ECONOMIC POLICY

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Week 6

New keynesian model 1

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New keynesian model

- State of the art dynamic makromodel for monetary policy analysis
- It is much more complicated than any of the models we discussed so far. Therefore we neglect the formal derivations
- The real sector consists of an infinite time horizon RBC
- The original RBC model assumes perfect competition. Therefore it cannot model monetary policy

Main features

- Price rigidities as results of optimal decision making can be built into models only if there is such thing as decision on price setting
- Instead of assuming perfect competition this model assumes monopolistic competition in the supply side. Firms face elastic, but not infinitely elastic demand curves.

Main features

- Many competing firms maximizing profit while producing a product that is diferentiated. In all other respect firms are alike.
- In the long run money is neutral, output is at the potential level.

Main features

- This potential output is lover than the one prevailing at perfect competition. Firms determine output according to MR = MC, but in other respects the meaning of the natural rate is the same
- The representative consumer consumes all the products. Consumption demand of separate goods can be aggregated into an aggregate consumption demand (C) on the basis of the utility function.

Aggregate demand

- Just like in the RBC model, aggregate consumption, investment and government demand can be pulled together into an aggregate demand function.
- $Y_t = D(Y_t, Y_{t+1}, r_t,) + G_t$
- Due to consumption smoothing demand for goods depends on future income,
- It also depends on the real interest rate due to intertemporal consumer substitution as well as to interest sensitivity of investment.
- It also depends on government demand.

Output gap

- Monetary policy influences the output gap only. Therefore it is useful to set the model in gap terms.
- All variables are defined as percentage deviations from their natural rate values.
- The original relationships given in level terms are log linearized.
- It is simpler to handle, however, the approximation is good only in the environment of the natural rate.

Digression: taking logs

$$Y_t = D(Y_t, Y_{t+1}, r_t) + G_t$$

$$Y_t - \bar{Y} = D_y(Y_t - \bar{Y}) + D_y(Y_{t+1} - Y) + D_r(r_t - \bar{r}) + G_t - \bar{G}$$

$$\frac{Y_t - \bar{Y}}{\bar{Y}} = a\left(\frac{Y_{t+1} - \bar{Y}}{Y}\right) - \phi(r_t - \bar{r}) + c\left(\frac{G_t - \bar{G}}{\bar{Y}}\right)$$

- Taking natural logarithms

$$\ln Y_t - \ln \bar{Y} = a(\ln Y_{t+1} - \ln \bar{Y}) - \phi(r_t - \bar{r}) + c(\ln G_t - \ln G)$$

$$\tilde{Y}_t = \tilde{Y_{t+1}} - \phi \tilde{r}_t + g_t$$

Aggregate demand

- New keynesian IS curve, the log of the original, showing the size of excess demand (output gap)

$$\tilde{Y}_t = \widetilde{Y_{t+1}} - \phi \tilde{r}_t + g_t$$

- Current output gap depends:

1. on the level of expected future output gap,
2. on the real interest gap,
3. on the fluctuation of G, that is, on the government expenditure gap.

Aggregate demand

1. Given potential output, an expected increase in future income increases excess demand now. Consumers smooth.
2. If the real interest rate is larger than its natural value consumers tilt, they postpone their consumption into the future.
3. Higher interest also depresses investment demand. The output gap shrinks.

Aggregate demand

4. g_t is demand shock. Fluctuation of government spending, or any other exogenous changes in demand
- g_t is autoregressive. The shock lasts for several periods. Exhibits diminishing persistency

$$g_t = \mu g_{t-1} + \widehat{g_t} \qquad \mu < 1 \qquad \widehat{g_t}$$

Persistency

- Persistent and non persistent shocks also exist.
- Business cycles are persistent, but the reason is not necessarily shock persistency.
- In real economies there are lots of adjustment difficulties. We cannot represent all of them in a model. Assuming persistency in the shock itself can substitute for these adjustment problems.

Real interest gap

- The difference between the actual and the natural rate

$$\tilde{r}_t = r_t - rr_t$$

- where rr_t is the natural rate.
- If prices were perfectly flexible, the interest rate was zero. With staggering prices it contributes to the existence of the output gap.

Real interest gap

- The real interest rate cannot be observed. It is calculated from the nominal rate and the inflation according to the Fisher equation

$$\tilde{r}_t = i_t - \pi_{t+1} - rr_t$$

- Substituting into the demand equation:

$$\tilde{Y}_t = \tilde{\tilde{Y}}_{t+1} - \phi(i_t - \pi_{t+1} - rr_t) + g_t$$

Monetary policy

- Due to sticky prices the central bank can influence the real interest rate through manipulating the nominal rate.
- In the long run r is given independent of nominal variables, i and Π move together
- In the short run time paths of i and Π can differ from each other pushing r away from its natural rate.

Money supply or interest rate?

- So far we assumed M as policy intervention variable. The central bank manipulated r through changing the money supply
- LM curve
- Static model: one time increase in M →r
- Dynamic model: changing the growth rate of M
- Here the central bank uses i as policy variable. It sets i and allows M passively to change to meet money demand

Forward looking expectations

- Monetary policy: rising i will reduce the positive output gap.
- It is not just current i that counts. Due to forward looking, expected future values of i also influence current output gap.
- Monetary policy is not just setting i now, it is a rule that sets the time path of i conditional on the state of the economy.

Demand

$$\tilde{Y}_t = \sum_{i=0}^{\infty} \phi(i_{t+i} - \pi_{t+1+i} - rr_{t+i}) + g_{t+i}$$

- Current output gap is a function of current and future monetary policies as well as current and expected future shocks.

Supply – price setting

- Monopolistic competition
- Firms set prices, but they change them infrequently. Changing prices is costly
- Menu costs
- Institutional reasons
- Calculate the optimal prices is a costly and enduring process.

Calvo pricing

- Firms set prices that stay fixed for several periods. This price is to maximize profit for the period that lasts until they can set prices again. They will take MC and MR into consideration for that whole period.
- In periods when they do not set new prices, they meet any demand at the constant price. This gives the model the keynesian flavor.

Aggregation

- If the number of periods is between two pricing decisions for each firm is constant, then there is a constant share of firms setting prices in every period.
- It gives a constant probability for the representative firm to change the price in each period.
- The profit maximization problem for the representative firm with a given probability of not changing prices for subsequent periods can be solved.

Supply – price setting

- This allows for a formal aggregation into a price (inflation) determination:
  $\pi_t = \beta\pi_{t+1} + K\tilde{Y}_t + u_t$
- Inflation depends on expected future inflation, on the output gap and on a random autoregressive price shock.
- It is not output that depends on inflation, but the other way around. It is firms that change prices according to the size of the output gap.

Supply – price setting

- Inflation effect of the output gap
- Producers have increasing MC curves
- Increases of output relative to potential result in increasing marginal costs. This is why they increase prices if output is larger.
- The size of K coefficient depends on the slope of MC as well as on how frequently they set prices.

Price shock

- u_t comprises changes in costs that are independent of the level of production (output gap).
- Changes in excise taxes, price changes of imported energy, world price of food are examples.
- Similarly, changes in minimum wages or increases in the wages due to union claims.

Price shock

- Price shocks pass directly into inflation as there is no need for recalculating optimal prices
- u_t is autoregressive
- Changes in the output gap mean movements on the MC curve, while price shocks mean shifts of the MC curve

$$u_t = \varrho u_{t-1} + \hat{u}_t \quad \varrho < 1$$

Forward looking expectations

- Π_{t+1}, the role of expected future inflation

$$\pi_t = \beta\pi_{t+1} + K\tilde{Y}_t + u_t$$

$$\pi_t = \sum_{i=0}^{\infty} \beta^i \left(KY_{t+i} + u_{t+i}\right)$$

- Present inflation depends on output gaps and price shock in the present and in the future

New keynesian Phillips curve

$$\pi_t = \beta \pi_{t+1} + K\tilde{Y}_t + u_t$$

- Formally they are similar.
- Old: current inflation determines current output.
- New: current and future output (output gap) determines current inflation.

Supply and demand

$$\tilde{Y}_t = \widetilde{\widetilde{Y}}_{t+1} - \phi(i_t - \pi_{t+1} - rr_t) + g_t$$

$$\pi_t = \beta\pi_{t+1} + K\tilde{Y}_t + u_t$$

- Two dynamic equations with three unknowns.
- The model is closed with monetary policy, the time path of i.

Literature

- David Romer (1993): The New Keynesian Synthesis, The Journal of Economic Perspectives, Vol. 7, No. 1
- Clarida–Gali–Gertler (1999): The Science of Monetary Policy: A New Keynesian Perspective, Journal of Economic Literature, 1999. December