VI. Economic Interdependence and Choice of Exchange Rate Regimes

In the last section of this lecture, we take up the issue of choice of exchange rate regimes under economic interdependence. We concentrate on the analysis that shows us the possible benefit from losing monetary policy autonomy, because it provides a new perspective to the constraints represented by the "inconsistent triangle". It also brings to the fore the issue of symmetric and asymmetric exchange rate regimes and what makes a fixed exchange rate arrangement last.

A benefit from losing monetary policy autonomy

Economic interdependence and exchange rate regimes was a topic much discussed in the latter half of the 1980s, in the broader context of international policy co-operation. Using game theory, floating exchange rates was portrayed as a system in which monetary authorities did not co-operate, fixed exchange rates as a system in which they did co-operate (in one form or another). One fruit of such analyses was the economic interpretation given to the European Monetary System (EMS), as a way to achieve lower inflation by abandoning monetary policy autonomy.

By now we are familiar with the trade-off faced by monetary policymakers in choosing an exchange rate regime. We cannot have stable exchange rates, autonomous monetary policies and free capital flows at the same time, in general. Once capital controls are removed, a country that chooses to stabilise its exchange rate loses monetary policy autonomy. Losing monetary policy autonomy is undesirable, because that makes it harder to stabilise the domestic economy. However, there are times when it makes economic sense to choose to abandon monetary policy autonomy. This is when the autonomous monetary policy is not conducive to domestic stability. Monetary policy of members of the EMS other than (West) Germany fit this profile, and members actually experienced a decline in inflation rates after joining the EMS (although EMS members were not the only advanced nations that saw lower inflation during the same period). This was one important economic reason behind the EMS, and the Economic and Monetary Union (EMU) which eventually followed.

The economic reasons for the EMS

The EMS came into being in 1979, and provided a living example of a non-floating exchange rate system adopted by advanced nations. Giavazzi, F. and A. Giovannini (*Limiting Exchange Rate Flexibility, The European Monetary System*, MIT Press, 1989) were the first to explain in economic terms why the Europeans chose to establish the EMS. They

cited the mutual openness of European countries and the Common Agricultural Policy (CAP) as the economic reasons. The more countries are open towards each other, the higher the proportion of their GDP that is affected by gyrations in the relevant exchange rates. And since the CAP aimed at equalising agricultural product prices across nations, exchange rate changes were a huge nuisance. It made economic sense to introduce a system like the EMS.

To be precise, Europe's new exchange rate system was called the Exchange Rate Mechanism (ERM) of the EMS. The initial plan for the EMS was to establish the European Monetary Fund (EMF) along with the ERM. The EMF was supposed to be the precursor to a European central bank, but missed the planned starting date of March 1981. Only the ERM remained. It is for this reason that "EMS" is often used as a synonym for "ERM". The membership of the ERM changed throughout the years. There were even two major currency crises, in September 1992 and August 1993. But in the end, the ERM led to the successful introduction of the single currency euro, by fifteen members of the European Union (EU) as of 2008. These countries are Austria, Belgium, Cyprus, Germany, Greece, Finland, France, Ireland, Italy, Luxembourg, Malta, the Netherlands, Slovenia, Spain and Portugal. Of these, twelve are original members while Greece joined in January of 2001, Slovenia joined in January of 2007 and Malta joined in January of 2008.

What remains today of the ERM is ERM-II, a system whereby members maintain their exchange rates against the euro within a band of 15% above and below the central rates. As of 2008, five countries are in ERM II: Denmark, Estonia, Latvia, Lithuania and Slovakia. At its start in 1999, the Danish krone and Greek drachma were the only two currencies in ERM-II. After Greece adopted the euro on 1 January 2001, Denmark became the only participant, until the Estonian kroon, the Lithuanian lita and the Slovenian tolar joined on 28 June 2004. The Cyprus pound, Latvian lats and Maltese lira joined on 2 May 2005. The Slovak koruna joined on 28 November 2005. The Slovenian tolar was in ERM-II until January of 2007 and the Maltese lira was in ERM-II until January of 2008. For a brief account on the process of monetary integration in Europe, see for example Kaji ("The euro, the enlarged EU and Asia", *Asia Europe Journal*, Vol.2/No.3, pp.399-414, 2004).

The Canzoneri and Henderson Model

To analyse the choice of exchange rate regimes under mutual economic interdependence, we need a two-country model in which (at least some of the) endogenous variables depend not just on domestic exogenous variables but also foreign exogenous variables. Canzoneri, M. and D. Henderson ("Is Sovereign Policymaking Bad?" *Carnegie-Rochester Conference Series on Public Policy* No.28, pp.93-140, 1988 and "*Monetary Policy in Interdependent*

Economies", MIT Press, 1991) used such models to analyse, among other things, the economic gains from joining the ERM. Specifically, in Section IV of Canzoneri and Henderson (1988), they show how a country with a high inflationary bias (Italy) could see its inflation rate decline by joining the ERM. Although the authors themselves state that "this justification of the EMS is rather suspicious" (p.118), the analysis is attractive in several ways.

First, it correctly identifies the ERM as an asymmetric system in which some central banks sought an outside source (the Bundesbank's strict anti-inflationary policy stance) to secure lower inflation.

Second, their model is linear and simple, even though it is a two-country model. The variables are defined as percentage deviations from their (original) equilibrium values, and take the value zero at equilibrium. The relationship between the original model (in levels) and the linear model (in logs) is clear and Walras' Law holds in both versions. Their model is also convenient for deriving the reduced form for the exchange rate, which allows us to confirm that exchange rates respond to asymmetries.

Third, by studying this analysis, we can learn about another important contribution to macroeconomic theory. This is the Kydland-Prescott ("Rules Rather than Discretion: The Inconsistency of Optimal Plans", *Journal of Political Economy*, vol. 85, pp.473-491, 1977) and Barro-Gordon ("Rules, Discretion and Reputation in a Model of Monetary Policy", *Journal of Monetary Economics*, vol.12, pp. 101-121, 1983) structure of inflationary bias and time inconsistency.

There are no interest rates and no capital flows in the version of the Canzoneri and Henderson model used in Section IV of Canzoneri and Henderson (1988).

Notation: (*denotes foreign variables)

m : nominal stock of money supply — e : nominal exchange rate

u' : demand shock — y : aggregate income and supply

x' : supply shock — n : employment

$\underline{n}$: employment higher than level corresponding to the natural rate of unemployment

z : real exchange rate: $z = e + p^* - p$ — w : nominal wage rate

q : consumer price index — p : domestic product price

The model:

(CH1) $y = (1-\alpha)n - x'$

(CH2) $y^* = (1-\alpha)n^* - x^{*'}$

(CH 3) $w - p = -\alpha n - x'$

(CH 4) $w^* - p^* = -\alpha n^* - x^{*'}$
(CH 5) $m = p + y$
(CH 6) $m^* = p^* + y^*$
(CH 7) $y = \delta z + (1-\beta)y + \beta y^*$
(CH 8) $y^* = -\delta z + (1-\beta)y^* + \beta y$
(CH 9) $q = (1-\beta)p + \beta(e + p^*)$
(CH 10) $q^* = (1-\beta)p^* + \beta(p - e)$

Equations (CH1) and (CH2) are the aggregate supply functions. The representative firms in each country maximise profit as price takers, resulting in (CH3) and (CH4). (CH5) and (CH6) are the LM equations, (CH7) and (CH8) are the IS equations. In other versions of the model, demand shocks are added to the IS equations. Consumer price indices are defined in (CH9) and (CH10). $\delta, \sigma > 0$ and $0 < \alpha, \beta < 1$.
The endogenous variagbles are $y, y^*, n, n^*, p, p^*, q, q^*, e$ and the independent equations are (CH1) to (CH4), three out of (CH5) to (CH8), (CH9) and (CH10). Only three equations out of (CH5) to (CH8) are independent because of Walras' Law. If we count z as an endogenous variable, it is determined by the definition of z given in the notation. The exogenous variables are $x', x^{*'}, m, m^*$. The nominal wage rates w and w^* are set at the beginning of the period and are exogenous during the period.

Time inconsistency and inflationary bias in the C&H model

Here is how w and w^* are set. At the beginning of the period, monetary policy authorities announce the change in money supply for that period (m and m^*). Having heard that announcement, unions set wages in such a way that employment will be at the level consistent with the natural rate of unemployment ($n = 0$ and $n^* = 0$). In other words, they minimise the expected level of n and n^* whose reduced forms are:

(CH11) $n = m - w$
(CH12) $n^* = m^* - w^*$

This minimisation results in $w = m^e$ and $w^* = m^{*e}$ where m^e and m^{*e} are the workers' expectation of m and m^*. The policy authorities' optimisation problem, on the other hand, is to minimise their loss functions:

(CH 13) $L = (1/2)[\sigma(n - \underline{n})^2 + q^2\ ]$

(CH 14) $L^* = (1/2)[\sigma(n^* - \underline{n}^*)^2 + q^{*2}]$

The authorities care about both employment and inflation (by setting last period's q and q^* equal to zero, q and q^* themselves can be interpreted as inflation rates). $\underline{n}$ and $\underline{n}^*$ are higher than employment levels corresponding to the natural rate of employment. When $\underline{n}$ and $\underline{n}^*$ are zero, policymakers and unions want the same rate of employment, i.e. the rate corresponding to the natural rate of unemployment. When $\underline{n}$ and $\underline{n}^*$ are positive, policymakers want employment to be higher. In such a case, the monetary policies suffer from time-inconsistency and there is inflationary bias. In other words, once unions set their nominal wages, authorities have an incentive to switch to a higher rate of money supply growth, reducing real wages and increasing employment.

Italy and Germany in the ERM

Canzoneri and Henderson (ibid.) apply this framework to the ERM, by assuming that the foreign country, Italy, has a stronger inflationary bias than the home country, Germany. In other words, $\underline{n}^* > \underline{n}$. To concentrate on the relationship between inflationary biases and choice of exchange rate regimes, the supply shocks are set to zero.

When the two countries adopt floating exchange rates, both monetary authorities minimise their respective losses, taking each others' monetary policies as given. This corresponds to Nash equilibrium between the two. When the two enter the ERM, the ERM is an asymmetric system in which Germany minimises its loss, knowing that Italy takes on the entire burden of intervention to maintain the Deutsche Mark-Italian lira rate constant. In other words, Germany is the leader and Italy is the follower in this regime. Italy chooses to maintain m^* equal to m, and Germany minimises L given $m^* = m$.

Mathematically, the Nash and ERM equilibria are derived by substituting the reduced forms for n, n^*, q and q^* into the loss functions and calculating the first order conditions for minimisation with respect to m (and m^* in the case of Nash equilibrium). The reduced forms for n and n^* are, by substituting the levels of w and w^* set by unions into (CH11) and (CH12),

(CH11') $n = m - m^e$

(CH12′) $n^* = m^* - m^{*e*}$.

We can see that in this model, the endogenous variables n and n^* do not reflect economic interdependence, they depend only on exogenous variables of their own economy. In contrast, the reduced forms for q and q^* show the economic interdependence:

(CH15) $q = m + (\varepsilon + \alpha - 1)(m - m^e) - \varepsilon(m^* - m^{*e})$
(CH16) $q^* = m^* + (\varepsilon + \alpha - 1)(m^* - m^{*e}) - \varepsilon(m - m^e)$,
where $\varepsilon \equiv \beta^2\gamma(1-\alpha)$, $\gamma \equiv 1/\delta$.

When calculating the first order conditions for floating exchange rates, the expected money supply changes m^e and m^{*e} are treated as given. One interpretation is that policymakers act as Nash players not just against each other but also against unions, and take the unions' strategies as given in their optimisation. Or we could simply say that wages are set by unions first, and become fixed by the time the policymakers are optimising.
In any event, once the first order conditions are derived, we solve them simultaneously for the Nash equilibrium values of m and m^*. At this point, we must substitute the levels of m^e and m^{*e} that actually materialise, which are $m^e = m$ and $m^{*e} = m^*$ since unions end up correctly expecting the money supply changes.
When solving for the ERM equilibrium, we first substitute $m^* = m$ into L, then derive the first order condition for minimising L with respect to m. Again we treat m^e and m^{*e} as given at this stage. Once we have the first order condition, we use $m^e = m$ and $m^{*e} = m^*$ to solve for the equilibrium level of m, which is equal to m^*.

Does inflation go down by joining the ERM?
From the equilibrium levels of m and m^*, we can calculate n, n^*, q and q^*. The results regarding n and n^* are actually not very surprising, the structure of the analysis is such that they both remain at zero under both flexible exchange rates and ERM. The policymakers' effort to increase employment beyond the level corresponding to the natural rate of unemployment comes to naught.
What is more interesting in the present context is whether the inflation rates differ according to which exchange rate regime is adopted. From (CH15) and (CH16), $q = m$ and $q^* = m^*$ under $m^e = m$ and $m^{*e} = m^*$. Hence under floating exchange rates,

$$q^N = \frac{\sigma \underline{n}}{\varepsilon + \alpha}$$

$$q^{*N} = \frac{\sigma \underline{n}^*}{\varepsilon + \alpha}$$

and under ERM,

$$q^{ERM} = \frac{\sigma \underline{n}}{\alpha} = q^{*ERM}$$

Evidently, the two countries' inflation rates converge under ERM. And by subtracting the inflation rates under floating exchange rates from the inflation rates under ERM, we can confirm the following. The inflation rate for Italy declines by joining the ERM, if the initial gap in the inflation bias ($\underline{n} - \underline{n}^*$) is large enough. The inflation rate for Germany increases by joining the ERM. This is because joining ERM frees Germany from any concern over the exchange rate; Italy will take care of the stabilisation of the DM-lit rate. When interpreting this latter result, we should keep in mind that the strong anti-inflationary stance of the Bundesbank rests on historical experience, not incorporated in this analysis.

Lessons from the Canzoneri and Henderson analysis of ERM

As mentioned before, Canzoneri and Henderson find these results to be imperfect justification of the ERM (ibid. p.118). They provide three reasons. One is that German inflation is supposed to go up by joining. But we have already commented on this point.
The second reason is that they find no obvious reason why Italy should find it easier to commit to a fixed exchange rate than to a value for the money supply. The third related reason is that the distinction between commitment to an exchange rate value and commitment to a money-supply value is not even clear without uncertainty.
Regarding the second and third points, we should remember that commitment to an exchange rate value is an international commitment. The international reputation of a nation is at stake. Judging from the way the ERM has not only survived but led to more advanced stages, it seems to have played a role similar to one played by "gaiatsu" (external pressure) in Japan. Domestically unpopular policies can be pushed through, with the excuse that it is inevitable in light of pressure from abroad.

The basic mechanism continues to work in Europe. Unprecedented efforts at monetary and fiscal consolidation were made in the run-up to the introduction of the single currency. This was in order to be judged to have met the Maastricht criteria, a "must" for countries that wanted to join the first group of countries to introduce the euro. The Stability and Growth Pact designed to ensure fiscal prudence after joining the euro was reviewed, after repeated breaches on the part of members including Germany and France (information on this Pact is available from: http://ec.europa.eu/economy_finance/sg_pact_fiscal_policy/index_en.htm?cs_mid=570). Even then, there is no run-away inflation in the Eurozone, and the deficit-to-GDP ratios have not reached the level in Japan.

Another lesson from the Canzoneri and Henderson analysis is the importance of the monetary policy stance taken by the leader in a fixed exchange rate system. We have repeated several times that a country loses monetary policy autonomy in a fixed exchange rate system. The exception is when a country is the leader of the system. The leader maintains monetary policy autonomy, and assigns its monetary policy to domestic stabilisation. The followers assign their monetary policies to exchange rate stability.

The leader has more freedom after joining the regime, which could lead to higher inflation as shown by the Canzoneri and Henderson analysis. But such a fixed exchange rate arrangement is unlikely to last. Recall that the followers are effectively importing the monetary policy of the leader. If the leader allows high inflation to persist, this takes away an important economic reason for the followers to stay in the system. Eventually they will decide to leave. This is one important reason why the Bretton Woods system broke down. And the persistent anti-inflationary stance on the part of the Bundesbank was critical to the endurance of the ERM, which was an important stage along the path towards monetary unification in Europe.