Economics 202C
UCLA
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Homework 2

The Impact of the Computer on the Macroeconomy

There have been dramatic improvements in the productivity of capital in the last 30 years, including enormous improvements brought about by the development of information-processing equipment, such as the computer. This exercise will let you analyze the impact of this type of technological change on the economy, and give you practice using two-sector optimal growth models.

The planner's problem is:

Preferences are:

$$\max \sum_{t=0}^{\infty} \beta^t \{\ln(c_t) + \phi \ln(1 - l_{ct} - l_{kt})\}$$

The constraints are:

$$k_{ct}^{\theta}(x_{ct} l_{ct})^{1-\theta} \geq c_t$$

$$k_{kt}^{\theta}(x_{kt} l_{kt})^{1-\theta} \geq i_{kt} + i_{ct}$$

$$k_{kt+1} = (1-\delta)k_{kt} + i_{kt}, \;\; i_{kt} \geq 0$$

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$$x_{ct} = \exp(\gamma_c t)$$

$$x_{kt} = \exp(\gamma_k t)$$

(A) Define a competitive equilibrium for this economy, letting consumption be the numeraire.

Calibrate the model so that in the steady state, the rate of return to capital is 20%, that the household spends 1/3 of the time working, that the ratio of investment to output is 25 percent, that capital's share of income is 35 percent, and that the growth rate of productivity in both sectors is 1.5%.

Now, suppose the economy is in the steady state, and that the growth rate of productivity in the investment jumps permanently from 1.5% to 6%, and all other parameter values remain the same.

Calculate the transition path of the economy to the new steady state using a nonlinear equation solver. Plot the time paths of: consumption, capital in each sector, labor input in each sector, investment in each sector, and the relative price from the initial period in which γ_k jumps, for an additional 70 periods (you may assume that the economy is at its new steady state level at that point). Explain the economic forces generating these time paths.

Business Cycles with Time Varying Distortions in the Labor Market

$$\max E \sum_{t=0}^{\infty} \beta^t \{\ln(c_t) + \phi(1-l)\}$$

The constraints are:

$$Ak^{\theta} l^{1-\theta} \geq c_t + x_t$$

$$k_{t+1} = x_t + (1-\delta)k_t$$

$$0 \leq l \leq 1$$

Obtain data on the following time series, from 1959 - 2005, using annual data:

(1) real consumption of non-durable goods and services, (2) real GDP, (3) total hours worked, (4) real investment, all variables measured relative to the working age population (16 years to 65 years). Document the source of these data. You may re-normalize the data if you like. Choose a value of ϕ such that the first order condition for labor holds exactly in the first period. Choose depreciation so that the investment

to output ratio is 25 percent, and choose β so that the average return to capital is 6 percent. Choose θ so that 2/3 of income is paid to labor.

Using the method of Chari, Kehoe, and McGrattan, measure the ”wedge” in the first order condition that equates the marginal rate of substitution between consumption and leisure to the real wage. Plot this wedge in a graph. Show how this wedge can be interpreted as a tax rate on labor income.

Fit an AR(1) process to the log of this wedge. Given the value of the parameters of this wedge, simulate the model in response to shocks from this stochastic process (you may linearize the model, or use an alternative solution method). Calculate the correlation of output with consumption, with investment, and with hours worked. Is this ”one-shock” model consistent with these correlations in the actual data, where the actual data are measured as the deviations from a regression of the log of the variable on a constant and a time trend:

$$\ln(y_t) = \alpha + \xi t + v_t$$

(where y is one of the macro variables that you have collected, and t is calendar time.)

What other shock(s) do you think are missing from the model economy?