



## Solution to Individual homework 2

Revised: November 22, 2011

*November 24 at the start of class*

### 1. Fiscal Policy and Growth (50p)

After reviewing the latest figures of investment rates for China and US, the US Government is considering a fiscal policy manoeuver to increase investment rate in US. In this question you are asked to use the Solow model to evaluate the impact of this policy change. For simplicity assume that the US is a closed economy so that

$$Y = C + G + I$$

where  $Y$  is GDP,  $C$  is private consumption,  $G$  is government consumption and  $I$  is investment. Assume that the government currently taxes GDP at a 20% rate and all tax revenues go to finance government consumption expenditures, which are equal to 20% of GDP (so that  $G = 0.2Y$ ). The private sector consumes 80% of after-tax GDP  $((1-0.2)Y)$ .

a) Compute the current US investment rate ( $I/Y$ ) (5p)

#### Answer

From  $Y=C+G+I$ , using the assumptions on  $C$  and  $G$  we obtain  $Y = 0.8(1 - 0.2)Y + 0.2Y + I$ , which rearranging gives  $I/Y = (1 - 0.2 - 0.8 * 0.8) = 16\%$

Assume that aggregate production function is given by  $Y = K^{.5}L^{.5}$ , where  $K$  is the domestic capital stock and  $L$  is the number of workers and that the depreciation rate of capital is 8% per period.

b) Compute the steady state per-worker capital, private consumption, before and after-tax GDP(10p)

#### Answer

To compute the steady state per worker capital equate the per worker investment to the per worker depreciation. From the previous point we know that investment is 16% of  $Y$  so per worker investment will be given by

$$0.16 \frac{Y}{L} = 0.16 \frac{K^{.5}L^{.5}}{L} = 0.16 \left( \frac{K}{L} \right)^{0.5} = 0.16k^{0.5}$$

Since the per worker depreciation is simply given by  $0.08k$  equating the two one obtains

$$k = \left(\frac{0.16}{0.08}\right)^2 = 4$$

Before tax GDP is equal to  $4^{0.5} = 2$  and after tax GDP is  $0.8 \cdot 2 = 1.6$ . Private per-worker consumption is  $0.8 \cdot 1.6 = 1.28$ .

The government is thinking about increasing the tax rate to 25% of GDP. To do so government expenditure would have to increase from 20% to 21% of GDP (to pay for higher collection costs) but the remaining additional revenues (4% of GDP) will be used for investment. Assume that private citizens will continue to consume 80% of the after-tax GDP.

c) Compute investment rate (where investment now includes private and government investment) under the new policy (5p)

**Answer**

The new investment rate is given by  $0.04 + (1 - 0.25) \cdot 0.2 = 0.19$

d) Compute the per-worker steady state level of the capital stock, consumption and after tax income following the change in tax policy. Based on steady state comparisons would you think the reform is beneficial for citizens? Why? (10p)

**Answer**

Equating depreciation and investment one gets capital stock per worker is given by  $k = \left(\frac{0.19}{0.08}\right)^2 \simeq 5.64$

Before tax GDP is equal to  $\frac{0.19}{0.08} = 2.375$  and after tax GDP is  $0.8 \cdot 2.375 \simeq 1.78$ . Private per-worker consumption is  $0.8 \cdot 1.78 \simeq 1.425$ . Since the reform increases steady state consumption it is beneficial for citizens.

e) Starting from the pre-tax reform steady state, determine and graph (using excel) the transition path of investment, consumption, and after tax income for the first 50 periods after the tax reform. Does the tax reform increases consumption and after tax income right after its introduction? (10p)

**Answer**

No it does not. In the initial periods the private sector is more heavily taxed and the benefits of a higher capital stock and a higher income have not yet materialized. As a consequence private consumption and after tax income are lower than in the pre-reform stage. See the attached excel workbook.

f) Suppose that the private sector realizes that the government is now saving more so it responds to the change in tax policy by increasing its consumption from 80% of after tax income to 85% of after tax income. Does this change your evaluation of the impact of reform on steady state variables? How?(10p)

**Answer**

Yes. If the private sector changes its consumption behavior then the reform actually has the effect of *reducing* investment rate which falls to  $0.04 + 0.15 \cdot 0.75 = 0.1525$ .

As a consequence steady state capital, after tax income and consumption will fall if the reform is adopted.

## 2. US, Mexico and China (50p)

Economists and policy makers have argued that Mexico is probably losing from the entry of China in the world markets. In this question you are asked to analyze further this conjecture using the Ricardian model of trade. To simplify things throughout the exercise assume that all prices are quoted in US dollars.

### a) US and Mexico in Autarky

Assume that US and Mexico have 100 workers each and that each worker in the US can produce either 3 high tech goods or 2 low tech goods. In Mexico each worker can produce either 1 high tech good or 2 low tech goods. Assume that there is no trade between them, that the US produces and consumes 150 HT and 100 LT, and that Mexico produces and consumes 50 HT and 100 LT. Draw the production possibility frontier for US and for Mexico. Assume that the price of LT is 1 dollar both in the US and Mexico. What is the price of HT in both countries? Why?

### b) US-Mexico trade

Now assume that US and Mexico start trading with each other and that after trade both HT and LT goods cost 1 dollar. Determine US and Mexico pattern of production at these prices. Assume that after trade Mexico consumes 100 HT and 100 LT while US consumes 200 HT and 100 LT. What is the value and composition of US and Mexican exports? Do both countries (as a whole) benefit from trade?

### c) China enters

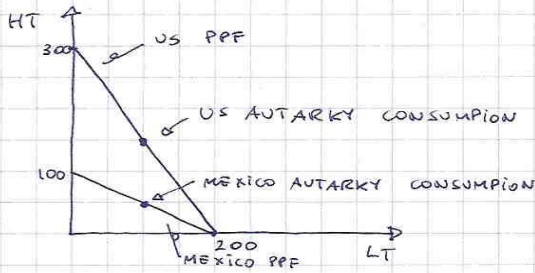
Now assume that China enters the world markets. Since China can produce LT goods with very cheap labor the world price of HT stays at 1 dollar but the price of LT goods falls to 1/4 of a dollar. Determine Mexico and US production at these new world prices. Show that Mexico can be worst off from the entry of China by showing that, at the new prices and production, Mexico cannot afford the consumption bundle it was consuming before (in point b). Show instead that the US is unambiguously better off. Suppose now that the Mexican authorities have the option of returning to isolation (i.e. return to the situation of point a). Should they do it?

### Answer

For answers to all points except the last two points of section c) see figure 1. Last two points of section c): US clearly benefits from the entrance of China as it does not change its production pattern (300 HT) but now the price of HT (relative to LT) is higher, and thus they can afford more. Graphically the US dashed line in section c) lies always above the dashed lines for US in section b).

Mexico could revert to isolation but it would be worst off. By trading with China Mexico can afford to consume more than it does in isolation. For example, after

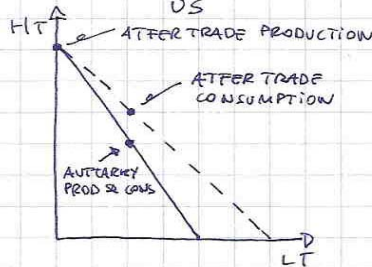
A) US & MEXICO IN AUTARKY



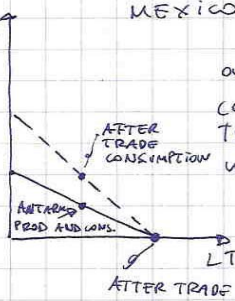
- Price of HT in US is \$ 2/3
- Price of HT in MEXICO is \$ 2

At those price each worker is indifferent between producing HT or LT. Since workers in US and MEX are producing both they must be indifferent.

B) US - MEXICO TRADE



MEXICO

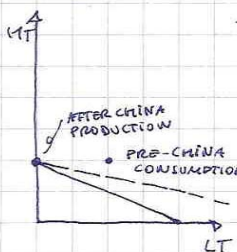
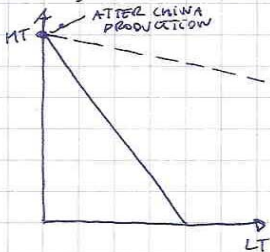


The dashed lines depict all the bundles US and MEX can afford after trade. The lines have slope 1 which is the price of LT relative to HT.

MEX EXPORTS = LT PROD - LT CONS = 200 - 100 = 100 LT  
 US EXPORTS = HT PROD - HT CONS = 300 - 200 = 100 HT

Both US & MEX are better off as they consume more relative to autarky.

C) CHINA ENTERS



- After China enters both US & MEX will specialize in HT. When prices of LT are so low it is convenient for both US & MEXICAN workers to produce only HT.

- At new prices and production the value of MEX income is \$ 100 while the cost of its previous consumption bundle is \$ 125 so Mex cannot afford what it was consuming before the entry of CHINA.

Figure 1: ANSWERS TO QUESTION 1

the entry of China, Mexico could consume the same bundle it was consuming in autarky, but could also consume the bundle 50HT and 200LT that was not affordable to Mexico in isolation.