The Fragile Benefits of Endowment Destruction

John Y. Campbell* and John H. Cochrane†‡

February 18, 2015

Abstract

We show that the benefits of endowment destruction documented by Ljungqvist and Uhlig (2014), and the related point that rising consumption can lower habits, are fragile. Both issues result from one way of discretely approximating the underlying continuous time model, or of adapting it to jumps. Other ways of calculating the discrete time approximation or extending the model to jumps easily overturn the result, while making no difference to the model’s description of asset prices and quantities. The calculation does however lead to an important lesson for how to extend the model to jumps so as to avoid endowment-destruction puzzles. The affair also allows useful reflection on the use of policy predictions in evaluating the predictive value of economic models.

*Harvard University and NBER
†University of Chicago Booth School of Business, Hoover Institution, and NBER.
‡We thank Darrell Duffie, Lars Ljungqvist, Stavros Panageas, Monika Piazzesi, and Philip Protter for helpful comments and discussion.
1 Beneficial Endowment Destruction?

Lowering consumption hurts. But, if a consumer has preferences with habits, lowering consumption today can lower future habits, and potentially raise utility overall. Is habit persistence this strong in the Campbell-Cochrane (1999, 2000) model?

Suppose a Campbell-Cochrane consumer at time $t = 0$ is at the steady-state log surplus consumption ratio $s_0 = \bar{s}$. Suppose log endowment grows steadily at the rate $g$ for periods 0, 1, 2, i.e. $y_0 = -g$, $y_1 = 0$, $y_2 = g$. Suppose that the government destroys some of the time-1 endowment, so that log time-1 consumption $c_1 = \psi < 0$. Thereafter the log endowment follows the usual process

$$y_{t+1} = g + y_t + v_{t+1}, \ t > 2, v_{t+1} \sim \mathcal{N}(0, \sigma_v^2)$$

(1)

and $c_t = y_t$. We simulate this endowment process for a variety of $\psi$, and we evaluate the utility function by averaging over a large number of simulations.

The solid line in Figure 1 presents the consumer’s utility. We include $\psi > 0$, transfers from abroad or manna from heaven, as well as endowment destruction $\psi < 0$.

Near $\psi = 0$, utility rises with $\psi$. Despite habit formation, endowment destruction hurts and transfers help. However, the relationship is u-shaped so that destroying a discrete amount of the endowment raises utility. This is Ljungqvist and Uhlig’s (2014) main point.

---

**Figure 1**: Effect of endowment destruction. At time $t = 1$ an amount $\psi$ is added or subtracted to log consumption. The figure plots achieved utility as a function of $\psi$. The solid line uses a monthly time interval, and perturbs consumption at month $t = 1$ only. The dashed line uses a daily time interval, modifying consumption in a V shaped pattern for two months.

The solid line uses a monthly time interval, as we did in Campbell and Cochrane (1999). The dashed line of Figure 1 presents instead the same endowment destruction episode, with the model simulated at a daily time interval. Starting at time $t = 0$ we add (or subtract, when $\psi < 0$) $\psi/30$ from log consumption each day for 30 days, and then restore consumption the same way, producing a V-shaped daily consumption pattern that bottoms out at the same $\psi$ value on the 30th day. We
then simulate the model forward as before. (We simulate daily here too, though this makes almost no difference to the results.)

In this daily simulation, the Ljungqvist and Uhlig pattern disappears. Output destruction is always harmful, and transfers are always welcome. Still smaller time intervals lead to visually indistinguishable results.

To produce Figure (1), we simulate the monthly or daily version of (1), using \( \sigma_v = 0.015 \Delta \), where \( \Delta = \frac{1}{12} \) or \( \Delta = \frac{1}{360} \) is the simulation interval. We then recursively calculate the surplus consumption ratio,

\[
s_{t+\Delta} = (1 - \phi \Delta) \bar{s} + \phi \Delta s_t + \lambda(s_t)(c_{t+\Delta} - c_t - g \Delta);
\]

where

\[
\lambda(s) \equiv \begin{cases} 
\frac{1}{2} \sqrt{1 - 2(s - \bar{s})} - 1 & s \leq s_{\text{max}} \\
0 & s \geq s_{\text{max}}
\end{cases},
\]

\[
s_t = \log(S_t) = \log \left( \frac{C_t}{C_t} \right),
\]

\( c_t = \log(C_t) \) is log consumption, \( X_t \) is habit, \( \bar{s} = \log(0.057) \), \( \phi = 0.87 \), \( g = 0.0189 \), \( s_{\text{max}} = \bar{s} + 1/2(1 - \bar{S}^2) \) are parameters. We then evaluate the utility function

\[
U = \frac{1}{1 - \gamma} E \sum_{t=0, \Delta, 2\Delta, \ldots}^{\infty} \delta^t (C_t - X_t)^{1-\gamma} = \frac{1}{1 - \gamma} E \sum_{t} \delta^t e^{(1-\gamma)(c_t + s_t)}
\]

with \( \delta = 0.89 \), \( \gamma = 2.00 \) by averaging over simulations. This is the Campbell-Cochrane (1999) model and parameters.

Why is the daily and finer simulation so different from the monthly simulation? Examine (2) closely. During the daily simulation \( \Delta = \frac{1}{360} \), the surplus consumption ratio responds to each little bit of consumption each day, and a new \( \lambda(s_t) \) is recomputed each day. During the monthly simulation the same \( \lambda(s_0) \) applies to all the daily changes from \( t = 0 \) to \( t = \frac{1}{12} \), and the same \( \lambda(s_{1/12}) \) applies to all the daily changes from \( t = 1/12 \) to \( t = 2/12 \). A daily simulation that uses the beginning-of-the-month value of \( \lambda(s_t) \) rather than the continuously evolving one would generate Ljungqvist and Uhlig’s result.

The key is not simulation interval. The key is whether the surplus consumption ratio can adjust within the endowment-destruction period to the evolving consumption decline.

The key is not whether habits adjust. The specification (2) allows habits to change contemporaneously with changes in consumption, even with \( s_t \) predetermined in \( \lambda(s_t) \). The key is the nature of habit adjustment when \( s_t \) is held fixed for a month in \( \lambda(s_t) \), vs the nature of habit adjustment when \( s_t \) changes during the month in \( \lambda(s_t) \).

2 Continuous Time

Ljungqvist and Uhlig might respond, let the government destroy endowment for one day only, returning the next day, and the effect is restored. And we might respond, let the surplus consumption ratio respond each hour as consumption is being destroyed during the day, and the effect disappears.

These issues are best understood by writing the underlying continuous-time version of our model. The endowment follows a geometric Brownian motion

\[
dc_t = gdt + \sigma dz_t,
\]

(3)
the surplus consumption ratio responds to consumption via

\[ ds_t = (1 - \phi) (\bar{s} - s_t) \, dt + \lambda(s_t)(dc_t - gdt), \]

and expected utility is

\[ W = E \int_{t=0}^{\infty} e^{-\delta t} \left(C_t - X_t \right)^{1-\gamma} dt = E \int_{t=0}^{\infty} e^{-\delta t} e^{(1-\gamma)(c_t + s_t)} dt. \]

This diffusion model does not produce benefits of output destruction. In order to produce Ljungqvist and Uhlig’s result, one must extend the model to consider endowment jumps,

\[ dc_t = gdt + \sigma dz_t + dJ_t. \]

(For this purpose, one doesn’t really need jumps in the underlying consumption process, i.e. to specify a stochastic process for \( dJ_t \) including its frequency and distribution. What matters is that the government can induce a downward jump in consumption and its reversal, which can be completely unexpected. Asset prices care about whether agents know about the possibility of jumps, but achieved utility does not. If \( dJ_t \) is a process with nonzero mean, one should adjust the \( gdt \) drift term as usual.)

Equation (4) on its own cannot handle jumps, as it is not clear whether \( s_t \) in \( \lambda(s_t) \) refers to the right limit, the left limit, or some intermediate value. So one must generalize (4). To produce the endowment destruction result, one generalizes (4) by specifying that \( \lambda(s_{t-}) \) applies to the entire jump episode,

\[ ds_t = (1 - \phi) (\bar{s} - s_t) \, dt + \lambda(s_{t-})(dc_t - gdt), \]

where \( s_{t-} \) denotes the left-hand limit, the value of \( s_t \) just before the jump.

One then specifies a downward jump \( dc_0 = \psi < 0 \), followed immediately by an opposite upward jump; i.e. followed by an upward jump at at time \( \varepsilon \) later, and take the limit as \( \varepsilon \to 0 \). (The endowment destruction effect can appear for \( \varepsilon > 0 \), but this limit gives an elegant and simple version of the result because the \( dt \) terms drop out.)

In the downward jump, the surplus consumption ratio then changes by

\[ s_0 - s_{0-} = \lambda(s_{0-})\psi. \]

On the way back up, however,

\[ s_{\varepsilon} - s_{\varepsilon-} = \lambda(s_{\varepsilon-})(-\psi). \]

For small \( \varepsilon \), so \( s_0 = s_{\varepsilon-} \), the round trip produces a net change in the surplus consumption ratio equal to

\[ s_{\varepsilon} - s_{0-} = \left[ \lambda(s_{0-}) - \lambda(s_0) \right] \psi. \]

The slope of the \( \lambda(s) \) function (\( \lambda'(s) < 0 \)) means that the surplus consumption ratio rises at time \( \varepsilon \) by more than it declined at 0, in response to \( \psi < 0 \), producing a net rise in the surplus consumption ratio, \( s_{\varepsilon} > s_{0-} \) and thus a decline in the habit. As \( \varepsilon \to 0 \), the endowment destruction episode has less and less impact on the flow utility from consumption.

In the limit, then, an instantaneous jump-valued endowment destruction and reversal generates a downward reset of habits, or upward reset of the surplus consumption ratio, free of any direct utility cost, simply and costlessly raising future utility. This is a powerful version of Ljungqvist and Uhlig’s result.
However, suppose we produce the same decline and rise in consumption by a rapid but continuous sample path, such as a V shape, that takes place in time $\varepsilon$. Return to the diffusion model (3)-(4), and let us produce the $\psi$ decline by a linear path $z_t = 2(\psi/\varepsilon)t$, $t \in (0, \varepsilon/2)$, and a contrary linear recovery between time $\varepsilon/2$ and $\varepsilon$. As $\varepsilon \to 0$ the $dt$ terms of (4) drop out, so the surplus consumption ratios at times $\varepsilon/2$ and $\varepsilon$ solve the differential equations

$$\int_{s_0}^{s_{\varepsilon/2}} \frac{1}{\lambda(s)} ds = \int_{t=0}^{\varepsilon/2} dz_t = c_{\varepsilon/2} - c_0 = \psi$$

(9)

$$\int_{s_{\varepsilon/2}}^{s_\varepsilon} \frac{1}{\lambda(s)} ds = \int_{t=\varepsilon/2}^{\varepsilon} dz_t = c_\varepsilon - c_{\varepsilon/2} = -\psi.$$ 

(10)

But $\int_a^b 1/\lambda(s) ds = - \int_a^b 1/\lambda(s) ds$, so $s_\varepsilon = s_0$. The second differential equation (10) exactly retraces the steps of the first one (9). This continuous sample path endowment destruction operation produces no change in surplus consumption ratio at all, and thus no change in overall utility.

The difference of the two approaches is clearest to see if we unite (7), written as

$$\frac{1}{\lambda(s_0)} (s_0 - s_{0-}) = \psi.$$

with its counterpart (9), taking the $\varepsilon \to 0$ limit,

$$\int_{s_{0-}}^{s_0} \frac{1}{\lambda(s)} ds = \psi$$

In the first case, $\lambda(s_{0-})$ applies to the entire jump, while in the second case, $\lambda(s)$ adapts continuously as the jump adapts.

These are curious results. A jump in consumption produces a different result than the jump-limit of a continuous change in consumption. The consumption jump outpaces surplus-consumption-ratio adjustment, but a femtosecond continuous consumption change does not. An instantaneously reversed jump produces a change in the surplus consumption ratio, but a continuous V-shaped movement arbitrarily close to the jump produces no change at all in the surplus consumption ratio. And in any discretely-sampled data there is no way to tell the difference between a fast continuous change and a jump. (At least without functional form restrictions. Remember also that these jumps are induced by the government, not necessarily a stochastic process expected by agents.)

These results are not, however, necessary features of an extension of the habit model to jump processes. One can easily extend the specification of the surplus-consumption-ratio adjustment function (4) in a different way from the left-limit approach of (6), so that jumps in consumption produce the same surplus-consumption-ratio change as their continuous-sample-path limits produce, as follows.

Write the solutions to the differential equation

$$\int_{s_-}^{s} \frac{1}{\lambda(\xi)} d\xi = c - c_-$$

(11)

as

$$s - s_- = f(c - c_-, s_-).$$

Then, write the generalization of (11) to handle jumps, as

$$ds_t = (1 - \phi) (s - s_t) dt + f(dc_t - gdt, s_t-)$$

(12)
rather than \([4]\).

Since, by differentiating \([11]\), \(\partial f(c - c_-, s_-) / \partial c = \lambda(s_-)\), \([12]\) is the same as the original specification \([4]\) for diffusion changes, \(dc_t\) of order \(dt\) or \(dz\). We could have written the original specification \([4]\) in this form. Thus, the form \([12]\) is also a generalization of the original \([4]\) to handle jumps, not a modification of that equation. And by construction, the specification \([12]\) produces the same result for a jump \(dc_t\) as for the jump-limit of continuous sample paths.

If we generalize the model to jumps via \([12]\) rather than \([6]\), then, the results of a jump are the same as those of an arbitrarily fast continuous approximation to the jump. And instantaneous output destruction has no effect on habits, surplus consumption ratio, or utility.

The question of how to extend economic models to jumps is common. Also, the \(f\) function in \([12]\) may seem a bit mysterious. For both reasons, a more explicit example is useful. Suppose that \(s\) follows \(c\) with a simpler linear differential equation,

\[
dc_t = g dt + \sigma dz_t
\]
\[
ds_t = s_t dc_t,
\]
and again we want to add a jump process \(dJ_t\) to the forcing variable \(dc_t\). The question is, how to generalize \([14]\) in this case.

First, let’s find the jump limit of the diffusion model. The solutions to \([13]-[14]\) are

\[
s_{t+\Delta} = s_t e^{(c_{t+\Delta} - c_t) - \frac{1}{2} \sigma^2 \Delta}.
\]

Consider realizations of \(dz_t\) that generate a fixed change \(D\) in \(c_t\), i.e. \(D = c_{t+\Delta} - c_t\), and take the limit as \(\Delta \to 0\), holding \(D\) fixed. In that limit, we have

\[
s_t = s_t e^D.
\]

This is the jump-limit of the diffusion model. (In this case we have created the limit from the diffusion \(dz\) term rather than from the \(dt\) term as in \([9]-[10]\), largely to show that one can also approximate the jump this way.)

Now suppose that when \(c_t\) can have jumps, we write

\[
ds_t = s_{t_-}(e^{dc_t - g dt} - 1) \equiv f(dc_t - g dt, s_{t_-})
\]

as our generalization of \([14]\). The last equality relates this example to the notation of \([12]\). When there is a jump in \(c\), this formula produces a jump in \(s\) equal to that of the continuous-path limit. If the \(c\) jump is broken down into two half-jumps, this formula produces the same cumulative change in \(s\). When there is no jump in \(c\), if \(dc_t\) is of order \(dz\) or \(dt\), formula \([15]\) reduces to the original \([14]\). (We need second-order Ito’s lemma terms for \(e^c\) but not for \(e^{dc}\).) We could have written the original model as \([15]\). Equation \([15]\) is thus as claimed a generalization not a modification of \([14]\).

Suppose instead that we generalize \([14]\) to jumps in \(c\) with the usual left limit,

\[
ds_t = s_{t_-} dc_t.
\]

This equation also reduces to \([14]\) when there are no jumps, so it too is a valid generalization. This equation tells us directly what happens to \(ds\) in the event of a jump in \(dc\). And it gives a different answer from \([15]\) – the limit point of a jump occasions a different response from limiting continuous changes, and two half-jumps produce a different answer than a full jump.
3 Which Model is Correct?

The point is not that one or the other method of extending a model to jumps is right or wrong. The point is that there is a way {15} to extend a diffusion model to include jumps, an alternative to the method {16} of just substituting left limits for variables, so that the result of a jump is the same as the result of infinitely fast continuous movement, and that multiple small jumps have the same result as a large jump. Thus, the continuous time version of our model does not produce benefits of endowment destruction, and there is a way to extend that model to jumps which also does not produce benefits of endowment destruction.

Which extension to jumps is correct? The answer depends on the economic situation.

For example, consider models with bankruptcy constraints. Agents who can continuously adjust their investments may always avoid bankruptcy in a diffusion setting. If we extend such a model to jumps as in {15}, implicitly preserving the investor’s ability to trade as fast as asset prices change even in the jump limit, we will preserve bankruptcy avoidance in face of a jump in prices. However, if we model portfolio adjustment to jumps with the left-limit generalization as in {16}, agents may be forced into bankruptcy for price jumps.

Sometimes, one introduces jumps precisely to model a situation in which prices can in fact move faster than agents can adjust their portfolios, so agents may be forced to bankruptcy. Then the left-limit generalization is correct. But if one wants to extend a model to jumps for other reasons, but avoid bankruptcy, negative consumption, negative utility, or the apparent violations of budget constraints, then one should choose a generalization such as {15} in which the jump gives the same result as the continuous limit.

Similarly, when extending option pricing models to jumps, one may want to model the jump in such a way that investors cannot adjust portfolios fast enough. Then the left-limit extension is appropriate, and investors must hold the jump risk. But one may wish to accommodate jumps in asset prices to better fit asset price dynamics while maintaining investor’s ability to dynamically hedge. Then the nonlinear extension is appropriate, maintaining the equivalence between jumps and the limiting diffusion.

Which is the right way to generalize our habit model to jumps? In our view, the continuous-limit specification is a more sensible economic model. While asset prices may move faster than investors can trade, it is not obvious that one should modify our model so that consumption can
move faster than the surplus consumption ratio can adjust. Already, our model specifies that habits themselves move contemporaneously with consumption when consumption changes, even when the surplus consumption ratio stays constant.

In fact, this is the important lesson we draw from Ljungqvist and Uhlig's result. Like them, we regard increases in utility from habit destruction as a pathological result. The continuous-time version of this result is even more pathological: The government can make us all better off by shutting down electric power for a millisecond, resetting our habits as it makes all the clocks flash 12:00. Yes, sensible specifications of habit-persistence utility should not produce such results. Yes, therefore, write the model in continuous time and extend the model to jumps, if one wishes to do so, in a way in which jumps have the same effects as arbitrarily close continuous paths. Let the surplus consumption ratio adapt as quickly as consumption can change, as habits themselves already do.

(Though the diffusion model we set out in (3)-(2) is the right way to think about varying simulation intervals and endowment destruction possibilities in our model, a serious application to high frequency data needs to recognize that all consumption is durable at high enough frequency, as pointed out by Hindy, Huang, and Kreps (1992).)

4 Habits That Move the Wrong Way

Figure 2 presents the relationship between monthly log consumption growth and log habit. The evolution of surplus consumption ratio described by (2) or (4) is really just a means to this end, a description of how habits \( x \) adapt to consumption \( c \). The figure calculates \( s_t + \Delta \), and then unwinds the definition of \( s_t + \Delta \) to the implied habit \( x_t + \Delta \).

The solid line verifies Ljungqvist and Uhlig's second paradoxical result: Discrete increases in consumption can lead to a contemporaneous decline in habits. This result is behind their benefits of endowment destruction. It is not so much the decline in consumption pushing habits down that does the work. Rather it is the further decline in habits when consumption takes the second discrete upward jump that leads to the benefits of endowment destruction.

The dashed line in Figure 2 once again subdivides the monthly consumption change into 30 increments. This line is also visually identical for any finer time interval, and to the continuous-time result for arbitrarily fast but continuous consumption changes. We see that in this version, habit is a nondecreasing function of consumption throughout.

The negative relation between consumption and habit is thus an equal artifact of introducing jumps in such a way that the jump produces a different result from its continuous limit.

(Figure 2 presents the calculation when the surplus consumption ratio is at its steady state, which is the hardest case. The derivative \( dx_t/dc_t = 0 \) in this case, represented by the slope of the solid line where it intersects the vertical line at \( \Delta c_t = g \). For other values of the initial surplus consumption ratio, we have \( dx_t/dc_t > 0 \); the solid curve moves to the right leaving a positive derivative in the middle.)

5 Models and Predictions

One may complain that we're changing the rules. The model we wrote down (Campbell and Cochrane 1999, 2000), was specified in discrete time at a monthly frequency, and we replicate
Figure 2: The effect of log consumption growth $\Delta c_{t+1}$ on contemporaneous log habit $x_{t+1}$, when $s_t = \bar{s}$. The solid line uses a monthly time interval. The dashed line subdivides the consumption change into 30 steps. The vertical line indicates the value of consumption $c_{t+1} - c_t = g$ at which the term multiplying $\lambda(s_t)$ is zero in the surplus consumption ratio transition equation.

here Ljungqvist and Uhlig’s conclusion that discrete endowment destruction can raise utility in the models as written. In the face of unpleasant one-month endowment destruction results, we want to change things and simulate the model at a one-day horizon. Or, we want now to interpret our one month model as an approximation to an underlying continuous time model, and use that one to evaluate endowment destruction. One might argue in a lawyerly way that this is the model we published, so we must stick with it.

But this is economics not law. All models contain simplifications. One wishes for a fundamental, robust critique of a model that the critique is not easily resolved by small changes in specification or numerical approximation procedure that have no effect on the points for which the model was created. The latter is a fragile critique. Ljungqvist and Uhlig show that there is one way to calculate the effect of endowment destruction which yields pathological results. We show that there is another way to calculate the effects of endowment destruction, which preserves completely unchanged all of the calculations for which our model was designed, and which yields no pathological results. At a minimum, Ljungqvist and Uhlig’s result is demoted to “there exists” a way to generate pathological results, rather than “for all” sensible ways of making the calculation, pathological results obtain.

The main point of our model is to show that time-varying risk aversion, induced by business cycle movements, can quantitatively explain a variety of asset pricing phenomena and their correlation with business cycles. We wrote the model in discrete time and simulated it at a monthly frequency with predetermined $s_t$ and normal shocks, rather than write the model in continuous time with an explicit extension to jumps, and discretized with the proper one-step ahead solutions of stochastic differential equations, because those approximations made no difference at all to the predictions that were the focus of our paper, and they made an already long and complex paper easier to read.
For that reason, we think the lesson of Ljungqvist and Uhlig’s provocative calculation, informs the proper way to generalize our model to continuous time and jumps so it can be avoided, rather than as a fatal flaw in the general modeling strategy.

While this sounds like a full-throated defense of the micro-foundations of our model, it is not. Our model, like practically every other macroeconomic model, has, if taken literally, many predictions for the data that fail, as well as untrustworthy policy predictions, that are not so easily remedied. Whether such predictions robustly undermine a model’s main points is not so obvious.

Taken literally, the micro-foundations of our model describe an externality in consumption. Quantities are exogenous in our model, so there is no inefficiency associated with this externality. But if one were to embed our preferences in a model with any decisions – capital, labor vs. leisure, etc. – it is likely that the consumption externality would matter and strong “policy implications” could be derived. Yet, as we already showed in Campbell and Cochrane (1999, p. 245), a model with internal habits, and thus no externality, would have nearly the same predictions for prices and quantities, though completely different policy and welfare conclusions.

Furthermore, completely different microfoundations can also produce similar business-cycle variation in risk aversion. Models with leverage and strong bankruptcy costs also produce time-varying risk aversion; debt can function much as habit does in our model. Constantinides and Duffie (1996) can produce a time-varying business-cycle risk premium with idiosyncratic shocks, whose variance increases in bad times. Chan and Kogan (2002) and Gärleanu and Panaceas (2014) produce a time-varying business-cycle risk premium with heterogeneous preferences in complete markets; the high-beta rich lose more in bad times, so the representative agent is more risk averse. Guvenen (2009) points out that a model with limited participation in risky asset markets can behave like a model with habit formation, where the consumption of nonparticipants plays the role of habit. Models with non separable preferences across goods such as Piazzesi, Schneider and Tuzel’s (2007) model with housing utility can also generate the same patterns.

These models all have drastically different micro-foundations and policy implications. The mapping from micro foundations and policy implications to basic predictions is many-to-one. So if one rules out one set, while that’s informative, it is not a fatal flaw of the basic predictions.

Moreover, judging any model by its policy implications rather than fit with the data is a questionable test of the model’s validity.

Most directly, in our model one can add to the utility function any function of aggregate consumption $v(c_t)$, thereby change the welfare implications of endowment addition or destruction completely, while not changing at all the individual’s first order conditions and therefore asset pricing and quantity predictions.

Furthermore, if indeed habits are irreplaceable micro-foundations to time-varying business-cycle-related risk aversion, and if the right specification implies benefits of habit destruction benefits, is that bug or a feature? Cigarette and heroin destruction are largely thought to be beneficial. The study of rational (Becker and Murphy 1988 for example) and irrational addiction shows that temporally interdependent preferences can lead to all sorts of interesting dynamics. Several inequality pundits are already advocating steep taxation of higher incomes precisely to offset perceived externalities of conspicuous consumption by the wealthy. (Bagwell and Bernheim 1996 offer a formal model.) Ramadan, Lent, and celebrity purge diets all can be interpreted as choices of time-varying consumption paths in order to reset habits. In Ljungqvist and Uhlig’s calculations, such consumption postponement is even better than endowment destruction, and optimal policy, which they do not consider, might well be of that form. In sum, it’s not obvious that even if endowment destruc-
tion had turned out to be robustly beneficial, that one should throw out the model for making that unusual policy prescription.

A better criticism is that our model, taken literally, does not fit many aspects of the aggregate data. Most of all, it has one state variable and one shock. The data clearly have more shocks and state variables. Dividend yields and interest spreads do not move in lockstep; multiple variables forecast returns; and VAR systems predicting stock returns imply imperfectly correlated shocks to cash flows and expected returns (Campbell 1991, Campbell and Vuolteenaho 2004, Cochrane 1994, 2011). The single consumption growth shock in our habit model ties the two effects together. Our model predicts 100% $R^2$ regressions, as the surplus consumption ratio and the price-dividend ratio should be perfectly correlated.

But this situation is common throughout macroeconomics. The standard real business cycle model (Kydland and Prescott 1982, King, Plosser, and Rebelo 1988) also has one, technology, shock, thus predicting a stochastic singularity among time series, which one can reject at arbitrary $p$ values in the data. The Q theory of investment predicts an easily-rejectable 100% $R$, in the regression of investment on $Q$.

And in none of these cases do we take these failings as “fatal flaws.” Rather, the models tell good stories, and it is usually clear how to embellish the models to better fit the data.

Good economic models are, or at least start as, quantitative parables, not literal descriptions of the economy. Realistically detailed “models of everything” whose predictions and policy implications are designed be taken literally are so complex that they hide basic mechanisms, and engender little trust. The parable of the sower is not useful for its agricultural policy implications, nor do measurements of wheat yields on various kinds of terrain invalidate its message. Taking parables too literally, and too far from the points they are trying to illustrate can lead to nonsense.
6 References


Piazzesi, Monika, Martin Schneider and Selale Tuzel. 2007. “Housing, Consumption, and Asset