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CHUNG-HUA INSTITUTION FOR ECONOMIC RESEARCH

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On the Choice of Exchange Rate Regimes

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ABSTRACT

This paper utilizes recent research developments in portfolio-balance theory and in real exchange rate instability to synthesize, update, and test the optimum currency area (OCA) theory. Five hypotheses are advanced and tested in a logit and OLS setup. The empirical results based on two-year cross-sectional data establish in the medium term the linkage between the exchange rate regime and financial integration and trade integration, while establish in the short term the linkage with the relative inflation rate. Unexpected shocks have become more important recently in regime choice, especially for short-term exchange rate policy decisions.

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I. INTRODUCTION

The blueprint for implementing European economic and monetary union by the end of 1998, as agreed in the Treaty of Maastricht in December 1991, is clouded by the Danish civil vote of nonsupport. Monetary union is also threatened by Britain's wishing to ''opt out'' to preserve its sovereignty. In a region of increasing financial and trade integration and various disturbances, what exchange rate regime choice is appropriate? This question can be addressed in the context of the optimum currency area (OCA) theory, which provides criteria for different types of countries to choose between floating and fixed exchange rate regimes. (Useful reviews of the OCA theory can be found in Ishiyama 1975, Tower and Willet 1976, and Obstfeld 1985.)

The OCA theory, however, has not sufficiently incorporated more recent developments in portfolio-balance theory and recent research on real exchange rate instability under a nominal floating exchange rate regime. Moreover, based on early (1970s) data, existing empirical studies of the OCA theory have generally supported the linkage between trade integration and a fixed rate, but have found the linkage between financial integration and the exchange rate regime to be blurred (see Dreyer 1977, Heller 1978, Holden, Holden, and Suss 1979, and Weil 1984). In a world

environment of increasingly integrated financial markets, it is important to investigate the linkage between financial integration and exchange rate regimes more closely. Also, Melvin (1985) provides an interesting study which directs attention to unexpected shocks. However, are structural variables really impotent in explaining exchange rate regime choices?

This paper updates and extends Heller (1978) and Melvin (1985) by readdressing various empirical questions based on an updated OCA theory. A more complete theoretical and empirical framework is carefully set up. Both early and recent data are exploited. Both discrete and continuous measures of the exchange rate regime choice variable are specified. The empirical evidence supports the linkage between financial integration and the floating exchange rate regime and the linkage between trade integration and the fixed exchange rate regime. Moreover, inflation differentials and unexpected shocks are also identified as important criteria in choosing exchange rate regimes. However, the evidence shows that short-term and medium-term choices are based on different criteria. The 1970s evidence and 1980s evidence also convey different messages. These results provide some insights into the monetary integration process and an empirical basis for exchange rate policy choices.

II. OPTIMUM CURRENCY AREA THEORY

This section develops five sets of hypotheses, each of which includes two alternative hypotheses based on an updated OCA theory. This is different from earlier studies, which usually specified only one alternative hypothesis, amounting to a deficiency of alternative theories and corresponding to a one-tail test; the more conservative two-tail test is used in this study. (See for example, Dreyer 1978, and Holden, Holden & Suss 1979.)

The first set of hypotheses concerns financial integration. Perfect financial integration means perfect international asset substitution with instantaneous adjustment. The first alternative hypothesis is based on Mundell (1963, 1964) and Fleming (1962). The M-F hypothesis assumes that price adjusts slower than the exchange rate. Here financial integration refers to asset substitution on the supply side among central banks. In this case, as financial integration deepens, monetary policy becomes less effective under a fixed exchange rate regime. Therefore,

H_1^1: When the degree of financial integration increases, a country will choose a flexible exchange rate regime for monetary independence.

However, the M-F hypothesis can be refuted due to the effect of asset substitution on the private demand side and real exchange rate instability.[1] The former

means that a significant subset of a country's citizens and businesses may maintain diversified international asset portfolios. In that case, even with a floating exchange rate, domestic monetary policy changes can be offset by intercountry movement of assets from adjustments of private portfolios. Also, foreign asset disturbances may easily be transmitted to the domestic economy, causing volatile exchange rate expectations and thus unstable money demand. This instability and volatility will also undermine domestic monetary independence and spill over to real sectors (Chen 1973, Miles 1978, Kareken and Wallace 1981, and McKinnon 1982).[2]

Stockman (1983) and Mussa (1986) find that under a nominal floating exchange rate regime, the real exchange rate is more unstable than under a nominal fixed rate regime. Under the assumption that asset prices adjust faster than commodity prices, real exchange rate instability may increase the costs of international trade and financial transactions. Some empirical studies (e.g., IMF 1984, Bailey and Tavlas 1988) do not find substantial impacts on trade from short-term exchange rate volatility. However, some studies based on bilateral trade and bilateral exchange rates find significant impacts (e.g., Thursby & Thursby 1987, and Cushman 1988). Long-term exchange rate misalignment was shown to have significant impacts on production and trade (see Marston 1988 and McKinnon 1988).

Therefore, we have the second alternative hypothesis:

H_2^1: Under increasing financial integration, a more fixed exchange rate regime is preferred both because monetary independence is constrained

by private asset substitution and because the impact of exchange rate shocks on international trade, international finance, and domestic production can be stabilized.

The second set of hypotheses concerns trade integration, that is, the direct importance of the trade sector in the national economy. The latter is also related to the country's economic size and trade patterns. In a small, trade-integrated economy, the exchange rate adjustment mechanism tends to be less effective because relative prices between domestic and foreign goods (terms of trade [TOT]) and between tradeable and nontradeable goods are more difficult to change (McKinnon 1963).

A small country often does not have a well-developed and deep financial market. Therefore, problems arise in monetary policy ineffectiveness and exchange rate instability. Also, a more trade-integrated economy adjusts more easily to external imbalances through absorption changes because less income adjustment is needed. Furthermore, the lack of money illusion in a trade-integrated economy and the downward rigidity of wage rates will ratchet up world inflation under a floating-rate regime.

A more undiversified economy (in terms of commodity variety) will experience more exchange rate changes because microshocks to the export sector do not cancel each other out. Moreover, an economy characterized by geographically undiversified trade is apt to peg to a single country's currency (or to relatively few countries' currencies) in order to promote trade. We can summarize the effect of increasing

trade integration as an alternative hypothesis:

H_1^2: Under increasing trade integration, a fixed rate is preferred for the sake of less inflation and lower costs in trade and in BOP adjustment.

However, there are alternative cases based on stabilizing real shocks. In a small, open economy, the real disturbances originating in external sectors are likely to dominate real disturbances of domestic origin. However, on the one hand, external real demand disturbances tend to move the BOP and the domestic economy in the same direction. This situation makes a case for a flexible rate regime (Whitman 1967). On the other hand, real external supply shocks, such as productivity or technology shocks in the tradeable sector, would result in differential wage and price trends. Then exchange rate changes provide the least costly route to prevent wealth or relative price effects from taking place (see Friedman 1953 and Kravis and Lipsey 1983). Thus, we have the other alternative hypothesis:

H_2^2: Under increasing trade integration, a floating rate regime is preferred for the sake of stabilizing the mpact of real shocks in the least costly way.

In the long run, a floating exchange rate provides more policy independence than a fixed rate. However, concern about reduced monetary independence under a fixed rate regime is most pronounced in countries with either relatively high or relatively low inflation rates. High-inflation countries would refrain from adopting a fixed exchange rate because it would reduce their seigniorage revenues and complicate their already difficult fiscal problems. Low-inflation countries would

refrain from adopting a fixed exchange rate because they would lose both their price-stability objectives and their hard-won anti-inflationary reputations (see Frenkel and Goldstein 1988).

Thus, we have an alternative hypothesis:

H_1^3: With divergent inflation rates, a floating rate regime is preferred for the sake of seigniorage and the ability to maintain national price stability.

Alternatively, a fixed rate regime provides valuable anti-inflationary discipline. Under a fixed rate regime, the government will be more prudent in macro-policy management for fear of losing political support as a result of lost reserves and huge exchange rate changes. This is especially true when policy coordination among countries can help rectify the externality caused by the spillover where one country's policies affect other countries' targets and when price-stability objectives are convergent among the nations. One interpretation of the European monetary system (EMS) is that high-inflation France and Italy borrow the anti-inflation reputation from low-inflation Germany. Therefore:

H_2^3: With divergent inflation rates, a fixed rate is preferred in order to provide external discipline on inflation.

While increasing financial integration and trade integration increase the *expectation* for more financial and real shocks, the fourth set of hypotheses considers *unexpected* monetary shocks and the fifth set of hypotheses considers *unexpected* foreign price shocks.

According to Flood (1979) and Aizenman (1983), domestic price changes can affect output through the expectation-augmented Phillips curve. According to them, the exchange rate regime choice may affect domestic price and the loss function. If the objective function is to lower the impact on domestic prices, a fixed exchange rate regime is more appropriate. The reason is that under a fixed rate, international capital movement can at least compensate for part of the excess supply or demand in the money market. Therefore, the first alternative hypothesis is:

H_1^4: If a country's policy objective is to lower the impact of shocks on the price level, more unexpected monetary shocks will lead the country to adopt a more fixed exchange rate regime.

However, according to Fischer (1977) and Frenkel & Aizenman (1983), if the domestic price variation does not affect the output and the national objective function is to lower the impact on real consumption, more unexpected monetary shocks will lead the country to adopt a floating exchange rate regime. Therefore, the second alternative hypothesis is:

H_2^4: If a country's policy objective is to lower the impact of shocks on real consumption and the price variation has no real effect, more unexpected monetary shocks will lead the country to adopt a more flexible exchange rate regime.

The insulation property of floating exchange rates can prevent the impact of foreign prices on domestic real sectors. In that case, larger unexpected foreign price shocks will lead the country to adopt a floating exchange rate regime. The first alternative hypothesis thus is:

H_1^5: Larger foreign price shocks will lead the nation to adopt a floating exchange rate regime in order to insulate the domestic economy from unexpected foreign price shocks.

However, the insulation property of a floating exchange rate is found to be incomplete, and exchange rate variation easily spills over to real sectors. If the critical point is passed, we have the second alternative hypothesis:

H_2^5: Larger foreign price shocks will lead a country to adopt a fixed exchange rate regime in order to prevent the spillover to real sectors.

III. THE EMPIRICAL MODEL

A. The Logit Model and Its Dependent Variable

The choice of exchange rate regime in reality is to choose the extent of exchange rate flexibility. That is, to decide *ex ante* the extent to which exchange rates will be allowed to vary. Every year IMF member countries report to the IMF about their exchange rate regimes. The report can be viewed as the policy intent of each country in choosing respective discrete exchange rate regimes. This *ex ante* commitment is often an intermediate-run choice, involving a time dimension of at least several years.

To test the (extended) OCA theory, a logit model is built that uses country characteristics and unexpected shocks to explain the exchange rate regime choice.

The actual regime choice (the dependent variable) can be classified into several discrete categories, while the explanatory variables are continuous measures of country characteristics and unexpected shocks. For logit models, the relative odds of choosing a discrete regime can be represented by a linear combination of explanatory variables, where the coefficients are the maximum likelihood estimates (MLE).

The discrete measure of the dependent variable is based on the IMF exchange rate classification of member countries contained in the IMF's 1977 and 1989 annual reports. Yearly data from 65 and 69 countries are represented respectively.[3] The dependent variables in terms of ascending order of flexibility are:

(1) Narrow Margin Peg (NMP): Maintains the exchange rate within a margin of less than 1% of the central rates, for a single currency or for a basket of currencies.

(2) Wider Margin Peg (WMP): maintains a margin of up to 2.25% of the central rates.

(3) Crawler (C): Changes rates discretely according to a set of predetermined indicators.

(4) Group Float (GF): EMS (snake) countries, which maintain within-group rates up to a 2.25% margin and between-group rates without a margin.

(5) Independent Float (IF): Does not maintain exchange rates within a specific margin.

Here (1) and (2) can be subsumed under ''peg'', while (3), (4) and (5) can be subsumed under ''float''.

The dependent variable can be viewed as the revealed preference of the authorities regarding the exchange rate flexibility adopted. It should reflect the underlying cost-benefit calculations. Melvin (1985) classifies fixed exchange rate regimes by whether they peg a single currency or peg a basket of currencies, and he deems the latter as providing more flexibility than the former. However, we believe that there is no inherent difference in flexibility between pegging a single currency and pegging a basket of currencies. The single currency itself may be highly floating versus other currencies. Though pegging a basket of currencies can lower the variability of the effective exchange rate, this does not mean more flexibility for exchange rate adjustment under balance of payment disequilibrium. Our criteria for classifying different flexibilities is based on the view that no matter whether pegging a single currency or a basket of currencies, a wider band allows more flexibility than a narrow band.

The second amendment of the IMF's Articles of Agreement came into effect on April 1, 1978. It granted each member the right to choose its own form of exchange rate arrangement. Intending not to categorize exchange rate arrangements according to the previous adjustable-peg system, the IMF has not classified member countries in terms of narrow/wider margin practices since 1978. Therefore, the 1989

classification only differentiates between fixed and floating exchange rate regimes. The 1977 data is used for two reasons: (i) it represents the experience of early post-Bretton-Woods exchange rate regime choice, (ii) the data contains narrow/wider band information to support more detailed analysis. The 1989 data is adopted to investigate the evolution of exchange rate regime choice and to analyze the recent situation.

B. The OLS Model and Its Dependent Variable

Current generalized managed floats are composed of managed float, joint float and fixed exchange rate arrangements. The exchange rate policy variability is continuous. The variability involves the exchange rate change and the degree of intervention. The degree of intervention is meaningful only relative to exchange rate pressure, and the exchange rate variability itself is not sufficient to point out the effort of monetary authority to maintain the exchange rate (see Holden, Holden and Suss 1979).

We adopt a dependent variable, similar to that used in Holden, Holden and Suss (1979), as an allowed exchange rate variability index. However, a major difference between our measure and H-H-S's is that H-H-S use a trade-weighted exchange rate as part of their measure, while we use the exchange rate with respect to the currency that a country pegs. We think the latter better reveals a country's policy intent regarding the regime choice. Because the dependent variable is a

continuous measure, we can use an OLS model with 1977 and 1989 yearly data. The variability index is:

$$V_t^i = \frac{\dfrac{|E_t - E_{t-1}|}{E_{t-1}}}{\dfrac{|R_t - R_{t-1}|}{X_{t-1} + M_{t-1}}}$$

V_t^i: the exchange rate policy variability of country i at time t.
E_t: the exchange rate of country i at time t with respect to the currency it pegs, the currency can be the US dollar, British pound, French franc, SDR, ECU or, in the case of a floating rate country, US dollar is used
R_t: the official foreign exchange reserve (in millions of US$) holding of country i at time t
X_t: the export of country i at time t (in millions of US$)
M_t: the import of country i at time t (in millions of US$)

This index reflects the extent to which exchange market intervention is used to offset exchange rate variation. It can be deemed the exchange rate variability under the same degree of intervention. Dividing the foreign exchange variation by the trade account is mainly to eliminate the bias due to different sizes of respective countries' external departments. R_t is the official foreign exchange reserve except gold, including Special Drawing Rights, the reserve position in the IMF, and foreign exchange assets. Even though some national governments still accept gold as an official reserve, the role of gold as a reserve asset has been crippled by the U.S. declaration of dollar-gold inconvertibility and by the IMF's commitment to bring about its demise. The value of V_t^i ranges from zero to infinity, with the former

referring to fixed exchange rates and the latter referring to a non-intervention, free exchange rate policy. This variability index is an *ex post* measure, often reflecting a short-term (one or two years) BOP situation. The data comes from *International Financial Statistics* (IFS), 1990 annual report, country page, and *Balance of Payment Statistics*, 1990 Yearbook. Yearly data from the same 65 and 69 countries as in the logit model are represented.

C. Country Characteristics and Unexpected Shocks (Explanatory Variables)

The above two models have the same explanatory variables. These variables represent the factors thought to be important in determining the size of the benefits and costs of adopting any of the alternative regimes.[4] The variables come from the (extended) OCA theory. Data from 1976 and 1988 are used, lagging one year behind the dependent variable.

X_1 (FI): Financial integration involves asset substitution both on the supply side and the demand side. However, in the first set of hypotheses, the central bank's holding of foreign currencies and assets (supply side FI) are assumed to be changed in the same way in the two alternative hypotheses. It is whether the private financial market produces a significant offsetting effect that differentiates the two alternative hypotheses. Therefore, the FI measure is a *private* financial market integration index.

Here we adopt the FI measure as the ratio of private bank holdings of foreign

assets to GNP. An increase in this ratio is presumed to indicate increasing depth in the private financial market. We have also tried to substitute GNP by domestic money supply. The result is similar. The foreign asset data are from IMF *Balance of Payment Statistics*, 1981 and 1982 monthly report and 1990 Yearbook. The GNP data are from *World Bank Atlas*, 1977 and 1990.[5]

X_2 (TI): Because size, trade integration and trade patterns are related characteristics, we use trade integration to represent this tripartite group. The measure of TI is taken as the trade amount (Export + Import) over GNP. Export and import data are from IMF *Direction of Trade*, 1982 and 1990 Yearbook.

X_3 (RIR): The relative inflation rate is calculated as the absolute deviation of a nation's CPI inflation rate from the world CPI inflation rate. The world rate is a proxy for the weighted-average inflation rate of the nation's trading partners. The data are from the *IFS Yearbook*, 1981 and 1990.

X_4 (Sm): The unexpected shock measure is similar to Melvin (1985). The unexpected monetary shock measure is the standard error of the second-order money supply autoregression. Corresponding to 1977 and 1989 regimes, data from the previous fourteen quarters are adopted (e.g. the Sm corresponding to the 1977 exchange rate regime choice refers to the 1973III-1976IV data). The data are from *IFS* Yearbook and tape, 1981 and 1990.

X_5 (Sp): To get the measure for unexpected foreign price shocks, we first

calculate the trade-weighted consumer price index of a country's ten largest trading partners, then we measure Sp by using the standard error of the second-order autoregression of the calculated index. Here we also adopt data from fourteen quarters. All the data are from *IFS* Yearbook and tape, 1981 and 1990.

IV. EMPIRICAL RESULTS

A. Logit Model Applying 1977 Data

a. Multinomial Logit Model Applying 1977 Data

The econometric results are reported here by examining the exchange rate regime selection problem with three alternatives: narrow margin peg (NMP), wider margin peg (WMP), and float.

The MLE of the coefficients are reported in equations (1), (2) and (3). Here the relative odds of choosing regime 1 with respect to regime 2 are defined as the log value of Prob(regime 1)/Prob(regime 2).

$$\log \frac{P(Y=WMP)}{P(Y=Float)} = \underset{(-2.8738)^{**}}{-1.7112 \log(FI)} + \underset{(3.2161)^{**}}{4.7111 \log(TI)} + \underset{(0.0342)}{0.0164 \log(RIR)} - \underset{(-0.8941)}{1.2273 \text{ Constant}} \quad (1)$$

$$\log \frac{P(Y=NMP)}{P(Y=Float)} = \underset{(-3.4431)^{**}}{-1.9930 \log(FI)} + \underset{(3.3344)^{**}}{4.7225 \log(TI)} \underset{(-0.1727)}{- 0.0783 \log(RIR)} \underset{(-1.1654)}{- 1.4013 \text{ Constant}} \quad (2)$$

Since $\log(P_1/P_2) = \log (P_1/P_3)-(P_2/P_3)$,

where P_1 = probability of choosing NMP,
P_2 = probability of choosing WMP,
P_3 = probability of choosing Float.

We can derive equation (3) from equation (1) and (2)

$$\log \frac{P(Y=NMP)}{P(Y=WMP)} = \underset{(-0.8776)}{-0.2818 \log(FI)} + \underset{(0.0172)}{0.0114 \log(TI)} \underset{(-0.3242)}{- 0.0947 \log(RIR)} \underset{(-0.1436)}{- 0.1740 \text{ Constant}} \quad (3)$$

Number in the bracket is t-statistic
** Significant at 1% level
Overall, likelihood ratio statistic = 97.29

From equation (1), the significant variables affecting the relative odds of selecting a WMP regime as compared to a Float regime are FI and TI. Their signs show that an economy more integrated with the international financial market is more likely to choose a floating-rate regime, while an economy more integrated with the international commodity market is more likely to choose a fixed rate regime. Equation (2) also conveys the same message. In sum:

(H_1^1 dominates H_2^1) The Mundell-Fleming ranking of exchange rate regimes is still correct because the unstable nature

of a floating rate under increasing financial integration is less important than the loss of policy independence even under increasing private asset substitution.

(H_1^2 dominates H_2^2) An economy facing more real shocks due to increasing trade integration still prefers a fixed rate because, in an economy open to trade, a floating rate causes higher inflation and incurs more costs in BOP adjustment and trade.

Moreover, a country with an inflation rate different from its major trading partners tends to adopt a floating rate to preserve its domestic inflation target and to adopt a fixed rate to receive anti-inflationary discipline. The evidence here shows that RIR is not significant in affecting the exchange rate regime choice, implying the two contradicting forces balance each other out.

The three-alternative, multinomial-logit model simulates real-world choices among more than two alternative exchange rate regimes. Overall, the likelihood ratio statistic, which tests the joint significance of all coefficients, is asymptotically distributed as a chi-square with 8 degrees of freedom (number of parameters to be estimated). It is 97.29, and is significant at the 1% level.

It is worthwhile to emphasize the importance of H_1^1. That is, higher financial integration increases the likelihood of adopting a floating rate regime. Previous studies such as Heller (1977, 1978) showed an apparent positive relation between financial integration and a floating rate regime. However, Heller adopted discriminant analysis, without providing a meaningful explanation and a test for the estimated

coefficient. Holden, Holden and Suss (1979) showed that the FI coefficient is insignificant. However, this study consistently shows (and will show repeatedly) a significant linkage between FI and a floating-rate regime.

Adding two more explanatory variables, unexpected monetary shocks and unexpected price shocks, we have the results in Table 1.

Table 1 The Results of Multinomial Logit Model Including Unexpected Shocks, 1977/76 Data

Dependent Variable	FI	TI	RIR	Sm	Sp	Constant
(4) WMP / Float	-1.9065 (-2.9181)**	4.9480 (3.0799)**	0.2208 (0.4279)	0.3126 (1.5436)	0.3196 (0.3662)	-1.9793 (-1.0080)
(5) NMP / Float	-2.0449 (-3.2863)**	4.9556 (3.1850)**	0.0059 (0.0123)	0.1677 (0.9320)	-0.3921 (-0.4812)	-2.0971 (-1.1944)
(6) NMP / WMP	-0.1384 (-0.4069)	0.0076 (-0.0112)	-0.2149 (-0.6796)	-0.1449 (-1.0985)	-0.7117 (-1.3671)	-0.1178 (-0.0836)

Notes: a. Number in bracket is t-statistic.
b. ** Significant at 1% level.
c. Overall, likelihood statistic = 92.17, significant at 1% level.

The significant variables are FI and TI, reconfirming the importance of financial integration and trade integration in the choice of exchange rate regimes. The unexpected shock variables are insignificant. And the likelihood-ratio statistic testing the joint significance of unexpected shocks is "5.1", showing insignificant joint explanatory power.

The reason for the insignificance of the unexpected shock terms can be found by investigating the related alternative hypotheses. The impact of monetary shocks on exchange rate regime choice is directly related to the national objective function; the impact of foreign price shocks on exchange rate regime choice is closely related to the insulating property of floating exchange rates. However, the form of the national objective function and the nature of the Phillip's curve are controversial; the insulating property of a floating rate depends on the models, the nature of disturbances, and the sectors to be insulated. There is no theoretical consensus (refer to Bordo and Schwartz 1988). In the early period (1977), lacking sufficient unexpected shocks, countries may well not have included unexpected shocks in their choice criteria.

These empirical results are contrary to Melvin (1985). Melvin (adopting 1976-78 quarterly data) found significant explanatory power of unexpected shock terms on the exchange rate regime choice. He also found the explanatory power of conventional OCA variables (OPEN, TRADE, IDIFF, and SIZE) to be insignificant.

However, Melvin classified the fixed exchange rate regimes by whether they peg a basket of currencies or peg a single currency, which is not an appropriate way to differentiate flexibilities. This empirical model has adopted a different classification. Moreover, Melvin omitted the FI variable in his study.

b. Binomial Logit Model Applying 1977 Data

The empirical model here considers two choices: Peg and Float, by applying 1977/1976 data, where Peg includes NMP and WMP.

$$\text{Log}\frac{P(y=\text{Peg})}{P(y=\text{Float})} = \underset{(-3.3582)^{**}}{-1.8968}\log(\text{FI}) + \underset{(3.3701)^{**}}{4.7017}\log(\text{TI}) \underset{(-0.0945)}{-0.0416}\log(\text{RIR}) \underset{(-0.6355)}{-0.7118}\text{Constant} \quad (7)$$

Number in bracket is the t-ratio

** Significant at 1% level; R^2 =0.4936; likelihood ratio statistic = 35.08

FI and TI are significant and again confirm the previous results. R^2 is high among cross-sectional data. The likelihood ratio statistic is significant at the 1% level. Moreover, the within- sample prediction is correct at 89%. All show that the model fits the sample well. Adding two shock variables, we have:

$$\log\frac{P(y=\text{Peg})}{P(y=\text{Float})} = \underset{(-3.2721)^{**}}{-2.0135}\log(\text{FI}) + \underset{(3.2370)^{**}}{4.9882}\log(\text{TI}) + \underset{(0.1620)}{0.0750}\log(\text{RIR}) + \underset{(1.1873)}{0.2094}\log(\text{Sm}) \quad (8)$$
$$\underset{(-0.2228)}{-0.1761}\log(\text{Sp}) \underset{(-0.8304)}{-1.4063}\text{Constant}$$

Number in bracket is the t-ratio

** Significant at 1% level; R^2 = 0.5075; likelihood-ratio statistic = 33.6

Again, the significant FI and TI confirm previous results. R^2 is quite high. The joint explanatory power of Sm and Sp in terms of the likelihood-ratio statistic is 1.48, which is insignificant, contrary to Melvin (1985).

B. OLS Model Applying 1977 Data

Using 1977/1976 data, and adopting the continuous exchange rate variability measure as specified earlier, we get the OLS results:

$$V = \underset{(-0.3584)}{-42.639\ FI} + \underset{(1.3169)}{48.586\ TI} + \underset{(7.1037)^{**}}{8.0408\ RIR} - \underset{(-2.6540)^{**}}{65.931\ Constant} \qquad (9)$$

** Significant at 1% level
R^2 = 0.4616; F(3,61) = 17.4, joint coefficients are significantly different from 0 at 1% level Number in bracket is the t-ratio

The only significant explanatory variable is RIR. It shows that the larger the gap between a country's inflation rates and those of its trading partners, the more exchange rate variability is allowed. This result is different from the logit model result (where FI and TI are significant explanatory variables). The reason may be that the dependent variable used in the logit model represents a country's *commitment* to the medium-term exchange rate regime. In this longer time dimension, a country puts more weight on slowly-changing but critical national structural characteristics such as international financial integration and trade integration. Also, the incentive to adopt

a floating-rate regime due to large inflation differences is offset in the longer run by the intent to seek price stability discipline. On the other hand, the *ex post* exchange rate policy adjustment is reflected in the allowed exchange rate variability index, often affected by short-term BOP disequilibrium pressure. The BOP disequilibrium is often a result of international differential inflation rates, thus the latter has a significant impact on the allowed exchange rate variability.

Adding unexpected shock terms, the OLS result becomes:

$$
\begin{aligned}
V = {} & -110.595\ FI + 59.274\ TI \\
& \quad (-0.7939) \qquad (1.4814) \\
& + 8.1610\ RIR + 0.1166\ Sm \\
& \quad (7.0923)^{**} \qquad (1.0162) \\
& - 11.714\ Sp - 10.799\ Constant \qquad (10) \\
& \quad (-0.2050) \qquad (-2.5115)^{*}
\end{aligned}
$$

** Significant at 1% level; $R^2 = 0.4722$, very high; $F(5,59) = 10.56$, joint coefficients are significant at 1% level.

Again the significant explanatory variable is RIR. The joint explanatory power of Sm and Sp is 1.75, which is insignificant, showing no contribution to short-term exchange rate policy decisions.

C. Logit Model Applying 1989 Data

To understand the evolution of the exchange rate system and the recent exchange rate choice behavior, we also use the 1989/1988 data to redo the binomial logit estimation and the results are listed in Table 2.

Table 2 The Binomial-Logit Result, 1989 Data

Dependent Variable		FI	TI	RIR	Sm	Sp	Constant	R^2
(11)	Peg	-0.7012	0.7187	0.2819			-2.0233	0.1418
	Float	(-2.8726)**	(1.3289)	(1.1160)			(-2.0827)*	
(12)	Peg	-0.8760	0.7811	0.4225	-0.1003	-0.3877	-2.5709	0.2168
	Float	(-3.1554)**	(1.3436)	(1.5079)	(-1.0262)	(-2.0228)*	(-2.1623)*	

Notes: a.**Significant at 1% level.
b.*Significant at 5% level.
c.Number in bracket is t-statistic.
d.Likelihood-ratio statistic for (11) is 83.55, significant at 1% level.
e.Likelihood-ratio statistic for (12) is 77.60, significant at 1% level.

Both equation (11) and (12) show that FI is significantly linked to the flexible rate regime, reconfirming the previous result. However, TI becomes insignificant. The reason for the insignificance of TI is probably due to people's having learned from ample real shocks in the 1970s and 1980s, which reinforces the linkage between TI and a floating-rate regime. Nevertheless, the unexpected price shock is significant. The joint explanatory power of Sm and Sp in terms of likelihood-ratio statistics is 5.95, which is significant at the 11% level for a 2-d.o.f. chi-square distribution. These results are different from the results applying 1977/1976 data. The joint significance of shock variables probably is due to the abundance of unexpected shocks in the late 1970s and 1980s that reinforces the importance of unexpected shocks in

determining the exchange rate regimes. Moreover, the sign of Sp implies that H_1^5 dominates H_2^5:

> "The benefit of insulation under a floating-rate regime exceeds the negative externality due to exchange rate spillover to real sectors, thus causing a country to adopt a floating-rate regime under increasing unexpected foreign price shocks."

D. OLS Model Applying 1989 Data

Adopting *the ex post* allowable exchange rate variability index, the short-term exchange rate policy can be better explained. The OLS model result by applying 1989/1988 data is:

Table 3 The OLS Results, 1989/1988 Data

Dependent Variable	FI	TI	RIR	Sm	Sp	Constant	R^2
(13)Exchange rate	36.151	-19.1193	0.4434			15.494	0.1790
Variability Index	(0.7098)	(-0.8028)	(3.5794)**			(0.9260)	
(14)Exchange rate	82.762	-12.7383	0.3832	-0.0024	4.646	-10.5189	0.4224
Variability Index	(1.4777)	(-0.5957)	(3.6087)**	(-0.8854)	(5.0608)**	(-0.6891)	

Notes: a.** Significant at 1% level.
b.Number in bracket is t-statistic.
c.Likelihood-ratio statistic for (13) is 799.4, significant at 1% level.
d.Likelihood-ratio statistic for (14) is 775.12, significant at 1% level.

The two regression results again demonstrate significant impacts from RIR on allowable exchange rate variability. In (14), the joint explanatory power of Sm and Sp is significant at the 1% level in terms of the likelihood ratio statistic (with a value 24.28). This again may show the learning effect in a shock-abundant environment.

V. CONCLUSIONS

This study establishes five basic hypotheses based on an updated OCA theory and on previous empirical evidence. Subsequently, two-year cross-sectional data are used to do an empirical analysis. The 1977 data allow us to do multinomial and binomial studies; the 1989 data allow us to study the new developments. The conventional explanatory variables are condensed to financial integration, trade integration, and relative inflation rate. Two unsystematic shock variables are also included.

The empirical results show that for intermediate-term exchange rate regime choices, higher financial integration will increase the incentive to adopt a floating-rate regime, while higher trade integration will increase the incentive to adopt a fixed rate regime. This revealed national preference shows a basic difficulty in monetary integration. That is, the insistence of national sovereignty. Thus, in order to form

a monetary union, EC countries should perhaps first devote themselves to commodity, financial, and labor market integration, meanwhile allowing more flexible exchange rate adjustment. As integration deepens, national goals converge and the externality of national policies becomes more important. The opportunity for monetary integration may mature at the point where the benefit of policy coordination exceeds the benefit of policy independence.

For short-term exchange rate policies, the empirical results show that increasing relative inflation rates will increase a government's tolerance for more exchange rate variation, where structural factors such as financial integration and trade integration are unimportant. Moreover, in the early period (1970s), the impact of unexpected shocks on the choice of exchange rate regime is uncertain and lacks consensus. It is the structural variables, financial integration and trade integration that have explanatory power. However, recently unexpected shocks (especially foreign price shocks) have become more important in the choice of the exchange rate regime. This is especially the case for short-term exchange rate policy decisions.

Footnotes

[1]The Mundell-Fleming ranking of exchange rate regimes has been reversed by Fischer (1976) and by Frenkel and Aizenman (1983). However, these studies mainly assume a financially-closed economy, which misses the central role of capital mobility. Marston (1985) illustrates the importance of wage indexation. Domestic full-indexation will make foreign disturbances purely monetary. However, assuming there is a contractual lag of wage adjustment and a certain degree of capital mobility, thus preserving the assumptions in the M-F proposition, the M-F ranking of exchange rate regimes can still be reversed. This is the basis for the second alternative hypothesis.

[2]The empirical evidence of private asset substitution is mixed. Brittain (1981), Aktar & Putnam (1980), and Miles (1978) find currency-substitution evidence in developed countries. However, Laney, Radcliffe and Willet (1984), Cuddington (1983), and Bordo & Choudhri (1982) criticize their methods and find currency substitution insignificant.

[3]Countries in the sample:

(1) Sixty-five Countries (1977)

Algeria, Austria, Bahrain, Bangladesh, Barbados, Brazil, Burundi, Canada, Colombia, Costa Rica, Cyprus, Egypt, El Salvador, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Germany FR, Ghana, Greece, Guyana, Haiti, Honduras, Indonesia, Ireland, Italy, Ivory Coast, Jamaica, Japan, Jordan, Kenya, S. Korea, Kuwait, Madagascar, Malawi, Malaysia, Mauritius, Morocco, Nicaragua, Pakistan, Paraguay, Philippines, Portugal, Rwanda, Saudi Arabia, Senegal, Somalia, S. Africa, Spain, Sri Lanka, Sudan, Switzerland, Syria, Tanzania, Thailand, Togo, Tunisia, United Kingdom, United States, Upper Volta, Uruguay, Venezuela, Zaire.

(2) Sixty-nine Countries (1989)

Algeria, Australia, Bangladesh, Barbados, Burundi, Cameroon, Canada, Central Africa, Chad, Congo PR, Costa Rica, Cyprus, Ecuador, Egypt, El Salvador, Ethiopia, Finland, France, Gabon, Germany FR, Grenada, Guatemala, Guyana, Honduras, Iceland, Indonesia,

Ireland, Israel, Italy, Jamaica, Jordan, Kenya, S. Korea, Kuwait, Madagascar, Malawi, Malaysia, Malta, Mauritius, Morocco, Nepal, Netherlands, Nigeria, Norway, Pakistan, Papua New Guinea, Paraguay, Peru, Portugal, Rwanda, Senegal, Sierra Leone, Singapore, Somalia, S. Africa, Spain, Sri Lanka, Switzerland, Tanzania, Thailand, Togo, Trinidad & Tobago, Tunisia, United Kingdom, United States, Uruguay, Venezuela, Yugoslavia, Zambia.

[4]A word should be mentioned regarding possible multicollinearity problems among the explanatory variables. FI, TI, and RIR may be highly correlated, causing multi-collinearity problems. However, statistical correlation cannot be used to identify the degree of multicollinearity. In fact, an effective method to identify and to manage multicollinearity is lacking in econometrics (refer to Maddala 1977 and Judge 1980). Because multicollinearity is a problem of the sample, not the population, the multicollinearity problem is often inevitable in empirical studies. Moreover, because macroeconomic phenomena are closely related, multicollinearity problems are even more inevitable in macroeconomic studies. In this study, we try to diminish the multicollinearity problem by adopting as few explanatory variables as possible. However, we don't omit important variables from theories either.

[5]Arranging countries according to the magnitude of FI, we have the first 15 countries:

(1977) U.K., Switzerland, Bahrain, Ireland, Egypt, Austria, Kuwait, France, Germany FR, Canada, Italy, Korea, S. Arabia, Somalia, U.S.

(1989) U.K., Switzerland, Egypt, Singapore, Netherlands, Jordan, France, Kuwait, Uruguay, Finland, Germany FR, Israel, Malta, Grenada, Portugal.

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