

Midterm Exam
Intertemporal Choice
Fall, 2024
Answers

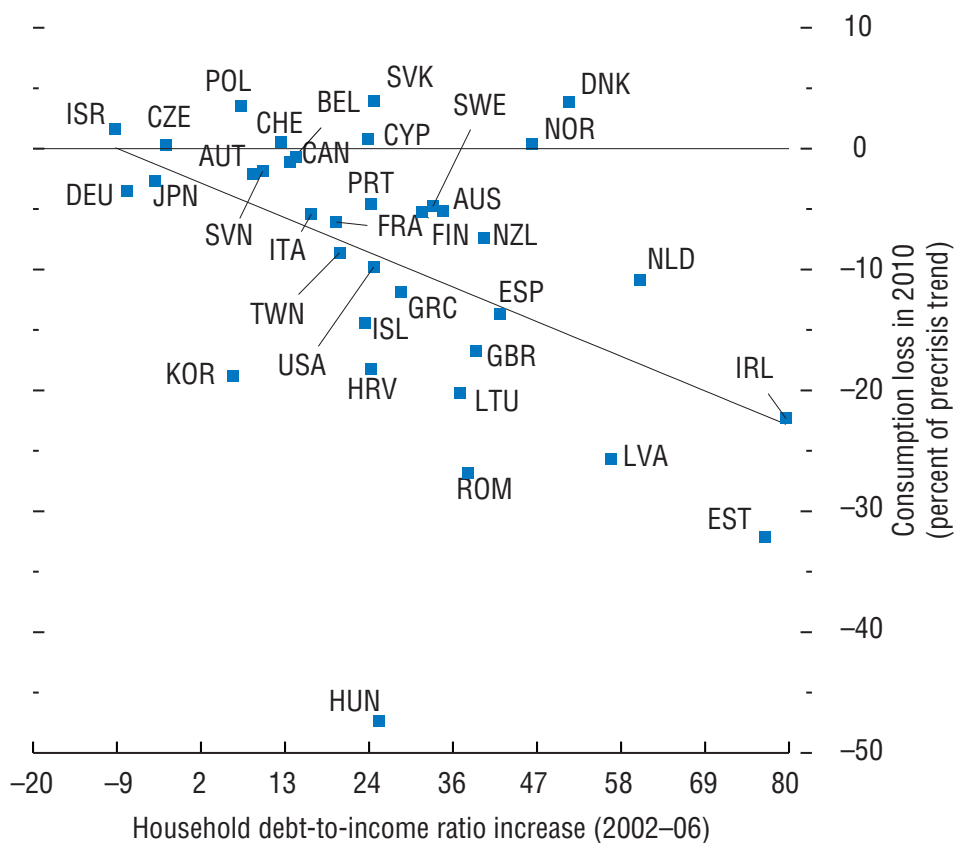
You are expected to answer all parts of all questions. If you cannot solve part of a question, *do not give up*. The exam is written so that you should be able to answer later parts even if you are stumped by earlier parts.

Write all answers on the exam itself; if you run out of room, use the back of the previous page.

Part I: Long Question

1. Buffer Stock Saving and Balance Sheets.

The Great Recession was particularly severe in economies that experienced a larger run-up in household debt prior to the crisis.



Source: IMF World Economic Outlook 2012, Chapter 3

The International Monetary Fund (2012), Mian, Rao, and Sufi (2011), and Dynan (2012) have pointed out, respectively for countries, states within the U.S., and for individual households, that those who ran up bigger debts in the period leading up to the Great Recession experienced bigger consumption drops when the Recession hit. (The figure above shows some of the IMF's evidence). This question asks you to interpret this pattern using a modified version of the tractable buffer stock model of saving, **TractableBufferStock**.

- In the modified model, rather than having their income go to zero when they become unemployed (call the period in which they become unemployed period 0), jobless persons will instead (forever) receive an unemployment

benefit proportional to the labor income $\ell_0 W_0$ they would have earned if they had remained employed in period 0. Assume that these benefits are financed by some new source of revenues that does not affect the employed consumer's budget constraint (maybe Mexico will pay for it ...)

- i. Call the beNefit $N_0 = \eta \ell_0 W_0$, where $0 < \eta < 1$ means that the consumer's unemployment/retirement benefit is positive but less than the income they earned when employed. If in any period t the consumer ends the period 'in debt' $A_t < 0$ assume that a lender who does not receive interest payments of at least $-rA_t$ in period $t + 1$ can seize any amount of the consumer's income less than or equal to jobless benefits N_{t+1} (whether the consumer is employed or unemployed). Explain why even an infinitely risk-averse private lender would, in period -1, have been willing to lend a consumer who was employed in period -1 any amount less than $\underline{H}_{-1} \equiv N_0/r$.

Answer:

The PDV of the maximum amount the lender can seize from a consumer who is unemployed in period 0 is

$$\begin{aligned}
 \mathbb{P}(N_0) &= N_0 + N_0/R + N_0/R^2 + \dots \\
 &= N_0(1 + R^{-1} + R^{-2} + \dots) \\
 &= N_0 \left(\frac{R}{R-1} \right) \\
 &= N_0(R/r),
 \end{aligned}$$

and this amount is perfectly secure so even an infinitely risk-averse lender will be willing to lend up to this amount. But if the consumer ends period -1 with some debt such that $A_{-1} > N_0/r$ then the dynamic budget constraint says that the consumer will arrive in period 0 with $B_0 = A_{-1}R > R(N_0/r)$ which means that they will owe less than the maximum amount that the lender has the right to seize.

Another way to see this is to realize that the lender will want to guarantee that

$$rA_t \leq N_0 \tag{1}$$

$$A_t \leq N_0/r \tag{2}$$

if A_t is the amount with which an employed consumer ends period $t = -1$ because this condition guarantees that the consumer can pay the interest that is owed on the loan in perpetuity.

- ii. Explain the role of the 'return impatience' condition $(R\beta)^{1/\rho}/R < 1$ in guaranteeing that the solution to the unemployed consumer's problem

makes sense, in that a consumer who has ended employment with

$$A_{-1} > -\underline{H}_{-1} \equiv -N_0/r \quad (3)$$

will have strictly positive consumption throughout their unemployed life.

Answer:

Total consumption in the first period of unemployment will be

$$C_0 = (B_0 + \mathbb{P}(N_0))\kappa, \quad (4)$$

where $(B_0 + \mathbb{P}(N_0)) > 0$ is guaranteed by $A_{-1} > -\underline{H}_{-1}$.

An approximate form of the marginal propensity to consume is

$$\kappa \approx r - \rho^{-1}(r - \vartheta) \quad (5)$$

and the role of the Return Impatience Condition (RIC) $(R\beta)^{1/\rho}/R < 1$ is that it guarantees that this is also a positive finite number. Thus, C_0 is positive and finite. Thereafter, consumption grows by factor $(R\beta)^{1/\rho}$ forever, so consumption always remains a positive finite number.

- iii. Explain why the existence of this unemployment insurance system is equivalent (in its implications for the path of consumption) to a system in which newly unemployed consumers receive a lump sum payment of $N_0(R/r)$ upon entering their first period of unemployment.

Answer:

In a perfect foresight model with well functioning capital markets, all that matters for the household's level of consumption is the intertemporal budget constraint. The IBC is the same for a consumer who will receive a stream of payments with perfect certainty, or for a consumer who receives instead the PDV of that stream of payments.

For fuller treatment, see **PerfForesightCRRA**.

- iv. Call the equivalent lump sum $\varsigma \ell W$, and suppose that for an employed consumer, labor income grows by factor Γ from year to year. Defining lower-case variables as the upper-case versions divided by ℓW , explain why $\underline{h}_{-1} = \varsigma = \eta\Gamma/r$.

Answer:

$$\underline{h}_{-1} = \underline{H}_{-1}/\ell_{-1}W_{-1} \quad (6)$$

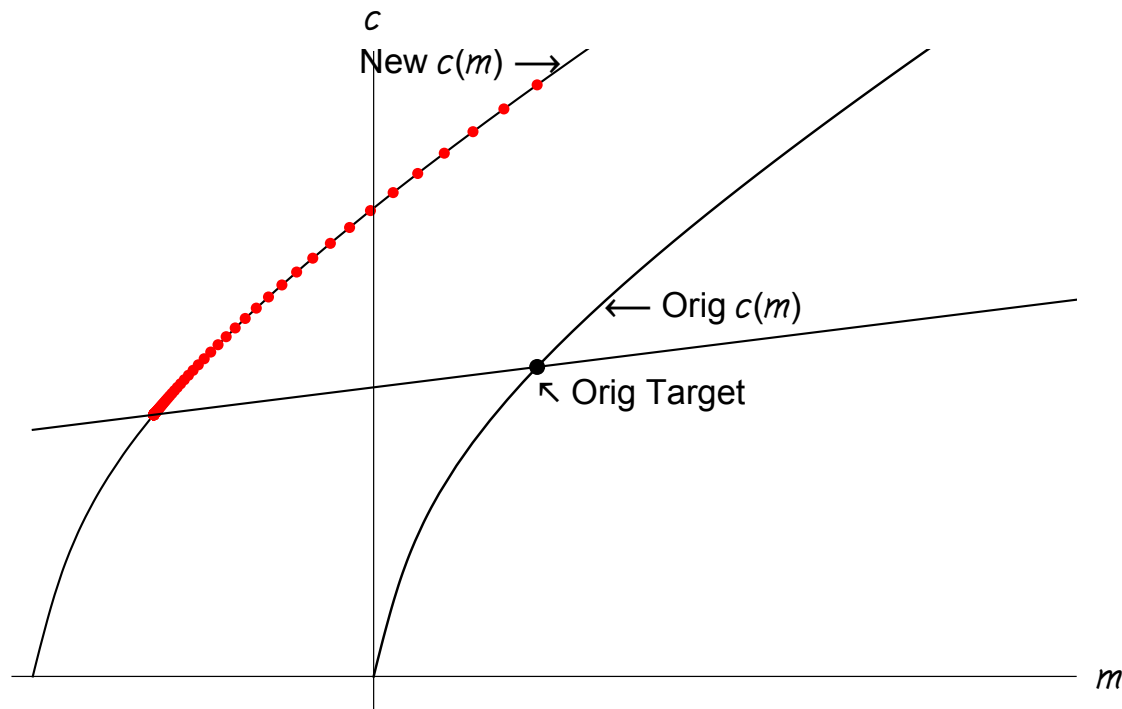
$$= (N_0/r)/\ell_{-1}W_{-1} \quad (7)$$

$$= (\eta\ell_0W_0/r)/\ell_{-1}W_{-1} \quad (8)$$

$$= \eta\Gamma/r. \quad (9)$$

- v. Explain why the effect of the introduction of such a system is simply to shift the consumption function in the phase diagram to the left by the amount $\underline{h} = \eta/r$. Draw an example of such a leftward shift that is large enough so that the target ratio of bank balances b is negative (so that in steady state the consumer will be in debt).

Answer:



shows such a shift, which occurs because the availability of the future benefits relaxes the ‘natural borrowing constraint’ of the consumer (the maximum amount that the consumer would voluntarily choose to borrow). The natural borrowing constraint causes the consumption function to intersect the horizontal axis at $-\underline{h}$ because a consumer with $b > -\underline{h}$ can guarantee that his consumption will be positive forever, but a consumer with $b \leq -\underline{h}$ cannot guarantee positive future consumption.

- vi. Explain why an expansion of unemployment benefits corresponds to a relaxation of a ‘natural borrowing constraint.’

Answer:

The ‘natural borrowing constraint’ defines an upper bound on the amount that the consumer will ever *wish* to borrow (subject to the constraint that the consumer must satisfy his intertemporal budget constraint with certainty). The consumer is impatient (by assumption) and so if the benefits available to be borrowed against rise, the consumer desires to take advantage of the increased borrowing capacity that lenders know now exists because of the increased resources the consumer will have in retirement. The expansion of unemployment benefits therefore gives the consumer a greater ‘natural’ borrowing capacity.

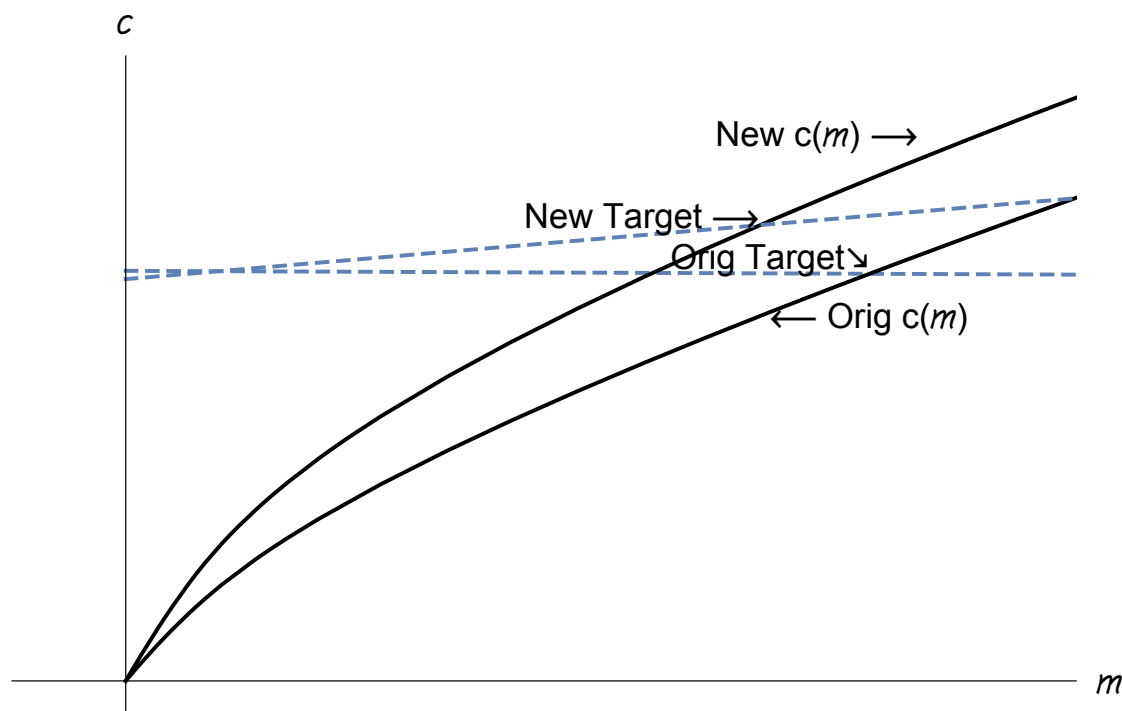
- b) Using the model, for each of the experiments below, show how the phase diagram changes, and show the path of the personal saving rate of debtors leading up to, during, and after the experiment.

Experiments:

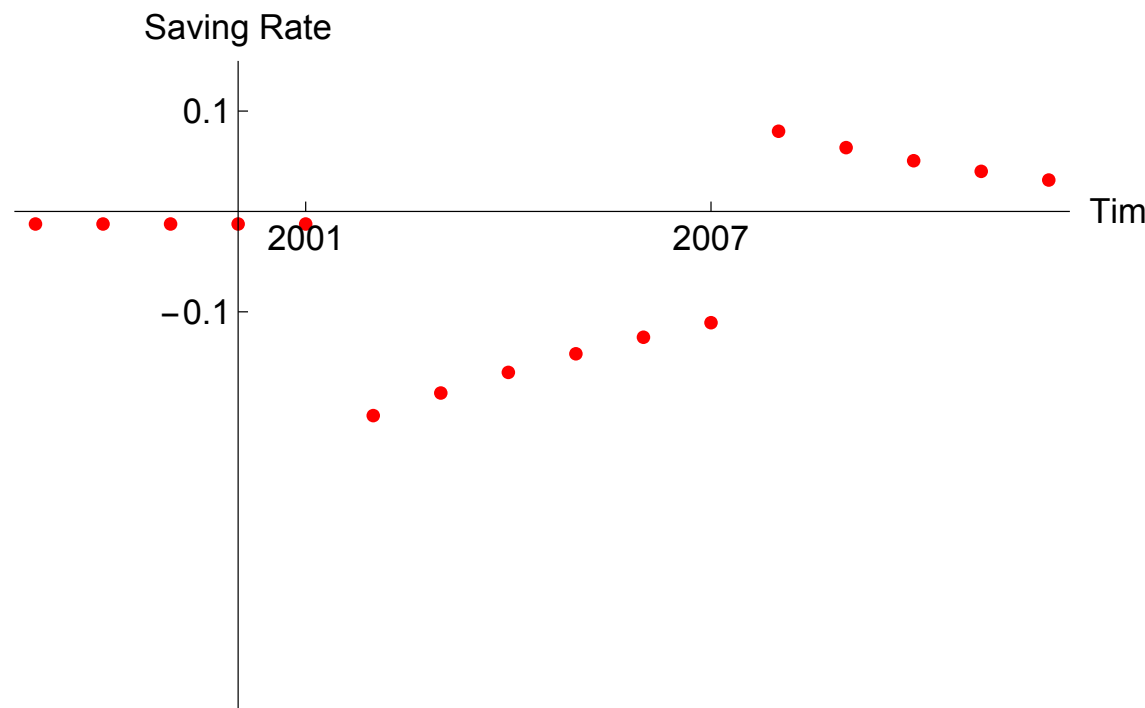
- i. Suddenly and without warning, consumers become more optimistic about the probability becoming unemployed: They believe there has been a permanent improvement in the functioning of the labor market so that the probability of unemployment \mathcal{U} will be lower forever. This period of optimism lasts for six years, and then suddenly reverses itself (unemployment expectations revert to their previous value).

Answer:

This change reduces the intensity of the precautionary saving motive. The effect of such a reduction is to twist the consumption function counterclockwise, and to reduce the target level of wealth. Because the slope of the $\Delta m = 0$ locus is determined by the growth rate and the growth rate changes in order to keep human wealth constant, the target does not decline as much as it would have because of the upward rotation of the $\Delta m = 0$ locus. But for the parameter values considered in class, the result of a reduction in unemployment risk is a decrease in target wealth and saving.



The saving rate drops sharply upon the reduction in unemployment risk, and gradually rises as the consumer's wealth gets drawn down.



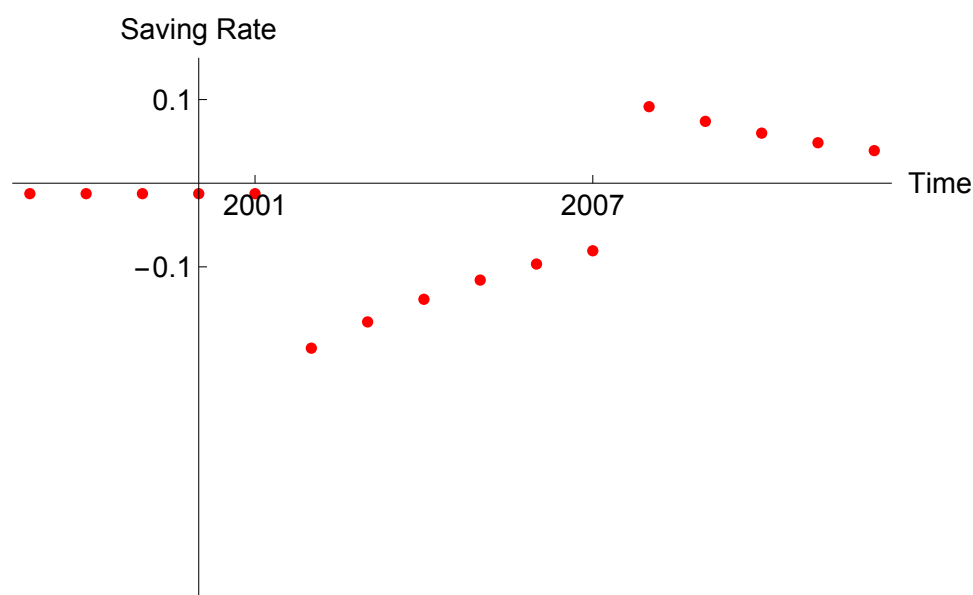
- ii. Suddenly and without warning, consumers become more optimistic about future income growth: They believe there has been a permanent improve-

ment in Γ . This period of optimism lasts for six years, and then suddenly reverses itself (growth expectations revert to their previous value).

Answer:

The increase in the growth rate effectively makes the consumers more impatient, causing a counterclockwise rotation of the consumption function in a manner similar to that caused by a decrease in unemployment risk.

The path of the saving rate is given in red in the figure.

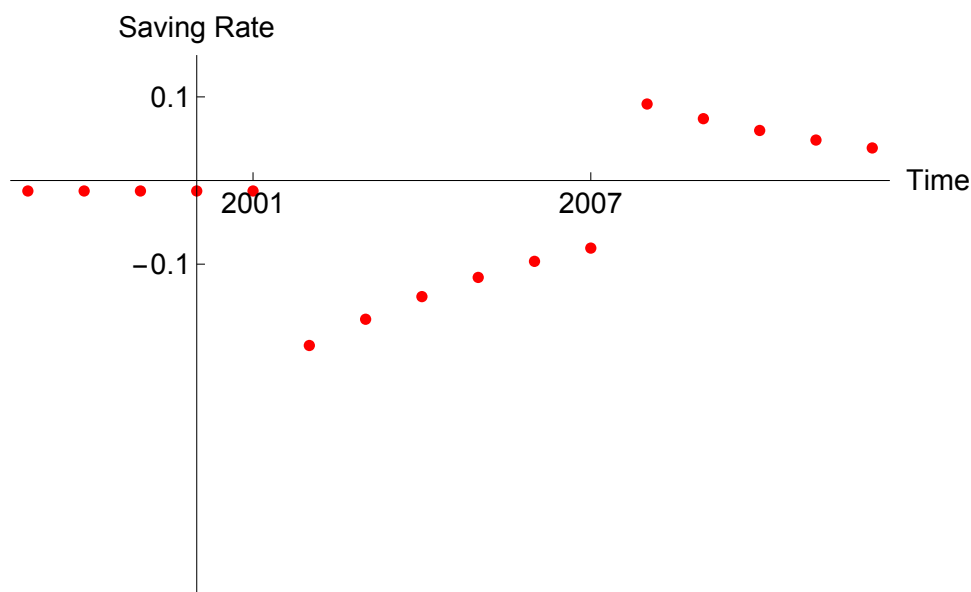


- iii. Suddenly and without warning, the government announces a permanent increase in the generosity of the unemployment insurance system (specifically: η goes from $\underline{\eta}$ before period t to $\bar{\eta} > \underline{\eta}$ in period t). Everyone believes this change is permanent. For six years, the change in the program persists. Then, without warning, the government reduces the generosity of the unemployment system back to its original level (η goes back down to $\underline{\eta}$).

Answer:

The expansion in UI generosity shifts the phase diagram further to the left, as in the figure you were asked to draw for the introduction of the UI system above.

The path of the saving rate is similar to the path for the previous experiment.



- c) For each of your answers to the prior question, provide an interpretation of the pattern described above: “those who ran up bigger debts in the period leading up to the Great Recession experienced bigger consumption drops when the Recession hit”

Answer:

The answers should be along the following lines:

For experiment (a) the story would be that in the period leading up to the Great Recession, consumers became optimistic that unemployment was going to be permanently low. This reduced their precautionary saving motive and caused them to run up debt.

For experiment (b) the story would be that in the period leading up to the Great Recession, consumers became optimistic that income growth would be permanently faster. This increased their (perceived) human wealth, so they borrowed more.

For experiment (c) the story would be that the increase in the generosity of the UI system meant that consumers needed to do less precautionary saving. When the generosity reversed, they had to cut back severely.

Part II: Short Question

1. **Small Open Economy Models of A Shock to Capital.** In the spring of 2011, Japan was hit by a terrible earthquake, tsunami, and resulting nuclear accident that destroyed a substantial amount of capital. This question asks what effect different models might lead you to expect for consumption spending in response to this disaster. Assume that before the shock, Japan was at its steady-state level of the capital/output ratio, and that the shock is perceived as a one-time destruction of a fixed amount of aggregate capital. Describe the dynamics of consumption per capita under the following models:

- a) A Diamond 2-Period OLG model

Answer:

Consumption drops discretely at the time of the shock, then gradually increases over time back toward its original value

- b) A Hall Random Walk model

Answer:

Consumption drops discretely at the time of the shock, and then permanently remains at the lower level forever

- c) A model with habit formation in aggregate consumption

Answer:

Consumption drops a bit in the first period and gradually subsides toward a lower steady-state level

- d) A model where the reason aggregate consumption is normally sluggish is ‘sticky information’ (hint: you do not need to assume that information is *always* equally sticky in every period)

Answer:

Taking the hint, recall that the idea of this model is that people *usually, on average* do not quickly notice macroeconomic events that will ultimately affect their consumption. But it is hard to imagine that there are any Japanese people who have not noticed the earthquake, tsunami, and nuclear calamity. So the spirit of this model would lead you to expect that consumption in this instance will behave as it would in the rational Hall model: An immediate permanent downward drop.

References

- DYNAN, KAREN E. (2012): “Is Household Debt Overhang Holding Back Consumption?,” *Brookings Papers on Economic Activity*.
- INTERNATIONAL MONETARY FUND (2012): *World Economic Outlook, 2012* chap. 3. International Monetary Fund, Available at <http://www.imf.org/external/pubs/ft/weo/2012/01/pdf/text.pdf>.
- MIAN, ATIF, KAMALESH RAO, AND AMIR SUFI (2011): “Household Balance Sheets, Consumption, and the Economic Slump,” *Manuscript, University of California at Berkeley*.