

ADVANCED MACROECONOMICS I

Retake Exam, Winter Semester 19/20, August 20, 2020

I. Short Questions (2 points each)

Explain for each of the following statements why you agree or disagree.

1.	In the Malthusian age, capital was the limiting factor for population growth.
2.	According to recent research, the forces of β -convergence account for most of the cross-country variation in per-capita growth rates.
3.	The parable of the baby-sitting coop illustrates the Keynesian view of a recession.
4.	In constructing a short-run macroeconomic model, David Romer derives a downward-sloping AD curve in output-inflation space to demonstrate how a reduction in output pushes up marginal production costs and inflation.
5.	Observance of the Taylor Principle is a feature of optimizing monetary model in a new Keynesian DSGE model.

II. 3 Problems (30 Points)

Problem 1 (10 Points)

Consider a Solow model with production function $Y = K^\alpha (AL)^{1-\alpha}$, gross saving rate s , depreciation rate δ , and exogenous rates of growth n and g of labor and technology, respectively.

- (a) Derive the rate of change of the capital-output ratio (K/Y) and demonstrate that it converges towards a steady-state value. Compute that value.
- (b) Repeat part a) for an extended production function $Y = K^\alpha E^\beta (AL)^{1-\alpha-\beta}$, where E is energy, the use of which shrinks at an exogenous rate ε due to environmental policies.
- (c) “With the necessity of curbing the consumption of energy on an ongoing basis, there is no way we can have continued per-capita income growth.” True or false? Explain in the light of your analysis in b).

Problem 2 (10 Points)

- (a) In which major ways does the Real Business Cycle model differ from the Ramsey-Cass-Koopmans growth model?
- (b) How does a transitory adverse productivity shock affect the endogenous variables of the RBC model? Which income and substitution effects are at work?
- (c) How would your answer in part b) change if the productivity shock were perceived to be permanent?
- (d) How do proponents of the RBC model measure productivity shocks and how do they determine to what extent such shocks are transitory or permanent?

Problem 3 (10 Points)

- (a) Explain what Clarida/Gali/Gertler (JEL 1999) mean by the “classic inflationary bias problem” of discretionary monetary policy.
- (b) If such an inflationary bias exists, how do output and inflation differ from their socially optimal levels in the long run?
- (c) How does an inflationary bias affect the response of monetary policy to an inflationary cost-push shock?
- (d) In an influential paper, Rogoff suggested to reduce the inflationary bias by appointing a “conservative central banker”.
 - da) What did Rogoff mean by a “conservative central banker”?
 - db) How does the appointment of a “conservative central banker” affect output and inflation in the long run?
 - dc) How does the appointment of a “conservative central banker” change the response of monetary policy to an inflationary cost-push shock and what follows for the volatility of output and inflation?

SOLUTION

Problem	Points				Total
I	2P each				10
	(a)	(b)	(c)	(d)	
II1	5	3	2		10
II2	2	4	2	2	10
II3	2	2	2	4	10

I. Short Questions (10 Points)

1. False. According to Malthusian logic, population growth was governed by living standards which in turn were limited by resource scarcity (due to decreasing returns to land).
2. False. Regressions testing for β -convergence explain less than 5% of the cross-country variation in per-capita growth rates. Other factors such as differences in innovation, technology adaptation, institutions and governance explain the bulk of the variation.
3. True. The parable of the baby-sitting coop illustrates the coordination failure of a monetary market economy which is at the heart of Keynesian thinking.
4. False. The downward-sloping AD-Curve illustrates how a rise (fall) in inflation, by inducing a corresponding interest-rate response by the central bank, induces a fall (rise) in output.
5. True. The Taylor Principle says that the central bank should raise the nominal interest rate by more than one-for-one in response to a rise in inflation. Maximizing an objective function in output and inflation, subject to a Phillips-Curve constraint, ensures observance of the Taylor Principle.

II. 3 Problems (30 Points)

Problem 1 (10 Points)

(a) The growth rate of the capital intensity develops as:

$$\begin{aligned}g_{\frac{K}{Y}} &= g_K - g_Y \\&= g_K - [\alpha g_K + (1 - \alpha)(g + n)] \\&= (1 - \alpha)(g_K - g - n) \\&= (1 - \alpha) \left(\frac{sY - \delta K}{K} - g - n \right) \\&= (1 - \alpha) \left(\frac{s}{K/Y} - \delta - g - n \right)\end{aligned}$$

In the steady state, $g_{\frac{K}{Y}} = 0$ implies $\frac{K}{Y} = \frac{s}{n+g+\delta}$. Since $g_{\frac{K}{Y}}$ is decreasing in $\frac{K}{Y}$, the steady state is stable.

(b)

$$\begin{aligned}g_{\frac{K}{Y}} &= g_K - g_Y \\&= g_K - [\alpha g_K + \beta g_E + (1 - \alpha - \beta)(g + n)] \\&= (1 - \alpha)(g_K - g - n) \\&= (1 - \alpha) \frac{sY - \delta K}{K} - \beta g_E - (1 - \alpha - \beta)(g + n) \\&= (1 - \alpha) \frac{s}{K/Y} - (1 - \alpha)\delta + \beta\epsilon - (1 - \alpha - \beta)(g + n)\end{aligned}$$

Again, the steady state is stable and $g_{\frac{K}{Y}} = 0$ implies $\frac{K}{Y} = \frac{(1-\alpha)s}{(1-\alpha)\delta - \beta\epsilon + (1-\alpha-\beta)(n+g)}$

(c) First, g_Y in the steady state is derived from:

$$g_Y = g_K = \frac{s}{K/Y} - \delta$$

Plugging in steady-state K/Y from b):

$$\begin{aligned}g_Y &= \frac{(1 - \alpha)\delta - \beta\epsilon + (1 - \alpha - \beta)(n + g)}{(1 - \alpha)} - \delta \\&\Rightarrow g_Y - n = \frac{(1 - \alpha - \beta)g - \beta(\epsilon + n)}{(1 - \alpha)}\end{aligned}$$

We can see that both population growth and the shrinking use of energy create a drag on per-capita income growth. However, with g large enough, continued per-capita income growth is still possible.

Problem 2 (10 Points)

- (a) RBC model is the RCK model, augmented by two major extensions:
1. Endogenous, optimal labor supply decision
 2. Key exogenous variables (technology, government spending) are assumed to be generated by a well-defined stochastic process. With these two extensions, potential output can be shown to be subject to stochastic fluctuations so that the business cycle can be interpreted as a fluctuating potential output rather than as fluctuating departures from a deterministic growth path of potential output.
- (b) Associated with a transitory adverse productivity shock, we have
1. An adverse income effect which lowers consumption and leisure (forces: $C_t \downarrow, 1 - L_t \downarrow$)
 2. An intratemporal substitution effect: Households substitute leisure for consumption (forces: $C_t \downarrow$ and $1 - L_t \uparrow$).
 3. An intertemporal substitution effect: Households substitute current leisure for future leisure and current consumption for future consumption as the marginal return on capital is temporarily low (forces: $C_{t+1}/C_t \uparrow, (1 - L_{t+1})/(1 - L_t) \uparrow$).
- As a result, employment is down (the two substitution effects are assumed to dominate the income effect w.r.t. labor supply); output is down (both because of reduced productivity and labor inputs); consumption is down (but by less than output because of consumption smoothing).
- (c) The permanence of the productivity shock eliminates the intertemporal substitution effects. As a consequence, the fall in output is attenuated since employment is higher than in the case of a temporary shock. It is not even clear that employment falls at all (income effect and intratemporal substitution effect pull in opposite directions). At the same time, consumption falls by the full amount of the income loss.
- (d) Total factor productivity is measured by the Solow residual. Productivity shocks are identified with the innovations in the stochastic process generating the Solow residual. How long the effects of shocks persist is inferred from the autoregressive properties of that stochastic process.

Problem 3 (10 Points)

- (a) The temptation of policymakers to aim at an output level above natural output causes policy to be over-expansionary and hence inflationary.
- (b) In the long run, output is not affected, but inflation ends up higher than its target level.
- (c) The response of monetary policy to an inflationary cost-push shock is not affected since the marginal rate of substitution between output and inflation is the same.
- (d) da) A policy maker who places a larger weight on inflation in his objective function than the social welfare function does.
- db) Inflation is reduced whereas output is unaffected in the long run.
- dc) The “conservative central banker” raises the interest rate more aggressively in response to inflationary cost-push shocks, thereby lowering the volatility of inflation at the expense of the volatility of output (“Taylor trade-off”).