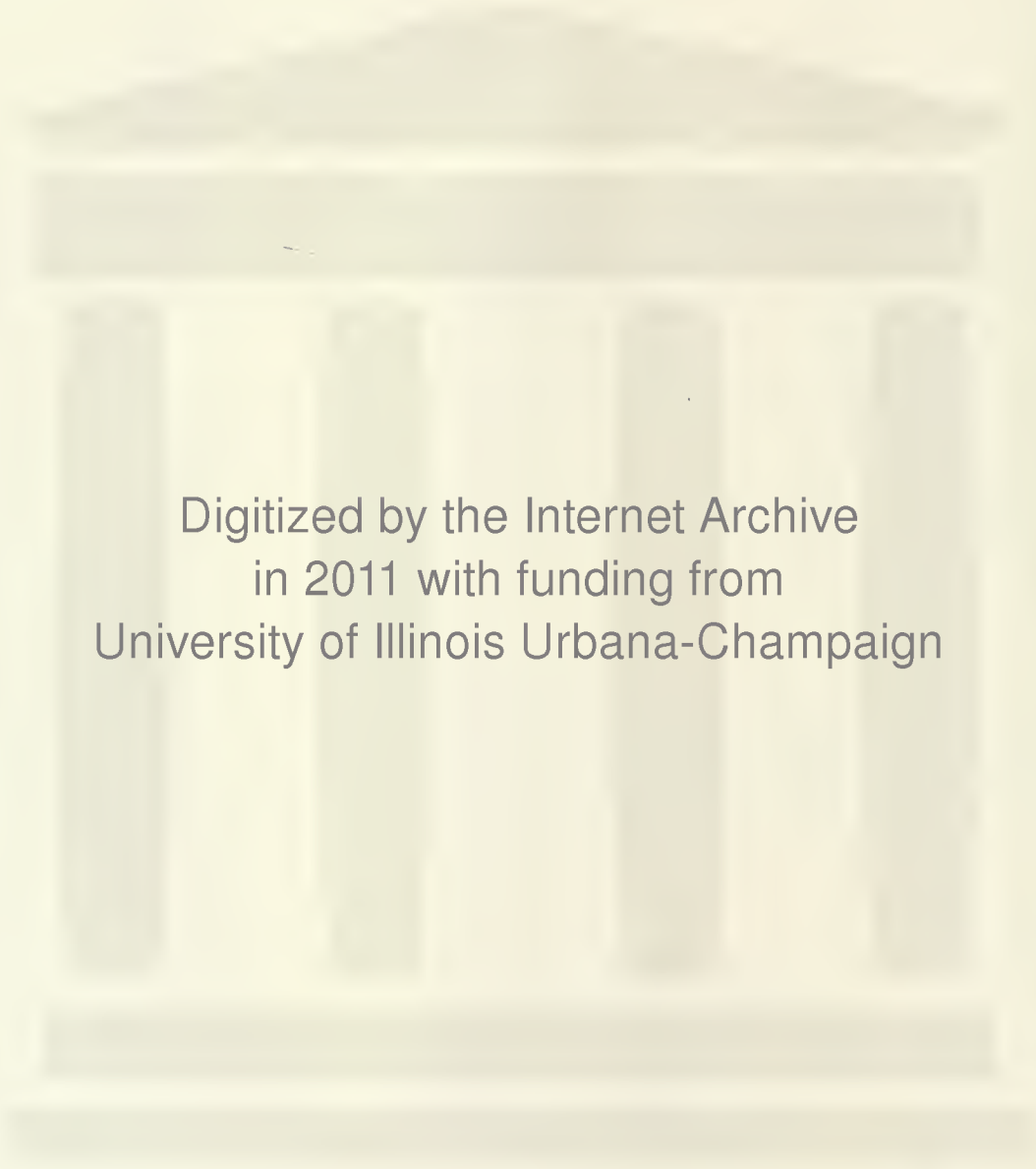

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FACULTY WORKING
PAPER NO. 934

The Structure of International Interest Rates Under Different Exchange Rate Regimes: An Econometric Analysis

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February 1983

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Abstract

Based upon short-term yields of seven nations over the period January 1963-December 1981. Three alternative econometric models are used to investigate the potential structure change of international interest rates under two different exchange rate regimes. It was found that the short-term interest rates under floating exchange rate regime did behave differently from those under fixed exchange rate regime. Policy implications associated with this finding also analyze in accordance with different sources of variation.

I. Introduction, Hypotheses and Recent Studies

International capital market theory postulates that national interest rates are in some way co-determined through the influence of international funds movements upon domestic markets. Given capital mobility in an open world economy, an interrelationship exists among short-term interest rates. Predicting foreign rate behavior can thus enhance the effectiveness of monetary policy.

A recent article by Dr. Henry Kissinger (1983) alludes to an apparent incompatibility between political practice and the "changing fashions" in the economic theory of exchange rates. Views held inviolate at one time were radically altered relatively quickly in the early 1970s.

Empirical investigations of international interest rate relationships have increased within the last ten years. Much of the motivation for this was the change in foreign exchange rate regimes starting in August, 1971.

Artificial pegging of each country's currency by its central bankers was the hallmark of the pre-1971 period. The gold standard held strong as a means of monetary self-discipline from 1812 until World War I. It was followed by fixed exchange rates by formal agreement. Since international short-term rates were not allowed to fluctuate in market forces, co-determination of rates would have been minimal. Domestic monetary and fiscal policy would have been the key determiners of interest rates.

As market forces gradually prevailed in the 1971-73 transitory period, and especially after 1973, country X's rates would influence

country Y's, and vice versa. The flow of investment capital would tend to make the rates more competitive in different countries with close trading ties. Co-determination would have increased. Kissinger argued that the different floating exchange rate policies used by different countries has produced exchange-rate politics and affected the free trade system of the free world.

Using least-biased disaggregated monthly data over a 17 year period, this study tests the following hypotheses. First, domestic policy was a more important determiner of short-term interest rates under the fixed exchange rate system than under the floating regime. Second, co-determination of rates was more significant during the floating exchange rate period than earlier. Domestic variables would now be expected to play a smaller role.

Finerty, Schneeweis and Hegde (1980) postulated a strong relationship between yield levels and yield changes in domestic and foreign securities under a fixed exchange rate system. Under a floating system domestic yield levels might move independently of foreign yields. They found that under both systems, foreign bond yields and the domestic U.S. bond rate were principal variables explaining Eurobond yields levels and movement.

R. Z. Aliber (1975) concluded that greater monetary independence among nations exists under the floating exchange rate regime. Investors are more reluctant to shift funds internationally because of increased uncertainty about future exchange rates. Domestic and foreign assets are not perfect substitutes.

This paper is divided into four additional sections. Section two presents the background and results of correlation coefficient measures between countries' short-term rates.

Correlation analyses by Hendershott (1967) and Kwack (1971) suggested that U.S. short-term rates explain partially the behavior of euro-dollar yields. A later econometric analysis by Argy and Hodjera (1973) lent support to this hypothesis. That study notes that euro-dollar movements are statistically dominated by conditions in the United States. But the findings also suggest that euro-dollar rates are influenced as well by economic conditions in Europe.

The Hendershott and Kwack studies stopped short of considering foreign influences upon U.S. short-term rates. Argy and Hodjera, however, extended their research to encompass the existence of financial linkages among the short-term rates of ten industrialized nations. One test--a simple correlation analysis of each of a series of national yields with the U.S. rate--produced a strong relationship in most cases.[1] The data, however, was obtained on a quarterly basis. The use of monthly figures would have improved the predictive power. More important, the methodology neglected the interaction and interrelationship among various foreign interest rates. Incorporation of these factors, as well as the change in exchange rates in 1971, would demand additional econometric considerations with a different set of data.

Section three considers the explicit impact of each country's determinants on its short-term rates. The number of explanatory variables (including a binary variable for the exchange rate regime) is increased, and ordinary least squares and seemingly-unrelated regression techniques are applied.

Different models test for the effects from different variables. The Bomberger and Frazer (1981) reduced form and structural equations included inflation, uncertainty and lagged variables. Elliott and Baier (1979) presented six econometric models to explain and predict interest rates. They found that these models generally explained long-term interest rates very well, by relating interest rate movements to concurrent movements in various macroeconomic variables. But the models did a poor job of explaining the following month's rates by using this month's macro variables.

The fourth section constructs the full-structure model for investigating simultaneous relationships of international interest rates.

Finally, section five summarizes the results. Several tentative conclusions are offered.

II. Correlation Coefficient Analysis

Table I presents the correlation matrix resulting from taking a group of interest rates into consideration. The sample data comprised short-term yields from seven nations over the period January 1965 - December 1981. The figures were obtained on a monthly basis in order to reduce the time aggregation bias.[2]

But even with these added touches the results are similar to those obtained from the Argy and Hodjera tests. The correlation is high for U.S., France, the United Kingdom, and Canada. West German and Japanese statistical relationships with yields from other countries are highly significant.

Tables II and III present correlation matrices on all seven countries' short-term rates for the periods of fixed and floating exchange rates, respectively.

Table I

Correlation Matrix of Seven Countries
Short-term Interest Rate
(January 1965 - December 1981)

Country[1]	United States	Federal Republic of Germany	France	Netherlands	Japan	United Kingdom	Canada
United States	1	.5632**	.7647**	.6889**	.2643**	.7527**	.9067**
Federal Republic of Germany		1	.6030**	.4947**	.3730**	.4566**	.4301**
France			1	.7454**	.4896**	.7461**	.7727**
Netherlands				1	.3993**	.7604**	.6787**
Japan					1	.4610**	.2133**
United Kingdom						1	.7940**
Canada							1

*Figures significant at the 5% level.
**Figures significant at the 1% level.

Source: OECD, Main Economic Indicators, 1965-1981.

[1]United States, United Kingdom and Canada: Three-month treasury bill rate.
France, West Germany, The Netherlands and Japan: Call money rate.

Table II

Correlation Matrix of Seven Countries
Short-term Interest Rate with Fixed Exchange Rates
(January 1965 - July 1971)

Country	United States	Federal Republic of Germany	France	Netherlands	Japan	United Kingdom	Canada
United States	1	.3457**	.8745**	.7091**	.5602**	.7324**	.8649**
Federal Republic of Germany		1	.4541**	.4109**	.1977	.1155	.0820
France			1	.7543**	.6136**	.6932**	.7213**
Netherlands				1	.4100**	.5445**	.6465**
Japan					1	.6703**	.5264**
United Kingdom						1	.7991**
Canada							1

*Figures significant at the 5% level.
**Figures significant at the 1% level.

Source: Same as Table I.

Table III

Correlation Matrix of Seven Countries
Short-term Interest Rate with Floating Exchange Rates
(August 1971 - December 1981)

Country	United States	Federal Republic of Germany	France	Netherlands	Japan	United Kingdom	Canada
United States	1	.5603**	.6970**	.6371**	.2300**	.6869**	.8868**
Federal Republic of Germany		1	.6009**	.4674**	.3965**	.4436**	.4158**
France			1	.7149**	.5141**	.6697**	.7198**
Netherlands				1	.3935**	.7536**	.6276**
Japan					1	.4978**	.1741*
United Kingdom						1	.7238**
Canada							1

*Figures significant at the 5% level.
**Figures significant at the 1% level.

Source: Same as Table I.

The correlations in the two periods are for the most part comparable. The Canadian-German, British-German, and Japanese-German values improved noticeably in the latter period. The Japanese-Canadian and Japanese-U.S.A. correlations worsened under the floating rate system.

As Argy and Hodjera point out in their study, however, any statistical correlations under these conditions do not take into account the impact of domestic variables in determining yield levels. They call for a more complex model, one that can link national short-term rates to both indigenous and foreign market influences.

III. OLS and SUR Analysis

Neither the Bomberger-Frazer nor Elliott-Baier models were satisfactory for our purposes, since they did not emphasize the explicit role of codetermination and market dominance.

The model decided upon was a modified version of one suggested and tested by Marcis and Smith (1974). It employs domestic variables, with foreign rates considered as residuals.

Econometric studies abound on U.S. interest rate determinants. While the findings differ in details, there exists a broad consensus as to the dominant influences. Three domestic variables loom especially important: (1) some measure of income, (2) a measure of liquidity, and (3) some measure of the expected rate of inflation.[3] Additionally, a binary variable should be included to measure the impact of the 1971 change in foreign exchange rate regimes.

A domestic interest rate equation can therefore be written as:

$$r_{it} = \alpha_0 + \alpha_1 Y_{it} + \alpha_2 M_{it} + \alpha_3 E_{it} + \alpha_4 D_t + \alpha_5 D \cdot Y_{it} + \alpha_6 D \cdot M_{it} + \alpha_7 D \cdot E_{it} + e_{it} \qquad (1)$$

where the subscripts i and t refer to country and month, respectively, and the variables are defined as:

r_{it} = short-term interest rate, either treasury bill or call money rate,

Y_{it} = total adjusted industrial production index (1975 = 100), a proxy for income,

M_{it} = money supply, adjusted, in each nation's currency,

E_{it} = the monthly inflation rate, calculated as the natural log of the ratio of consecutive consumer price index values, or

$$\ln\left(\frac{CPI_t}{CPI_{t-1}}\right),$$

D_t = the foreign exchange rate binary variable

$$= \begin{cases} 0, & \text{for fixed rate (Jan., 1965 to July, 1971)} \\ 1, & \text{for floating rate (Aug., 1971 to Dec., 1981),} \end{cases}$$

$D \cdot Y_{it}$, $D \cdot M_{it}$ and $D \cdot E_{it}$ = interaction variables between domestic factors and the exchange rate dummy.

Separate regressions were run for the entire sample period, as well as for each subsample fixed and floating regime period. The dummy variable and three interaction terms were excluded from the subsample models.

This formulation differs somewhat from the one employed by Marcis and Smith. Their study incorporated percentage changes in all variables over three-quarter average intervals, rather than monthly levels.

The results of an ordinary least squares regression (OLS) of equation (1) and its subsample-modified version are presented in Tables IV, V and VI. Interest rates came from the same data set employed in Table I.

OLS and SUR Estimates of Determinants of Movements of Short-Term Interest Rates in Seven Countries, 1965-1981
(statistical t values are in parentheses)

Country	Method	R^2	Constant	Y	M	E	D	D Y	D M	D E
1. USA	OLS	.76	-6.641	.194	-.028	90.344	1.827	-.208	.068	158.423
			(-2.49)**	(3.31)**	(-1.54)	(0.92)	(0.56)	(-3.22)**	(3.55)**	(1.47)
	SUR		-2.650	.058	.014	39.578	-5.730	-.004	.014	115.204
			(-1.16)	(1.33)	(0.93)	(0.53)	(-2.07)*	(-0.09)	(0.93)	(1.40)
2. Germany	OLS	.21	-5.997	.275	-.139	65.996	-8.695	-.065	.124	117.396
			(-2.17)**	(2.56)**	(-1.39)	(0.85)	(-1.29)	(-0.50)	(1.24)	(0.97)
			-4.922	.072	.042	79.485	-8.122	.125	-.054	-44.522
			(-1.84)*	(0.80)	(0.49)	(1.23)	(-1.36)	(1.15)	(-0.63)	(-0.44)
3. France	OLS	.57	-5.148	.005	.055	49.551	-.227	.080	-.048	221.670
			(-2.22)**	(0.16)	(3.52)**	(0.65)	(-0.05)	(1.43)	(-3.04)**	(2.32)**
	SUR		-6.514	.022	.056	37.896	-4.096	.139	-.052	25.953
			(-2.95)**	(0.93)	(4.19)**	(0.69)	(-1.06)	(3.35)**	(-3.85)**	(0.38)
4. Netherland	OLS	.47	-.0008	.322	-.837	-62.879	-39.457	.171	.737	44.257
			(-0.00)	(3.38)**	(-2.88)**	(-1.17)	(-7.91)**	(1.55)	(2.52)**	(0.61)
	SUR		.922	.103	-.164	-16.786	-32.465	.291	.116	-44.079
			(0.55)	(1.30)	(-0.68)	(-0.38)	(-7.46)**	(3.15)**	(0.47)	(-0.73)
5. Japan	OLS	.12	4.131	.128	-.042	11.172	1.348	-.118	.043	79.982
			(3.78)**	(2.26)**	(-1.74)*	(0.40)	(0.63)	(-1.92)*	(1.76)*	(2.22)**
	SUR		4.990	.053	-.011	13.600	5.554	-.101	.016	38.127
			(4.96)**	(1.17)	(-0.57)	(0.64)	(3.01)**	(-2.06)*	(0.81)	(1.38)
6. United Kingdom	OLS	.63	-5.926	.241	-.117	2.967	2.481	-.167	.142	94.523
			(-1.25)	(2.53)**	(-1.59)	(0.07)	(0.42)	(-1.64)*	(1.92)*	(1.90)*
	SUR		-.412	.066	.011	1.594	-12.042	.108	.009	40.703
			(-0.10)	(0.87)	(0.18)	(0.05)	(-2.380)**	(1.33)	(0.15)	(1.09)
7. Canada	OLS	.79	-5.368	.429	-2.449	18.615	4.412	-.497	3.341	47.787
			(-1.62)*	(2.57)**	(-2.17)**	(0.29)	(0.67)	(-2.64)**	(2.92)**	(0.62)
	SUR		.921	.054	.061	25.831	-5.859	-.055	.696	-35.765
			(0.35)	(0.46)	(0.08)	(0.58)	(-1.19)	(-0.41)	(0.88)	(-0.67)

*5% level of significance
**1% level of significance
Source: OECD, Main Economic Indicators, 1965-1981.

The figures in Table IV support the hypothesis that domestic economic indicators are relatively important in explaining movements in a country's short-term rate. Every national market is influenced by at least one of the independent variables in the regression equation. In most cases two or more factors play a statistically significant role. Industrial production or its interaction variable are important for explaining short-term yield behavior in all countries except France. Money supply or its interaction variable ($D \cdot M_{it}$) are related to changes in interest rate levels in the United States, France, the Netherlands, Japan, the United Kingdom and Canada. The inflation rate interaction variable determines changes in French, English and Japanese yields.

Tables V and VI show results over the fixed and floating time periods, respectively. By our hypothesis, domestic variables should be less significant determiners of interest rates in the latter, floating period.

The hypothesis holds in the U.S.A., Netherlands, Japan and Canada. In these countries fewer regressors (including the constant term) were significant in the floating period model. The German models had different significant variables, but the same number, in each period. But the hypothesis did not reflect the French and British experience. Both had more significant variables during the fluctuating period.

Marcis and Smith have tried to reduce residual influence and gain greater estimate efficiency by applying Zellner's (1962) seemingly unrelated regression (SUR) simultaneously to the specifications on the

Table V

OLS and SUR Estimates of Determinants of Movements of Short-Term Interest Rates in Seven Countries, Fixed Exchange Rate Period (statistical t values are in parentheses)

	Country	Method	R^2	Constant	Y	M	E
1.	USA	OLS	.59	-6.641	.194	-.028	90.344
				(-4.88)**	(6.50)**	(-3.02)**	(1.80)*
		SUR		-6.580	.183	-.023	32.975
				(-6.07)**	(9.44)**	(-3.33)**	(1.05)
2.	Germany	OLS	.40	-5.997	.275	-.139	65.996
				(-3.50)**	(4.13)**	(-2.24)**	(1.37)
		SUR		-5.166	.214	-.091	70.485
				(-3.05)**	(3.54)**	(-1.59)	(1.64)*
3.	France	OLS	.41	-5.148	.005	.055	49.551
				(-3.06)**	(0.22)	(4.84)**	(0.89)
		SUR		-7.286	.034	.056	21.704
				(-4.63)**	(2.52)**	(6.25)**	(0.72)
4.	Netherlands	OLS	.55	-.0008	.322	-.837	-62.879
				(-0.00)	(8.56)**	(-7.27)**	(-2.97)**
		SUR		.254	.275	-.696	-52.718
				(0.38)	(8.29)**	(-6.83)**	(-2.91)**
5.	Japan	OLS	.57	4.131	.128	-.042	11.172
				(12.78)**	(7.63)**	(-5.89)**	(1.35)
		SUR		4.129	.133	-.045	2.066
				(13.24)**	(8.96)**	(-6.98)**	(0.30)
6.	United Kingdom	OLS	.56	-5.926	.241	-.117	2.967
				(-4.35)**	(8.82)**	(-5.53)**	(0.23)
		SUR		-4.384	.189	-.078	-2.180
				(-3.36)**	(7.57)**	(-3.99)**	(-0.19)
7.	Canada	OLS	.24	-5.368	.429	-2.449	18.615
				(-2.40)**	(3.81)**	(-3.22)**	(0.42)
		SUR		-2.439	.268	-1.396	10.907
				(-1.40)	(3.44)**	(-2.63)**	(0.37)

*5% level of significance
**1% level of significance

Source: Same as Table IV.

Table VI

OLS and SUR Estimates of Determinants of Movements of Short-Term Interest Rates in Seven Countries, Floating Exchange Rate Period (statistical t values are in parentheses)

	Country	Method	R^2	Constant	Y	M	E
1.	USA	OLS	.72	-4.814	-.015	.039	248.767
				(-2.10)*	(-0.44)	(7.23)**	(4.68)**
		SUR		-8.309	.052	.028	159.051
				(-4.58)**	(2.08)*	(6.54)**	(4.12)**
2.	Germany	OLS	.10	-14.692	.210	-.014	183.392
				(-2.04)*	(2.51)**	(-1.08)	(1.68)*
		SUR		-13.724	.204	-.012	14.971
				(-2.32)**	(3.00)**	(-1.09)	(0.18)
3.	France	OLS	.45	-5.375	.085	.007	271.222
				(-1.15)	(1.67)*	(2.89)**	(4.15)**
		SUR		-9.855	.1517	.005	78.142
				(-2.81)**	(4.04)**	(2.31)**	(1.72)
4.	Netherlands	OLS	.39	-39.458	.493	-.100	-18.622
				(-6.85)**	(7.17)**	(-2.67)**	(-0.30)
		SUR		-31.152	.388	-.044	-65.668
				(-6.43)**	(6.82)**	(-1.34)	(-1.33)
5.	Japan	OLS	.08	5.479	.010	.0006	91.154
				(2.36)**	(0.31)	(0.18)	(3.18)**
		SUR		10.817	-.052	-.005	49.992
				(5.69)**	(-2.26)**	(1.89)*	(2.32)**
6.	United Kingdom	OLS	.45	-3.445	.074	.025	97.490
				(-0.77)	(1.64)*	(7.15)**	(3.49)**
		SUR		-12.883	.178	.020	41.104
				(-3.80)**	(5.28)**	(6.43)**	(1.97)*
7.	Canada	OLS	.76	-.956	-.068	.892	66.402
				(-0.15)	(-0.67)	(3.93)**	(1.36)
		SUR		-6.755	.026	.703	-17.960
				(-1.49)	(0.37)	(4.40)**	(-0.57)

*5% level of significance
**1% level of significance

Source: Same as Table IV.

order of equation (1). Indeed, their test results have shown some improvement in regression estimate significance.

An SUR application was made to the data set of the study at hand. The statistical results are also listed in Tables IV, V and VI. For comparative purposes they are placed below the corresponding OLS estimates. Note in Table IV that the SUR method actually reduces estimate significance in several instances. Certain variable estimates were improved in all equations except Germany's and Canada's. Other variable significances were diminished.

The results in Tables V and VI show that Germany, Netherlands and Canada followed the hypothesis. The U.S.A., France, Japan and the United Kingdom, however, each had more significant t values in the latter-period model.

Results from both OLS and SUR were consistent for the Netherlands and Canada (agreeing with the hypothesis), and for France and the U.K. (disagreeing with the hypothesis). Germany's SUR results agree with the hypothesis, while its OLS did not. The reverse was true for the U.S.A. and Japan. Their SUR results disagreed with both the hypothesis and their respective OLS findings.

The hypothesis is further strengthened by the relatively poorer R^2 of four countries' models (especially Germany and Japan) during the floating rate period. These latter two countries, economic mainstays during the inflationary 1970's, had rates highly influenced by other factors.

Meanwhile, what has happened to foreign interest rates as explanatory variables? The OLS procedure provides for them in residual terms. Their interrelationship can be seen in the residual correlation matrix presented as Table VII. Judging from these figures the co-determination

Table VII

Residual Correlation Matrix*
(1965-1981)

Country	U.S.A.	Germany	France	Netherlands	Japan	United Kingdom	Canada
U.S.A.	1	.4045	.4596	.4059	.2025	.2960	.6263
Germany		1	.4519	.3921	.3612	.3462	.3600
France			1	.4451	.4476	.3968	.5814
Netherlands				1	.2468	.4096	.4407
Japan					1	.5790	.2210
United Kingdom						1	.4065
Canada							1

*All figures significant at 1% level.

Source: OLS regressions in Table IV.

is moderately strong, and foreign rate influences are not removed by domestic economic indicators. American and Canadian yields show a high degree of interrelationship, as do the yields between Japan and the U.K. The Federal Republic of Germany and the Netherlands denote the least amount of statistical interdependence with other countries.

The subsample period matrices, listed in Tables VIII and IX, tend to support the view that co-determination has markedly increased since 1971. Whereas only eight correlations were significant during the fixed rate period, 21 were significant (all but one at the 1 percent level) during the floating rate period.

The use of OLS residuals in estimation, however, assumes that such figures relate specifically to foreign interest rates. No allowance is made for additional domestic explanatory variables. The SUR method, on the other hand, hides foreign influence within domestic variables. It cannot identify any interdependent effect associated with international co-movements of interest rates. The stage is thus set for a new approach, a new model, which will patently and directly take both domestic and foreign explanatory variables into account.

IV. Full Structure TSLS Models

The interrelationship among international short-term interest rates can be specified statistically with a full-structure simultaneous model. The equations are written as:

$$\begin{aligned}(i)\quad R_{at} = {} & \alpha_a + \gamma_{af}R_{ft} + \gamma_{ag}R_{gt} + \gamma_{an}R_{nt} + \gamma_{aj}R_{jt} + \gamma_{ak}R_{kt} \\ & + \gamma_{ac}R_{ct} + b_aY_{at} + c_aM_{at} + d_aE_{at} + f_aD_t \\ & + g_aD{\cdot}Y_{at} + h_aD{\cdot}M_{at} + j_aD{\cdot}E_{at} + e_{at}\end{aligned}$$

Table VIII

Residual Correlation Matrix,
Fixed Exchange Rate Period

Country	U.S.A.	Germany	France	Netherlands	Japan	United Kingdom	Canada
U.S.A.	1	.1475	.6948**	.1359	.3434**	.0555	.2959**
Germany		1	.0045	.1492	-.1362	-.1110	-.2814*
France			1	.3325**	.0581	.1386	.6193**
Netherlands				1	-.3238**	-.1961	.1595
Japan					1	.1536	-.0129
United Kingdom						1	.3614**
Canada							1

*5% level of significance
**1% level of significance

Source: OLS regressions over fixed period

Table IX

Residual Correlation Matrix,
Floating Exchange Rate Period

Country	U.S.A.	Germany	France	Netherlands	Japan	United Kingdom	Canada
U.S.A.	1	.4413**	.4261**	.4297**	.1958*	.3136**	.6811**
Germany		1	.5470**	.4224**	.4085**	.3895**	.4830**
France			1	.4716**	.5043**	.4388**	.5731**
Netherlands				1	.2742**	.4382**	.4817**
Japan					1	.5933**	.2485**
United Kingdom						1	.4247**
Canada							1

*5% level of significance
**1% level of significance

Source: Ols regressions over Floating Period

$$(ii)\quad R_{gt} = \alpha_g + \gamma_{ga}R_{at} + \gamma_{gf}R_{ft} + \gamma_{gn}R_{nt} + \gamma_{gj}R_{jt} + \gamma_{gk}R_{kt} + \gamma_{gc}R_{ct} + b_g Y_{gt} + c_g M_{gt} + d_g E_{gt} + f_g D_t + g_g D{\cdot}Y_{gt} + h_g D{\cdot}M_{gt} + j_g D{\cdot}E_{gt} + e_{gt}$$

$$\vdots \qquad \vdots$$

$$(vii)\quad R_{ct} = \alpha_c + \gamma_{ca}R_{at} + \gamma_{cg}R_{gt} + \gamma_{cf}R_{ft} + \gamma_{cn}R_{nt} + \gamma_{cj}R_{jt} + \gamma_{ck}R_{kt} + b_c Y_{ct} + c_c M_{ct} + d_c E_{ct} + f_c D_t + g_c D{\cdot}Y_{ct} + h_c D{\cdot}M_{ct} + j_c D{\cdot}E_{ct} + e_{ct}$$

where at time t the variables R_{at}, R_{gt}, R_{ft}, R_{nt}, R_{jt}, R_{kt}, and R_{ct} represent the short-term interest rate of the United States, Germany, France, Netherlands, Japan, United Kingdom and Canada, respectively. The subscripts a, g, f, ..., c represent the same countries for their domestic and interaction variables too.

A two-stage least squares (2SLS) procedure can be performed to estimate the related coefficients. The first step regresses the short-term rate of each country on 43 exogenous, domestic variables (seven nations times six variables plus the dummy). The result is a "purified" estimate of the short-term rate, which in turn is used in the second step of the equation to obtain full-structure empirical results.

The empirical findings of the 2SLS procedure are listed in Table X. The figures suggest that the American short-term rate is essentially explained by all six endogenous money rates of the other countries, as well as industrial production and money supply. American, French and Canadian short-term rates help determine West German rates. French rates are statistically accounted for by all other money rates, along with its money supply and two interaction variables. British and

Table X

2SLS Structural Estimates
(statistical t values are in parentheses)

pendent Variables	R_a	R_g	R_f	R_n	R_j	R_k	R_c
logenous Variables							
R_a	--	1.222	-.475	.092	.468	-.320	.515
	--	(6.12)**	(-3.38)**	(0.50)	(2.39)**	(-2.37)**	(5.05)
R_g	.419	--	.398	.053	.136	.126	-.317
	(6.44)**	--	(5.39)**	(0.48)	(1.15)	(1.53)	(-5.11)
R_f	-.355	.729	--	.223	.400	-.263	.675
	(-3.26)**	(3.65)**	--	(1.51)	(2.90)**	(-2.37)**	(7.55)
R_n	.228	-.045	.246	--	-.462	.424	-.028
	(2.47)**	(-0.25)	(2.38)**	--	(-4.23)**	(6.65)**	(-0.32)
R_j	.318	-.126	.375	-.339	--	.500	-.178
	(3.04)**	(-0.63)	(3.71)**	(-3.23)**	--	(7.63)**	(-2.26)
R_k	-.435	.253	-.418	.829	1.235	--	.124
	(-3.15)**	(0.80)	(-2.49)**	(5.38)**	(8.92)**	--	(0.99)
R_c	.538	-.984	.942	.242	-.291	.390	--
	(4.81)**	(-3.96)**	(6.76)**	(1.26)	(-1.73)*	(2.64)**	--
ogenous Variables							
Constant	-7.906	.228	-6.098	-1.648	-.691	-2.130	3.428
	(-2.82)**	(0.08)	(-3.51)**	(-1.04)	(-0.63)	(-0.56)	(1.31)
Y_i	.207	.018	.009	.030	-.038	.052	.076
	(3.23)**	(0.19)	(0.37)	(0.38)	(-0.68)	(0.67)	(0.61)
M_i	-.043	-.038	.030	-.106	.003	-.012	-1.010
	(-2.20)**	(-0.44)	(2.68)**	(-0.45)	(0.13)	(-0.22)	(-1.22)
E_i	13.983	89.003	48.233	-10.823	9.975	2.195	-3.956
	(0.16)	(1.35)	(0.88)	(-0.26)	(0.45)	(0.07)	(-0.08)
D	-1.831	7.746	-3.893	-8.051	14.764	-9.600	10.002
	(-0.51)	(0.92)	(-0.91)	(-1.53)	(5.43)**	(-2.08)*	(1.78)
$D \cdot Y_i$	-.010	-.119	.135	.113	-.144	.081	-.346
	(-1.41)	(-0.94)	(2.71)**	(1.22)	(-2.25)**	(0.97)	(-2.36)
$D \cdot M_i$	.047	.041	-.039	-.079	-.004	.022	1.865
	(2.05)*	(0.47)	(-3.33)**	(-0.33)	(-0.14)	(0.38)	(2.200)
$D \cdot E_i$	4.649	-66.427	-37.602	-48.555	6.767	3.532	-1.082
	(0.04)	(-0.62)	(-0.53)	(-0.84)	(0.23)	(0.11)	(-0.02)

1% level of significance
5% level of significance

urce: Same as Table IV.

Japanese rates play a role in the Dutch market. The Japanese short-term rate is essentially explained by all but the West German rate; the foreign exchange and the industrial production interaction variables are also significant. Again, only the West German rates are not related to British rates. Finally, Canadian rates are significantly influenced by American, German, French and Japanese yields, as well as the exchange rate variable and several interaction terms.

In reviewing the structural equation coefficients in Table X it is noteworthy that 31 of the 43 significant t values come from other endogenous interest rate variables, while only 12 came from domestic variables (excluding the constant term). These results, along with the significantly high correlation of Table I, are strong evidence of the co-determination of international short-term rates.

Analysis of Tables XI and XII for the subsample period equations lends further support to the co-determination hypothesis. International rate relationships were weaker during the period when normal market forces were restrained. Co-determination was greatly increased when this restraint was lifted. While 17 of the endogenous variables were significant in the period 1965-1971, exactly twice as many were significant after 1971.

The domestic policy hypothesis does not seem to hold, however. While six exogenous variables (excluding the constant) were significant during the fixed exchange rate periods, a greater number (eight) had large t values during the floating period. Domestic policy may not have weakened very much as a factor in short-term rates over the entire period of analysis.

Table XI

2SLS Structural Estimates
in Period of Fixed Exchange Rates
(statistical t values are in parentheses)

ependent Variables	R_a	R_g	R_f	R_n	R_j	R_k	R_c
ndogenous Variables							
R_a	--	1.627	1.126	-.399	1.058	-.401	.969
	--	(1.38)	(3.21)**	(-0.78)	(2.23)**	(-1.77)	(5.51)
R_g	.052	--	-.102	.143	.067	.004	-.117
	(0.95)	--	(-1.30)	(1.50)	(0.83)	(0.09)	(-2.17)
R_f	.195	-1.046	--	.548	-.367	.106	-.201
	(1.81)*	(-1.94)*	--	(2.67)**	(-1.80)*	(0.94)	(-1.43)
R_n	.0004	1.430	.698	--	-.162	.043	.144
	(0.00)	(3.40)**	(4.07)**	--	(-0.88)	(0.38)	(1.12)
R_j	-.094	-.128	.072	.071	--	.145	-.094
	(-0.53)	(-0.30)	(0.45)	(0.35)	--	(1.50)	(-0.77)
R_k	-.524	-1.789	.391	-.538	1.196	--	.857
	(-2.08)*	(-1.27)	(0.88)	(-0.85)	(2.80)**	--	(3.67)
R_c	.936	-.387	-.514	.486	-1.036	.572	--
	(4.37)**	(-0.30)	(-1.47)	(1.08)	(-2.52)**	(3.70)**	--
xogenous Variables							
Constant	3.977	-3.777	-7.554	3.605	-1.083	1.623	-2.788
	(1.72)*	(-0.78)	(-5.85)**	(1.60)	(-0.60)	(0.69)	(-1.44)
Y_i	-.075	.247	.041	.096	.187	.013	.006
	(-1.05)	(1.73)*	(3.10)**	(1.03)	(4.06)**	(0.27)	(0.07)
M_i	.028	-.069	.009	-.342	-.070	.009	-.139
	(1.17)	(-0.85)	(1.22)	(-1.52)	(-3.81)**	(0.31)	(-0.27)
E_i	-8.274	166.273	44.484	-42.830	1.215	3.359	27.12
	(-0.24)	(2.89)**	(1.41)	(-1.81)*	(0.11)	(0.29)	(1.15)

*5% level of significance
**1% level of significance

Source: Same as Table IV

Table XII

2SLS Structural Estimates
in Period of Floating Exchange Rates
(statistical t values are in parentheses)

ndent Variables	R_a	R_g	R_f	R_n	R_j	R_k	R_c
genous Variables							
R_a	--	1.248	-.780	.454	.766	-.665	.622
	--	(5.37)**	(-3.55)**	(1.46)	(2.39)**	(-2.67)**	(3.16)**
R_g	.591	--	.675	-.369	-.115	.440	-.511
	(5.34)**	--	(4.84)**	(-1.43)	(-0.38)	(2.40)**	(-3.04)**
R_f	-.563	.805	--	.504	.635	-.516	.862
	(-3.23)**	(3.28)**	--	(1.94)*	(2.47)**	(-2.53)**	(5.33)**
R_n	.258	-.367	.290	--	-.570	.469	-.085
	(1.85)*	(-1.64)*	(1.85)*	--	(-3.29)**	(4.89)**	(-0.58)
R_j	.373	-.377	.351	-.363	--	.511	-.238
	(2.39)**	(-1.49)	(2.32)**	(-2.56)**	--	(5.00)**	(-1.93)*
R_k	-.474	.767	-.530	.969	1.356	--	.218
	(-2.32)**	(1.91)*	(-2.09)*	(4.64)**	(5.90)**	--	(1.02)
R_c	.584	-.769	.776	.038	-.392	.576	--
	(3.38)**	(-2.48)**	(3.45)**	(0.13)	(-1.58)	(2.28)**	--
enous Variables							
Constant	-11.185	13.283	-10.108	-3.055	14.528	-12.854	18.058
	(-2.55)**	(1.37)	(-1.82)*	(-0.44)	(-4.16)**	(-2.97)**	(2.24)**
Y_i	.130	.140	.132	.068	-.190	.146	-.333
	(2.33)**	(-1.25)	(2.13)*	(0.78)	(-3.80)**	(3.24)**	(-2.69)**
M_i	.003	-.024	.0004	-.201	-.004	.013	.882
	(0.22)	(-1.09)	(0.06)	(-4.18)**	(-0.61)	1.64)*	(3.11)**
E_i	-32.901	-21.801	64.169	-80.702	3.969	11.485	4.374
	(-0.39)	(-0.23)	(0.94)	(-1.52)	(0.14)	(0.45)	(0.09)

level of significance
level of significance

ce: Same as Table IV

V. Conclusion

Our two-period comparisons empirically agree with Kissinger's (1983) assessment. Individual countries can no longer make unilateral decisions regarding exchange rates without affecting the world economy. The current floating exchange rate system is not completely market-oriented. Market forces are allowed to operate within certain upper and lower bounds found acceptable to the central banks.

Our two-period comparisons started with simple correlations and gradually grew in completeness, culminating in the simultaneous equation model of two stage least squares. This latter model explicitly showed a distinct increase in co-determination as a by-product of greater reliance on open international fund movements. Domestic policy, meanwhile, did not diminish as a significant factor in rate determination in most of the countries sampled.

As one policy implication, we agree with Kissinger that greater cooperation among the major trading countries, and their respective central banks, is necessary in order to reduce the unpredictability of exchange rate politics. But monetary reform will not succeed in the external arena without the coordination of fiscal and monetary policies internally. In the modern world economy many more factors determine domestic interest rates than used to be the case in the near past. More research is needed in this area.

Footnotes

[1]Argy and Hodjera employed other tests, as well, including one involving bilateral interest differentials and forward exchange discounts. These, however, were all concerned with discerning financial linkage and not the co-determination of interest rates per se. In addition the authors acknowledged the limitations of tests in terms of inadequate data and insufficient explanatory variables.

[2]Zellner and Montmarquette (1971) have pointed out that the temporal aggregated data in general will affect the precision of estimation and prediction, the power of tests, the possibility of making short-run forecast and the probability of discovering new hypothesis about the short-run behavior from data. The more aggregated data produces a higher R^2 but lower coefficient t values.

[3]See Gibson and Kaufman (1968) and Hanburger and Silber (1969).

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