

Midterm Examination

October 29, 2004

Instructions. Answer all the questions in your bluebook. You have 55 minutes to complete the exam, which consists of 5 problems. The first problem is worth 9 points, the second 18 points, the third 45 points, the fourth 14 points, and the fifth problem is worth 14 points, for a total of 100 points. This exam has 3 pages. Good luck!

Overview: One of the consequences of the events of September 2001 is that individuals, businesses and governments are expending more resources on security measures. In this exam, we will consider the effects of these security measures from several perspectives.

1. (9 points) Let's begin by considering how the security expenditures would appear in the National Accounts.
 - (a) Would security expenditures by households (e.g., home alarms) be included in GDP? If so, what expenditure category would they appear in? If they are not part of GDP, why not? Be succinct.
 - (b) Would security expenditures by businesses (e.g., metal detectors, ID systems) be included in GDP? (You can assume that the market value of the businesses' final products does not change.) If so, what expenditure category would they appear in? If they are not part of GDP, why not? Be succinct.

The increase in business security requirements will raise the cost of producing goods and services. As such, it can be viewed as a negative productivity shock. In the next 4 questions, you will evaluate the effects of a negative productivity shock in several different models.

2. (18 points) Consider the one-period macroeconomic model, where consumers choose labor supply and firms choose labor inputs. Using a labor demand-labor supply framework, determine how the increase in security requirements will affect aggregate output, consumption, employment and the real wage. (Be sure to discuss all of these variables.) Use a graph to illustrate your findings. Briefly explain your results.

3. (45 points) Consider the following application of the Solow model. Total output (Y , measured in billions of year-2000 U.S. dollars) is given by

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

where K is the aggregate capital stock, N denotes the work force (measured in millions), and z denotes total factor productivity. Assume that $z = 15$, and N equals 100. Investment is equal to 25 percent of output. Capital depreciates at a rate of 10 percent per year, while the work force is constant.

- (a) Derive the per worker production function, $y = zf(k)$, where y and k are output and capital per worker, respectively, and show that it can be written as $y = zk^{0.36}$.
 (b) In the Solow model, the steady-state capital stock, k^* , will satisfy

$$s \cdot zf(k^*) = (n + d)k^*,$$

where s denotes the saving rate, n denotes the growth rate of the labor force, and d denotes the depreciation rate. Find the steady state quantities k^* , y^* , i^* and c^* .

- (c) Suppose that the events of September 2001 permanently reduce total factor productivity from 15 to 14. Find the revised values of k^* , y^* , i^* and c^* .
 (d) Use a graph to illustrate how k^* , y^* , i^* and c^* have moved from their values in part (a).
4. (14 points) Consider the following version of an endogenous growth model. Output per worker (y , measured in billions of year-2000 U.S. dollars) is given by

$$y = Ak,$$

where k denotes capital per worker, and $A = 0.5$ is a constant. Continuing, it can be shown that capital per worker follows.

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

where s denotes the saving rate, n denotes the growth rate of the labor force, and d denotes the depreciation rate. In this example, investment is equal to 25 percent of output, capital depreciates at a rate of 10 percent per year, and the work force is constant.

- (a) Derive an expression for the gross growth rate of capital, $G_k = k'/k$.
 (b) Using the parameters given above, calculate the net growth rate of per worker capital (and output).
 (c) Suppose that the events of September 2001 reduce A from 0.5 to 0.45. What happens to the net growth rate?

5. (14 points) In the most recent homework, we collected the following data for the U.S.:

	Real		Real		Employ-				
	GDP (Y)	g_Y (%)	Capital (K)	g_K (%)	ment (N)	g_N (%)	TFP (z)	g_z (%)	
1996	8,328.9	3.63	25,153.1	2.55	126.7	1.44	9.79	1.80	
1997	8,703.5	4.40	25,882.3	2.86	129.6	2.22	9.98	1.95	
1998	9,066.9	4.09	26,677.3	3.03	131.5	1.46	10.19	2.07	
1999	9,470.3	4.35	27,570.3	3.29	133.5	1.53	10.41	2.19	
2000	9,817.0	3.60	28,551.8	3.50	136.9	2.52	10.49	0.73	
2001	9,890.7	0.75	29,561.8	3.48	136.9	0.03	10.43	-0.52	
2002	10,074.8	1.84	30,430.3	2.90	136.5	-0.33	10.54	1.01	
2003	10,381.3	3.00	31,229.1	2.59	137.7	0.91	10.70	1.48	

Note that TFP is an abbreviation for Total Factor Productivity.

- Are the data consistent with the hypothesis that the events of September 2001 reduced productivity? Briefly explain.
- Are the labor market data consistent with your findings in problem 2? Briefly explain.
- Which model of economic growth, the Solow model discussed in question 3 or the endogenous growth model discussed in question 4, seems more consistent with the data? Briefly explain. (**Hint:** The distinction between changes in levels and changes in growth rates could be useful here.)