PhD. Macroeconomics Qualifying Exam *Summer 2009*

Instructions: You have four hours to complete the exam. The exam has three parts. Each part counts for 1/3 of the exam. Part 3 has two questions. To receive full credit, you must answer all questions. Please answer each question in a separate blue book.

Part 1

Consider an economy with a continuum of infinitely lived individuals each of who work one of two work shifts or not at all. The shifts correspond to working only a straight time shift (h_1) or straight time plus overtime ($h_1 + h_2$). Let n_{1t} be the fraction of individuals that work only straight time and n_{2t} be the fraction that work straight time plus overtime. Each individual has preferences given by $E\sum_{t=0}^{\infty}\beta^t\left[\log c_t + A\log(1-h_t)\right]$, where $h_t \in \{0, h_1, h_1+h_2\}$.

Output, which can be used for consumption or investment, is produced using a Cobb-Douglas technology that is a function of capital, labor and a technology shock. That is, $y_t = e^{z_t}K_t^{\theta}(H_{1t}^{1-\theta} + H_{2t}^{1-\theta})$, where K_t is the stock of capital, H_{1t} is total straight time hours worked and H_{2t} is total overtime hours worked. Output can be used as consumption or investment (i_t). Investment in period t become productive capital in period t+1, and the stock of capital depreciates at the rate δ. Finally, the technology shock, z_t, evolves over time according to a first order autoregression, $z_{t+1} = \rho z_t + \varepsilon_{t+1}$, where $\varepsilon \square N(0, \sigma_\varepsilon^2)$.

A. Write down the social planner's problem for this economy as a dynamic program. The planner should give equal weight to the utility of all individuals in its objective function.

B. Define a *recursive competitive equilibrium* for this economy. Be specific about the market structure assumed.

C. Is there an "overtime wage premium" for this economy? Explain by relating measured hourly wage rates to the pricing functions in your definition of equilibrium.

D. Derive a set of first order necessary conditions that characterize an equilibrium. In particular, find equations that determine the following variables: y_t (output), c_t, n_{1t}, n_{2t}, H_t, i_t and K_{t+1}. Here, H_t is total hours worked.

E. Suppose that you are given the following statistics computed from U. S. data: (1) average labor's share; (2) the average capital to output ratio (annual); (3) the average investment to output ratio; and (4) the average fraction of time that individuals spend working in the market sector. Suppose that a period is one quarter of a year. Your job is to calibrate the economy so that the steady state matches the U.S. averages in these four respects. Show how these facts can be used to find values for A, β, θ, and δ. That is, give a set of equations that can be solved to obtain values for these parameters given values for h_1 and h_2.

Question 2

In this question, we examine the relationship between the money supply and the price level.

Consider the following cash-in-advance economy. In this part of the problem, we assume that there is no government debt or spending and that all money is injected through transfers to the households. Time is discrete and denoted $t = 1, 2, 3, \ldots$. Every period, there is a constant aggregate endowment of a non-storable consumption good denoted $y_t = y$. There is a representative household with preferences over consumption of this good given by

$$\sum_{t=1}^{\infty} \beta^t u(c_t)$$

with $\beta \in (0, 1)$. The agent has initial nominal bond holdings B_0^g and cash-holdings M_0^g. The agent faces a sequence of nominal bond prices $\{q_t\}_{t=0}^{\infty}$ related to the nominal interest rate by

$$\frac{1}{q_t} = (1 + i_t).$$

The agent faces a sequence of budget constraints in the asset market for $t \geq 2$

$$q_t B_t + M_t = P_{t-1} y + M_{t-1} - P_{t-1} c_{t-1} + B_{t-1} + \tau_t$$

and, for $t = 1$

$$q_1 B_1 + M_1 = M_0^g + B_{t-1} + \tau_1$$

where $\{\tau\}_{t=1}^{\infty}$ is the sequence of government tax rates. In addition, the agent faces a lower bound on his bond holdings of $\bar{B}$. The agent also faces a sequence of cash-in-advance constraints

$$P_t c_t \leq M_t$$

for all $t \geq 1$. The government's budget constraint is given by

$$\tau_t = M_t^g - M_{t-1}^g + q_t B_t^g - B_{t-1}^g$$

The goods market clearing condition is $c_t = y$, the money market clearing condition is $M_t = M_t^g$, and the bond market clearing condition is $B_t = B_t^g$.

An equilibrium is a collection of sequences of agents' decisions $\{c_t, M_t, B_t\}_{t=1}^{\infty}$, prices $\{q_t, P_t\}_{t=1}^{\infty}$, and policy $\{M_t^g, B_t^g, \tau_t\}_{t=1}^{\infty}$ such that the agents' decisions maximize the utility of the representative agent subject to the agents' budget constraints, cash-in-advance constraints, and the lower bound on agents' bond-holdings and such that goods, money, and bond markets clear.

Part A: Prove that $q_t \leq 1$ in any equilibrium.

For parts B, C, and D assume that $\{B_t^g\}_{t=1}^{\infty} = 0$ and that $B_0^g = 0$ and $M_0^g = \bar{M}$.

Part B: Assume that $M_t^g = \bar{M}$ for all $t \geq 1$. Solve for the sequences of equilibrium prices $\{q_t, P_t\}_{t=1}^{\infty}$.

Part C: Now assume that $M_t^g = \bar{M}$ for all $t \geq 2$, and solve for the sequences of equilibrium prices $\{q_t, P_t\}_{t=1}^{\infty}$ as you vary M_1^g. Be careful to fully characterize the equilibrium values of q_1 and P_1 as functions of M_1^g. Also describe the sequence of transfers (or taxes) $\{\tau_t\}_{t=1}^{\infty}$ required to implement each alternative sequence of money stocks $\{M_t^g\}_{t=0}^{\infty}$. Is it necessarily the case that doubling the money supply in period $t = 1$ leads to a doubling of the price level in period $t = 1$? Explain your answer.

Part D: We now want to assess the fiscal impact of different monetary policies. Does the real discounted present value of real transfers (τ_t/P_t) differ across these alternative equilibria? Give a proof yes or no.

Question 3A

Please read the attached article by Robert Barro, "Government Spending is No Free Lunch" (see next page), which argues that government spending reduces private spending and thus reduces GDP. In contrast, President Obama's economic advisors have suggested that government spending will increase private spending substantially, and thus increase GDP substantially.

Write down an economic model to evaluate Barro's arguement that the impact of government military spending reduces private spending, and that the impact of peacetime spending reduces private spending even more than that.

Assume that the increase in spending is permanent. Be specific regarding preferences, technology, endowments, government policy, defining an equilibrium, and using the model to address this issue. It is easiest to conduct the analysis with a technology that uses only labor as a factor input, rather than labor and capital.

Your grade does not depend on whether you agree or disagree with Barro, rather it depends only on the quality of the economic analysis.

Question 3B

Consider a discrete-time, infinite horizon risk-sharing problem between a risk-averse agent and a risk neutral planner. The agent faces a stochastic endowment sequence $\{y_t\}$, where y_t is iid over time, and drawn from the set $\{y_1, ..., y_N\}$ with iid probabilities $\{\pi_1, ..., \pi_N\}$. The planner can commit to future transfers, but the agent can't: At each date, the agent has the option to walk away from the risk-sharing agreement, in which case his subsequent consumption equals his endowment (autarky). The agent ranks consumption plans according to $\mathbb{E}\left\{\sum_{t=0}^{\infty} \beta^t u(c_t)\right\}$, where $\beta \in (0,1)$, and $u(\cdot)$ is increasing, concave, bounded and twice differentiable. The planner ranks the same sequence according to $\mathbb{E}\left\{\sum_{t=0}^{\infty} R^{-t}(y_t - c_t)\right\}$.

Set up the recursive planning problem associated with this risk-sharing problem, and characterize its solution. What are the implications for optimal consumption smoothing with limited commitment.

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Government Spending Is No Free Lunch

Now the Democrats are peddling voodoo economics.

By ROBERT J. BARRO

Back in the 1980s, many commentators ridiculed as voodoo economics the extreme supply-side view that across-the-board cuts in income-tax rates might raise overall tax revenues. Now we have the extreme demand-side view that the so-called "multiplier" effect of government spending on economic output is greater than one -- Team Obama is reportedly using a number around 1.5.

To think about what this means, first assume that the multiplier was 1.0. In this case, an increase by one unit in government purchases and, thereby, in the aggregate demand for goods would lead to an increase by one unit in real gross domestic product (GDP). Thus, the added public goods are essentially free to society. If the government buys another airplane or bridge, the economy's total output expands by enough to create the airplane or bridge without requiring a cut in anyone's consumption or investment.

The explanation for this magic is that idle resources -- unemployed labor and capital -- are put to work to produce the added goods and services.

If the multiplier is greater than 1.0, as is apparently assumed by Team Obama, the process is even more wonderful. In this case, real GDP rises by more than the increase in government purchases. Thus, in addition to the free airplane or bridge, we also have more goods and services left over to raise private consumption or investment. In this scenario, the added government spending is a good idea even if the bridge goes to nowhere, or if public employees are just filling useless holes. Of course, if this mechanism is genuine, one might ask why the government should stop with only $1 trillion of added purchases.

What's the flaw? The theory (a simple Keynesian macroeconomic model) implicitly assumes that the government is better than the private market at marshaling idle resources to produce useful stuff. Unemployed labor and capital can be utilized at essentially zero social cost, but the private market is somehow unable to figure any of this out. In other words, there is something wrong with the price system.

John Maynard Keynes thought that the problem lay with wages and prices that were stuck at excessive levels. But this problem could be readily fixed by expansionary monetary policy, enough of which will mean that wages and prices do not have to fall. So, something deeper must be involved -- but economists have not come up with explanations, such as incomplete information, for multipliers above one.

A much more plausible starting point is a multiplier of zero. In this case, the GDP is given, and a rise in government purchases requires an equal fall in the total of other parts of GDP -- consumption, investment and net exports. In other words, the social cost of one unit of additional government purchases is one.

This approach is the one usually applied to cost-benefit analyses of public projects. In particular, the value of the project (counting, say, the whole flow of future benefits from a bridge or a road) has to justify the social cost. I think this perspective, not the supposed macroeconomic benefits from fiscal stimulus, is the right one to apply to the many new and expanded government programs that we are likely to see this year and next.

What do the data show about multipliers? Because it is not easy to separate movements in government purchases from overall business fluctuations, the best evidence comes from large changes in military purchases that are driven by shifts in war and peace. A particularly good experiment is the massive expansion of U.S. defense expenditures during World War II. The usual Keynesian view is that the World War II fiscal expansion provided the stimulus that finally got us out of the Great Depression. Thus, I think that most macroeconomists would regard this case as a fair one for seeing whether a large multiplier ever exists.

I have estimated that World War II raised U.S. defense expenditures by $540 billion (1996 dollars) per year at the peak in 1943-44, amounting to 44% of real GDP. I also estimated that the war raised real GDP by $430 billion per year in 1943-44. Thus, the multiplier was 0.8 (430/540). The other way to put this is that the war lowered components of GDP aside from military purchases. The main declines were in private investment, nonmilitary parts of government purchases, and net exports -- personal consumer expenditure changed little. Wartime production siphoned off resources from other economic uses -- there was a dampener, rather than a multiplier.

We can consider similarly three other U.S. wartime experiences -- World War I, the Korean War, and the Vietnam War -- although the magnitudes of the added defense expenditures were much smaller in comparison to GDP. Combining the evidence with that of World War II (which gets a lot of the weight because the added government spending is so large in that case) yields an overall estimate of the multiplier of 0.8 -- the same value as before. (These estimates were published last year in my book, "Macroeconomics, a Modern Approach.")

There are reasons to believe that the war-based multiplier of 0.8 substantially overstates the multiplier that applies to peacetime government purchases. For one thing, people would expect the added wartime outlays to be partly temporary (so that consumer demand would not fall a lot). Second, the use of the military draft in wartime has a direct, coercive effect on total employment. Finally, the U.S. economy was already growing rapidly after 1933 (aside from the 1938 recession), and it is probably unfair to ascribe all of the rapid GDP growth from 1941 to 1945 to the added military outlays. In any event, when I attempted to estimate directly the multiplier associated with peacetime government purchases, I got a number insignificantly different from zero.

As we all know, we are in the middle of what will likely be the worst U.S. economic contraction since the 1930s. In this context and from the history of the Great Depression, I can understand various attempts to prop up the financial system. These efforts, akin to avoiding bank runs in prior periods, recognize that the social consequences of credit-market decisions extend well beyond the individuals and businesses making the decisions.

But, in terms of fiscal-stimulus proposals, it would be unfortunate if the best Team Obama can offer is an unvarnished version of Keynes's 1936 "General Theory of Employment, Interest and Money." The financial crisis and possible depression do not invalidate everything we have learned about macroeconomics since 1936.

Much more focus should be on incentives for people and businesses to invest, produce and work. On the tax side, we should avoid programs that throw money at people and emphasize instead reductions in marginal income-tax rates -- especially where these rates are already high and fall on capital income. Eliminating the federal corporate income tax would be brilliant. On the spending side, the main point is that we should not be considering massive public-works programs that do not pass muster from the perspective of cost-benefit analysis. Just as in the 1980s, when extreme supply-side views on tax cuts were unjustified, it is wrong now to think that added government spending is free.

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