Jealousy and Equilibrium Overconsumption

Bill Dupor and Wen-Fang Liu*

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The idea that the happiness of an individual depends upon the consumption of others is widely viewed as an important feature of our shared social existence. Recent research in finance has used this idea, through consumption externalities, to explore asset pricing anomalies.1 Consumption externalities potentially break the link between Pareto optimality and competitive equilibria and open the door for beneficial government intervention (e.g. Lars Ljungqvist and Harald Uhlig 2000).

In this paper, we delineate two effects that a consumption externality may have. An increase in aggregate consumption may: (a) raise the marginal utility of individual consumption relative to leisure, and/or (b) lower an individual’s utility level. We refer to (a) as ‘keeping up with the Joneses’ (henceforth KUJ) following Jordi Galí (1994), and we refer to (b) as jealousy.2 Jealousy is a distinct concept from KUJ. Under KUJ, an individual derives greater utility from additional own consumption relative to leisure when others consume more. At the same time, higher per capita consumption holding fixed individual consumption can trigger either jealousy, so that individual utility falls, or admiration, so that individual utility rises.

In section 1 of this paper, we show that jealousy implies that the laissez faire equilibrium consumption level is greater than the optimal level. Whether or not preferences exhibit KUJ is not necessary for this main result. Intuitively, in the presence of jealousy, consumption is similar to

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*Assistant Professor of Finance, The Wharton School, University of Pennsylvania; Assistant Professor of Economics, University of Washington. The authors would like to thank Andrew Abel, Sanjay Chugh, Andrew Hanssen, Richard Kihlstrom, Lars Ljungqvist, Beatrix Paal, Richard Startz, Stephen Turnovsky and two anonymous referees for helpful comments. The first author is grateful to the Hoover Institution for its support and hospitality.

1See, for example, Andrew Abel (1990, 1999) and John Campbell and John Cochrane (1999).

2In contrast, Ljungqvist and Uhlig state that both assumptions (a) and (b) are features of Joneses preferences. Given Galí’s definitions and this paper’s results, we believe our taxonomy is useful. In Ljungqvist and Uhlig’s utility function, (a) and (b) are not disentangled because jealousy only exists in the presence of KUJ; however, in other models, such as Galí (1994), Abel (1990, 1999) and Narayana Kocherlakota (1996), jealousy and KUJ, as defined here, are not intrinsically wed.
pollution. Overpollution exists because individuals do not take into account the cost of polluting on others, not because an increase in economy-wide pollution makes the return to individual polluting higher. Similarly, overconsumption (underconsumption) exists because individuals do not take into account the negative (positive) effect of own consumption on jealous (admiring) others.\textsuperscript{3} In section 2, we consider a functional form that encompasses several existing models. We show that jealousy determines the optimal tax to correct overconsumption and that KUJ is mainly important for asset pricing.

1 Overconsumption and the Green-Eyed Monster

Preferences

Our economy consists of many consumers, each with the same utility function

\[ U(c, x, n) \]

where \( c, x \geq 0 \), \( 0 \leq n \leq 1 \) denote individual and per capita consumption and individual labor.\textsuperscript{4} Assume \( U \) is twice differentiable, \( U_1 > 0, U_3 < 0 \) for all \( c, n, x \) and \( U_1 + U_2 > 0 \) when \( c = x \). The final inequality implies that higher per capita consumption increases utility for an individual whose own consumption is the per capita level. Furthermore, we assume \( \lim_{c \to 0} U_1(c, x, n) = \infty \) for all \( x, n \). Let us define \( z \) to be the marginal rate of substitution between leisure and consumption:

\[ z(c, x, n) \equiv \frac{U_3(c, x, n)}{U_1(c, x, n)}. \]

We present four definitions. If \( U_2 < 0 \), preferences exhibit jealousy; if \( U_2 > 0 \), preferences exhibit admiration. Next, if \( \frac{dz}{dx} > 0 \), preferences exhibit keeping up with the Joneses; if \( \frac{dz}{dx} < 0 \), preferences exhibit running away from the Joneses (hereafter RAJ). As an example, Duane’s Ferrari purchase may raise the marginal utility of Joyce’s Ferrari ownership relative to leisure (KUJ)—leading Joyce to work more at fixed prices. Holding fixed Joyce’s Ferrari consumption, she may either be happy (admiring) or unhappy (jealous) about Duane’s purchase.

If there exists a representation of \( U \) which is additively separable between \((c, x)\) and \(n\), which

\textsuperscript{3}In the presence of jealousy that is not corrected by government intervention, KUJ may amplify jealousy’s distortionary effect. We explain this possibility below.

\textsuperscript{4}We follow existing research and do not include per capita leisure in (1). Robert Frank (1999) discusses why empirically consumption externalities are the more likely of the two. Sara Solnick and David Hemenway (1998), based on their survey study, conclude that relative consumption positions may be more important determinants of individuals’ welfare than relative leisure positions.
we denote $W(c, x, n)$, then $dz/dx > 0$ is equivalent to $W_{12} > 0$.

**Technology**

The consumer faces a budget constraint $c \leq f(n)$, where $f$ is the individual production function. Assume $f$ is strictly increasing, weakly concave and twice differentiable. Taking $x$ as given, the consumer maximizes $U(c, x, n)$ by choice of $c$ and $n$ subject to the budget constraint. Let $g$ be the inverse of $f$: $g(c) \equiv f^{-1}(c) = n$. We then write the consumer’s problem as maximizing $U(c, x, g(c))$ by choice of $c$. Assume

$\lim_{c \to f(1)} [U_1(c, x, g(c)) + g'(c)U_3(c, x, g(c))] < 0$ and $\lim_{c \to 0} g'(c)U_3(c, x, g(c)) > -\infty$. Also, assume $U(c, x, g(c))$ is concave in $c$.

These conditions guarantee that there exists only interior and at least one symmetric equilibrium (i.e. $x = c$). The first-order condition in a symmetric equilibrium is:

$$U_1(c, c, g(c)) + g'(c)U_3(c, c, g(c)) = 0. \quad (2)$$

Define the left-hand side of (2) to be $h(c)$.

A benevolent social planner, taking into account the consumption externality, maximizes utility $U(c, c, g(c))$ subject to the resource constraint. Assume $U(c, c, g(c))$ is strictly concave in $c$ and that similar Inada conditions as above hold. The first-order condition for the planner is

$$U_1(c, c, g(c)) + U_2(c, c, g(c)) + g'(c)U_3(c, c, g(c)) = 0. \quad (3)$$

Define the left-hand side of (3) to be $p(c)$. From the concavity of $U$, $p'(c) < 0$. Finally, let $\hat{c}$ and $c^*$ denote one of the equilibrium consumption and the optimal consumption, respectively.

**Theorem:** (i) Jealousy $U_2 < 0$ implies that consumption in any equilibrium is greater than the optimal level; (ii) If equilibrium consumption is greater than optimal consumption, then consumers are jealous within a neighborhood of the equilibrium point; that is, there exists a $K > 0$ such that $U_2(c, c, g(c)) < 0$ for all $\hat{c} - K < c < \hat{c} + K$.

**Proof** (i) Let $\hat{c}$ and $c^*$ denote one of the equilibrium consumption levels and the optimal consumption level, respectively. Our boundary conditions guarantee $\hat{c}$ and $c^*$ exist and are interior points: $h(\hat{c}) = 0, p(c^*) = 0$. Suppose preferences exhibit jealousy; then $h(c) > p(c)$ for all $c > 0$. This inequality together with $p'(c) < 0$ implies $c^* < \hat{c}$. See figure 1(i).

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5 We do not use the sign of $U_{12}$ in our KUJ definition because in a deterministic static model, the sign of $U_{12}$ may not be invariant to any positive transformation of $U$. An alternative definition of KUJ is $dc/dx > 0$. For the current model, the two definitions of KUJ are equivalent; however, the second definition can apply in a model where individuals may substitute out of consumption and into other goods, such as future consumption or consumption in other states of the world.
Figure 1: (i) jealousy implies overconsumption; (ii) overconsumption implies jealousy locally.

(ii) Suppose $c^* < \hat{c}$. By our boundary conditions, both are interior points. Since $p'(c) < 0$ for all $c$ and $p(c^*) = 0$, there must exist a $K > 0$ such that $p(c) < h(c)$ for all $\hat{c} - K < c < \hat{c} + K$. This implies $U_2(c, c, g(c)) < 0$ for all $\hat{c} - K < c < \hat{c} + K$. See figure 1(ii). QED.

The theorem establishes the relationship between jealousy and equilibrium overconsumption. There is no corresponding relationship between KUJ and equilibrium overconsumption; in the next section, we consider a functional form where either KUJ or RAJ may be consistent with overconsumption.

With the divergence of equilibrium and optimal consumption, a government tax may correct the distortion.\(^6\) Suppose production is subject to a tax. The consumer’s budget constraint becomes $c = (1 - \tau)f(n) + \nu$ where $\tau, \nu$ are the tax rate and lump-sum transfer. The government budget constraint is $\tau f(n) = \nu$.

The first-order condition for the optimization problem of an individual who faces this policy in

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\(^6\) Although using government policy for this purpose may seem novel, Frank (1999, p. 169) finds some precedent: “Christianity, Judaism and many other religions of the world embrace Sabbath norms, which enjoin practitioners to set aside a day each week for rest and worship. Such norms may be viewed as early precursors to blue laws, which mobilized the state’s enforcement powers towards similar ends. In both cases, the effect is to limit the extent to which people can trade leisure time for additional income.”
the symmetric equilibrium is
\[ U_1(c, c, g(c)) + \frac{g'(c)}{1 - \tau} U_3(c, c, g(c)) = 0. \] (4)

Comparing (3) with (4), we see the optimal tax rate sets \( \tau = -U_2/U_1 \). The optimal tax is positive (negative) under jealousy (admiration) and does not depend upon the sign of \( dz/dx \).

Next, we show how KUJ can amplify the distortion created by jealousy in absence of the optimal tax. Figure 2(i) shows \( f \), the production function, and \( I_0 \), the highest feasible social indifference curve (hereafter IC). The slope of \( I_0 \) equals \(-U_3/(U_1 + U_2)\) and the optimal consumption is \( c^* \). Whereas a social planner considers the welfare effect of \( x \), individuals do not. To see this, we plot \( I_1 \), the IC of an individual at \((n^*, c^*)\) living in an economy with \( x = c^* \). If preferences exhibit jealousy, \( I_1 \) is flatter than \( I_0 \) at the optimal allocation because \( U_2 < 0 \). The slope of \( I_1 \) is \(-z(c^*, c^*, n^*)\), the private marginal rate of substitution, at that point.

Consider how the individual with labor-consumption pair \((n^*, c^*)\) would change his consumption assuming that \( x \) remains equal to \( c^* \). With convex ICs, the individual chooses \((n_1, c_1)\)—which lies on \( I_2 \). With jealousy, \( c_1 > c^* \). Note that this point is not a symmetric equilibrium because \( c_1 \neq x = c^* \); however, the movement from \( I_0 \) to \( I_2 \) illustrates that jealousy implies overconsumption (relative to the social optimum) whether or not there exists KUJ. This is because we have not varied \( x \) (which might change the private marginal rate of substitution) in moving from \( I_0 \) to \( I_2 \).

Figure 2(ii) demonstrates the effect of KUJ on equilibrium consumption. Figure 2(ii) plots \( f \) and \( I_2 \) as in (i). As mentioned above, \((c_1, c^*, n_1)\) is not a symmetric equilibrium. What happens to the private IC if the consumer views \( x \) as \( c_1 \) instead of \( c^* \)? Recall the definition of KUJ: higher per capita consumption raises the marginal utility of own consumption relative to leisure. Under KUJ, an increase in per capita consumption from \( c^* \) to \( c_1 \) flattens the private IC even further to \( I_3 \). Now, \( I_3 \) is a symmetric allocation, but no longer privately optimal. The consumer would increase own consumption and achieve a higher feasible private IC. In response to higher per capita consumption, a KUJ individual will increase own consumption. In this model, KUJ has an amplifying effect on jealousy although jealousy is necessary to generate overconsumption. Finally, we plot the symmetric equilibrium allocation \((\hat{n}, \hat{c})\), which occurs at the tangency between \( f \) and \( I_4 \), the private IC, where \( c = x \).

What if preferences exhibited jealousy and RAJ? Figure 2(i) would be identical. The difference would arise in (ii). An increase in \( x \) from \( c^* \) to \( c_1 \) would lower the private marginal rate of substitution causing \( I_3 \) to steepen relative to \( I_2 \). Individuals would reduce own consumption in response
to a higher $x$. RAJ, therefore, dampens the effect of jealousy on equilibrium overconsumption.

2 Jealousy and Taxes; The Joneses and Asset Pricing

In this section, we consider a specific form of preferences:

$$U(c, x, n) = \frac{1}{1 - \gamma} \left\{ (c^\rho - \alpha x^\rho)^{1/\rho} \right\}^{1-\gamma} - An$$

(5)

where $\gamma, A > 0$, $-\infty < \rho \leq 1$ and $\alpha < 1$. If $\alpha > 0$ ($\alpha < 0$), preferences exhibit jealousy (admiration). If $\alpha (\gamma + \rho - 1) > 0$, preferences exhibit KUJ. If the inequality is reversed, preferences exhibit RAJ. Equation (5) nests several specifications used in existing research, including:

- Ljungqvist and Uhlig consider: $\rho = 1$, $0 < \alpha < 1$. Campbell and Cochrane (1999) consider a dynamic externality version of (5) where $\rho = 1$. When $\rho = 1$, $U_2$ has the opposite sign of $\alpha$ and $U_{12}$. Then, jealousy implies KUJ and vice versa.
- Galí considers the limit as $\rho \to 0$, which corresponds to

$$U(c, x, n) = \frac{1}{1 - \gamma} (cx^{-\alpha})^{1-\gamma} - An$$

(6)
Here, jealousy is consistent with either KUJ ($\gamma > 1$) or RAJ ($\gamma < 1$).\(^7\)

Next, assume production is linear in labor $y = n$. Consumers maximize (5) subject to: $c = (1 - \tau) n + v$, where $\tau, v$ are the tax rate and lump-sum transfer. The government budget constraint is: $\tau n = v$.

In a symmetric equilibrium, consumer maximization implies:

$$\hat{c} = \left( \frac{1 - \tau}{A (1 - \alpha)} \right)^{1/\gamma} \left( 1 - \alpha \right)^{(1 - \gamma)/(\rho \gamma)}$$

(7)

On the other hand, the difference between equilibrium and optimal consumption is

$$\hat{c} - c^* = A^{-1/\gamma} (1 - \alpha)^{(1 - \gamma)/(\rho \gamma)} \left[ \left( \frac{1 - \tau}{1 - \alpha} \right)^{1/\gamma} - 1 \right]$$

(8)

As in section 1, with $\tau = 0$, equilibrium consumption is greater than the social optimum if and only if preferences exhibit jealousy $\alpha > 0$. Likewise, $\hat{c} < c^*$ if and only if $\alpha < 0$. The sign of $U_{12}$, that is whether the economy exhibits KUJ or RAJ, has no effect on whether there is under or overconsumption in the laissez faire equilibrium. The corrective tax does not depend upon whether preferences exhibit KUJ. The optimal tax is $\tau = \alpha$. The tax is positive (negative) under jealousy (admiration) and does not depend upon the sign of $U_{12}$.

There is a direct relationship between jealousy and equilibrium overconsumption. There is no direct connection between jealousy and asset pricing. To see this, we remove endogenous labor supply and add randomness. Let the state-contingent utility function be $V(c, x)$.

Assume the endowment is random and identical across individuals. As above, $x$ is the consumption externality; however, we no longer require that $x$ equals current per capita consumption. More generally, let $x$ be any random variable (such as lagged consumption). Let $y$ be a state-contingent payoff bought before the endowment and $x$ are realized. The payoff’s ex ante price is:

$$P_y = E[V_1(c, x) y]$$

(9)

Since the pricing kernel is already the first derivative of utility with respect to individual consumption, $V_2$ does not enter the pricing formula. By inspection of (9), variations in the consumption externality $x$ influence $P_y$ only through $V_{12}$. The sign of $V_{12}$ is determined by whether consumers have KUJ preferences according to our alternative definition in footnote 5.\(^8\) Thus, KUJ influences asset prices directly through (9) and jealousy plays no direct role.

\(^7\)In this limiting case, assume that $\alpha (\gamma - 1) < \gamma$ to guarantee the existence of a symmetric equilibrium.

\(^8\)Our primary definition in section 1 relies on elastic labor supply. The definition presented in footnote 5 is applicable in this model.
3 Bibliography


