Sensorveiledning:

ECON 4325 Monetary policy and business fluctuations Spring 2005

PART A

Question 1
Define and explain how one can measure potential output and the output gap. Explain why the output gap is a central concept in inflation-targeting monetary-policy.

Define:
In a situation where employment is high compared to the total labour force and the available capital is fully used, there will be a tendency that price and wage growth picks up, (and vice versa when there are available resources). That means that at all time, there will be a level on the use of resources that will be compatible with a stable development in prices and wages. The corresponding level for production is usually called *potential production*. The deviation between actual production and potential production is given by the *output gap*.

Measuring the output gap
Need to say something about how to measure the trend in the data. Different methodologies may give different results (linear trend, Hodrick-Prescott filter, multivariate stochastic trends etc). Inappropriate detrending may give rise to spurious cycles. Trend need to be consistent with the underlying tine series properties in the data (i.e. test for unit root).

Output gap central for monetary policy makers:
If there are pressures in the economy, actual production will increase above the potential and the output gap will be positive. Isolated this will imply higher inflation. A negative output gap implies available resources which isolated will imply falling inflation. For a Central Bank that targets inflation in the near future (1-3 years), quantifying the level of pressures in the economy is important as it will say something about future price growth. Monetary policy is about forecasting inflation.

Question 2
Briefly explain the concept of driving force and persistence in the Real Business Cycle (RBC) models. How are these models evaluated against empirical data? Do they provide a convincing explanation of the stylized facts of business cycles?

Driving force and persistence :

Example (do not need to write the equation):
Output: $Y_t = \alpha Y_{t-1} + \overline{Y} + \varepsilon_t$ time series with lag

ε_t is the driving force, $\overline{Y}$ is the natural rate (trend), α measures persistence

Driving force: What is spurring cyclical movement/deviation from trend. Example: Total factor productivity shocks (change factor allocation and aggregate production)

Persistence: From time series studies we know that if $0<\alpha<1$, we observe temporary cycles (around trend), but if $\alpha=1$, a cycle will be a permanent movements in the series itself (shocks have permanent effects on the series). In RBC models: persistence due to Cost of adjustment (e.g. time to build), intertemporal substitution of leisure etc.

Evaluation

RBC proponents calibrate their models. Parameters taken from separate micro studies and imported into the RBC model. Can also use impulse responses to match data. Calibrated models are simulated and compared with actual data (ie. compare variance, autocorrelation, covariance among variables etc.). The variance of the shocks are usually set so that the variance in simulated output is equal to the variance in actual output.

Convincing explanation of the business cycle?

RBC models are generally successful at describing business cycles (with regard to matching sample moments).

Some criticism:

a. Use exogenous shocks (the Solow residual) to explain variation in output, but the variation in productivity may be due to measurement errors in e.g. labour and capital rather than the Solow residual.
b. RBC theory is not very specific of what these shocks are. If productivity shocks are variations in the level of technology, then why would there be negative (adverse) shocks?
c. If productivity shocks are the only source of variation in output, then the correlation between productivity shocks and output should be high – not observed in practice.
d. The RBC model itself gives little persistence. Rely on a strongly autocorrelated and relatively volatile process for the productivity shocks. The variability and autocorrelation in output and other variables are mostly explained by the exogenous random variable. Output dynamics are essentially the same as impulse dynamics.
e. Since the capital stock grows smoothly, the most important endogenous source of variability in output is employment fluctuations. Requires a sizeable wage elasticity of the supply of labour. Not found empirically.
f. The RBC theory relies heavily on the intertemporal substitution hypothesis, ie strong pro-cyclicality of the real wage rate and a significant positive correlation between movements in real wage and the supply of labor. Empirically the pro-cyclicality of real wages is not very pronounced.

Question 3

Explain why a discretionary monetary policy can be subject to the dynamic inconsistency problem. How can one solve this problem?

Define inflation bias

Walsh, chapter 8 (8.1 for brief introduction).

Solve problem

The problem of inflation bias can only be eliminated by having authorities that actually does what they are expected to, and resist the temptation of setting higher money growth rates.

Possible elimination methods (explain briefly):

- Reputation
- Preferences – delegating to conservative central banker
- Contracts
- Institutional structure
- Explicit targeting rules

Question 4

Describe the empirical effects of monetary policy in an open economy. How effective is monetary policy in stabilizing the real economy if there is inflation inertia?

Effects of monetary policy:

Tools to evaluate the effects of monetary policy has developed over time. Simple correlations (little evidence on causation). Sophisticated time series analysis using for instance VAR models-more effects.

Common core in macroeconomics: Money have significant effects on real output in the short run, but in the long run changes only prices. Friedman and Schwartz (1963): Systematic evidence that slowdown in money growth dampens real economic activity.

VAR studies evaluated through impulse responses. A contractionary monetary policy that increases the interest rate lowers output and other real variables temporarily. Minimum after a year. Inflation and real wage fall significantly, reaches minimum after 2-3 years. Strong evidence of an interaction between monetary policy and exchange rates. For Norway: The exchange rates appreciates immediately. No evidence of an exchange rate puzzle. No evidence of delayed overshooting.

Inflation inertia (persistence) implies that there may be difficult to stabilize inflation without incurring cost to the real economy (i.e. destabilizing the real economy)

In particular, the backward looking nature in inflation process implies that reductions in money growth will be costly in terms of output.

PART B

Monetary policy – Instrument choice and policy rules

$$y_t = -\alpha i_t + \varepsilon_t \qquad (1)$$

$$m_t = y_t - \beta i_t + \eta_t \qquad (2)$$

ε_t and η_t are mean zero disturbances that are uncorrelated with each other and have variances given by $Var(\varepsilon_t) = \sigma_\varepsilon^2$, $Var(\eta_t) = \sigma_\eta^2$ respectively. Policy makers objective is to minimize:

$$E(y_t)^2 , \qquad (3)$$

All variables have been normalized so that the economy's equilibrium level of output in the absence of shocks is *y=0*.

a) *Compare and derive the value of the objective function under both a money supply operating procedure and an interest rate operating procedure.*

Rearrange (2) to get an expression for the interest rate:

$$i_t = \frac{1}{\beta}(y_t + \eta_t - m_t)$$

Insert expression for interest rate into (1), rearrange with respect to output

$$y_t = -\frac{\alpha}{\beta}(y_t + \eta_t - m_t) + \varepsilon_t$$

$$\Leftrightarrow$$

$$y_t + \frac{\alpha}{\beta} y_t = -\frac{\alpha}{\beta}(\eta_t - m_t - \beta \varepsilon_t)$$

$$\Leftrightarrow$$

$$y_t = \frac{\alpha(m_t - \eta_t) + \beta \varepsilon_t}{\alpha + \beta}$$

The value of the objective function under a money supply procedure:

$$E_m(y_t)^2 = E\left(\frac{\alpha(m_t - \eta_t) + \beta \varepsilon_t}{\alpha + \beta}\right)^2 = \frac{\alpha^2 \sigma_\eta^2 + \beta^2 \sigma_\varepsilon^2}{(\alpha + \beta)^2}$$

Under an interest rate procedure, place the IS-equation directly into the objective function. Set i_t such that $E(y_t)=0$, hence output will equal ε_t.

$$E_i(y_t)^2 = E(-\alpha i_t + \varepsilon_t)^2 = \sigma_\varepsilon^2$$

b) *Under what conditions is an interest rate procedure preferred to a money supply procedure?*

Optimal objective function under an interest rate procedure is less than the objective function under a money supply procedure if:

$$E_i(y_t)^2 < E_m(y_t)^2$$
$$\Leftrightarrow$$
$$\sigma_\varepsilon^2 < \frac{\alpha^2\sigma_\eta^2 + \beta^2\sigma_\varepsilon^2}{(\alpha+\beta)^2}$$
$$\Leftrightarrow$$
$$\sigma_\eta^2 > (1 + {}^{2\beta}\!/\!{}_{\alpha})\sigma_\varepsilon^2$$

Interest rate procedure preferred if variance of money demand shocks σ_η^2 large, LM curve steeper (slope $1/\beta$) and the IS curve flatter (slope $(-1/\alpha)$). Money supply procedure preferred if variance of aggregate demand shocks σ_ε^2 is large etc.

The Central Bank has no control over money supply but instead control a narrow aggregate like base money

$$m_t = b_t + \chi_t, \qquad (4)$$

where b_t is base money and χ_t is a random money-multiplier disturbance with mean zero and variance given by $Var(\chi_t) = \sigma_\chi^2$. The authorities now decide to follow a simple policy rule

$$b_t = \lambda i_t \qquad (5)$$

c) *Find expressions for the interest rate and output given this rule. Show that the optimal policy rule (in the sense of minimizing the variance of output) is given by:*

The expression for the interest rate from equation (2):

$$i_t = \frac{1}{\beta}(y_t + \eta_t - \lambda i_t - \chi_t)$$

$$\Leftrightarrow$$

$$i_t = \frac{1}{(\lambda + \beta)}(y_t + \eta_t - \chi_t)$$

Substitute into (1) yields:

$$y_t = -\alpha i_t + \varepsilon_t$$

$$\Leftrightarrow$$

$$y_t = -\frac{\alpha}{(\lambda + \beta)}(y_t + \eta_t - \chi_t) + \varepsilon_t$$

$$\Leftrightarrow$$

$$\frac{(\lambda + \beta + \alpha)}{(\lambda + \beta)} y_t = -\frac{\alpha}{(\lambda + \beta)}(\eta_t - \chi_t) + \varepsilon_t$$

$$\Leftrightarrow$$

$$y_t = \frac{(\lambda + \beta)\varepsilon_t - \alpha(\eta_t - \chi_t)}{(\lambda + \beta + \alpha)}$$

hence

$$i_t = \frac{\eta_t + \varepsilon_t - \chi_t}{\alpha + \beta + \lambda}$$

$$E(y_t)^2 = \frac{(\lambda + \beta)^2 \sigma_\varepsilon^2 + \alpha^2(\sigma_\eta^2 + \sigma_\chi^2)}{(\lambda + \beta + \alpha)^2}$$

Minimize with respect to λ, we obtain:

$$\frac{[2(\lambda^* + \beta)\sigma_\varepsilon^2][(\lambda^* + \beta + \alpha)^2] - [(\lambda^* + \beta)^2 \sigma_\varepsilon^2 + \alpha^2(\sigma_\eta^2 + \sigma_\chi^2)]2(\lambda^* + \beta + \alpha)}{((\lambda^* + \beta + \alpha)^2)^2} = 0$$

$$\Leftrightarrow$$

$$[(\lambda^* + \beta)\sigma_\varepsilon^2][(\lambda^* + \beta + \alpha)] - [(\lambda^* + \beta)^2 \sigma_\varepsilon^2 + \alpha^2(\sigma_\eta^2 + \sigma_\chi^2)] = 0$$

$$\Leftrightarrow \tag{6}$$

$$(\lambda^*)^2 + \lambda^*\beta + \lambda^*\alpha + \beta\lambda^* + \beta^2 + \beta\alpha - (\lambda^*)^2 - 2\lambda^*\beta + \beta^2 = [\alpha^2(\sigma_\eta^2 + \sigma_\chi^2)/\sigma_\varepsilon^2]$$

$$\Leftrightarrow$$

$$\lambda^* = -\beta + \frac{\alpha(\sigma_\eta^2 + \sigma_\chi^2)}{\sigma_\varepsilon^2}$$

d) *An alternative to the instrument rule (as that studied above) is a targeting regime. Explain briefly the main differences between a targeting regime and an instrument rule? List the characteristics of a typical inflation-targeting monetary-policy regime.*

Instrument rules

Set interest rates directly, e.g. Taylor rule

$$i_t = \pi^T + \overline{r} + \alpha(\pi_t - \pi^T) + \beta(\ln Y_t - \ln \overline{Y})$$

where π^T is the target inflation rate, Taylor rules do not match economic policy when using data actually available at the time policy was conducted (not revised data).

Optimal values of the rule can be obtained when the CB can commit to the rule.

Alternative rules (i.e. the Orphanides rule, rule with interest abroad etc.)

Implication of different rules

Targeting regimes

A targeting regime, in which the CB is assigned an objective, is defined by 1) The variables in the CB's loss function (objectives) and 2) the weights assigned to these objectives, with policy implemented under discretion to minimize the expected discounted value of the CB's loss function.

Alternative targeting regimes; Inflation targeting, price level targeting, nominal income growth targeting regimes, average inflation targeting etc.

Inflation targeting
The objective function of the CB can take the form:

$$L_t = E_t \sum_{i=0}^{\infty} \beta^i \left[(\pi_{t+i} - \pi^T)^2 + \lambda x_{t+i}^2 \right]$$

where π^T is the target inflation rate, x_t is the output gap and λ is the weight assigned to achieving the output gap objective relative to the inflation objective, (λ=0, strict inflation targeting, λ>0, flexible inflation targeting).

If policy decisions in time t only affect future values of inflation and output, then the CB must rely on forecasts.

- Inflation targeting, a rule or constrained discretion?

- Many central banks that target inflation does not only control inflation, but try to smooth output fluctuations and keep exchange rates and interest rates stable.
- Central banks in inflation targeting countries place more weight on the behaviour of inflation than other central banks do.

- Transparency