Prof. Tybout

Economics 404W
First Midterm Exam

February 20, 2004

Answer Key

This exam has five sections. Each will be weighted in accordance with the time it is allotted. **For numerical problems, please be sure to show your work**.

Cheating on this exam will result in failure of the course. Violations will also be reported to the appropriate University authorities for further action.

Part I: Stylized Facts of Development (10 minutes)

1. As a country's per capita income rises from low levels (around $400 annual per capita income) to middle income (around $5,000 per capita income) many of its features change. By putting check marks in the relevant boxes, indicate the direction of movement in each of the characteristics listed in the left-hand column below.

Economic Indicator	***Goes Up***	***Goes Down***	***No Clear Pattern***
Share of agricultural output in GDP		X	
Mortality (death) rate		X	
Imports as a fraction of GDP	X		
Government spending as a fraction of GDP	X		
Basic literacy rate	X		
Fraction of the population below age 15.		X	
Degree of income inequality			X

3 pts per, max of 20

Part II: Numerical problems (20 minutes) Answer any two of the following three questions

2. Suppose an economy is characterized by perfectly competitive markets and constant returns to scale. Further suppose that the rate of growth in the number of workers is $L' = .02$, the rate of growth in the capital stock is $K' = .04$. Finally, 50 percent of national income is paid to workers and the rate of growth in output per worker is $(Y/L)' = y' = .04$. What is the rate of productivity growth in this economy? A' = _____ (Please show your work.)

$Y = AK^bL^{(1-b)}$
$(Y/L) = A(K/L)^b$
$\log(Y/L) = \log A + b\log(K/L)$
$\log(Y/L) = \log A + b[\log(K) - \log(L)]$
$(Y/L)' = A' + b(K' - L')$
$A' = (Y/L)' - b(K' - L')$

$A' = .04 - 0.5(.04 - .02)$
$A' = .03$

8 points for getting the equation right, 12 points for arriving at the solution through the proper means. 1-3 points were taken off for math errors, if everything else was correct.

3. Consider an economy described by the surplus labor phase of Lewis's dual economy model. The modern industrial sector produces output according to the production function $Y = 6\sqrt{KL}$, where Y is output, K is capital and L is labor. Letting the price of output be 1, this implies that the value of the marginal product of labor is $VMP_L = 3\sqrt{\frac{K}{L}}$.

   a) If the current capital stock is $K = 9$ and agricultural workers earn a subsistence wage of $w = 3$, how many workers are currently employed in the industrial sector? L _____

   w= VMP_L $w = 3\sqrt{\frac{K}{L}}$ $3 = 3\sqrt{\frac{K}{L}}$ $1 = \sqrt{\frac{K}{L}}$ L = K L = 9

   5 points for the correct relationship, 5 for the correct calculation, 1-4 off for incorrect numbers and math errors.

   b) If capitalists save $\frac{1}{9}$ of their income, at what rate is the capital stock growing? _____

   Firm profit: $6\sqrt{KL} - wL$

   Savings: $s*(6\sqrt{KL} - wL)$

   Capital growth: $\frac{\Delta K}{K} = [s*(6\sqrt{KL} - wL)]/K$

   $$\frac{\Delta K}{K} = \frac{[\frac{1}{9}*(6\sqrt{9*9} - 3*9)]}{9} = 1/3 = 0.333$$

   5 points for the correct relationship, 5 for the correct calculation, 1-4 off for incorrect numbers and math errors.

4. Aggregate production in a certain economy is characterized by the Cobb-Douglas production technology: $Y = 3\sqrt{KL}$ where Y is gross national product, K is the capital stock, and L is the labor force. The quality of factor inputs does not change over time and the rate at which capital depreciates is $\delta = 0.02$. In this economy we distinguish population (P) from labor force (L).

   If the labor force growth rate is 5 percent (that is, $L' = n = 0.03$) and people save 15 percent out of every dollar of income (that is, $s = 0.15$), what is the equilibrium output per worker (Y/L)? _____ If the labor force participation rate is $L/P = 1/3$, what is the equilibrium level of output *per capita* (Y/P)? _____ How fast does the capital stock grow in this equilibrium? K'= ____. Be sure to show your work.

   $Y = 3\sqrt{KL}$ $y = Y/L = 3\sqrt{\frac{K}{L}} = 3\sqrt{k}$

   $(\delta + n)k^* = s*3\sqrt{k^*}$ capital savings equals capital decline at equilibrium

   $$k^* = \left(\frac{s*3}{\delta + n}\right)^2 = \left(\frac{0.15*3}{0.02 + 0.03}\right)^2 = 81$$

   $y^* = 3\sqrt{81} = 27$ $\frac{Y}{P} = \frac{Y}{L}\frac{L}{P} = 27*\frac{1}{3} = 9$ K'=L'=0.03 (at equilibrium)

   6 points for the savings relationship, 6, 4, and 4 points for the responses respectively. 1-4 points off for math errors

Part III: Multiple choice (10 minutes) Circle the single best answer to the following questions

5. Which of the following is not an example of a "complementarity" or "externality"?
   a) Entrepreneur A builds a toll road leading from the manufacturing district to the airport, and charges other entrepreneurs a "fair" price to use it.
   b) Entrepreneur A develops a new production technique, and other entrepreneurs are able to copy it.
   c) Entrepreneur A researches foreign markets and identifies some buyers for her products. Other entrepreneurs observe her new clientele and approach them with their own wares.
   d) Entrepreneur A establishes a private police force that eliminates crime in the manufacturing district.

6. According to recent studies, rapid growth in per capita incomes of Taiwan, S. Korea, Singapore and Hong Kong during the past 30 years is attributable to:
   a) human and physical capital accumulation.
   b) growth in the labor force participation rate.
   c) growth in total factor productivity.
   d) All of the above.
   e) (a) and (b) only.

7. According to William Easterly, the main justification for foreign aid during the post-World War II era has been:
   a) to give back some the resources that were extracted from the recipient countries during their colonial periods.
   b) to close the financing gap in the recipient countries, and thus improve their long run growth rates.
   c) to create larger markets for the exports of the high income countries.
   d) To generate long run growth through the mechanism described by the Solow model.

8. Taking the Harrod-Domar model at face value, what savings rate out of national income is needed to generate an annual GDP growth rate of 5 percent (i.e., $Y' = .05$) if the capital output ratio is $\theta_K = 3$ and the depreciation rate is $\delta = .02$?
   a) $s = 0.12$ b) $s = 0.15$ c) $s = 0.18$ d) $s = 0.21$

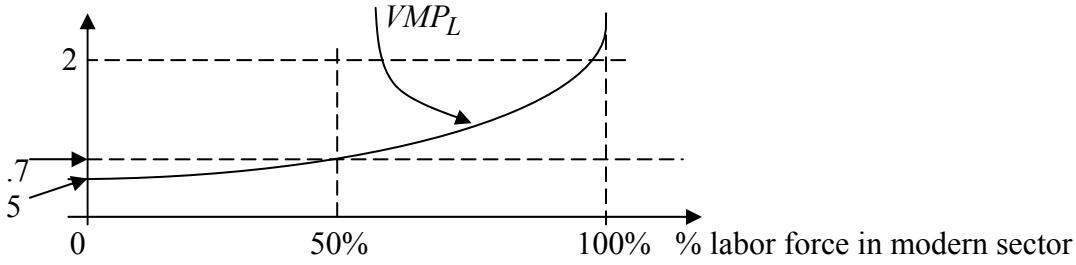
answers 1) A, 2)D, 3)B, 4)D 5 pts each

Part IV: True, False or Uncertain (15 minutes) Indicate whether each of the following statements are true (T), false (F) or uncertain (U). Briefly explain your answers. Half of your score for this section will be based on your explanations.

9. Suppose that all entrepreneurs in an Examistan use traditional production techniques. Also, suppose that for each entrepreneur, modern techniques are more profitable if others are using them too. Finally, suppose that breakthroughs in mind control allow the government of Examistan to convince each entrepreneur that *others* will definitely modernize. (That is the only kind of mind control that the government can exercise.) This mind control policy is unlikely to induce modernization if there are transitory costs associated with switching from traditional to modern techniques. (T,F,or U) _T or U_. 5 pts

   Explanation:
   This not likely to work based on transitory costs and time. The new techniques are only profitable if everyone else is doing them. A firm will wait for the economic environment to change before it makes the change itself. If all firms are waiting, no one is modernizing. By this logic, the transition costs would be higher for the firms first to move. 10 points, based on your defense of your answer, mentioning transitory costs and choice were necessary for full credit.

10. In the diagram below, the value of the marginal product of labor VMP_L in the modern sector is graphed as an increasing function of the fraction of the labor force that is employed in the modern sector.



   If workers who do not enter the modern sector remain in the traditional sector and earn the subsistence wage rate $w = 1$, multiple equilibria are possible in this economy (T,F,U)_____ 5 pts

   Explanation:
   There are three equilibriums. The first is that where the entire work force is employed in the traditional sector; no one will work in the modern sector because no individual worker would choose to work at its lower wage. The modern sector would therefore never be able to get out of its low VMP_L and offer a higher wage. The opposite is true at 100% modern sector employment. Any given worker would choose to work at the high modern wage and there would be no employment in the traditional sector. Nash equilibrium is at play in both of these instances, based upon the expectation that no one else will shift sectors, it is better for a worker to stay at the equilibrium point, so everyone will do so. The third (unstable) equilibrium point is where both wages are equal. This is a highly unlikely point because only one worker would have to move to a different sector and then it becomes advantageous for everyone else to do so. 10 points, based on your defense of your answer, explaining the equilibriums and mentioning the concept of Nash equilibrium were necessary for full credit.