Name _____

Midterm Exam

Intertemporal Choice

Fall, 2021

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: Short Questions

1. A recent literature stimulated by Bloom (2009) has argued that shocks to aggregate and idiosyncratic uncertainty are a major source of business cycle fluctuations. Explain, using both math and words, why this argument cannot be investigated using a model in which a representative consumer with quadratic utility makes optimal consumption choices.

2. **CARA Utility and Impatience Over Infinite Horizons**. For a consumer with Constant Absolute Risk Aversion utility,

$$\mathrm{u}(c) = -\alpha^{-1} e^{-\alpha c} \tag{1}$$

calculate the expected change in consumption if $\mathsf{R}\beta$ is not equal to 1. Discuss why the long-run implications of this result are disturbing for consumers for whom $\mathsf{R}\beta < 1$ in an infinite-horizon framework. (Hint: Where will consumption go?)

3. **Dynamic Inefficiency and Japan's Woes.**

   Define dynamic inefficiency and explain why a plausible way of thinking about Japan's economic problems after 1990 is to argue that Japan's economy has been dynamically inefficient. Explain why the fact that Japan's capital/output ratio is not much higher than the U.S. capital/output ratio presents a challenge to the dynamic inefficiency interpretation of Japan's problems, and discuss how the question of dynamic inefficiency is connected not just to the level of aggregate capital but also to the efficiency with which financial markets allocate capital to productive uses.

4. Consider a Diamond OLG model in which the economy has reached the steady state equilibrium with a constant level of population. Suppose that suddenly in period t there is a permanent increase in the level of population (perhaps as a result of a one-time inflow of immigrants). Show the dynamics of k in the model, and explain whether the surprise increase in the population of workers is good or bad for the old people in period t in this economy, and why.

Part II: Medium Question

Social Security and Dynamic Inefficiency. Consumers born in period t in a small open economy solve the problem

$$\begin{aligned} \max_{\{c_{1,t}\}} \quad & \log c_{1,t} + \beta \log c_{2,t+1} \\ \text{s.t.} \quad & \\ y_{1,t} &= \mathsf{W}_t - z_{1,t} \\ c_{2,t+1} &= \mathsf{R}_{t+1}(y_{1,t} - c_{1,t}) - z_{2,t+1} \end{aligned}$$

where a consumer supplies 1 unit of labor when young earning wage rate W_t and $z_{1,t}$ reflects lump-sum taxes. Interest rates are set by global capital markets exogenously and fixed at $\mathsf{R}_t = \bar{\mathsf{R}} \; \forall \; t$, and wages are constant at $\mathsf{W}_t = \bar{\mathsf{W}}$. A Social Security system is run using a strictly "Pay As You Go" system: Benefits paid to the elderly (generation 2) in any period $t + n$ must be raised by taxation on the young generation in that period (generation 1):

$$Z_{2,t+n} = -Z_{1,t+n} \tag{2}$$

where upper-case variables reflect the total amounts paid and received by all persons of a given generation: $Z_{\bullet,t+n} = z_{\bullet,t+n} L_{t+n}$. That is, each member of the generation that is young at date $t + n$ pays $z_{1,t+n}$ in taxes, and the proceeds are evenly divided among the elderly.

The labor force (the population of young people) grows according to

$$L_{t+1} = \Xi_{t+1} L_t. \tag{3}$$

The PAYG system is not allowed to change the tax rate on the young unless there is a "surprise" that causes the system to become "unbalanced." What this means is that the system tells young people that they should expect a "return" of $z_{2,t+1}/z_{1,t}$ on Social Security "savings" that is based on an assumption that the future rate of population growth will be constant at some value Ξ, and tries to keep that rate of return stable across generations.

If a "surprise" occurs at date t, then it is possible to allow for changes to the current tax rate on the young generation, and to announce a different tax rate for next period's young generation, but no further changes in expected tax rates are allowed beyond that. In other words, $z_{1,t}$ and $z_{1,t+1}$ can be changed, but $z_{1,t+1+n} = z_{1,t+1} \; \forall \; n > 0$.

1. What return should young people in period $t - 1$ expect?

2. Suppose that at date t there is a surprise: The projected rate of growth of the population permanently falls, causing a projected "imbalance" as of the beginning of period t (before $z_{1,t}$ has been set). Explain why this constitutes an "imbalance."

3. Define the 'generational account' of the generation that is young at date $t+n$ as $z_{t+n} = z_{1,t+n} + \mathsf{R}^{-1} z_{2,t+n+1}$, and define the 'Social Security return' of that generation as $z_{2,t+n+1}/z_{1,t+n}$. Explain why the 'Social Security return' of the generation born at $t+1$ must decline when the population growth rate declines.

4. Using this framework, discuss the government's options for reacting to the population growth shock. Suppose there are three principles of 'fairness' that the government might adopt:

   a) Taxes should be (re)set such that, after the reset, every generation is expected to receive the same SS return as every other generation

   b) Taxes should be (re)set such that the generation young at time t will get the same rate of return it would have been projected to get in a projection made in period $t-1$

      - That is, the generation born at t should get the same return as the one born at $t-1$ even though population growth has changed

   c) Taxes should be (re)set so that the only generation that experiences a rate of return different from the 'sustainable' return expected when they were young is the generation that is young when the surprise occurs.

   Describe the tax policies that will achieve each of these objectives, and explain how they will affect the 'old' (people who were young in period $t-1$), the 'young' (people who are young in period t) and the 'unborn' (people who will be young in periods $t+1$ and thereafter. (Assume that the government is only allowed to break promises about 'Social Security return' when a surprise happens; assume further that the government is prohibited from adjusting Social Security taxes for any reason except to implement one of the rules above).

5. Discuss the relationship between these choices and considerations of 'dynamic efficiency.' In particular, discuss how the level of world interest rates is related to the question of which responses to the population slowdown might affect the well-being of the different generations differently.

6. Briefly discuss whether these conclusions would change if the economy were a Diamond (1965) closed economy rather than a small open economy, and if so how and why.

References

Bloom, Nicholas (2009): "The Impact of Uncertainty Shocks," *Econometrica*, 77(3), 623–685.

Diamond, Peter A. (1965): "National Debt in a Neoclassical Growth Model," *American Economic Review*, 55, 1126–1150, http://www.jstor.org/stable/1809231.