997, Frey and Stutzer, 2002, Layard, 2004). While it is only rarely explicitly stated, one can frequently read between the lines that researchers opine that the character trait of building up reference stocks and comparing achievements is a vice rather than a virtue or, given that it is probably hard or impossible to change this behavior, a curse rather than a blessing.

For a description of the adaptation process Brickman and Campbell (1971) have created the image of the hedonic treadmill on which we all live, unable to draw perpetual happiness from the status quo. Frank (1985) has added the idea of the positional treadmill for our comparison with friends, neighbors, and colleagues, and in the vernacular the untiring endeavor to compare with others is known as "keeping up with the Joneses". In his Lionel Robbins Memorial Lectures Richard Layard (2004) states that "obviously people are happier if they are able to appreciate what they have, whatever it is and if they do not always compare themselves with others."

Yet, is this really true? If we are endowed with comparison utility a verification (or rejection) of the claim is actually not that easy because the non-comparing counterfactual is missing. Estimating the coefficients of the utility function and drawing inferences from happiness revelations does not provide any clue if we believe that utility functions are only defined up to a linear transformation so that only relative changes can be compared. How should we know how happy we were if we – and the Joneses – lived in a world where people were not comparing their consumption achievements?

In this paper I propose one method of assessing the impact of consumption comparisons on individual happiness. Using the association of happiness and family income in the U.S., I calibrate a simple model of economic growth under the assumption that we are comparing our consumption with the Joneses or, alternatively, with our own past achievements. I then calculate how the economy reacts to negative and positive shocks and calculate welfare changes using consumption equivalents according to the Lucas' (1990) methodology. Results are compared to those obtained for a counterfactual economy where everything is assumed to be the same besides that people are not comparing their consumption achievements. This means, I compare the representative individual of each economy relative to its own balanced growth situation. For example, for a negative shock, I ask how much do people suffer from a 10 percent loss of wealth when they compare their consumption with own past achievements, that of the Joneses, and when they do not compare at all.

For that purpose I use the dynamic equilibrium model of Carroll, Overland, and Weil (1997, 2000) who have introduced comparison utility as formalized by Abel (1990) into a standard Ak growth setup. The model has become a kind of benchmark for theoretical and quantitative analyses of the impact of consumer reference stocks on growth and has been developed further in several other papers, for example, Corneo and Jeanne (2001), Futagami and Shibata (1998), Grossmann (1998), Fisher and Hof (2000), Alvarez-Cuadrado et al. (2004) and Alonso-Carrera et al (2005), and Wirl et al. (2008). Alvarez-Cuadrado et al. (2004) also calculate some welfare effects. The task of the current paper, however, i.e. a systematic quantitative comparison of welfare performance under different assumptions for the utility function has not been performed before.

The next section briefly re-introduces the model of Carroll et al. and its steady-state solution. Section 3 calibrates the life-time utility function using the empirical correlation between family income and happiness in the U.S. Section 4 describes adjustment dynamics and the used method to obtain welfare effects. Section 5 investigates the effect of an unexpected wealth loss and how people cope with this event compared to a counterfactual type who does not compare consumption with past achievements or with others. Section 6 investigates the joint effect of a positive and negative shock, i.e. the ups and downs of life, on welfare, and Section 7 concludes.

2. Setup of the Model and Steady-State Solution

This section contains a brief recap of Carroll et al.'s model. Consider an economy populated by identical households (of measure one) maximizing an infinite stream of utility derived from consumption relative to a reference stock. Consumption of a household i is denoted by c_i, the corresponding stock of habits is h_i, and instantaneous utility is given by $u_i = \left[c_i^{1-\gamma}(c_i/h_i)^{\gamma}\right]^{1-\sigma}/(1-\sigma)$, where σ denotes the coefficient of relative risk aversion and

$\gamma \in (0, 1)$ measures the strength of the attitude to compare consumption. The implied intertemporal (life-time-) utility is given by

$$V(t) = \int_t^\infty \frac{(c_i/h_i^\gamma)^{1-\sigma}}{1-\sigma} \cdot \mathrm{e}^{-\theta(\tau-t)} \mathrm{d}\tau \tag{1}$$

where θ denotes the rate of pure time preference. In line with the empirical literature on risk aversion and intertemporal substitution as well as with earlier numerical discussion of this model we focus on the case of $\sigma > 1$ and $0 \leq \gamma < 1$.

Comparisons may be formed with respect to household i's own past consumption (inward-looking preferences) or with respect to consumption of others (outward-looking preferences). In the latter case the reference stock evolves according to

$$\dot{h}_i = \rho(c - h_i), \tag{2}$$

whereas the case of inward looking preferences implies the law of motion

$$\dot{h}_i = \rho(c_i - h_i). \tag{3}$$

The important difference between (2) and (3) is that there is strategic interaction between consumption and habits in the case of inward-looking preferences but not in the case of outward-looking preferences. When making their utility maximizing consumption plans, individuals with inward-looking preferences take the feedback of their consumption c_i on the evolution of their habit stock into account. Figuratively speaking, they know how their reference stock will adjust when they buy a new car. With contrast, individuals with outward-oriented preferences take consumption of others, which equals average consumption c, as given. When buying a new car they do not anticipate that the Joneses (because of symmetry) will buy a new car as well and how this will affect their reference stock.

The equation of motions (2) and (3) can also be interpreted differently, taking into account the debate about whether individuals are aware of their adjustment of habits (Clark et al., 2008). Equation (3) would then capture the case of outward oriented preferences when individuals are realizing the fact that the Joneses are just like them and will thus follow the same consumption strategy. Equation (2) would represent inward looking consumers which are not aware of the adjustment of their consumption habits.

The speed at which the reference stock adjusts to current consumption is given by ρ. The larger ρ the more important is consumption of the recent past. The speed of adaptation after a gain or loss of wealth and thus income will be the major focus of investigation in this paper. For $\rho \to \infty$ people have what could be called with reference to the Grimm Brothers' fairy tale "Hans in Luck" preferences. After a change of wealth they immediately "forget" how life was and adapt to the new situation. Thus, people equipped with the character trait of adjusting habits rapidly are coping quickly with negative events. On the other hand, they also get rapidly used to improvements vis a vis the status quo so that they derive less utility from unexpected gains in wealth.

Output is produced using capital and a linear production function such that income of household i is $y_i = Ak_i$ where k_i is capital (wealth) of household i and A is capital productivity. With depreciation rate δ the capital stock of household i evolves according to $\dot{k}_i = (A-\delta)k_i - c_i$. Carroll et al. show that the steady-state solution of the optimization problem is the same irrespective of whether habits are formed outward-looking or inward-looking and is given by

$$g_c^* \equiv \frac{\dot{c}}{c} = \frac{A-\delta-\theta}{\gamma(1-\sigma)+\sigma}, \tag{4a}$$

$$\frac{c}{h} \equiv x = 1 + \frac{1}{\rho}\left(\frac{A-\delta-\theta}{\gamma(1-\sigma)+\sigma}\right) = 1 + \frac{g_c}{\rho}, \tag{4b}$$

$$\frac{k}{h} \equiv p = \frac{1}{\rho}\left[\frac{\rho(\gamma(1-\sigma)+\sigma)+(A-\delta-\theta)}{(A-\delta)\left[(1-\sigma)\gamma+\sigma-1\right]+\theta}\right] \tag{4c}$$

where g_c^* denotes the balanced growth rate. Individual indices have been dropped since all households are identical.

3. Happiness: A Calibration Exercise

In order to relate the model to the empirical happiness literature I use in the following the expressions *intertemporal utility* and *happiness* interchangeably. Based on the rational expectations paradigm it is thus – as in every other dynamic general equilibrium model – assumed that individuals try to form correct expectations about their future streams of income and consumption and express these expectations in their statement about their current experience of intertemporal utility $V(t)$, i.e. about their current happiness.[1] Of course, individuals can make

[1] See Clark et al., 2008 and, in more detail, Stutzer and Frey (2004) for a discussion of this assumption. One could argue that there is a distinction between happiness and "life satisfaction" and that the latter is more appropriately approximating $V(t)$, see Stevenson and Wolfers, 2008. Here I adhere to the term happiness because I can then use individual (family) data for the calibration.

mistakes in assessing their utility in the event of unexpected shocks. They are also allowed to mispredict adaption (if equation (3) holds, see the discussion above).

At the steady-state consumption grows at rate at rate g_c^*, such that $c(\tau) = c(t)\mathrm{e}^{g_c^*(\tau-t)}$. Inserting this information and (4a) and (4b) in (1) and solving the utility integral yields (5).

$$V(t) = \frac{x^{\gamma(1-\sigma)}}{1-\sigma} \cdot c(t)^{\frac{(1-\gamma)(1-\sigma)}{\theta - g_c^*(1-\gamma)(1-\sigma)}}. \tag{5}$$

Using the fact that $c = (x/p) \cdot k$ and inserting (4b) and (4c) provides intertemporal utility as a function of the current capital stock per capita. Finally, substituting $y(t) = Ak(t)$ as implied by the production function we get intertemporal utility (happiness) as a unique function of current income per capita.

$$V(t) = \beta_0 \cdot y(t)^{\beta_1} \tag{6}$$

$$\beta_0 \equiv \frac{1}{1-\sigma} \cdot \left(\frac{g_c^* + \rho}{\rho}\right)^{\gamma(1-\sigma)} \cdot \frac{[(A-\delta-g_c^*)/A]^{(1-\gamma)(1-\sigma)}}{\theta - g_c^*(1-\gamma)(1-\sigma)} < 0$$

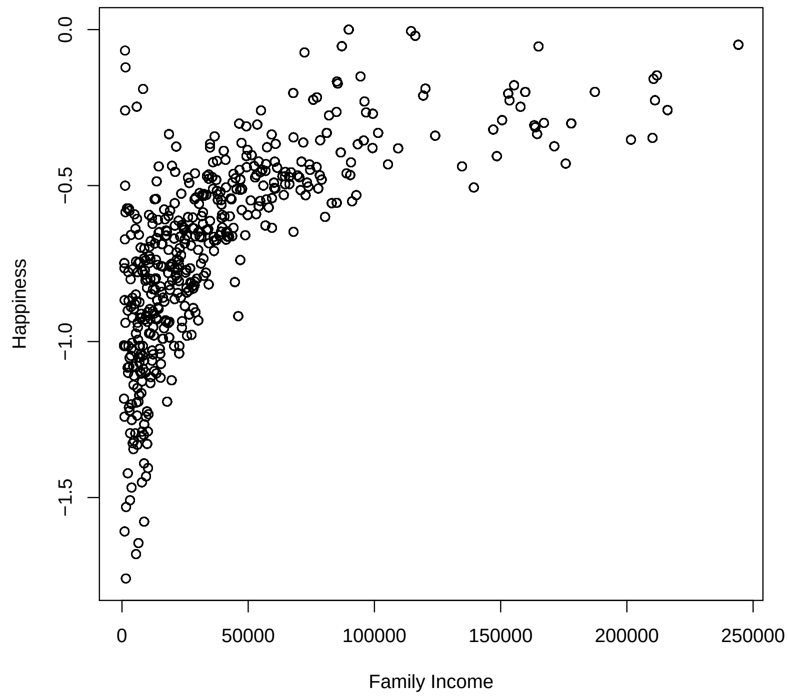
$$\beta_1 \equiv (1-\gamma)(1-\sigma) < 0.$$

Equation (6) obtains happiness as a concave function of income. While the earlier empirical literature on income and happiness focussed largely on a linear association, a concave association (of log-linear form), has recently been estimated by Deaton (2007) and Stevenson and Wolfers (2008).

In order to estimate (6) I take U.S. data on family income and happiness from 1972 through 2006 from the General Social Service (USA) as compiled by Stevenson and Wolfers (2008, described in detail on pp. 26-27). I linearly transform the happiness index such that the bliss point of maximum happiness is at zero, in line with equation (6). Figure 1 shows the transformed data. From the 45985 observations I get the non-linear least squares estimate of β_1 of -0.271 with a standard error of 0.001, indicating a rather precise estimate. The value of β_0 is not informative for the subsequent analysis because utility is defined only up to a linear transformation.

The exponent β_1 can be used to infer the intertemporal elasticity of substitution, $1/[\sigma + \gamma(1-\sigma)]$, which is estimated as $1/[1-\beta_1] = 0.78$. But, because β_1 is jointly determined by the coefficient of relative risk aversion σ and the strength of comparison utility γ, the empirical association

Figure 1: The Happiness Income Association in the U.S.



Data from the General Social Service (USA) as compiled by Stevenson and Wolfers (2008).

between income and happiness cannot be used in order to infer to what degree people are comparing their consumption with reference standards.

Another implication is that irrespective of the role of reference stocks in preference formation there is not much variation of utility when income is high. This fact has been widely ignored in the earlier happiness literature. The observation "that over the last 30 years income went up tremendously with only comparatively little improvements of happiness" is not sufficient to establish habit formation of consumer behavior, in particular, if the country under observation was already quite rich initially. Little variation in happiness could be simply a consequence of the concave nature of the utility function. In the limit, as income goes to infinity, extra happiness from income gains goes to zero irrespective of the presence and strength of the attitude to compare consumption achievements.

In order to proceed we have to identify a reasonable (σ, γ) couple. The happiness literature apparently suggests a value of γ somewhere between 0.5 and 0.7. For example, Clark et al. (2008, p. 111) conclude their discussion of the empirical happiness literature: "Together, this suggests a utility function in which two- thirds of aggregate income has no effect because it is status related". Using U.S. panel data on credit card purchases, Ravina (2007) estimates a value of γ around 0.5 in the case of inward-looking habit formation. The mean value derived from experiments by Alpizar et al. (2005) is 0.45. In their calibration Carroll et al. (2000) use 0.5 as the benchmark value. Heaton (1995) estimates a value of 0.71. Boldrin et al. (1997) find that a value of 0.58 fits best to explain the risk premium. We thus mainly focus on benchmark values $\gamma \in \{0.5, 0.7\}$ identifying the borders of a "confidence interval" for the strength of consumption comparisons.

The choice of γ together with the estimate of β_1 pins down the coefficient of relative risk aversion, $\sigma = 1 - \beta_1/(1-\gamma)$, implying $\sigma = 1.54$ for $\gamma = 0.5$ and $\sigma = 1.90$ for $\gamma = 0.7$. The implied range of values for σ is compatible with values imposed in other calibration studies as well as with recent empirical estimates (e.g. Chetty, 2006).

Concerning the speed of adaptation, Di Tella et al. (2007) estimate that $8/23 = 34\%$ of an income shock have still an impact on happiness after 4 years. Solving the back- of-the envelope calculation $\mathrm{e}^{-4\rho} = 0.34$ provides an estimate of $\rho = 0.27$. This is slightly larger than Carroll et al.'s (2000) benchmark case where $\rho = 0.2$. On the other hand Heaton (1995) and Boldrin (1997) suggest much larger values for ρ of 0.58 and 0.7, respectively. Since the assumed speed of adaptation crucially affects the results, we meet the parameter uncertainty by considering a wide range of values, $\rho \in [0.1, 1]$.

The remainder of parameters is straightforwardly specified. Following the mainstream DSGE literature I set the time preference rate θ to 0.015 and the depreciation rate δ to 0.08 and obtain factor productivity A endogenously such that the economy generates a long run growth rate of 2 percent annually in line with the long- run growth experience of the US. The implied net return on capital, $r = A - \delta$, is 4 % annually.

4. Comparing Comparison Utility: Methodology

How can we calculate whether comparing consumption with own past achievements or with that of the Joneses makes us unhappier without referring to interpersonal utility comparisons? In this section I propose one possibility. Individuals are compared to their own self with and without the experience of a wealth shock. In order to avoid case differentiation, the explanation of methodology focusses on a negative shock but, of course, it works symmetrically in case of a positive shock. In particular, we ask what is the percentage welfare loss experienced after a 10 percent loss of capital (caused, for example, by an unanticipated stock market breakdown). We then compare the result to the individual welfare loss in a counterfactual world where everything is same besides that individuals are not comparing their consumption achievements. The question then is: will the non-comparing types be more or less severely affected by the shock, i.e. are we unhappier because we are comparing our consumption achievements?

The answer to this question is not obvious. On the one hand, we expect to suffer more because we compare consumption. Income, investment and consumption decrease in line with the wealth shock and, in particular, shortly after the shock we are still used to our high pre-shock consumption habits. On the other hand, we adjust our reference stock to the new after-shock situation. If adjustment of the reference stock is fast, we are good in coping with negative events and may actually suffer less than our hypothetical selves living in an otherwise identical world where consumers are not comparing their achievements.

In order to evaluate consequences of shocks on life-time utility we have to analyze the implied adjustment dynamics. Using the quasi-control variable $x \equiv c/h$ and the quasi-state variable $p \equiv k/h$ dynamics of the economy under outward-looking preferences is given by the following two-dimensional system (see Carroll et al., 1997, for details).

$$\dot{x} = x\left[g_c - \rho(x-1)\right] \tag{7a}$$

$$\dot{p} = p\left[A - \delta - \rho(x-1)\right] - x \tag{7b}$$

$$g_c = \frac{1}{\sigma}\left[A - \delta - \theta + \rho\gamma(\sigma-1)(x-1)\right]. \tag{7c}$$

Dynamics for the inward looking case are a little more involved because people take into account how their consumption affects the evolution of the reference stock. This implies a second dynamic constraint of the optimization problem and leads to the replacement of the algebraic equation (7c) by the differential equation (7d).

$$\begin{aligned}\dot{g}_c = {} & \sigma g_c^2 + g_c(2\theta + \rho + \delta - A - 2\gamma\rho(1-\sigma)) - \rho^2\gamma(\gamma(1-\sigma)+1)x^2 + 2\gamma\rho(1-\sigma)g_c x \\ & + \frac{\rho\gamma}{\sigma}x(\rho\gamma(1-\sigma)(2\sigma-1) + \theta + \rho - \sigma(2\theta + \delta - A)) \\ & + \frac{1}{\sigma}((\rho+\theta)(\theta+\delta-A) + \rho\gamma(1-\sigma)(\rho(\gamma(1-\sigma)+1) - (2\theta + 2\rho + \delta - A))).\end{aligned} \tag{7d}$$

Adjustment dynamics are unique along the one-dimensional stable manifold towards the steady-state (again, see Carroll at al. for details).

In order to obtain adjustment dynamics quantitatively we consider the economy, calibrated as described in the last section, resting at the steady-state initially. Since the habit stock h cannot jump (unless we have "Hans in Luck preferences" and ρ is infinitely large), a 10 percent wealth shock is represented by a 10 percent shock of p. Using the method of backward integration I start arbitrary close to the steady-state (4) and integrate system (7) backwards until $p = 0.9p^*$, where $p^* = (k/h)^*$ according to (4c).[2] A second reversion of time provides the forward looking solution. The initial closeness to the steady-state determines how precisely the finite numerical model approximates the infinite time horizon. I decrease this initial value until a further decrease modifies the calculated welfare effect of the shock by less than 10^{-5}.

For the computation of welfare effects under comparison utility note that $c/h^\gamma = x^\gamma c^{1-\gamma}$ and thus intertemporal utility experienced after the wealth shock is given by

$$V_0 = \frac{c(0)^{(1-\gamma)(1-\sigma)}}{1-\sigma} \underbrace{\int_0^\infty x(t)^{\gamma(1-\sigma)} \mathrm{e}^{\int_0^t g_c(v)(1-\gamma)(1-\sigma)\mathrm{d}v} \mathrm{e}^{-\theta t} dt}_{=:v_0}$$

where $c(0)$ is the initial consumption level after the shock. The time series for $x(t)$ and $g_c(t)$ are revealed by backward integration so that the integral, for simplicity abbreviated as v_0, can be obtained numerically by a second integration (in forward direction).

Without a shock the economy remains on the balanced growth path and intertemporal utility is obtained as

$$V_s = \frac{c(s)^{(1-\gamma)(1-\sigma)}}{1-\sigma} \underbrace{\int_0^\infty x^{*\gamma(1-\sigma)} \mathrm{e}^{g_c{}^*(1-\gamma)(1-\sigma)t} \mathrm{e}^{-\theta t} dt}_{=:v_s},$$

where a star indicates a steady-state value and $c(s)$ is the (unknown) level of consumption along the steady-state at the time of the shock. Tthe value of v_s can be computed analytically.

In order to evaluate and compare happiness I employ the methodology established in Lucas (1990) and measure the change of welfare (happiness) caused by the wealth shock in consumption equivalents. I calculate the constant percentage change of consumption along the balanced growth path that equates intertemporal utility from remaining on the balanced path without

[2] The method of backward integration is particularly useful to compute welfare implications from adjustment dynamics because it approximates non-linear adjustment dynamics correctly up to a pre-specified, arbitrarily small error of discretization, see Brunner and Strulik (2002).

shock and intertemporal utility including the adjustment dynamics induced by the shock. For the counterfactual of non-comparing utility ($\gamma = 0$) this is trivially easy since there are no adjustment dynamics and c/k stays constant everywhere. A ten percent loss of capital thus causes a ten percent decrease of consumption and the consumption equivalent is ten percent.

Under comparison utility, the welfare effect of the shock, denoted by ξ, is computed as the percentage change of $c(s)$ that that solves $c(0)^{(1-\gamma)(1-\sigma)}v_0 = [(1+\xi)c(s)]^{(1-\gamma)(1-\sigma)} v_s$. Because the reference stock h cannot jump we have $c_0 = x(0) \cdot h^*$ and $c(s) = x^* \cdot h^*$ and since $x(0)$ is revealed by backward integration and x^* is obtained analytically the welfare effect of the wealth shock can be computed as

$$\xi = \frac{x(0)}{x^*} \cdot \left(\frac{v_0}{v_s}\right)^{\frac{1}{(1-\gamma)(1-\sigma)}} - 1.$$

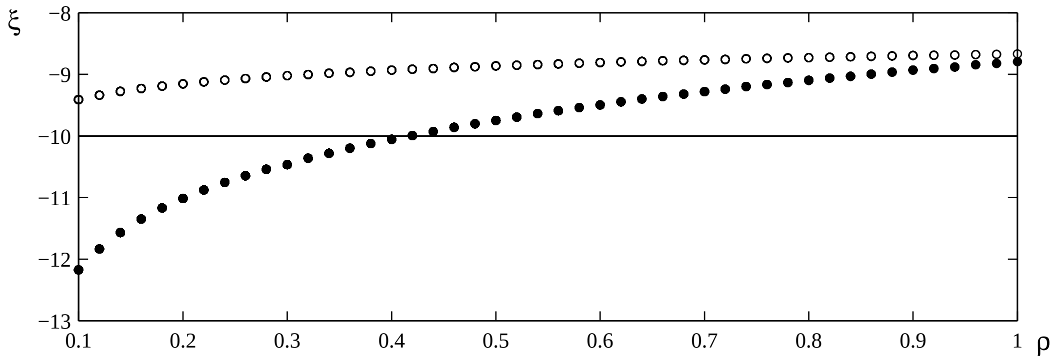
5. Coping with Unexpected Loss

The welfare loss incurred by a ten percent loss of wealth under outward-looking consumption comparison is shown in the upper panel of Figure 2. Each dot represents one calculation of loss of welfare (loss of happiness) ξ for an alternative speed of adaptation ρ and benchmark parameters as specified below Figure 2. Black dots represent the case of $\gamma = 0.7$ and white dots the case of $\gamma = 0.5$. Results are contrasted with the counterfactual welfare loss entailed if we would not compare our consumption achievements. Without consumption comparisons the Ak model displays no adjustment dynamics and a 10% percent loss of wealth translates one-to-one into a 10% percent reduction of consumption and welfare. The implied loss of happiness is indicated by the -10%-line.

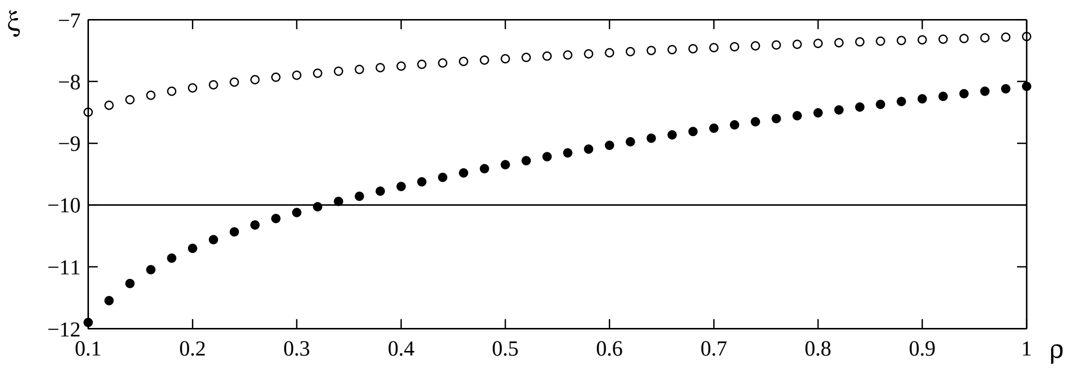
Comparison utility causes households to smooth consumption stronger than in the non-comparing, linear case. The fact that after-shock consumption falls below the reference stock built up during the good times before the shock, adds an additional motive to smooth consumption. Consequently the savings rate decrease. Response of the savings rate and the implied macroeconomic adjustment dynamics were the motivation of Carroll et al.'s (1997, 2000) articles. Here, we focus on a new phenomenon: the implications for individual happiness.

Of course, taken for itself, the fact that individuals compare consumption achievements reduces happiness. One straightforward way to see this is to take the partial derivative of $V(t)$ in (6) with respect to γ. It is through the adjustment of the reference stock that the analysis becomes interesting. Realizing that the Joneses consume less as well, households adjust their reference

Figure 2: Welfare Loss after an Un-anticipated 10 percent Loss of Wealth
Outward Looking Preferences



Inward Looking Preferences



Parameters: $\delta = 0.08$, $\theta = 0.015$, A adjusted such that equilibrium growth $g_c = 0.02$. White dots: $\gamma = 0.5$ and $\sigma = 1.54$, black dots $\gamma = 0.7$ and $\sigma = 1.90$. Straight line: standard model, no comparison of consumption with reference stock.

stocks downwards. This effect, taken for itself, causes comparing households to suffer less from the shock, reminiscent of the old saying "Here we suffer grief and pain, but over the road it's just the same".[3]

Summarizing, it is the interplay between the strength of the comparing attitude γ and the speed of adaptation ρ that determines the overall impact on individual happiness. Figure 2 reveals that when γ assumes the lower bound of its empirical support, comparing consumption with others entails for all reasonable ρ a smaller loss of happiness than a non-comparing attitude (happiness would cross the -10%–line at $\rho = 0.03$). On the other hand, when γ assumes the upper bound of its support, and ρ lies in the $[0.2, 0.5]$ range, as mainly suggested in the literature,

[3] See Lyubomirsky (2008) for a (somewhat exaggerated) journalistic statement in this sense with respect to the current recessions' impact on happiness.

then comparing consumers experience about the same loss of happiness as the counterfactual non-comparing types.

The results of the upper panel of Figure 1 also apply when individuals compare consumption with their own past achievements but are not aware of this attitude when they make their consumption plans. Yet, if consumers are aware of their comparing behavior, i.e. if they make their plans subject to the law of motion (3), they internalize the fact that their habit stock will adjust and smooth consumption even more strongly than outward-oriented (or naive inward-oriented) consumers. Consequently they experience a smaller loss of welfare from the negative shock.

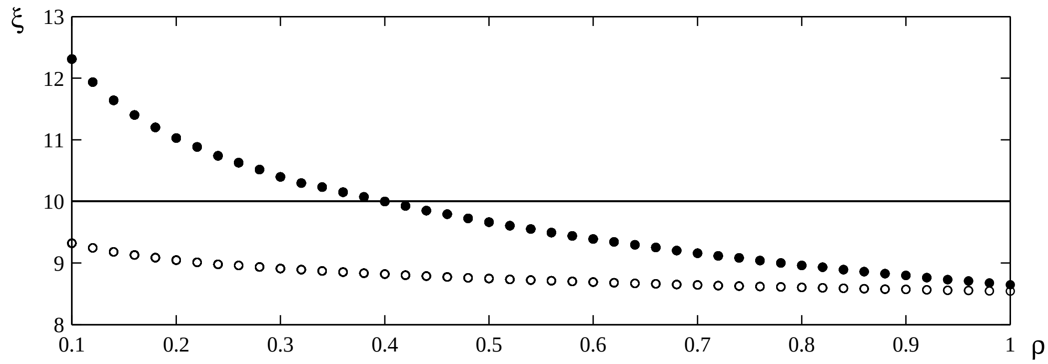
The lower panel of Figure 2 shows that the benefit from internalizing habit adjustments is visible in the happiness account but that the size of the effect is not very large. When γ is taken from its lower range of support, inward-oriented consumers experience from the 10 percent loss of wealth about an 8 percentage point reduction of welfare (compared to about 9 percent for outward-oriented consumers and 10 percent for non-comparing types). The same is true when γ is taken from its upper range of support and the reference stock adjusts quickly. For low and intermediate values of ρ there is no pronounced difference between the inward- and outward-looking case.

Sensitivity analysis has confirmed that these results are generally robust against variations of parameter values for equilibrium growth g_c and depreciation rate δ. Higher values for time preferences θ and risk aversion σ let individuals with comparison utility and small ρ's suffer somewhat more from a shock while the opposite is true for larger θ's and lower σ's. But then, if the curvature of utility is shaped as suggested by the income and happiness data, there is little scope for independent variation of σ. Summarizing, our attitude to compare with the Joneses or with own consumption achievements in the past does not increase our unhappiness after a loss of wealth. Most probably it lets us suffer a little less than we would without the comparing attitude.

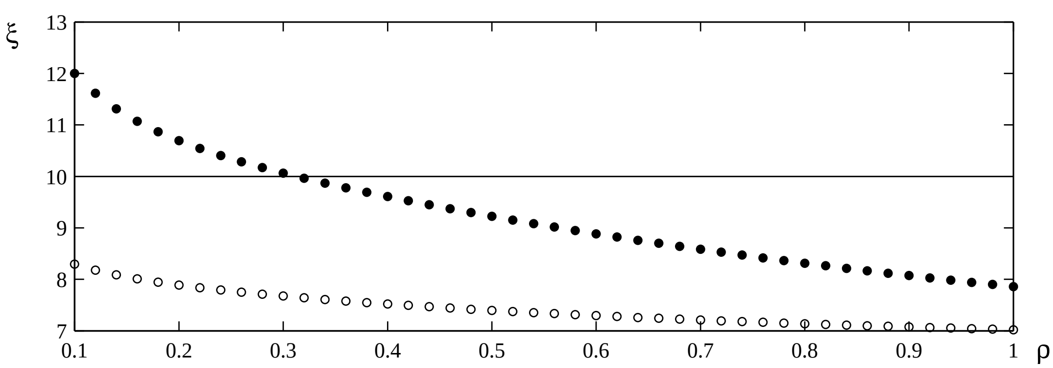
6. Dealing with Ups and Downs

During life we are not only experiencing windfall losses of wealth but, from time to time, we also enjoy windfall gains. Qualitatively, positive events generate the mirror image to the previous results from Section 5. If we adapt slowly to the new situation, our comparing attitude provides us extra happiness drawn from the unexpected boost of consumption above reference stock. On the other hand, if we adapt quickly to the increasing consumption possibilities, we suffer additionally from the fact that the temporarily higher consumption rate cannot be indefinitely sustained.

Figure 3: Welfare Gain from an Un-anticipated 10 percent Increase of Wealth
Outward-Looking Case



Inward-Looking Case



Parameters as for Figure 2. White dots: $\gamma = 0.5$ and $\sigma = 1.54$, black dots $\gamma = 0.7$ and $\sigma = 1.90$. Straight line: standard model, no comparison of consumption with reference stock.

The welfare gains from an unexpected 10 percent increase of wealth are shown in Figure 3 for benchmark parameters and outward- and inward-looking consumption comparisons. The counterfactual welfare gain of non-comparing consumers is indicated by the 10 percent line. If γ is taken from the lower bound of its support, the welfare gain (represented by white dots) is for all ρ around 8 or 9 percent, i.e. about 1 to 2 percentage points lower than for non-comparing types. If γ is taken from the upper bound of its support and ρ is in the range $[0.2, 0.5]$, as mainly suggested in the literature, comparing and non-comparing types experience about the same welfare loss.

Since our comparing attitude amplifies happiness after a positive event whenever it deteriorates happiness after a negative event, and vice versa, the question occurs to what total size amplification and deterioration add up to. We thus finally investigate how individual welfare is affected by the joint impact of positive and negative shocks of equal size. Given the simple structure of the Ak growth model, we know that the joint impact would be exactly zero if consumers were not non-comparing their consumption achievements ($\gamma = 0$).

Table 1: Joint Welfare Impact of a 10 percent Loss and Gain of Wealth

Inward Looking Preferences

	$\gamma = 0.50$	$\gamma = 0.7$	$\gamma = 0.8$
	$\sigma = 1.54$	$\sigma = 1.90$	$\sigma = 2.35$
$\rho = 0.2$	-0.24	-0.04	2.14
$\rho = 0.5$	-0.26	-0.20	1.17
$\rho = 0.8$	-0.26	-0.22	0.71

Outward Looking Preferences

	$\gamma = 0.50$	$\gamma = 0.7$	$\gamma = 0.8$
	$\sigma = 1.54$	$\sigma = 1.90$	$\sigma = 2.35$
$\rho = 0.2$	-0.22	-0.01	2.16
$\rho = 0.5$	-0.24	-0.12	1.22
$\rho = 0.8$	-0.25	-0.18	0.79

Other parameters: $\delta = 0.08$, $\theta = 0.015$, A adjusted such that equilibrium growth $g_c = 0.02$. Entries show welfare effects in percent.

Table 1 shows the aggregate impact of a positive and negative shock of equal magnitude given benchmark parameters together with some additional results. For parameters from the empirical support our attitude to compare consumption achievements lets us experience somewhat less happiness than we could without consumption comparisons. The extra losses of happiness are not completely compensated by extra gains. The main conclusion to be drawn, however, is how strikingly small the differences are in the aggregate. Given the concave curvature of the utility function the losses get larger for larger fluctuation of wealth and smaller for smaller ones. For example for the parameter couple $\{\gamma = 0.7, \rho = 0.5\}$ the aggregate impact on welfare is -0.47 percent for a twenty percent loss and gain of wealth and -0.04 percent for a 3 percent loss and gain of wealth. This means that in any case the extra welfare loss from comparing utilities is dwarfed against the size of the individual shocks as such.

With $\gamma = 0.8$ we investigate finally a case off the benchmark domain for the strength of consumption comparisons. Maintaining the curvature of the utility function supported by the data, $\gamma = 0.8$ implies that the value of the coefficient of relative risk aversion falls (mildly) outside the range that can be supported empirically (requiring $\sigma < 2$, see Chetty, 2006). We now observe a welfare gain from comparing consumption which gets particularly large if adjustment of adaptation is fast. The aggregate size of the welfare effect, however, hides the fact that these high- γ types would live a life high on adrenaline. For example, if $\rho = 0.5$, inward-oriented consumers would experience an 18.16 percent welfare increase from an unexpected 10 percent increase of wealth and suffer from 16.99 percent welfare loss after an unexpected 10 percent loss of wealth. It can be shown that these effects are further amplified if γ (and thus σ) assume even higher values. With contrast, if γ assumes a value from the lower bound of its empirical support (or even lower) comparing consumption lets us live a more balanced live, as has been shown in Figure 2 and 3: we suffer less from negative events and get less thrilled by positive ones than we would if we were not comparing our consumption achievements.

Suppose that $\gamma \in \{0.5, 0.7\}$ and that brain-surgery were available removing the attitude to compare consumption, i.e. effectively setting $\gamma = 0$ for all individuals in society. The values from Table 1 then seemingly suggests that we should spend up to 0.26 percent of permanent income to get the operation. While this value is not large (compared to, for example, the welfare gain from abolishing capital taxation, see e.g. Lucas, 1990), it is probably exaggerated if not misleading. One side effect of the operation would be that the new society is less ambitious, saves less, and thus generates less economic growth, see (4a). For $\gamma = 0.5$ and benchmark parameters, the annual growth rate would decline from 2 percent to 1.65 percent; for $\gamma = 0.7$ it would decline to 1.34 percent.[4]

7. Conclusion

Using consumption equivalents it has been shown that the fact that we compare our consumption with others or past achievements has surprisingly small consequences on how negative or positive events affect our life time utility, i.e. our happiness. So far this result has only been demonstrated for wealth shocks and comparison utility with respect to consumption (and thus income) in a simple model of economic growth. It remains to be shown whether it is robust against more complicated dynamic models including further elements that interact with consumption in generating (un-) happiness like, for example, leisure and public goods.

Probably the most salient difference of any real society of comparing consumers and the current model is that in reality initial wealth is unequally distributed and wealth shocks hit

[4] In the calibration exercise we have controlled for the growth effect by adjusting productivity A such that in any case $g_c^* = 0.02$.

individuals idiosyncratically. This way, the simple setup of a society consisting of symmetric consumers turns out to be very helpful to conclude and to derive a new hypothesis. If it is true that we and the Joneses are unhappier than we could be, then the problem originates *not* from the comparing attitude *as such*. Instead, the origin of unhappiness has to lie in the unequal distribution of initial wealth and the good and bad luck that individuals experience differently across time and space.

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