Monetary and Exchange Rate Policy in a Small Open Economy

Fixed or Flexible Exchange Rates?
A Short Term Model of a Small Open Economy

• We analyze the effects of monetary and exchange rate policy in a short run model of a small open economy that combines the characteristics of the keynesian and the monetary approach.

• We assume that nominal wages are determined in the beginning of each period, through collective bargaining, and that wages are fixed for one period and non indexed.

• After the determination of nominal wages the economy is subjected to unanticipated shocks in output, productivity, money demand, international interest rates and international inflation.
Alternative Monetary and Exchange Rate Regimes

• We examine the effectiveness of alternative rules for monetary policy in stabilizing the economy in the face of such disturbances, as well as optimal monetary policy.

• The analysis demonstrates that neither a fixed rate of growth for the money supply, under flexible exchange rates, as suggested by Friedman (1953, 1960), nor a regime of fixed exchange rates can insulate the economy against the effects of unanticipated disturbances on inflation and unemployment.
Optimal Monetary and Exchange Rate Policy

• The optimal monetary and exchange rate policy that seeks to minimize deviations of inflation and unemployment from the targets of the monetary authorities faces two problems:
• The first is the problem of credibility, as attempts to stabilize unemployment below the economy’s “natural” rate causes inflationary expectations and equilibrium inflation to rise to the point where the monetary authorities no longer have the incentive to use monetary policy to reduce unemployment.
• However, even if the problem of credibility is addressed, there is a second problem, as optimal monetary policy cannot fully stabilize inflation and unemployment in the face of unanticipated disturbances.
• One instrument, monetary policy, does not suffice for the achievement of two targets, inflation and unemployment.
Output and Employment in a Small Open Economy

• We consider a small open economy that produces an internationally traded good. Capital is fixed, and a short run production function determines output as a function of employment.

• Firms are competitive and determine employment equating the marginal product of labor with the real wage.

• Nominal wages are determined in the beginning of the period and remain constant for one period.

• Wage setters determine nominal wages so as to make expected employment equal to a target employment level which is lower than full employment.
Output and Employment in a Small Open Economy

\[ y_t = \beta l_t + \mu_t \]

\[ \mu_t = g + \mu_{t-1} + \nu_t^{\mu} \]

where \( \nu_t^{\mu} \sim N(0, \sigma_{\mu}^2) \)

\[ l_t = -\frac{1}{1 - \beta} (w_t - p_t - \mu_t) \]

\( y \) is the log of output, \( l \) the log of employment, and \( \mu \) the log of productivity. \( g \) is the average rate of growth of productivity, and \( w \) and \( p \) the logs of the nominal wage and the price level respectively.
Determination of Nominal Wages

\[ \min E_{t-1}(l_t - n)^2 \]

where \( n < n \)

\[ w_t = E_{t-1}p_t + E_{t-1}\mu_t - (1 - \beta)n \]

\( n \) is the log of the labor force and \( n \) with a ~ the log of the employment target of wage setters. \( E \) is the mathematical expectations operator, on the basis of information available up to the end of period \( t-1 \).
Employment, Output and Unanticipated Inflation

\[ l_t = n + \frac{1}{1 - \beta} (p_t - E_{t-1} p_t + v_t^\mu) \]

\[ y_t = y_t + \frac{\beta}{1 - \beta} (p_t - E_{t-1} p_t + v_t^\mu) \]

where

\[ y = \beta n + \mu_t \]
The Short Term Relation between Inflation and Unemployment

\[ u_t = u - \frac{1}{1 - \beta} (\Delta p_t - E_{t-1} \Delta p_t + \nu_{t}^u) \]

where \( u \sim n - \hat{n} \)

This equation depicts an expectational Phillips curve, i.e. a negative relation between unemployment and unanticipated inflation, and describes the supply side in this model.
Equilibrium in the Domestic Money Market and the Foreign Exchange Market

\[(m - p)_t = y_t - \alpha i_t + k_t\]

\[k_t = k_{t-1} + \nu_t^k \quad \text{where} \quad \nu_t^k \sim N(0, \sigma_k^2)\]

\[i_t = i_t^* + E_t s_{t+1} - s_t\]

\[i_t^* = i_{t-1}^* + \nu_t^i \quad \text{where} \quad \nu_t^i \sim N(0, \sigma_i^2)\]

$m$ log of the domestic money supply, $i$ domestic nominal interest rate, $k$ shock to money demand, $i^*$ international nominal interest rate, $s$ logarithm of the nominal exchange rate.
Equilibrium in the Domestic Market for Goods and Services implies Purchasing Power Parity

\[ p_t = s_t + p_t^* \]

\[ p_t^* = \pi^* + p_{t-1}^* + \nu_t^p \quad \text{where} \quad \nu_t^p \sim N(0, \sigma_p^2) \]

\[ \Delta p_t = \Delta s_t + \Delta p_t^* \]

\( p^* \) log of international price level, \( \pi^* \) average international inflation.
Friedman Rule and Flexible Exchange Rates

\[ m_t = x + m_{t-1} \]

\[ \left( F - \frac{1 + \alpha}{\alpha} \right)s_t = -\frac{1}{\alpha}(m_t - p_t^* - \beta \tilde{n} - \mu_t + \alpha i_t^* - k_t) \]

\[ s_t = \frac{1}{1 + \alpha} \sum_{j=0}^{\infty} \left( \frac{\alpha}{1 + \alpha} \right)^j E_t(m_{t+j} - p_{t+j}^* - \beta \tilde{n} - \mu_{t+j} + \alpha i_{t+j}^* - k_{t+j}) \]
The Determination of the Nominal Exchange Rate

• The current nominal exchange rate depends on the expected future evolution of the fundamentals, such as the domestic money supply, employment, shocks to productivity and money demand, as well as shocks to the international nominal interest rate and the international price level.

• These variables determine the current and expected future conditions in the domestic money market, that call for an adjustment of the nominal exchange rate.
The Nominal Exchange Rate under a Friedman Rule

\[ s_t = \frac{\alpha}{1+\alpha} (x - \pi^* - g) + (m_t - p_t^* - \beta \hat{n} - \mu_t + \alpha i_t^* - k_t) \]

\[ E_t \Delta s_{t+1} = x - \pi^* - g \]

\[ s_t - E_{t-1} s_t = -\nu_t^p + a\nu_t^i - \nu_t^\mu - \nu_t^k \]
Inflation and Unemployment under a Friedman Rule

\[ \Delta p_t = x - g + \alpha v_t^i - v_t^\mu - v_t^k \]

\[ u_t = u - \frac{1}{1 - \beta} (\alpha v_t^i - v_t^k) \]
Under a constant rate of growth of the money supply, domestic inflation is on average equal to $x-g$. It deviates from this average to the extent that there are unanticipated disturbances to international nominal interest rates, productivity and money demand.

Unemployment is not affected by permanent productivity shocks, but only by monetary shocks, such as shocks to international nominal interest rates and shocks to domestic money demand.

This happens because the money supply does not respond to monetary shocks, and this causes unanticipated effects on the price level, inflation and real wages.

With regard to productivity shocks, the unanticipated changes in the price level are exactly those required to neutralize their effects on employment, output and unemployment.
Fixed Exchange Rates

\[ S_t = S \]

\[ i_t = i_t^* \]

\[ \Delta p_t = \Delta p_t^* = \pi^* + \nu_t^p \]

\[ u_t = u - \frac{1}{1 - \beta} \left( \nu_t^p + \nu_t^\mu \right) \]
Inflation and Unemployment under Fixed Exchange Rates

- Domestic inflation is determined by international inflation, and the only shocks that affect it are shocks to international inflation.
- Only shocks to international inflation and productivity affect unemployment under fixed exchange rates.
- The reason is that monetary disturbances, such as shocks to international interest rates and domestic money demand, cause equilibrating changes in the domestic money supply, as the central bank intervenes to maintain a fixed exchange rate. Thus, these disturbances do not affect either the domestic price level or domestic unemployment.
- The domestic price level only depends on the level of the fixed exchange rate, while domestic inflation only depends on international inflation.
The Friedman Rule versus Fixed Exchange Rates

- With a fixed rate of growth of the money supply and flexible exchange rates, monetary shocks (shocks in international interest rates and the demand for money) affect both inflation and unemployment. The advantage is that in this case, the monetary authorities may choose the average domestic inflation rate through the choice of the average rate of money supply growth $x$.

- Under fixed exchange rates, domestic inflation equals international inflation. Shocks in international inflation affect domestic inflation and domestic unemployment, which is also influenced by shocks to productivity.

- If international inflation is low and productivity shocks small compared with monetary shocks, fixed exchange rates dominate the rule of a constant rate of growth in the money supply. Otherwise the opposite applies.
Optimal Monetary and Exchange Rate Policy

- The monetary authorities care both about inflation and unemployment.
- They choose the domestic nominal interest rate, and through uncovered interest parity the current exchange rate, in order to minimize an objective that depends both on inflation and unemployment.

\[ \Lambda_t = \frac{1}{2} (\Delta p_t)^2 + \frac{\theta}{2} (u_t)^2 \]

- \( \theta \) is a measure of the relative aversion of the monetary authorities to unemployment relative to inflation. The higher the weight that the authorities attribute to unemployment relative to inflation the higher is \( \theta \).
First Order Conditions for the Optimal Exchange Rate Policy

Substituting the purchasing power parity condition and the expectational Phillips curve in the objective function of the monetary authorities, we get,

\[ \Lambda_t = \frac{1}{2} (\Delta s_t + \Delta p_t^*)^2 + \frac{\theta}{2} \left( u - \frac{1}{1-\beta} (\Delta s_t - E_{t-1} \Delta s_t + \Delta p_t^* - E_{t-1} \Delta p_t^* + v_t^\mu) \right)^2 \]

From the first order conditions for a minimum with respect to \( \Delta s \)

\[ \Delta s_t = -\Delta p_t^* + \frac{\theta}{1-\beta} u - \frac{\theta}{(1-\beta)^2} (\Delta s_t - E_{t-1} \Delta s_t + \Delta p_t^* - E_{t-1} \Delta p_t^* + v_t^\mu) \]
The Expected Rate of Depreciation, Inflation and Unemployment

Taking rational expectations in the first order condition, it follows that,

\[ E_{t-1} \Delta s_t = -\pi^* + \frac{\theta}{1-\beta} \tilde{u} = E_t \Delta s_{t+1} = i_t - i_t^* \]

\[ E_{t-1} \Delta p_t = \frac{\theta}{1-\beta} \tilde{u} \]

\[ E_{t-1} u_t = \tilde{u} \]
The Inflationary Bias of Optimal Monetary and Exchange Rate Policy

• From the first order conditions, we get the problem of inflationary bias (time inconsistency) of optimal monetary policy (Barro Gordon 1983).

• The higher the natural rate of unemployment (the distortion in the labor market), the greater will be the expected equilibrium inflation. This is because the incentive to create unexpected inflation by the monetary authorities is stronger the higher the “natural” rate of unemployment.

• This incentive is incorporated in the expectations of wage setters, and in equilibrium the economy ends up with higher expected inflation, without the monetary authorities being able to affect the unemployment rate. Equilibrium unemployment is at its “natural” rate, and equilibrium inflation at a level that depends positively on the “natural” rate of unemployment, without the higher inflation rate affecting unemployment.
Solving for the current rate of exchange rate depreciation, inflation and unemployment, we get

\[
\Delta s_t = -\Delta p_t^* + \frac{\theta}{1 - \beta} u^\sim - \phi v_t^\mu = -\pi^* + \frac{\theta}{1 - \beta} u^\sim - v_t^p - \phi v_t^\mu
\]

\[
\Delta p_t = \frac{\theta}{1 - \beta} u^\sim - \phi v_t^\mu
\]

\[
u_t = u^\sim - \psi v_t^\mu
\]

where, \( \phi = \frac{\theta}{\theta + (1 - \beta)^2} < 1 \) \quad \psi = \frac{1 - \beta}{\theta + (1 - \beta)^2} \)
The Optimal Policy and Unanticipated Shocks

• The optimal monetary policy counteracts all nominal disturbances (disturbances in international inflation, international interest rates and domestic demand for money), but only partially counteracts real (productivity) shocks. This is because there are two targets (inflation and unemployment) and one policy instrument (monetary policy), which affects the economy through inflation.

• However, the most important problem of optimal monetary policy is the inflationary bias, due to the incentive to create unanticipated inflation to reduce unemployment below its “natural” rate. Inflation depends on the “natural” rate of unemployment, because the higher it is, the greater the incentive of the monetary authorities to resort to unanticipated inflation. This incentive is taken into account by wage setters, who adjust their inflationary expectations accordingly.
How to Deal with the Inflationary Bias of Optimal Monetary Policy

• Since the monetary authorities cannot affect the unemployment rate, the problem is how to convince the private sector (in this case wage setters) that they will not create unanticipated inflation, if inflationary expectations are low. If they manage this, then the economy cannot solve the problem of high unemployment through monetary policy, but at least it can solve the problem of high inflation.

• One solution is the delegation of decisions on monetary policy to a central bank whose goal is to address the problem of inflation, without the mandate to maintain unemployment below its natural rate. This solution takes the form of delegating monetary policy to an agency with different objectives than the true objectives of the government.
An Independent Central Bank

Assume that the government delegates monetary policy to a central bank which is instructed, through its constitution, to minimize the following objective function,

\[
\Lambda_t = \frac{1}{2} (\Delta p_t)^2 + \frac{\theta}{2} (u_t - \tilde{u})^2
\]

This is different from the one we have assumed so far, in that the central banker cares not for the level of unemployment, but only for its deviation from the “natural” rate of unemployment. The first-order conditions for the minimization of this objective function imply that,

\[
\Delta s_t = - \Delta p_t^* - \phi u_t
\]
Inflation and Unemployment with an Independent Central Bank

• The optimal depreciation rate does not depend on the “natural” rate of unemployment, because the central bank has no incentive to generate inflation in order to reduce the unemployment rate below the “natural” rate.

• Inflation and unemployment are determined by,

\[ \Delta p_t = -\phi v_t^u \]

\[ u_t = u - \psi v_t^u \]

• The inflationary bias of monetary policy no longer exists, as the central bank does not attempt to create inflation in order to lower the unemployment rate below its natural rate, and nominal disturbances fully neutralized because they operate through the same channel as monetary policy.
The regime of delegating decisions for monetary and exchange rate policy to a central bank that has as its objectives only inflation and deviations of unemployment from its “natural” rate, is the best monetary and foreign exchange regime for the economy of this model.

It is easy to show that this regime is superior to both the rule of a fixed rate of growth of the money supply, and the rule of fixed exchange rates.

Exchange policy completely neutralizes nominal disturbances and partly neutralizes real disturbances. The average inflation rate is equal to zero and the average unemployment is equal to its natural rate.
Conclusions on Alternative Monetary and Exchange Rate Policy Rules

• The analysis of this model shows that neither a constant rate of growth of the money supply, with flexible exchange rates (as recommended by Friedman), nor a fixed exchange rate regime can cope adequately with unanticipated shocks affecting fluctuations of inflation and unemployment in a small open economy.

• With constant rate of growth of the money supply (as recommended by Friedman), monetary shocks (disturbances in international interest rates and money demand) cause fluctuations in both inflation and unemployment. The only advantage of this policy rule is that the monetary authorities may choose the average domestic inflation rate through the choice of the average rate of growth of the money supply.

• Under a fixed exchange rate, domestic inflation equals international inflation. However, shocks to international inflation affect domestic unemployment, as is the case with productivity shocks.

• If international inflation is low and productivity shocks small compared with monetary shocks, a fixed exchange rate regime dominates the rule for a constant rate of growth of the money supply. Otherwise, the opposite is true.
Conclusions on the Optimal Policy

• An optimal monetary and exchange rate policy, which seeks to minimize fluctuations in inflation and unemployment, faces two problems. First the problem of credibility, and second the problem of pursuing two objectives with one instrument.

• The problem of credibility arises because the effort to reduce unemployment below the “natural” rate of unemployment increases inflationary expectations and leads to high inflation without addressing the problem of unemployment.

• The problem of credibility can be solved through the delegation of the design and conduct of monetary policy to a central bank, which has the primary aim of tackling inflation, and the secondary aim of tackling unemployment fluctuations around its natural rate.

• Even then, however, a second problem arises. The optimal policy cannot fully address the impact of real shocks. The reason is that the tool of monetary policy is not sufficient to achieve two objectives, thus, in addressing fluctuations in inflation and unemployment, the central bank will only be partially successful. However, the optimal monetary and exchange rate policy can adequately deal with the effects of monetary disturbances.