

First Quiz  
Eco 603  
Quiz date: October 5, 2017

The quiz is open notes. Good luck!

**Question 1 (10 points).**

In class, we saw that that hours were more variable in the data than in the RBC model. Give two possible reasons why.

**Question 2 (10 points) .**

Some models assume a constant savings rate  $s \in (0,1)$ . Investment spending is then equal to:

$$x_t = se^z F(k, h). \tag{1}$$

A stylized fact is that investment spending is more variable than GDP. Show the model with a constant savings rate does/does not have this property.

**Question 3 (15 points) .**

Calculate the addition to a category or categories in the RBC model.

- a. The US imports a toy from China worth \$10. China spends the \$10 on US Treasuries (spending side only).
- b. Ralph employer pays \$100 towards his health insurance as part of his compensation package (income and spending sides).
- c. A Japanese car is sold in the US. Included in the price is a \$100 tariff. Assign the tariff on both the income and spending side.
- d. Chris, a sole proprietor, sells one textbook worth \$50 from his inventory. (Assume that books are a durable good, spending side only).
- e. The government pays a private contractor \$12 million to build a bridge. The contractor pays the workers \$6 million and keeps the rest (income and spending sides).

**Question 4 (10 points).**

Accounting for durable goods in the RBC model causes the capital share to rise from about 0.36 to 0.4. Explain why the capital share rises.

**Question 5 (10 points).**

Suppose Parmeter's educational services company earns revenues of \$4,400, pays it's workers \$3,000. It pays \$400 in sales taxes and reports a \$1000 profit to the government.

- a. Calculate the capital share.
- b. Calculate capital income, labor income, and GNP.

**Question 6 (45 points).**

This problem (from Dave's research) incorporates pollution into the RBC model. Suppose the assumptions of the RBC model except that:

- The stock of pollution  $m$  causes disutility:  $U = u(c_t) - \psi h_t - D(m_{t+1})$ , with  $D$  concave. For example, pollution might reduce health.
- The pollution stock evolves over time according to:  $m_{t+1} = E_t + (1 - \phi) m_t$ . Here  $E_t$  are current pollution emissions, and  $\phi$  is the decay rate. Over time, pollution naturally falls back to Earth or otherwise decays.
- Producing output causes pollution emissions,  $E_t = (1 - \mu_t) y_t$ .
- The planner can reduce pollution through abatement: installing filters on smokestacks, or tuning machines more often. Let  $\mu_t$  be the fraction of emissions abated and the resource cost of abatement is  $\text{cost} = (1 - (1 - \mu)^\epsilon) y_t$ .
- We have Cobb-Douglas Production:  $y_t = e^{z_t} k_t^\gamma h_t^{1-\gamma}$ .

- a. Write the resource constraint.
- b. Use the constraints to eliminate  $\mu_t$  from the problem.
- c. Write the value function.
- d. Find the first order conditions and relevant envelope equations.
- e. Assume for this question only that  $\phi = 1$  and  $h$  is procyclical as in the data. Are emissions pro-cyclical or counter cyclical? Explain the result.
- f. Find the certainty equivalence steady state.
- g. Suppose we have data on total environmental compliance spending, which we can take as the cost of abatement, and emissions. Use the abatement cost equation and the emissions equation to create an equation which can be used to calibrate  $\epsilon$ .
- h. What is the share of income that goes to capital owners in this model (the capital share)?