Department of Economics University of Maryland

Economics 325
Intermediate Macroeconomic Analysis
Practice Problem Set 4
Professor Sanjay Chugh
Spring 2009

1. **Infrequent Stock Transactions.** Consider a representative consumer at time t seeking to maximize the sum of discounted lifetime utility from t on,
$$\sum_{s=0}^{\infty}\beta^s u(c_{t+s})$$
subject to the infinite sequence of flow budget constraints
$$P_t c_t + S_t a_t = S_t a_{t-2} + D_t a_{t-2} + Y_t \,,$$
where the notation is as in class: a_t is holdings of a real asset (a "stock") at the end of period t, S_t is its nominal price in t, D_t is the nominal dividend that each units of assets carried into t **from period t-2** pays out, Y_t is nominal income in t, c_t is consumption in t, and P_t is the nominal price of each unit of consumption in t. Note well how the budget constraint is written: it is assets accumulated in period t-2 that pay off in period t – thus, in this model, stocks (for some reason…) must be held for two periods, rather than being able to be traded every period. Construct the Lagrangian to compute the stock price S_t in period t. Explain intuitively how and why the stock price differs from that in the model studied in class, in which all shares can be traded every period.

2. **House Prices.** With all the talk in the news the past few years of soaring and then crashing house prices, let's see how our simple multi-period model can be used to think of how house prices are determined. Suppose the instantaneous utility function is $u(c_t, h_t)$, where c_t as usual stands for consumption in period t, and now h_t stands for the level of housing services an individual enjoys in period t (i.e., the "quantity" of house an individual owns). Denote by H_t the nominal price of a house in period t. The quantity of house owned at the beginning of period t is h_{t-1}, and the quantity of house owned at the end of period t is h_t, and assume that the quantity of house can be changed every period (think of this loosely as making additions, repairs, etc to your house on a regular basis). Thus, we can write the flow budget constraint in period t as $P_t c_t + H_t h_t = H_t h_{t-1} + Y_t$, where Y_t is nominal income over which the consumer has no control. Note for simplicity we have omitted other assets from the model, houses are the only assets in this model. Solve for the nominal price of a house in period t, H_t. Discuss qualitatively why the marginal rate of substitution between housing services and consumption appears in the pricing equation. How is the setup of this asset-

pricing model different from the setup of our “stock-pricing” model in class? How is it the same?

3. **Habit Persistence in Consumption.** An increasingly common utility function used in macroeconomic applications is one in which period-t utility depends not only on period-t consumption but also on consumption in periods earlier than period t. This idea is known as “habit persistence,” which is meant to indicate that consumers become “habituated” to previous levels of consumption. To simplify things, let’s suppose only period-(t-1) consumption enters the period-t utility function. Thus, we can write the instantaneous utility function as $u(c_t, c_{t-1})$. When a consumer arrives in period t, c_{t-1} of course cannot be changed (because it happened in the past).
   a. In a model in which stocks (modeled in the way we introduced them in class) can be traded every period, how is the pricing equation for S_t (the nominal stock price) altered due to the assumption of habit persistence? Consumption in which periods affects the period-t stock price under habit persistence? To answer this, derive the pricing equation using a Lagrangian and compare its properties to the standard model’s pricing equation developed in class. Without habit persistence (i.e., our baseline model in class), consumption in which periods affects the stock price in period t?
   b. Based on your solution in part a and the pattern you notice there, if the instantaneous utility function were $u(c_t, c_{t-1}, c_{t-2})$ (that is, two lags of consumption appear, meaning that period t utility depends on consumption in periods t, t-1, and t-2), consumption in which periods would affect the period-t stock price? No need to derive the result very formally here, just draw an analogy with what you found above.