Economics 501: Macroeconomics
Fall 2004
Professor Jones

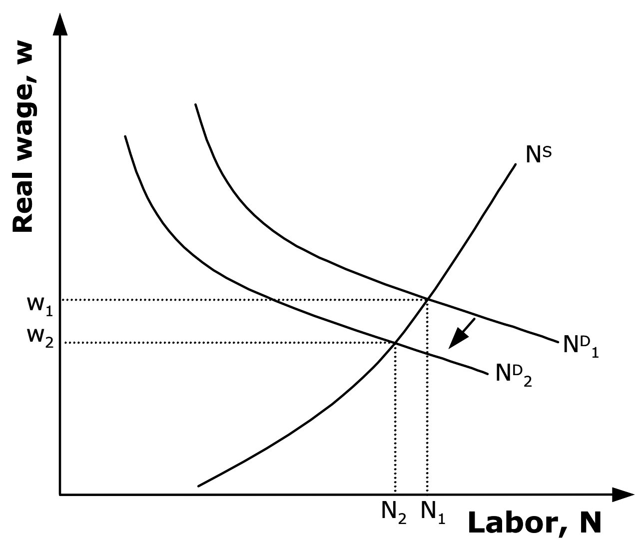
Midterm Examination
Answer Key

1. (9 points) Let's begin by considering how the security expenditures would appear in the National Accounts.

   (a) Security expenditures by households (e.g., home alarms) are final goods and services that would be included in GDP. Security products would probably be treated either as consumer durables (C) or residential investment (I). Security services (e.g., night watchmen) would be included in consumption (C).

   (b) Some security expenditures by businesses—especially security services—would be treated as intermediate inputs and thus not be included in be included in GDP. (Recall that we assume that the market value of the businesses' final products does not change.) Other, longer-lived, business security expenditures (e.g., security systems) could be classified as business fixed investment (I), which would be part of GDP.

2. (18 points) The increase in security requirements manifests itself as a decrease in total factor productivity. (There could be other effects, but your instructions were to ignore them.) A decrease in TFP in turn decreases MP_N and thus shifts the labor demand curve to the left. The labor supply curve is unchanged. Depending on the slope of the labor supply curve, equilibrium labor may increase or decrease. If substitution effects dominate, the curve slopes up and labor decreases—this is the case shown in the graph. If income effects dominate, the curve slopes back and labor rises. In either case, real wages will fall. This implies a loss in income for the consumer. Consumption, being a normal good, will also fall, which in turn implies that output will fall as well (as government spending is unchanged, and $Y = C + G$).



3. (45 points) Consider a version of the Solow model where total output is given by

$$Y = zK^{0.36}N^{0.64},$$

Assume that $z = 15$, N equals 100, $s = 0.25$, $d = 0.1$, and $n = 0.0$.

(a) Output per worker is given by

$$y = \frac{Y}{N} = \frac{1}{N}zK^{0.36}N^{0.64} = zK^{0.36}\left(\frac{N^{0.64}}{N}\right) = zK^{0.36}N^{-0.36} = z\left(\frac{K}{N}\right)^{0.36} = zk^{0.36}.$$

(b) Steady state capital per worker can be derived as follows

$$\begin{aligned} s \cdot zf(k^*) &= (n+d)k^*, \\ 0.25 \cdot 15 (k^*)^{0.36} &= 0.1k^*, \\ 37.5 &= (k^*)^{1-0.36} = (k^*)^{0.64}, \\ k^* &= 37.5^{1/0.64} = 288.02. \end{aligned}$$

The remaining steady state quantities can be calculated as follows

$$\begin{aligned} y^* &= z(k^*)^{0.36} = 15 \cdot 288.02^{0.36} = 115.21, \\ i^* &= s \cdot y^* = 0.25 \cdot 115.21 = 28.8 \\ &= (n+d)k^* = 0.1 \cdot 288 = 28.8, \\ c^* &= y^* - i^* = 115.21 - 28.8 = 86.41. \end{aligned}$$

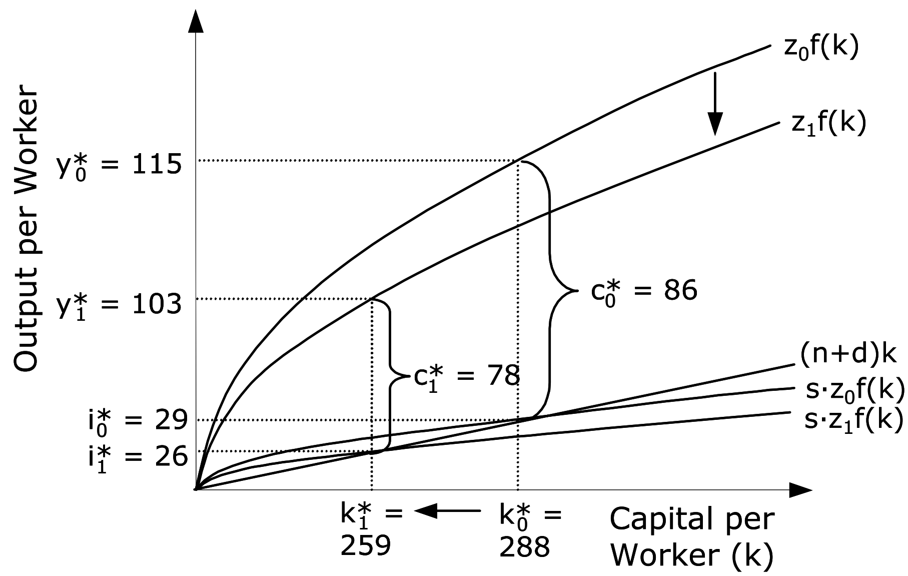
(c) Now suppose that total factor productivity permanently decreases from 15 to 14. Steady state capital per worker can be derived as follows

$$\begin{aligned} 0.25 \cdot 14 (k^*)^{0.36} &= 0.1k^*, \\ 35 &= (k^*)^{0.64}, \\ k^* &= 35^{1/0.64} = 258.59. \end{aligned}$$

The remaining steady state quantities can be calculated as follows

$$\begin{aligned} y^* &= z(k^*)^{0.36} = 14 \cdot 258.59^{0.36} = 103.44, \\ i^* &= s \cdot y^* = 0.25 \cdot 103.44 = 25.86 \\ &= (n+d)k^* = 0.1 \cdot 258.59 = 25.86, \\ c^* &= y^* - i^* = 103.44 - 25.86 = 77.58. \end{aligned}$$

(d) Recalling our answer to part (b), we see that lowering total factor productivity reduces steady state capital, output, investment and consumption. Graphically, both the output and the saving curve shift down, leading to lower values of k^*, y^*, i^*, and c^*. (In the interest of clarity, the graph has not been drawn to scale.)



4. (14 points) Consider an endogenous growth model where output per worker is given by

$$y = Ak,$$

with $A = 0.5$. Capital per worker follows

$$k'(1+n) = sy + (1-d)k,$$

with $s = 0.25$, $n = 0.0$, and $d = 0.1$.

(a) Rearranging the preceding equation yields

$$\begin{aligned} \frac{k'}{k}(1+n) &= s\frac{y}{k} + (1-d) = s\frac{Ak}{k} + (1-d) \\ &= 1 - d + sA, \end{aligned}$$

so that

$$G_k = \frac{k'}{k} = \frac{1-d+sA}{1+n}.$$

(b) The gross per worker growth rate is $[1 - 0.1 + 0.25 \cdot 0.5]/1 = 1.025$, for a net growth rate of 2.5% per year.

(c) If A drops from 0.5 to 0.45, the gross per worker growth rate is $[1 - 0.1 + 0.25 \cdot 0.45]/1 = 1.0125$, for a net growth rate of 1.25% per year.

5. (14 points) We finish by comparing our models' predictions to the data.

(a) The data clearly show that total factor productivity dropped in 2001, which is consistent with the hypothesis that the events of September 2001 reduced productivity.

(b) Depending on the slope of the labor supply curve (which in turn depends on the relative strengths of income and substitution effects), your answer to question 2 might or might not have shown equilbrium labor decreasing. A decrease in equilibrium labor—which was the case shown above—would be consistent with the data, which shows employment not changing and then shrinking in 2001 and 2002.

(c) The analysis of the Solow model in question 3 suggested that the productivity decrease generated by the events of September 2001 would cause a permanent drop in the level of per worker output. This would cause a temporary decline in output growth, but as long as future productivity growth was unchanged, long-term output growth would be unchanged as well. In contrast, the endogenous growth model suggested that the events of September 2001 would permanently reduce output growth. The data shows output growth significantly dropping around 2001 and 2002, but returning to a "regular" level in 2003. This suggests (to me) that the events of September 2001 had temporary rather than permanent effects on output growth, which is more in keeping with the Solow model.