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INTERNATIONAL CAPITAL MOBILITY AND ASSET SUBSTITUTABILITY: SOME THEORY AND EVIDENCE ON RECENT STRUCTURAL CHANGES

Francesco Caramazza

Kevin Clinton

Agathe Côté

David Longworth

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ABSTRACT

This study examines different aspects of the international integration of capital markets. In particular, it attempts to determine whether the changes in controls and regulatory policies that have occurred in the past decade have been associated with a greater degree of market integration. The pertinent empirical literature is surveyed and some new estimates are provided. These estimates are principally for Canada, France, Germany, Japan, the United Kingdom, and the United States for the 1973-85 period as a whole and for the subperiods of the 1970s and 1980s. The issues examined are the degree of international mobility and substitutability of financial assets, the role of transactions costs in explaining deviations from covered interest parity, and the international equality (or inequality) of short-term real interest rates.

The results are consistent with a high degree of mobility of financial assets in periods when capital controls are absent. Capital controls are the main identifiable barrier to mobility. Factors other than controls and regulations that have been thought to impede mobility are found not to be empirically significant. Most notably, political risk has not had significant effects in the expected direction on the differential between Euromarket and domestic interest rates, and transactions costs are too small to account for sizable deviations from covered interest parity. Tests of a portfolio-balance model of the exchange risk premium give results that are also consistent with a high degree of substitutability for financial assets. But despite the high degree of capital mobility and substitutability, short-term real interest rates are not equalized internationally. The empirical evidence indicates that although removal of controls in various countries over the past ten years has stimulated mobility, there is no evidence that substitutability has tended to increase during the 1980s, nor have real interest rates generally moved towards international equality.

RÉSUMÉ

La présente étude vise à examiner sous divers angles l'intégration internationale des marchés de capitaux. Elle tente en particulier de déterminer si l'intégration s'est accrue par suite des changements apportés au cours de la dernière décennie aux politiques de contrôle et de réglementation des marchés. Les auteurs passent en revue les études empiriques traitant de cette question et présentent les résultats des nouvelles estimations qu'ils ont effectuées. Celles-ci concernent surtout l'Allemagne, le Canada, les États-Unis, la France, le Japon et le Royaume-Uni et elles couvrent l'ensemble de la période 1973-1985, qui est aussi découpée en deux sous-périodes, les années 70 et les années 80. L'étude porte sur le degré de mobilité et de substituabilité internationales des actifs financiers, sur le rôle du coût des opérations dans les écarts par rapport à la parité des taux d'intérêt après couverture des risques de change et sur l'égalité (ou l'inégalité) des taux d'intérêt réels à court terme entre pays.

Les résultats de l'étude indiquent que la mobilité des actifs financiers est très grande durant les périodes où les mouvements de capitaux ne sont soumis à aucun contrôle. Les contrôles des capitaux sont la principale entrave à la mobilité qui ait pu être identifiée. Un certain nombre de facteurs autres que les contrôle et la réglementation, qui étaient considérés comme des obstacles à la mobilité des capitaux, ne se sont pas avérés des facteurs significatifs sur le plan empirique. L'exemple le plus frappant a été celui du risque politique, qui n'a pas eu d'effets significatifs dans le sens attendu sur l'écart entre les taux d'intérêt pratiqués d'une part sur l'euromarché et d'autre part sur les marchés nationaux. En outre, les coûts des opérations sont trop faibles pour causer d'importants écarts par rapport à la parité des taux d'intérêt après couverture des risques de change. Les tests effectués sur un modèle de portefeuille établi en fonction de la prime de risque donnent des résultats qui confirment également la grande substituabilité des actifs financiers. Toutefois, en dépit du haut degré de mobilité et de substituabilité des capitaux, il n'existe pas à l'échelle internationale d'égalité des taux d'intérêt réels à court terme. Les résultats empiriques obtenus révèlent que la suppression des contrôles dans divers pays durant les dix dernières années a renforcé la mobilité des capitaux, mais rien ne prouve que la substituabilité de ces derniers a eu tendance à augmenter durant les années 80 ni que les taux d'intérêt réels ont dans l'ensemble eu davantage tendance à s'égaliser à l'échelle internationale.

PREFACE

An earlier version of this study was prepared as a background report for the Study Group, established by the central banks of the Group of Ten Countries, that produced the report entitled Recent Innovations in International Banking, published by the Bank for International Settlements.

While each of us had significant input into the various aspects covered in this study, Kevin Clinton was the primary author of sections 2 and 3, Agathe Côté and David Longworth were the primary authors of section 4 and the two appendixes, and Francesco Caramazza was the primary author of section 5.

We would like to thank William Alexander and Charles Freedman for helpful comments. We are also grateful to Steven Beal for research assistance, Suzanne Bercier for typing various drafts, and Jill Moxley for editorial assistance.

CONTENTS

1 INTRODUCTION

This study examines the international integration of financial activity, focusing on recent changes in the degree of integration between some of the major financial markets.

The theoretical concepts of capital mobility and capital substitutability are used to assess the extent of financial integration. Capital mobility refers to the ease with which funds may be shifted from one financial market to another in response to changes in expected relative returns. The degree of capital mobility depends on transactions costs, taxes, official regulations and controls and other barriers to capital movements. Capital substitutability refers to the willingness of investors, in response to changes in expected relative returns, to shift among assets that differ only by currency of denomination and that are not covered against exchange rate movements.

Various changes in financial markets since the move to generalized floating of exchange rates in 1973 have favoured increased capital mobility and substitutability. Some of the most important of these are:

1. reductions in controls on entry and exit of financial capital;
2. the abolition of interest rate ceilings and the easing of restrictions on financial activities in some domestic financial markets, which have made it easier for foreigners to participate;
3. the deepening of forward exchange markets and the development of foreign exchange futures markets;
4. the development of foreign currency options and currency swaps which, respectively, have created new opportunities to manage the risk of foreign exchange exposure and to lower the cost of borrowing abroad;
5. the development of new instruments in domestic and international markets such as note issuance facilities (NIFs), floating rate long-term notes (FRNs), interest rate options, interest rate swaps and forward rate agreements, the majority of which can also be exploited by foreigners borrowing or lending in the domestic market;

6. the recent growth of "securitization", which displaces traditional bank intermediation by means of new negotiable instruments, and the movement of banks to off-balance-sheet activities. This potentially reduces the wedges between domestic and international rates created by domestic banking regulations.

The first three of the above set of factors have been taking place over a number of years. The other three series of innovations are very recent, mostly occurring in the past two or three years, and their full impact on the integration of financial markets is yet to be realized.[1]

In the 1980s, however, there have been some developments in international banking adverse to increased financial integration: increased uncertainties associated with the international debt crisis; a perceived weakening of the stability of banking systems; an increased reluctance of banks to undertake traditional financial intermediation because of concerns about capital adequacy; and heightened volatility (and misalignments) of exchange rates and interest rates. Indeed, some of the financial innovations mentioned in 5 and 6 above were largely stimulated by these difficulties.

Therefore, while the overall thrust of developments may well have increased the degree of integration, this is not a certainty. In this study we assemble some empirical evidence on the degree of mobility and substitutability between major financial assests of industrial countries. We then attempt to determine whether mobility and substitutability increased in the 1980s compared with the 1970s.

We review the existing empirical literature and provide new research of our own. Our new research concentrates on Canada, France, Germany, Japan, the United Kingdom, and the United States and compares the evidence for the 1973-79 period with that for the 1980s. The econometric work focuses mainly on deposit rates, and we have not studied the extent to which innovation and deregulation may have reduced net financing costs to the non-financial sectors.

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1. For a description of recent innovations in financial markets and their effect on the conduct of international banking see Bank for International Settlements (1986).

We begin by discussing the mobility of financial assets and present evidence on how it has changed over time. We then examine theory and evidence on the effect of transactions costs on foreign interest arbitrage. International asset substitutability is explored next, first within the portfolio-balance framework, with the emphasis on financial assets, and second within the saving-investment framework for the balance of payments. The international equality or inequality of real interest rates is also investigated.

2 CAPITAL MOBILITY

2.1 Overview

Capital is perfectly mobile when arbitrage across different geographical centres forces the convergence of expected yields on assets with identical characteristics. In fact there is a degree of immobility between onshore and offshore markets. For short-term assets denominated in certain currencies the spreads in yields between the domestic market and the Euromarket have been much larger than the covered spreads within the Euromarket between assets denominated in different currencies.

The dimensions of the phenomenon are quite clear in Table 1 and Figures 1 to 6. All the G-5 countries except the United States have experienced periods when the differential between the Euromarket rate (measured by the interbank deposit rate) and the domestic rate has been very large in absolute value. At times it has reached 9 percentage points or more for Germany, France and Japan. For the United States and Canada the divergences between domestic and offshore rates are usually quite small. This is especially true if the domestic rate is represented by a commercial paper rate, which is less constrained by official regulations than the bank rates on certificates of deposit (CDs).[2]

It is notable that large differentials have existed only where the authorities controlled capital movements. Controls were usually imposed to resist capital outflows and to hold the domestic interest rate below

2. Ceilings on deposit rates have been much more common in the United States than in Canada. The one noteworthy case of deposit rate ceilings in Canada was the Winnipeg Agreement, June 1972 - January 1975.

Table 1

DESCRIPTIVE STATISTICS: 90-DAY INTEREST RATE DIFFERENTIALS, EUROMARKET RATE MINUS DOMESTIC RATE MONTH-END DATA 1973M6-1985M6 PER CENT PER ANNUM

	Mean (Standard deviations) A	Mean (Standard deviations) B	Subperiods with big interbank market differentials: Dates	Mean	Maximum absolute (date)
Canada					
1973M6-1985M6	0.02(0.34)	0.57(0.81)			
1973M6-1979M12	0.01(0.30)	0.33(0.72)			
1980M1-1985M6	0.03(0.38)	0.87(0.82)			
1983M1-1985M6	0.04(0.17)	1.39(0.59)			
France					
1973M6-1985M6		2.17(2.75)	1974M1-1974M12	4.79	15.75 (1974M12)
1973M6-1979M12		2.25(2.44)			
1980M1-1985M6		2.08(3.10)	1981M5-1982M12	4.69	10.87 (1982M5)
1983M1-1985M6		1.25(2.18)			
Germany					
1973M6-1985M6		-0.57(1.30)	1973M6-1973M12	-5.60	-9.00 (1973M6)
1973M6-1979M12		-0.78(1.73)			
1980M1-1985M6		-0.33(0.24)			
1983M1-1985M6		-0.26(0.13)			
Japan					
1977M9-1985M6	-0.36(1.31)	2.36(2.23)	1978M1-1978M12	-1.15	-2.87 (1978M12)
1977M9-1979M12	-1.60(1.71)	0.58(2.13)			
1980M1-1985M6	0.16(0.57)	3.11(1.82)	1980M1-1980M12	6.09	11.63 (1980M3)
1983M1-1985M6	-0.02(0.10)	2.15(0.96)			
United Kingdom					
1973M6-1985M6		0.69(1.18)			
1973M6-1979M12		1.31(1.30)	1974M1-1974M12	3.05	5.63 (1974M12)
1980M1-1985M6		-0.05(0.22)			
1983M1-1985M6		-0.03(0.09)			
United States					
1973M6-1985M6	0.56(0.44)	0.74(0.45)			
1973M6-1979M12	0.54(0.36)	0.69(0.36)			
1980M1-1985M6	0.60(0.52)	0.81(0.53)			
1983M1-1985M6	0.28(0.23)	0.44(0.19)			

A. Commercial paper rate in domestic market, interbank rate in Euromarket.
B. Interbank rate in domestic and Euromarket.

Figure 1

CANADA 90-DAY INTEREST RATE DIFFERENTIALS

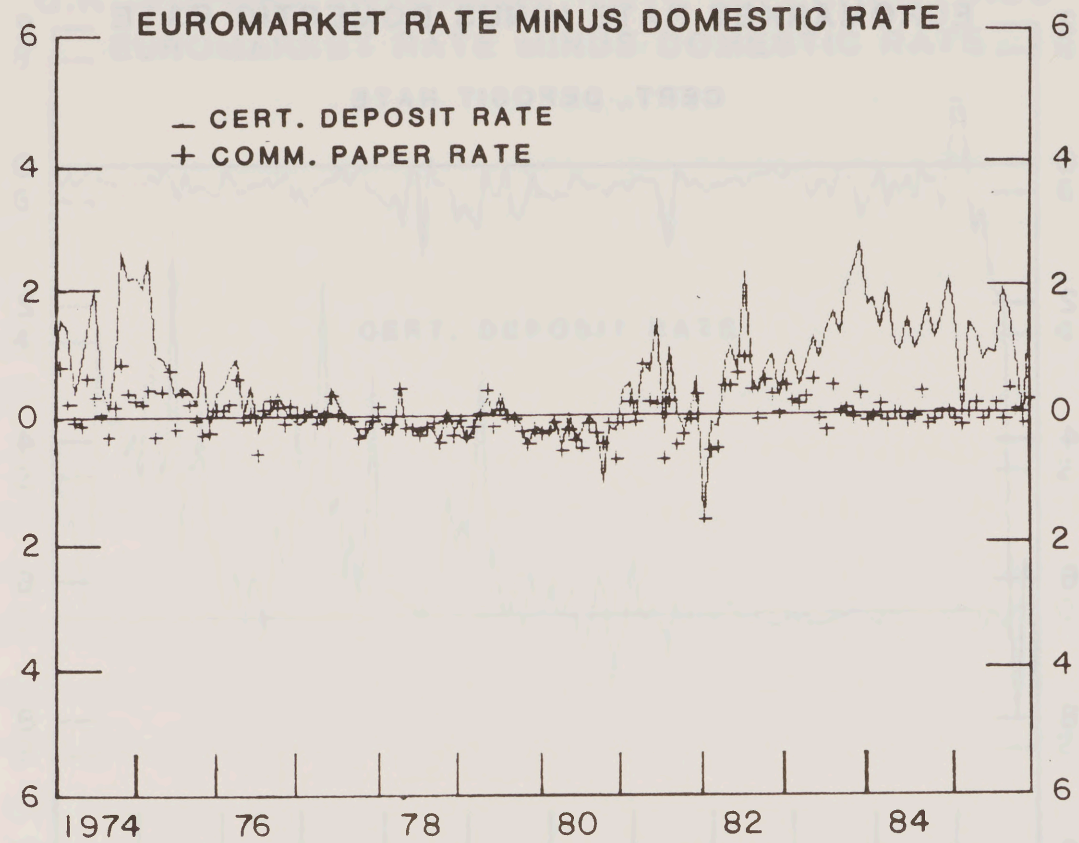


Figure 2

FRANCE 90-DAY INTEREST RATE DIFFERENTIALS

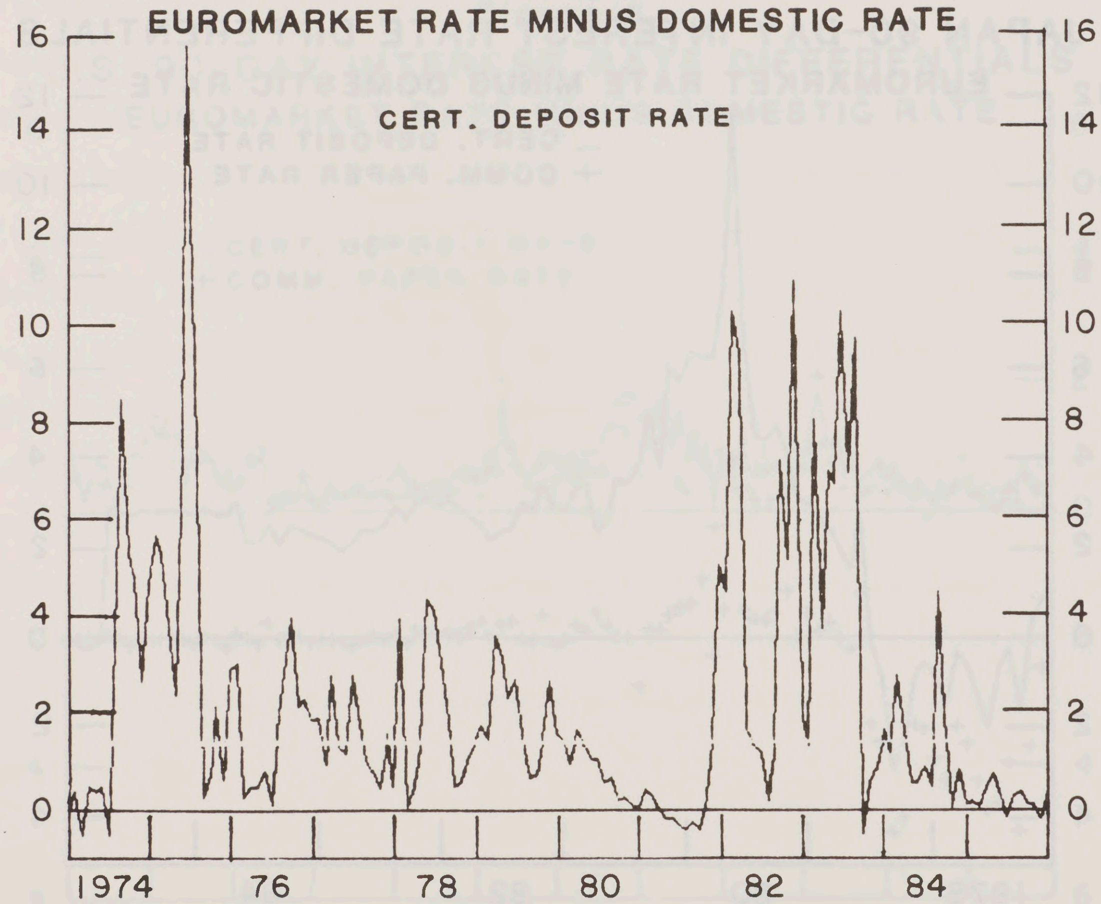


Figure 3

GERMANY 90-DAY INTEREST RATE DIFFERENTIALS

EUROMARKET RATE MINUS DOMESTIC RATE

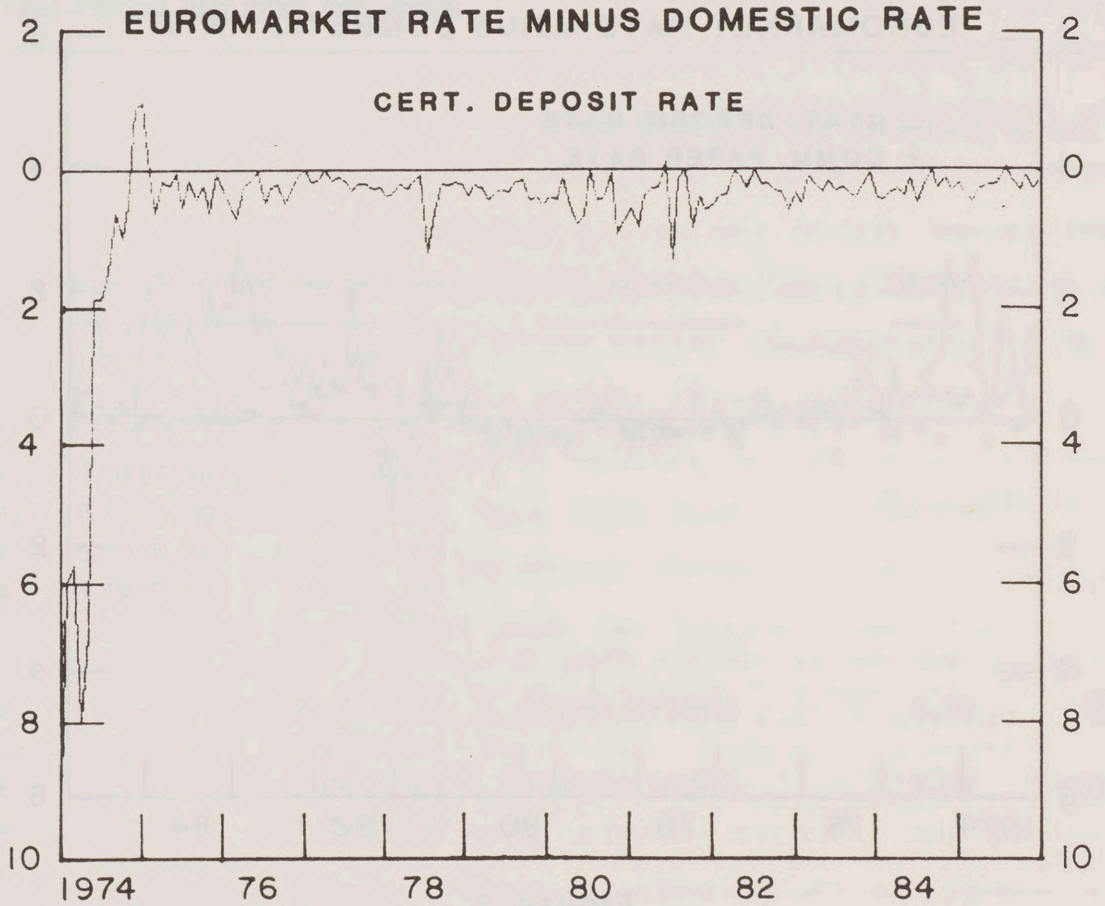


Figure 4

JAPAN 90-DAY INTEREST RATE DIFFERENTIALS

EUROMARKET RATE MINUS DOMESTIC RATE

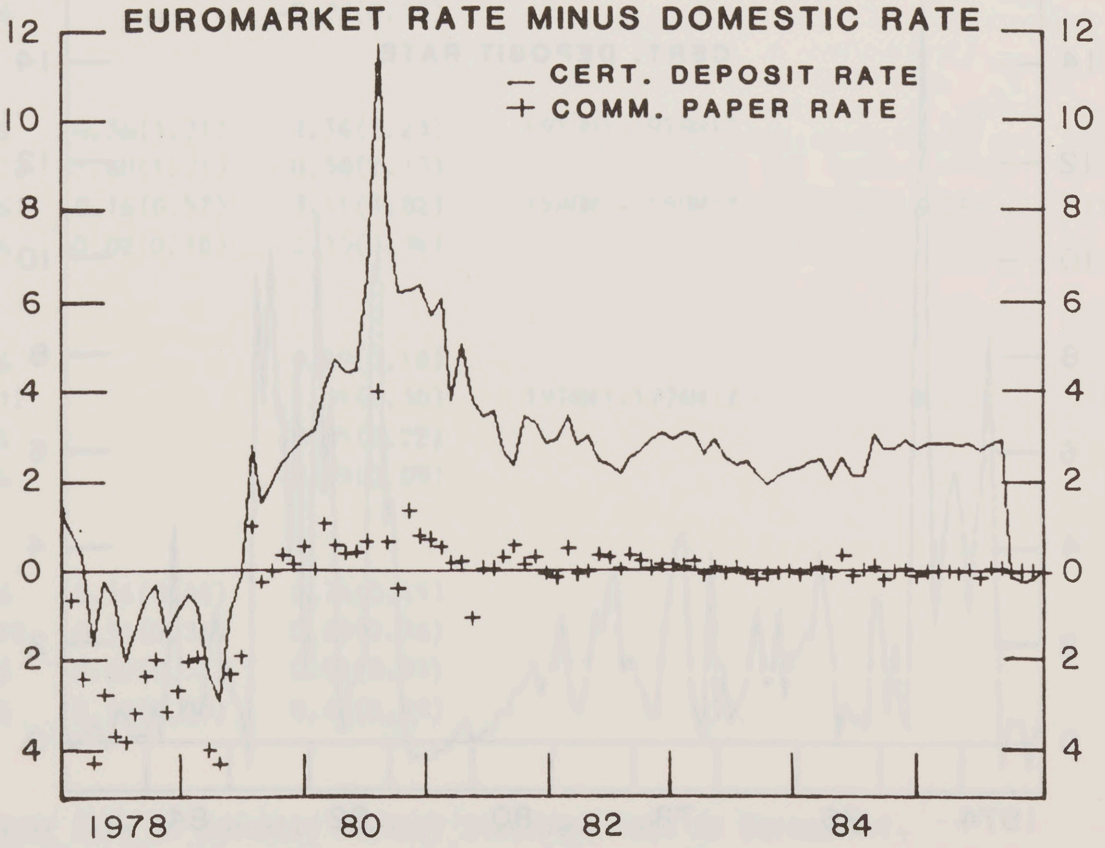


Figure 5
U.K. 90-DAY INTEREST RATE DIFFERENTIALS
EUROMARKET RATE MINUS DOMESTIC RATE

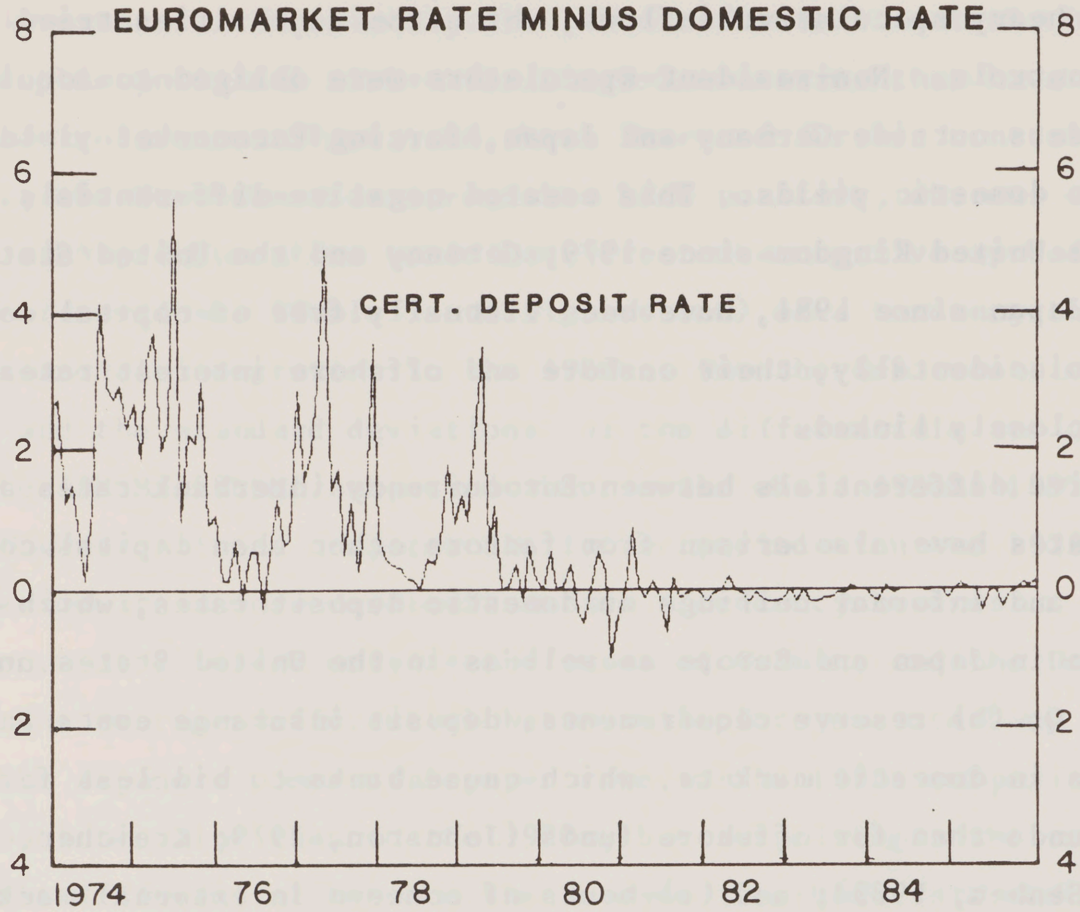
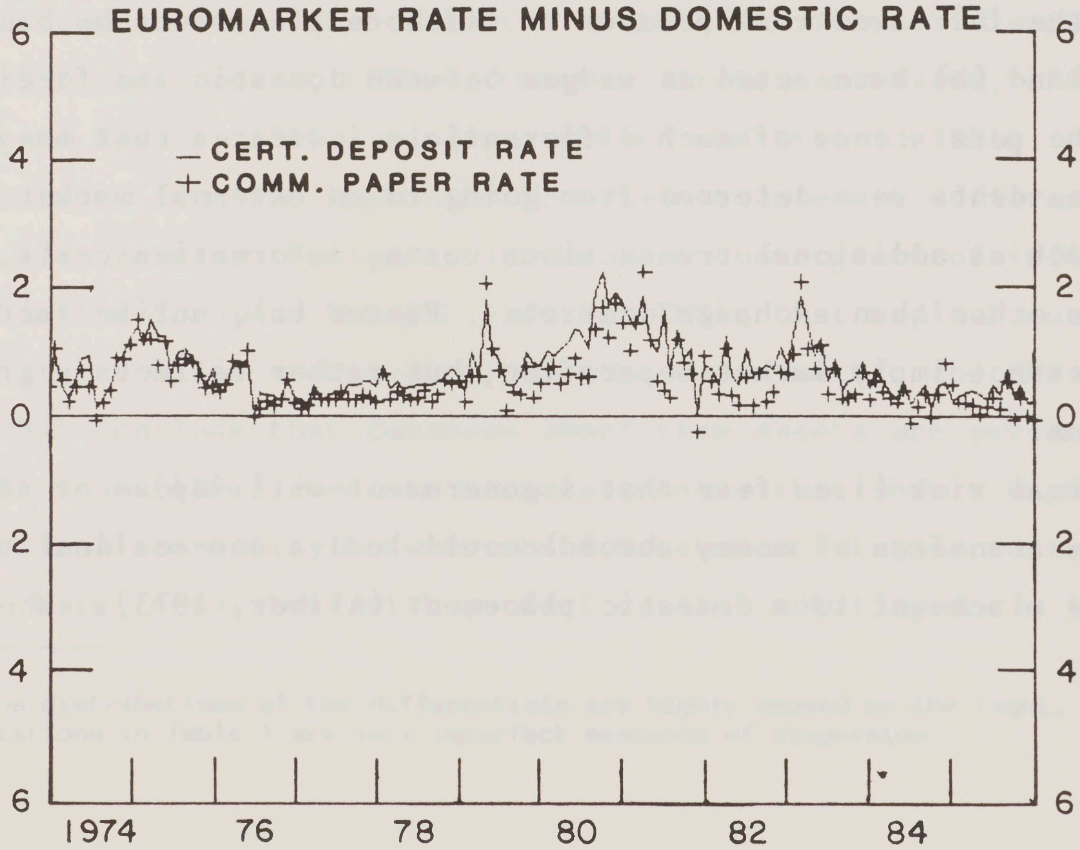


Figure 6
U.S. 90-DAY INTEREST RATE DIFFERENTIALS
EUROMARKET RATE MINUS DOMESTIC RATE



the international rate. Hence, Euro-domestic differentials have been predominantly positive. However, Germany in 1973 and Japan in 1978 were faced with heavy speculative inflows, which the authorities tried to fend off with controls. Non-resident speculators were obliged to acquire mark and yen assets outside Germany and Japan, forcing Euromarket yields down relative to domestic yields. This created negative differentials. Canada, the United Kingdom since 1979, Germany and the United States since 1974, and Japan since 1981, have been virtually free of capital controls and, not coincidentally, their onshore and offshore interest rates have been more closely linked.

Positive differentials between Eurocurrency interbank rates and domestic rates have also arisen from factors other than capital controls: (a) formal and informal ceilings on domestic deposit rates, which have been common in Japan and Europe as well as in the United States under regulation Q; (b) reserve requirements, deposit insurance costs and other regulations in domestic markets, which cause banks to bid less for domestic funds than for offshore funds (Johnston, 1979; Kreicher, 1982; Logue and Senbet, 1983); and (c) bouts of concern in external markets about default risks of particular banks or banking systems (e.g. the Eurocurrency-domestic differential after the Herstatt crisis of 1974 reflected the increased risk premium on offshore placements by banks). Factors (a) and (b) have acted as wedges between domestic and foreign returns; the persistence of such differentials indicates that many domestic residents were deterred from going to an external market by barriers such as additional transactions costs, information costs, and regulations other than exchange controls. Factor (c), unlike factors (a) and (b) does not imply market separation, but rather reflects a greater risk premium.

Political risk (i.e. fear that a government will impose or tighten controls on transfers of money abroad) could lead a non-resident to prefer an offshore placement to a domestic placement (Aliber, 1973). Whereas actual controls on outflows lead to a positive offshore-minus-domestic spread, fear of tightened controls creates a political risk premium on domestic investment. Empirically the effect of actual controls has outweighed this political risk: for the G-5 countries that have imposed exchange controls on outflows, and where fears of further controls would be highest, the Euro-domestic spread has been positive, whereas a political risk premium alone would have created a negative spread.

There is evidence (Table 1 and Figures 1-6) of a tendency towards greater financial integration in the 1980s. For the G-5 countries both the means and the standard deviations[3] of the differentials are uniformly less in the 1983M1-1985M6 subperiod than in the whole 1980M6-1985M6 period. However, if one compares the latter period with the 1973M6-1979M12 period it is more difficult to see a tendency towards integration. It is clear only in the cases of Germany and the United Kingdom. The average differential between the Euroyen interbank deposit rate and the Japanese commercial paper rate in the 1980s subperiod is less in absolute value than in the 1970s, but surprisingly the reverse is true for the differential between the Euroyen interbank rate and the Japanese domestic bank deposit rate.

Econometric studies have found that controls constitute the major explainable component of Euro-domestic spreads for France (Claassen and Wyplosz, 1982 and Frankel, 1982c), Germany (Dooley and Isard, 1980), Italy (Giavazzi and Pagano, 1984) and Japan (Otani and Tiwari, 1981). Rogoff (1985) concludes from the high onshore-offshore interest differentials for franc and lira assets, together with the slow convergence of inflation rates within the European Monetary System (EMS), that capital controls played a large role in stabilizing exchange rates within the EMS. Boothe et al. (1985) conclude that Canadian short-term assets are perfectly mobile. Hartman (1984) conducts causality tests that show a high degree of bidirectional causality between the U.S. commercial paper rate and the Eurodollar rate, consistent with perfect capital mobility for a large

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3. Since the distributions of the differentials are highly skewed to the right, the standard deviations in Table 1 are very imperfect measures of dispersion.

economy. Taken as a whole, existing research strongly suggests that official capital controls have been a significant barrier to capital mobility, but that political risk, as defined by Aliber, has not been a major impediment to capital mobility among the major industrialized countries.

Results reported in section 2.2 largely confirm these findings. For the countries studied, variables that might be interpreted as political risk proxies have implausible and unstable estimated effects and explain only a small part of the variance in offshore-onshore spreads. Our evidence indicates that a high degree of short-term capital mobility already existed between developed countries in the 1970s in those periods when exchange controls were absent and when anxiety about bank default risk was not acute, and that removal of exchange controls in various countries has been the major cause of increased mobility over the past ten years.

2.2 Empirical Equations

An empirical model of the Euro-domestic rate spread should incorporate variables for actual controls and for political risk. Dooley and Isard (1980) and Frankel (1982c) derive the exposure to political risk as a function of the ratio to total world wealth of the outstanding stock of government debt[4] and of domestic wealth.

Variations in the strength of capital controls can be represented partly by dummy variables for the periods in question. To the extent that controls do successfully segment markets, variables are also needed that capture the impact on the spread of different external and internal movements in the balance of demand and supply for a country's assets. These can be represented by the ratio of the stock of government debt to world wealth (the same variable as the political risk proxy) and the ratio

4. Haas and Alexander (1979) use the net foreign asset position of the country. The use of this variable is not explicitly derived from optimizing portfolio behaviour, and we found that equations incorporating it tended to be slightly inferior to those employing government debt.

of domestic wealth to world wealth. The latter variable allows for a preference at the margin for domestic assets over foreign assets. With these specifications, the following reduced form equation can be derived from the domestic and rest-of-world demand functions for a country's short-term assets:

$$i_{de} - i_d = a_0 + a_1(B/S)/W + a_2(W_d/S)/W + a_3 C \qquad (1)$$

i_{de} = external rate on domestic currency assets,
i_d = domestic interest rate,
B = stock of net government liabilities to the private sector, in domestic currency,
W_d = domestic wealth in domestic currency,
W = aggregate world wealth in U.S. dollars,
C = a vector of dummy variables for control periods,
S = price of U.S. dollar in domestic currency.

The stock of net government liabilities (which represents assets for the private sector) is defined to include total central government debt plus the monetary base, minus debt held by monetary authorities and local-currency assets held by foreign central banks as foreign exchange reserves. Domestic-wealth series are constructed as the sum of financial asset stocks and cumulated current account balances. Aggregate world wealth is simply assumed to be the total domestic wealth of the six countries. Bond stocks and national wealth are expressed in local currency, and world wealth in U.S. dollars. (Data construction and sources are explained in detail in Appendix A.)

An increase in the dependent variable of equation (1) signals an increase in the Euro-domestic spread, which would correspond to a decrease in the domestic political risk premium. Dummy variables are used parsimoniously in our tests, with no more than two applied to any country, each having a constant value.[5] The strength of controls was by no means constant within the periods selected and controls were not always binding. We have defined the dummy variables to be zero where it seemed that controls were not binding (in the sense that incipient capital flows were mainly in the opposite direction to those that the controls were aimed at), and one otherwise. In the studies cited above the exchange control variables are more richly specified so that more precise point estimates of their effect can be obtained. Our purpose is slightly different. Since we can take it as established that controls significantly affect the spread, we want to avoid a set of dummies that "explains" the differential well but detracts from the explanatory power of the "political risk" variables, i.e. wealth and government debt.

Dooley and Isard (1980) argue that there are no priors on the signs of coefficients a_1 and a_2. For a given level of controls and wealth an increase in government debt might raise both domestic and offshore interest rates, with the spread going either way. Likewise, depending on the preference of residents for domestic investment over international diversification, an increase in the ratio of domestic to world wealth might reduce or raise the spread. Notwithstanding Dooley and Isard's argument, we might expect that, with normal risk aversion and with the preferences of residents biased at the margin towards domestic assets,[6] a_1 should be negative and a_2 positive. Other things being equal, increased government debt should raise the political risk premium required by asset holders to absorb that debt, and increased domestic wealth should reduce it.

Results of the regressions are in Table 2. Two countries had more observations for 3-month interest rates than for 1-month rates, so the former are used in the regressions.

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5. This allows for three levels of exchange controls, the lowest of which is no controls for all the countries except France. In the case of the United States a variable is included to capture the heightened perceived risks in the Eurodollar market following the collapse of the Herstatt Bank. The crisis of confidence in the solvency of banks in the Eurocurrency market induced depositors to demand a significant risk premium for depositing in the Eurocurrency market. Thus, Eurodollar rates temporarily rose above the effective cost to U.S. banks of borrowing domestically (see Kreicher (1982), p.17; Johnston (1979), p.59).

6. As in the symmetric-preference, portfolio-balance model outlined in section 4.1.3.

Table 2

90-DAY INTEREST SPREAD EQUATIONS, EUROMARKET RATE MINUS DOMESTIC RATE

(t-ratios in parentheses)

$i_{de} - i_d = a_0 + a_1 (B/S)/W + a_2 (W_d/S)/W + a_3 C$

			a_0	a_1	a_2	a_3+ I	a_3+ II	RHO	SEE	DW	F
Canada	A	1973M6-1984M12	-0.33 (0.71)	-3.39 (.32)	12.40 (2.29)			0.21 (2.53)	0.33	1.99	3.21*
		1973M6-1979M12	0.21 (0.37)	-25.05 (1.71)	24.52 (4.63)			-0.01 (0.12)	0.26	1.87	11.38*
		1980M1-1984M12	0.10 (0.05)	0.96 (0.02)	-3.21 (0.09)			0.26 (2.01)	0.39	2.10	0.03
	B	1973M6-1984M12	-2.71 (2.10)	32.99 (1.10)	35.38 (2.15)			0.55 (7.41)	0.58	2.23	4.80*
		1973M6-1979M12	2.06 (1.52)	-107.74 (3.13)	86.41 (6.43)			0.36 (3.34)	0.43	1.94	9.15*
		1980M1-1984M12	4.48 (1.13)	-184.01 (1.59)	162.27 (2.44)			0.37 (2.97)	0.66	2.22	4.21*
France	B	1973M6-1984M12	-1.34 (0.40)	-59.96 (0.89)	45.97 (2.07)	2.23 (2.45)	3.62 (2.86)	0.49 (6.28)	2.17	1.98	3.61*
		1973M6-1979M12	2.90 (0.68)	-99.21 (1.36)	19.14 (0.74)	2.30 (2.74)		0.51 (4.58)	1.84	1.68	1.88
		1980M1-1984M12	-6.57 (1.06)	-95.83 (0.65)	119.02 (2.16)		6.05 (3.22)	0.37 (2.94)	2.54	2.08	1.99
Germany	B	1973M6-1984M12	-0.39 (1.58)	0.91 (0.35)	-0.23 (0.16)	-5.92 (21.98)		0.24 (3.18)	0.37	1.71	0.06
		1973M6-1979M12	-2.71 (2.85)	-14.74 (1.70)	20.47 (2.32)	-5.78 (17.96)		0.25 (2.52)	0.43	1.60	2.98
		1980M1-1984M12	-0.06 (0.24)	2.55 (0.36)	-4.04 (1.30)			-0.11 (0.86)	0.24	2.06	4.15*
Japan	A	1977M9-1984M12	1.85 (1.05)	24.24 (3.07)	-24.36 (2.72)	-1.18 (2.27)	0.49 (1.64)	0.41 (3.68)	0.76	2.07	5.16*
		1977M9-1979M12	2.15 (0.88)	98.77 (4.20)	-64.82 (3.41)	-0.63 (0.98)		0.24 (1.11)	0.88	1.89	8.53*
		1980M1-1984M12	4.64 (3.70)	-22.98 (2.55)	-1.78 (0.25)		0.13 (0.78)		0.50	2.19	8.80*
	B	1977M9-1984M12	10.96 (3.09)	29.24 (1.18)	-52.66 (3.24)	-0.30 (0.41)	0.61 (0.87)	0.83 (11.92)	0.97	2.16	5.78*
		1977M9-1979M12	8.15 (2.96)	130.53 (5.00)	-96.59 (4.97)	-0.60 (0.97)		0.39 (1.93)	0.87	1.74	8.04*
		1980M1-1984M12	17.50 (5.56)	-112.95 (4.57)	22.33 (1.24)		0.65 (1.51)	0.38 (3.14)	0.89	1.98	8.13*
U.K.	B	1973M6-1984M12	0.52 (0.80)	0.01 (2.72)	-19.05 (4.60)	0.92 (3.93)		0.27 (3.18)	0.77	2.03	6.61*
		1973M6-1979M12	1.05 (0.61)	0.01 (1.33)	-31.65 (2.49)	0.91 (2.90)		0.25 (2.18)	1.00	2.03	6.80*
		1980M1-1984M12	1.34 (0.49)	0.002 (0.83)	-4.91 (0.88)			0.08 (0.61)	0.24	1.92	0.39
U.S.	A	1973M6-1984M12	2.68 (4.65)	-2.55 (1.56)	-2.19 (1.69)	-0.23 (0.93)	0.34 (1.64)	0.41 (5.09)	0.36	2.01	10.11*
		1973M6-1979M12	3.42 (4.23)	-6.59 (2.73)	-0.03 (0.02)	-0.34 (1.77)	0.35 (2.33)	0.23 (2.00)	0.28	1.86	6.74*
		1980M1-1984M12	3.59 (4.05)	-1.93 (0.50)	-4.77 (1.09)			0.37 (3.04)	0.42	2.04	3.91*
	B	1973M6-1984M12	3.34 (6.02)	-2.07 (1.32)	-3.82 (3.04)	-0.19 (0.83)	0.33 (1.73)	0.45 (5.82)	0.32	2.18	5.42*
		1973M6-1979M12	3.63 (5.25)	-5.00 (2.42)	-1.80 (2.00)	-0.27 (1.65)	0.41 (3.20)	0.17 (1.49)	0.25	1.88	2.29
		1980M1-1984M12	4.49 (5.76)	-3.20 (0.95)	-4.96 (1.30)			0.37 (2.97)	0.37	2.18	3.85*

A Commercial paper rate in domestic market, interbank rate in Euromarket.

B Interbank rate in domestic and Euromarket.

+ France: I 1974M1-74M12, 1976M1-76M12; II 1981M5-84M12,
Germany: I 1973M6-73M10:
Japan: I 1978M1-79M1; II 1980M1-80M12.
U.K.: I 1973M6-74M12, 1976M1-76M12, 1978M1-78M12.
U.S. I 1973M6-74M1; II 1974M6-75M1 (Herstatt crisis).

RHO Coefficient of residual autocorrelation.

* Indicates rejection of null hypothesis $a_1 = a_2 = 0$ at 0.95 probability level.

Estimates are presented for the period from 1973M6 to 1984M12 for all countries except Japan, for which data are available only from 1977M9. Estimates are also presented for the subperiods 1973M6-1979M12 and 1980M1-1984M12 to see if there was a structural shift. The year 1980 is a convenient place to split the sample period because it roughly coincides with several important developments, including: (a) the start of the EMS; (b) moves to decontrol in the United Kingdom and Japan; (c) the implementation of a revised system of monetary control in the United States, which was accompanied by an increase in the volatility of exchange rates and interest rates; and (d) an upward shift in the level of nominal and, later, real interest rates. We are particularly interested in whether operative elasticities of demands for assets were higher in the 1980s than in the entire estimation period.

We discuss first the regressions over the whole period, 1973M6 (1977M9 for Japan) to 1984M12. The estimates of coefficients a_1 and a_2 are jointly significantly different from zero in most equations.[7] But this is not strong evidence for the existence of a political risk premium that is a function of asset stocks and relative wealth. In only two of the nine equations does the government debt ratio have a t-ratio higher than 2, and in both cases the coefficient is positive. This contradicts Aliber's (1973) hypothesis that increased political risk should increase the domestic rate relative to the offshore rate. The t-ratios on the relative-wealth term are greater than 2 in seven of the nine equations but with no consistent sign. The coefficients of the wealth and debt variables are jointly significant in eight of the nine equations, but only those for Canada (commercial paper rate) and France have the expected signs.

For France, Germany, Japan and the United Kingdom, the estimated exchange-control dummies have the expected sign, are statistically significant and, particularly for France and Germany, are quite large.

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7. We are aware that the F-and t-ratios may be biased upwards in these equations by the overlapping of the 3-month interest rate horizons over the monthly data points (Hansen and Hodrick, 1981). Thus, the term "significant" is employed somewhat loosely but without prejudice to our conclusion that the equations are unsatisfactory, since under a more efficient estimation procedure the null hypothesis would be accepted more often.

For the reasons given earlier (page 8) the coefficients are positive except those for Germany in 1973 and Japan in 1978.

Most equations estimated over the 1980M1-1984M12 subperiod are quite different from those estimated over the 1973M6-1979M12 subperiod. Apart from the coefficients of certain dummy variables the coefficients are neither well determined nor stable.

In Table 1 some periods with exceptionally large and persistent spreads were highlighted. To gauge the relative importance of exchange controls versus political risk during these periods we use the equations estimated over the entire 1973M6-1984M12 period. If we define $y=i_{de}-i_d$, $x=(B/S)/W$ and $z=(W_d/S)/W$, equation (1) can be transformed to

$$y-\approx{y}=a_1(x-\approx{x})+a_2(z-\approx{z})+a_3(C-\approx{C}) \qquad (2)$$

where ≈ indicates the mean of the respective variable over the entire sample period. A measure of the contribution of the political risk variables[8] to the exceptional yield differential is then given by

$$POLR = \hat{a}_1\ (x-\approx{x}) + \hat{a}_2\ (z-\approx{z}) \qquad (3)$$

where ^ indicates an estimated value. The estimated "capital control contribution" is then $\hat{a}_3(C-\approx{C})$ (although as previously explained some of the impact of actual credit controls would also come through the variables x and z). Results of the calculation are given in Table 3.

In all cases a sizeable portion of the exceptional spreads is accounted for by controls. In the case of Germany controls more than fully account for the exceptional spread. Only for the United Kingdom does political risk account for an economically meaningful share of the

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8. The mean, $\approx{y}$, could also contain an element of time-invariant political risk. But it is more likely to reflect the effect of controls not captured by the dummy variables for France and Japan, the countries for which $\approx{y}$ is largest. Controls have been endemic in the financial systems of these two countries.

Table 3

ESTIMATED CONTRIBUTIONS OF EXCHANGE CONTROLS AND POLITICAL RISK VARIABLES TO LARGE INTEREST RATE SPREADS

	Exceptional spreads			Estimated components of $\tilde{y}-\tilde{\tilde{y}}$	
	Period	Average $\tilde{y}$	Deviation of average from entire 1973M6-84M12 average $\tilde{y}-\tilde{\tilde{y}}$	POLR	$\tilde{C}-\tilde{\tilde{C}}$
France	1981M5-82M12	4.69	2.43	-0.97	1.54
Germany	1973M6-73M12	-5.60	-5.01	-0.03	-5.71
Japan	1980M1-80M12	6.09	3.63	-0.20	0.44
U.K.	1974M1-74M12	3.05	2.33	0.90	0.64

Table 4

INFLUENCE ON DOMESTIC INTEREST RATE OF CENTRAL BANK RATE AND INTERNATIONAL INTEREST RATE FOR COUNTRIES WITH EXCHANGE CONTROLS

$i_d = b_0 + b_1 \, i_{disc} + b_2 \, i_{de}$

	b_0		b_1		b_2		SEE	DW
Tight Controls								
France	0.741	(1.49)	0.931	(14.91)	0.027	(0.76)	0.653	1.18
Japan	1.706	(4.90)	0.395	(2.92)	0.038	(0.53)	0.367	0.68
U.K.	-1.270	(2.76)	0.749	(11.52)	0.344	(6.52)	0.798	1.22
Reduced Controls								
France	-0.570	(0.96)	0.789	(8.14)	0.215	(3.16)	1.057	0.54
Japan	1.50	(2.03)	0.378	(3.74)	0.096	(2.01)	1.207	0.27
U.K.	(High multicollinearity)							

Tight control periods as defined by the dummy variables in Table 2 exceptional differential, but this is in spite of implausibly signed coefficients in the U.K. equation.

These results confirm the significant effect of exchange controls and raise the question of the magnitude of the independent movement of the domestic interest rate vis-à-vis the offshore rate under controls. A direct approach to this question is provided by the equation

$$i_d = b_0 + b_1 i_{disc} + b_2 i_{de} \tag{4}$$

i_{disc} = central bank discount rate.

In a situation of low capital mobility because of controls, the short-term domestic interest rate would tend to follow the discount rate, in which case b_1 would be near unity and b_2 near zero. In a situation of high mobility, b_1 would be near zero and b_2 near unity, or they would be indeterminate if i_{disc} and i_{de} are highly collinear.

Empirical estimates of equation (4) are presented in Table 4 for the three countries that have had exchange controls for significant periods: France, Japan and the United Kingdom. Because the expected depreciation rate of the domestic currency is jointly endogenous with i_d (e.g. in Dornbusch's model, 1976b) the instrumental variables estimation technique is used.[9] Because of the different institutional arrangements with respect to the setting of the discount rate, estimates of equation (4) should not be compared across countries.

The results indicate that in all three countries when tight controls were in place there was a substantial independent effect of the discount rate on the domestic interest rate, and that in France and Japan the offshore rate had no statistically significant influence. The elimination of controls substantially affected the results for the United Kingdom: meaningful estimates could not be obtained for equation (4) after 1981M1 because of the high collinearity of the two right-hand-side variables.[10]

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9. In the first-stage regression for i_{de} the regressors are i_{de} (t-1) and contemporaneous discount rates for five foreign central banks.

10. The Bank Rate was abandoned in 1981 in favour of a market-responsive minimum lending rate.

This is consistent with perfect capital mobility in the United Kingdom since 1979. In France and Japan reduced controls[11] caused the offshore rate to become statistically significant. For Japan the increased significance of the offshore rate coefficient accompanies a negligible drop in the coefficient on the central bank discount rate, but for France the latter coefficient drops from 0.93 to 0.79.

3 TRANSACTIONS COSTS IN SHORT-TERM MARKETS

3.1 Overview

Transactions costs create a neutral zone of interest differentials within which the movement of funds across exchanges is not profitable even when there are no other impediments to capital mobility. This zone is very narrow, however. Although transactions costs (as embodied in bid-ask spreads) can account for the bulk of divergences from covered interest parity (which are invariably small between Euromarket interest rates), they cannot explain persistent, sizable differentials between Euromarket and domestic interest rates and departures from uncovered interest parity.[12] Thus, the latter yield spreads have to be explained mainly by risk premiums and/or by systematic errors in expectations.

Some studies use a broad definition of transactions costs that includes costs of information, costs of avoiding controls, default risk, political risk, and so on (e.g. Otani and Tiwari, 1981). It seems more informative to use a narrow definition that focuses on observable market prices. Otherwise any yield differential is liable to be tautologically attributed to transactions costs. The other factors mentioned are more appropriately regarded as impediments to mobility than as elements of transactions costs.

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11. Widespread restrictions on the internal financial sector of Japan remained in place.

12. Covered interest parity is the equality between the interest rate differential and the premium (or discount) of the forward exchange rate relative to the spot exchange rate. Uncovered interest parity is the equality between the interest rate differential and the expected change in the spot exchange rate.

Frenkel and Levich (1975, 1981), in a pair of influential studies, assumed that deviations from triangular parity (i.e. deviations in the cross rates between three currencies) in spot and forward exchange rates are equal to transactions costs. McCormick (1979) showed that this assumption likely overstates true transactions costs by a considerable margin if the timing of the observations on the different market exchange rates is not exact. Frenkel and Levich also used a notion of covered interest arbitrage that leads to an overstatement of the width of the neutral zone (c.f. Deardorff, 1979 and Callier, 1981[13]). Moreover, the literature on this topic has ignored the swap market for foreign exchange, which is the standard vehicle for arbitrage transactions (Clinton, 1986).

3.2 Offshore Covered Interest Arbitrage Differentials and Transactions Costs

We now consider the role of transactions costs in causing deviations from covered interest parity in offshore markets. The outer limits of the neutral zone of deviations, within which covered transfers yield no positive return net of transactions costs, can be derived by assuming that participants in arbitrage activity minimize costs and maximize net returns (expectations and uncertainty are irrelevant to pure arbitrage).

Covered arbitrage transactions are carried out through swap transactions, in which, e.g., spot foreign exchange is swapped for forward foreign exchange. In a single transaction the equivalent of a spot purchase (or sale) and forward sale (or purchase) is accomplished. Because of the convenience of the swap instrument for trading off imbalances on foreign exchange books, both by term and by currency composition, there is a deep interbank market for swaps. Dealers give bid and ask quotations on the swap rate, i.e. the forward premium (or discount) on the foreign currency.

In the interbank market the functions that economists attribute to a forward exchange market are actually accomplished by spot and swap markets

13. Bahmani-Oskooee and Das (1985), evidently unaware of Callier's contribution, later published the same restrictions.

in tandem; there is no separate interbank market for outright forward exchange. Outright forward transactions can be carried out in the interbank market using an outright spot purchase and a forward swap to the desired maturity. The forward rate equals the spot rate plus the swap rate, and the transaction cost equals the sum of the spot market transaction cost and the swap market transaction cost. Therefore transactions costs on outright forward exchange are greater than those on spot exchange.

Clinton (1986) shows that the maximum absolute value of the deviation from interest parity that does not present a profitable arbitrage opportunity is given by the lower of (a) $t_w - |t^* - t|$ and (b) $t^* + t - t_w$, where the t's are transactions costs measured in the same units as interest rates: t_w for the swap market, t^* for foreign currency deposits and t for domestic currency deposits. For an equilibrium in which there is activity in all relevant markets and in which participants minimize costs it is sufficient that both expressions are not less than zero.[14] Otherwise one market will be abandoned because of its high transactions costs.

It is evident from these expressions that transactions costs in outright spot exchange and forward exchange are not per se relevant to deviations from covered interest parity, and that whether transactions costs imply any width to the neutral zone depends on the relative values of the t's. Inspection of (a) and (b) shows that the maximum deviation can in theory be no higher than the <u>lowest</u> of t_w, t^* or t, and the bounds on the neutral zone might be even tighter than this.

To illustrate this point, calculations for covered 90-day spreads against the U.S dollar in the Euromarket are given in Table 5.[15] Posted bid-ask spreads are used to gauge transactions costs. The t's correspond to one half of the bid-ask spread on the relevant instrument. The typical

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14. Once it is recognized that the transactions cost of outright forward exchange equals the transactions cost of outright spot exchange plus that of a forward swap this is identical to the conclusions of Callier.

15. Spot exchange spreads are also presented, although they do not enter the calculations for the covered interest parity neutral zone.

Table 5

ESTIMATED TRANSACTION COST IN 90-DAY ARBITRAGE, CALCULATED AS ONE-HALF OF MEAN BID-ASK SPREAD. EXCHANGE RATES VIS-À-VIS U.S. DOLLAR. Per Cent Per Annum.

	Spot exchange[(a)] t_s	90-day swap t_W	Eurocurrency deposit t^* (or t for the U.S.)	t^*+t-t_W	Bound on deviation from parity
Canadian dollar	0.028	0.055	0.0625	0.070	0.055
French franc	0.039	0.213	0.1777	0.027	0.027
German mark	0.023	0.034	0.0625	0.091	0.034
Japanese yen	0.031	0.038	0.0625	0.087	0.038
U.K. pound	0.035	0.065	0.0625	0.060	0.060
U.S. dollar			0.0625		

(a) Not annualized. Not relevant to covered arbitrage.

Note: bid-ask spreads as observed November 21, 1985 - May 9, 1986 on the Reuter Money Rates Service.

posted bid-ask spread on interbank deposits in the Euromarket is 1/8 per cent, implying that $t^* = t = 0.0625$. For the French franc, however, the bid-ask spread is usually higher than that on other G-5 currencies and varies substantially over time. Since posted spreads normally exceed those at which deals are made, the calculations may exaggerate the width of the neutral zone. The United States is represented as the home country, and all spreads and costs are calculated against the U.S. dollar as numeraire.

In Table 5, an upper limit on deviations from covered interest parity caused by transactions costs is given by the lower of the entries in the second and fourth columns. The effective bounds, repeated for convenience in the fifth column, suggest that for the major currencies transactions costs might cause divergences of up to about 0.06 per cent per year. For many purposes this is small enough to ignore.[16]

Although spot market transactions costs are not directly related to covered interest arbitrage, their movement over time may be an indicator of financial integration. A large body of research available on the empirical determinants of spot exchange bid-ask spreads (e.g. Fieleke, 1975 and Overturf, 1982) finds that the spreads are an increasing function of risk factors such as exchange rate volatility. It might be conjectured that bid-ask spreads in the swap markets and the financial asset markets are functions of analogous risk factors such as interest rate volatility. In view of the increase in these factors in the 1980s, it would not be surprising if the relevant spreads have risen since the latter half of the 1970s. But our foregoing discussion suggests that even so transactions costs do not explain more than the smallest departures from covered interest parity.

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16. Data on interest rates and swap factors must be of very high quality to test whether deviations from covered parity do lie within these narrow bounds. Prices contained in time series available after the fact are not as finely tuned and timed as those at which trades are made, and such series almost certainly overstate actual deviations from covered interest parity.

3.3 Transactions Costs and Onshore-Offshore Arbitrage

Deviations between onshore and offshore interest rates in various currencies can be substantial, and thus large deviations from covered interest parity between onshore instruments in different financial centres are rather common. This, as discussed in section 2, arises from impediments to mobility such as official controls, political risk and default risk as well as from differences in asset characteristics such as marketability and liquidity from one jurisdiction to another. Transactions costs, narrowly defined, should not give rise to systematic onshore-offshore differentials of any size, at least if onshore and offshore transactions costs are approximately equal. In fact, in the absence of controls, differences in covered short-term yields between major financial centres do not tend to be out of line with differences inside those centres among yields on assets such as commercial paper, treasury bills and CDs.

Banks, however, often do not have the same costs onshore and offshore, not because of transactions costs per se, but because of reserve requirements, deposit insurance costs and other regulations in the domestic market. Kreicher (1982) and Johnston (1979) write the effective cost of a domestic deposit to a bank as

$$i_{d,EFF} = (i_d+ins)/(1-reqd) \tag{5}$$

$i_{d,EFF}$ = effective cost,
i_d = deposit interest rate,
ins = insurance cost,
reqd = domestic reserve requirement.

The effective cost of a Eurodollar deposit is

$$i_{de,EFF} = i_{de}/(1-reqe) \tag{6}$$

where reqe = reserve requirement on Eurocurrency deposit (possibly zero).

Reserve requirements in the Euromarket have usually been lower than domestic requirements. Thus, if effective borrowing costs are to be equal in both markets the Eurocurrency rate must be the higher. In general the theoretical differential that equates the effective cost in both markets is

$$diff^{E} = i_{de} reqd - i_{d} reqe + ins\ (1-reqe). \qquad (7)$$

We estimate that the effective cost differential for the United States on average for 1973M6-1985M6 was 0.52 per cent,[17] which is not much less than the 0.74 per cent average for the raw differential. This indicates that the extra costs of reserve requirements and insurance in the domestic U.S. market account for most, but not all, of the observed differential in deposit rates.

Non-bank investors may face different tax rates on interest income and capital gains that create equilibrium interest differentials (Levi, 1977). For banks and other financial institutions dominant in international money markets interest income and capital gains are taxed only to the extent that they enter total net profit.

4 INTERNATIONAL ASSET SUBSTITUTABILITY

4.1 Substitutability of Financial Assets

4.1.1 Introduction

Perfect international asset substitutability means that domestic currency bonds and uncovered foreign currency bonds are perfect substitutes, in which case uncovered interest parity holds (the interest rate differential equals the expected rate of exchange rate depreciation) and there is no exchange risk premium. Since covered interest parity holds to a close approximation, the forward premium or discount will then be equal to the expected increase or decrease in the price of foreign exchange.

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17. An insurance cost of 0.04 per cent per annum was assumed (following Kreicher, 1982).

Researchers have used two basic models in their attempts to explain observed ex post "exchange risk premiums". The first is a portfolio-balance model, in which asset stocks and the distribution of world wealth matter. The second is a model in which optimizing investors take into account the variances and covariances among all the relevant economic variables. It has been admitted, however, that these latter models "do not lend themselves to easy empirical implementation" (Hodrick and Srivastava, 1984) since the relevant variables are not always clearly known nor are they necessarily small in number. In the following literature survey we therefore restrict ourselves to portfolio-balance alternatives to the hypothesis of perfect asset substitutability.

4.1.2 Literature Review

The relevant empirical literature can be divided into tests of the uncovered interest parity condition and tests of versions of the portfolio-balance model.

Tests of the uncovered interest parity condition are found in the literature on the efficiency of foreign exchange markets, which has recently been surveyed by Longworth et al. (1983), Hodrick and Srivastava (1984) and Boothe and Longworth (1986), among others. These surveys found that recent tests have almost unanimously rejected the joint hypothesis of rational expectations and uncovered interest parity. Thus, either expectations are not fully rational or there is a time-varying exchange risk premium or both. Which of these conditions holds has been a source of disagreement in the literature, and recent research has concentrated on searching for a risk premium explanation.

Literature on the research with portfolio-balance models of exchange rate determination has been summarized by Tryon (1983) and Boothe et al. (1985). It can generally be thought of as falling into three categories: models of the level of the exchange rate, models of the risk premium, and models of the international demand for assets (bonds).

Early studies of the portfolio-balance model were largely attempts to explain the level of the exchange rate. Some of the major models of this type are summarized in Table 6. Most of these models are plagued with coefficients that are incorrectly signed or correctly signed but insignificant. The models that do not suffer these problems tend either to refer to early sample periods (Artus, 1976; Branson et al., 1977; and Haas and Alexander, 1979) or to use measures related to the cumulated current account (Hooper et al., 1982 for the mark and yen; Artus, 1982; and Hooper and Morton, 1982). Models using the cumulated current account only roughly approximate theoretical portfolio-balance models and so do not provide strong support for these theoretical models.

The second type of portfolio-balance model is that which explains the exchange risk premium (deviations from uncovered interest parity under the hypothesis of rational expectations) in terms of relative asset and wealth variables. In the research surveyed in Table 7, only the Blundell-Wignall and Masson (1985) results support the portfolio-balance model, but their results do not include tests against alternative models.

The final type of portfolio-balance model explains the demand for assets (bonds) in terms of the interest rate differential between domestic and foreign assets adjusted for exchange rate expectations. Of the five studies surveyed in Table 8, only Claassen and Wyplosz (1982) and Obstfeld (1983) lend support to the portfolio-balance model.

Thus, there is little strong evidence in favour of the portfolio-balance model and imperfect asset substitutability. At the same time the rejection of the joint hypothesis of rational expectations and a constant exchange risk premium leaves open the possibility that assets are not perfect substitutes internationally.

4.1.3 New evidence from a risk premium model

We now report some new evidence on the degree of substitutability between U.S. assets and the assets of five other countries; namely, Canada, France, Germany, Japan, and the United Kingdom. The estimated equations are derived from a simple symmetric-preference, portfolio-balance model, along the lines of Frankel (1982b).

Table 6

PORTFOLIO-BALANCE MODELS OF THE LEVEL OF THE EXCHANGE RATE

Author	Currency	Estimation Period	Results
Artus (1976)	G	1973M4-1975M7	Private monetary capital flows highly significant.
Artus (1982)	G	1973Q4-1981Q2	Difference between export to import ratios in Germany and U.S. affects rate of change of exchange rate.
Backus (1984)	C	1971Q1-1980Q4	Bond stocks and net foreign asset stocks generally insignificant.
Branson et al. (1977)	G	1971M8-1976M12	Marginally significant domestic and foreign private asset stocks.
Branson et al. (1979)	G	1971M8-1978M3	Negative net foreign asset positions cause problems. Not all coefficients have correct signs.
Frankel (1982c)	F	1973M3-1981M9	Half the stock variables have coefficients of the incorrect sign (although insignificant).
Frankel (1983b)	G	1974M1-1978M10	Significant coefficients of incorrect sign in every formulation but one, a formulation where the only significant coefficient was rho.
Frankel (1984a)	C	1974M2-1981M6	Only domestic asset variable is significant.
	F	1974M2-1981M4	U.S. wealth has coefficient that is significant and of wrong sign.
	G	1974M2-1981M7	Three significant coefficients of incorrect sign.
	J	1974M2-1981M6	Two significant coefficients of incorrect sign.
	UK	1974M2-1981M6	Two significant coefficients of incorrect sign.
Haas and Alexander (1979)	C	1953Q3-1961Q4 and 1971Q1-1975Q2	Net stock of short-term liabilities significant.
Helliwell and Boothe (1982)	C	1954-61, 71-78	Insignificant coefficients on stock variables.
Hooper et al. (1982)	C	1970Q4-1980Q2	Stock of net short-term private liabilities and basic balance both have insignificant coefficients.
	G (effective)	1973Q1-1980Q4	Cumulated German current account balance has significant coefficient.
	J (effective)	1973Q2-1980Q3	Cumulated Japanese current account balance has marginally significant coefficient.
	UK (effective)	1973Q1-1980Q4	Significance levels not reported.
Hooper and Morton (1982)	US (effective)	1973M3-1978M12; 1973Q2-1978Q4	Cumulated current account is significant.
Martin and Masson (1979)	C	1973M4-1978M4	Net foreign asset stock has incorrectly signed coefficient for a net debtor.
	J	1973M4-1978M4	Most stock variables have incorrect signs.
	Western Europe	1973M4-1978M4	Bond stocks and net foreign asset stocks have insignificant coefficients.
Murphy and Van Duyne (1980)	G	1973Q2-1978Q2	All coefficients have expected signs, but only the coefficient on the U.S. private foreign asset position is significant.

Notes: In this and subsequent tables the exchange rate is that of the currency shown against the U.S. dollar unless otherwise indicated. C = Canadian dollar, F = French franc, G = German mark, J = Japanese yen, UK = UK pound.

Table 7

MODELS OF THE RISK PREMIUM

Author	Currency	Estimation Period	Results
Blundell-Wignall and Masson (1985)	G	1973Q3-1982Q2	Relative stock variable significant with correct sign.
Boothe et al. (1985)	C	1971M1-1982M11	Bond stock and wealth variables have incorrect signs in almost all cases.
Danker et al. (1985)	C	1971Q2-1981Q4	"Cannot reject the hypothesis that all the coefficients except rho are zero."
	G	1975M2-1981M12	Because of incorrect signs and insignificant coefficients, results "offer little support for the ... portfolio-balance model."
	J	1974M2-1980M12	Wealth and bond stock terms insignificant. Results "do not provide much positive support for the portfolio-balance model."
Dooley and Isard (1982)	G	1973M5-1977M6	Bayesian estimation. Model is better than forward rate.
Dooley and Isard (1983)	G	1973Q1-1978Q4	Coefficient on relative stock variable is generally not significant.
Frankel (1979)	G	1973Q1-1978Q4	None of the equations estimated show significant support for the portfolio-balance model.
Frankel (1982a)	C,F,G,J,UK,US	1972M6-1980M8	Assuming mean-variance optimization across six currencies, fails to reject null hypothesis of no risk premium.
Frankel (1982b)	G	1974M1-1978M10	None of the equations estimated show significant support for the portfolio-balance model.
Frankel (1982c)	F	1973M6-1981M9	Relative stock variables sometimes significant, but of wrong sign.
Frankel (1983a)	G	1973M6-1980M8	Assuming mean-variance optimization, fails to reject null hypothesis of no risk premium.
Rogoff (1984)	C	1973M3-1980M12	Relative stock variable has incorrect sign in full sample and in two subsamples (1973M3-1976M11, 1976M12-1980M12).

Notes: See Table 6.

Table 8

ASSET-DEMAND MODELS

Author	Currency	Estimation Period	Results
Claassen and Wyplosz (1982)	F	1972Q1-1981Q3	Risk premium is significant in demand for net foreign assets.
Danker et al. (1985)	C	1971Q2-1981Q4	Risk premium is an insignificant determinant.
	G	1975M2-1981M12	Risk premium is an insignificant determinant.
	J	1974M2-1980M12	Risk premium has incorrect sign in three out of four cases. In fourth case it is insignificant.
Obstfeld (1983)	G	1975M1-1981M10	Foreign demand for domestic bonds depends significantly on domestic and foreign rates of return. Domestic demand has correctly signed coefficients on these variables, but they are insignificant.

Notes: See Table 6
"Risk premium" refers to the interest rate differential between domestic and foreign assets adjusted for exchange rate expectations, which, depending upon the equation, are taken to be static or to be rational.

This model is based on the assumption that investors prefer to allocate increments of wealth to local-currency assets rather than to assets denominated in another currency. This implies that changes in the distribution of wealth (e.g. via current account flows) could affect the demand for assets in a particular currency. To reduce complexity we also assume that residents of the various countries respond in the same way to differentials in the rates of return. In this framework asset-demand functions in a three-country model can be written as:

$$B_d/W_d = a_d + b(i_d - i_f - \Delta s^e) \tag{8}$$

$$B_f/SW_f = a_f + b(i_d - i_f - \Delta s^e) \tag{9}$$

$$B_r/EW_r = a_r + b(i_d - i_f - \Delta s^e) \tag{10}$$

where B_d = domestic assets held by residents of the domestic country, measured in domestic currency;
B_f = domestic assets held by residents of the foreign country, measured in domestic currency;
B_r = domestic assets held by residents of the rest of the world, measured in domestic currency;
W_d = domestic wealth, measured in domestic currency;
W_f = foreign country's wealth, measured in foreign currency;
W_r = rest-of-the-world wealth, measured in rest-of-the-world currency;
i_d = domestic interest rate;
i_f = foreign interest rate;
S = spot price of foreign currency in terms of domestic currency;
E = spot price of rest-of-the-world currency in terms of domestic currency;
s = logarithm of S;
$\Delta s^e = s^e_{t+1} - s_t$, expected exchange rate depreciation.

Since data on B_d, B_f, and B_r are not easily available, the three equations are aggregated for estimation purposes:

$$(B/S)/W = a_d(W_d/S)/W+a_f(W_f/W)+a_r(EW_r/SW)+b(i_d-i_f-\Delta s^e) \quad (11)$$

where $B = B_d+B_f+B_r$, measured in domestic currency;
$W = (W_d/S)+W_f+(EW_r/S)$, measured in foreign currency.

To test the hypothesis of perfect asset substitutability, it is preferable to estimate the equation in an inverted form, that is, solved for the rate-of-return differential (sometimes called the "risk premium").[18] If rational expectations are assumed, the equation becomes:

$$i_d-i_f-\Delta s_{t+1} = a' + b'(B/S)/W+c'(W_d/S)/W+d'(W_f/W)+\varepsilon \quad (12)$$

where $a' = (-a_r/b)<0$
$b' = (1/b)>0$
$c' = [(a_r-a_d)/b]<0$
$d' = [(a_r-a_f)/b]\gtrless 0$
$\Delta s_{t+1} = s_{t+1}-s_t$,
ε = error term.

The null hypothesis of perfect substitutability, $b=\infty$, implies that all coefficients are zero. Under the alternative hypothesis b' should be positive, which means that for agents willingly to hold an increase in asset stock it must be accompanied by an increase in its rate of return. Under the assumption that residents of the domestic country hold a greater percentage of their wealth in domestic assets than do residents of the foreign country, c' is expected to be negative. Finally, d' may be positive or negative, depending on relative preferences of residents of the foreign country and the rest of the world for domestic assets. In what follows, the United States is assumed to be the foreign country. In

18. If asset-demand functions are estimated without being inverted they may not yield accurate estimates of the degree of substitutability when the true degree is very high. See, for example, Appendix B in Boothe et al. (1985).

regressions for Canada, d' is expected to be negative while for the four other countries, d' would likely be positive.[19]

One-month Eurocurrency interest rates are used.[20] The estimated equation takes the form:

$$i_d - i_{us} - \Delta s_{t+1} = a' + b'[(B/S)/W] + c'[(W_d/S)/W] + d'(W_{us}/W) \qquad (13)$$

where i_d and i_{us} = one-month Eurocurrency domestic and U.S. interest rates (annual percentage rates divided by 1200),

S = spot price of U.S. dollar in terms of domestic currency,

B = stock of outside government liabilities, in domestic currency,

W_d = domestic wealth, in domestic currency,

W_{us} = U.S. wealth, in U.S. dollars,

W = aggregate world wealth, in U.S. dollars.

Results of ordinary-least-squares regressions for the period 1973M7-1984M12 and subperiods 1973M7-1979M12 and 1980M1-1984M12 are shown in Table 9.[21],[22] These results do not support the existence of a risk premium related to relative asset and wealth variables. In fact, in all the equations the coefficient on the asset stock variable is insignificant and in over half of the cases also of the wrong sign. In addition, there are only two cases -- United Kingdom for the full sample period and France for the eighties -- where wealth appears to have a significant coefficient of the expected sign. Overall, our regressions, which include the most

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19. These expectations arise from the assumption that Americans hold a greater percentage of their wealth in Canadian assets than do residents of the rest of the world and a smaller percentage of their wealth in the assets of the four other countries than do residents of the rest of the world.

20. The international substitutability of long-term bonds is considered in Appendix B.

21. For Japan, the sample period starts in 1977M9 because of the availability of interest rate data.

22. If the error terms in the bond-demand equations (8-10) are assumed to follow a first-order-autocorrelation process, the error term in the equation to be estimated (13) will exhibit a moving-average process. In this case a more efficient estimator would be the two-step, two-stage, least squares estimator proposed by Cumby et al. (1983). Danker et al. (1985) used a similar estimator.

Table 9

RISK PREMIUM EQUATION RESULTS

$$i_d - i_{us} - \Delta s_{t+1} = a' + b'[(B/S)/W] + c'[(W_d/S)/W] + d'(W_{us}/W)$$

Country	SMPL Period	a'	b'	c'	d'	SEE	Mean value of dependent variable	DW
Canada	73M7-84M12	0.115 (0.62)	-0.730 (1.49)	0.037 (0.17)	0.060 (1.78)	0.0135	-0.0014	2.11
	73M7-79M12	0.030 (1.16)	-1.334 (1.78)	0.277 (0.97)	0.067 (1.69)	0.0132	-0.0011	2.05
	80M1-84M12	-0.045 (0.65)	0.852 (0.42)	-0.964 (0.90)	0.080 (1.10)	0.0140	-0.0018	2.25
France	73M7-84M12	-0.057 (1.50)	1.075 (0.89)	-0.267 (0.60)	0.030 (0.53)	0.0331	-0.0039	2.16
	73M7-79M12	-0.003 (0.05)	1.242 (0.72)	-0.833 (1.17)	0.028 (0.42)	0.0310	0.0024	2.41
	80M1-84M12	-0.641 (3.17)*	-5.100 (1.88)	4.684 (2.88)°	1.385 (3.28)*	0.0320	-0.0121	2.02
Germany	73M7-84M12	-0.083 (1.36)	-0.193 (0.32)	0.328 (1.22)	0.115 (1.38)	0.0338	-0.0052	2.14
	73M7-79M12	-0.018 (0.21)	-0.179 (0.16)	0.162 (0.23)	0.027 (0.27)	0.0344	0.0014	2.25
	80M1-84M12	-0.261 (1.97)	1.118 (0.74)	-0.202 (0.19)	0.391 (1.76)	0.0330	-0.0137	2.11
Japan	77M9-84M12	0.114 (1.48)	-0.372 (1.21)	-0.384 (1.11)	0.112 (1.11)	0.0363	-0.0042	1.90
	77M9-79M12	-0.633 (1.36)	1.224 (0.57)	-0.083 (0.09)	1.230 (1.64)	0.0406	-0.0024	2.27
	80M1-84M12	0.209 (2.22)°	-1.014 (0.90)	-0.183 (0.19)	0.681 (0.59)	0.0334	-0.0050	1.71
U.K.	73M7-84M12	0.117 (2.79)°	-0.105 (0.80)	-0.375 (3.15)*	-0.185 (2.95)°	0.0290	-0.0039	1.98
	73M7-79M12	0.094 (1.26)	-0.361 (1.54)	-0.043 (0.11)	-0.099 (1.00)	0.0285	0.0021	1.98
	80M1-84M12	-0.062 (0.31)	1.170 (1.20)	-1.737 (1.73)	0.194 (0.51)	0.0296	-0.0116	2.00

Note: Absolute value of t-statistics in parentheses.

* significant of the expected sign at a level $\alpha=0.95$
° significant of the wrong sign at a level $\alpha=0.95$

recent data, fail to reject the null hypothesis of a constant risk-premium, as was the case in most of the previous studies. The failure to find statistically significant risk premium variables in the portfolio-balance model does not necessarily imply the absence of such premiums, nor does it necessarily imply market inefficiency. However, there are as yet no models that provide demonstrably better empirical explanations of risk premiums.

4.2 Savings, Investment and the Current Account

To assess the mobility of real capital, authors such as Feldstein (1983) and Sachs (1981, 1983) have exploited the definition that the current account is equal to total domestic saving (private saving less the government deficit) minus domestic investment. Feldstein, using the ratio of investment to GNP as dependent variable, inferred that there was only a low degree of capital mobility between OECD countries. Sachs reached quite different conclusions for OECD countries on the basis of regressions of the current account/GNP ratio on the investment/GNP ratio.

Recent work (e.g. Penati and Dooley, 1983 and Caprio and Howard, 1984) shows that neither Feldstein's nor Sachs' findings are very stable. Results differ from one estimation period to another and from one country group to another.

Moreover, clear inferences about the degree of capital mobility cannot be drawn from correlations between the components of an identity. Obstfeld (1985) notes that bilateral transfers often exceed the total excess of domestic saving over investment. For example, transfers of savings from Germany to France in the early 1980s, as measured by the bilateral current account, have been greater than the aggregate excess domestic savings of Germany. This indicates an underlying degree of mobility camouflaged in aggregate current account data. Small countries tend to have much lower correlations between investment and savings ratios than large countries. This is consistent with high capital mobility and with a large-country effect on the world interest rate (Hartman, 1984; Murphy, 1984; Obstfeld, 1985; and Summers, 1985).

Frankel (1985b) points out that domestic crowding out occurs via the domestic real rate of interest. Even in a world with perfect capital mobility and rational exchange rate expectations there can be sizable short-run deviations among real interest rates across countries because of imperfect substitutability in goods markets. If goods prices and wages are sticky a fiscal expansion can cause an increase in the domestic interest rate and a simultaneous overshoot in the exchange value of the domestic currency. The expected depreciation back to the long-run equilibrium value of the currency then equates expected returns on domestic and foreign financial assets. But the rise in the domestic interest rate causes crowding out of domestic spending. Frankel therefore attributes the correlation of savings and investment rates to imperfections in goods markets, not in capital markets. But Frankel's argument can hold only for the short-to-medium run, since goods prices too are flexible in the long run. Therefore, the argument is not a good explanation for the long-run savings-investment correlation in the United States.

Because of its concern with the worldwide degree of capital mobility, and the use of averages for a number of years in saving and investment rates in order to remove cyclical variations in the data, the empirical literature taking the saving/investment/current account approach has concentrated on cross-sectional studies. The data requirements have meant that there has been little formal testing of whether mobility has increased in recent years. It is, however, worth noting that Feldstein, Niskanen and Poole (1984) in the Report of the Council of Economic Advisers argue that the U.S. government deficit is the basic cause of the U.S. trade deficit, an argument difficult to maintain if capital is not highly mobile and substitutable. Perhaps the ability of the United States over the last three years to attract a huge volume of international savings constitutes new evidence for the hypothesis of perfect mobility.

There have been few econometric studies of the effect of capital controls on the international flow of real investment. In theory the effect of controls on net real inflows of capital is unpredictable. A country usually imposes controls to limit outflows of capital. But such controls can also reduce inflows as foreign investors worry about their ability to transfer income outside the country. An estimate by Claassen and Wyplosz (1982) suggests that controls in France had no impact on the net inflow of real capital. Controls on banks apparently did inhibit gross outflows of domestic savings but at the same time deterred inflows from non-bank investors. In Japan the high correlation of the investment and savings ratios might be attributed in part to the stringent capital controls that used to exist (Obstfeld, 1985).

5 INTERNATIONAL EQUALITY OF REAL INTEREST RATES

We now examine whether real interest rates are equalized across countries. We first review the existing empirical literature and then present some tests of the hypothesis of the equality of short-run real Euromarket rates and domestic money market rates for six major currencies for the period 1973-85.

5.1 Review of Empirical Evidence

Whether short-run ex ante real interest rate equality holds internationally is an empirical question. Theoretically such an equality does not depend just on international asset substitutability, but on the formation of expectations and the factors that lead to equilibrium in the goods market. For example, the equality of ex ante real interest rates can be derived as a corollary of two parity conditions: uncovered interest rate parity (UIP) and ex ante purchasing power parity (PPP).[23]

Recent empirical evidence strongly rejects the hypothesis of the international equality of short-run ex ante real interest rates. Mishkin (1984a, 1984b), using three-month Eurocurrency interest rates and both consumer price and wholesale price indexes for the period 1967Q2-1979Q2 and for the shorter flexible rate period 1973Q3-1979Q2, strongly rejected

23. Ex ante PPP implies that expected nominal exchange rate changes equal expected inflation differentials. It is a weaker condition than ex post PPP since it holds even if the real exchange rate follows a random walk.

the joint equality of real rates across a group of seven OECD countries (the United States, Canada, France, Germany, the Netherlands, Switzerland, and the United Kingdom) under an assumption of rational expectations.[24] However, for the 1967Q2-1979Q2 period, the equality of real rates could not be rejected for the United States, Canada, and the United Kingdom as a subgroup. No information is provided for the flexible rate period by itself. Mishkin rejected both the equality of the mean real rates and the hypothesis that real rates move similarly over time. Moreover, he rejected the constancy of real rates for the group of countries as a whole. Indeed, real rates were negatively associated with beginning-of-period money growth and inflation. For a similar group of countries[25] Galli and Masera (1983) found that domestic short-term and long-term real interest rates were not constant and did not follow a constant trend for the period 1962Q2-1982Q2. They also found that in most countries real rates were affected by monetary forces.

Cumby and Obstfeld (1984) conducted bilateral tests of equality between U.S. real interest rates and those of Canada, Germany, Japan, Switzerland, and the United Kingdom for the 1976M1-1981M7 period. One- and three-month Eurocurrency rates and domestic money market rates were used in conjunction with both consumer price and wholesale price indexes.[26] Equality of ex ante real rates vis-à-vis the U.S. was rejected over the sample period for all combinations of interest rates and price indexes except for the United Kingdom and Japan.[27]

Using monthly Eurocurrency interest rates and consumer price indexes for the period 1973M5-1982M2, Mark (1985a) found decisive evidence against the bilateral equality of the U.S. real interest rate and the real rates

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24. All the studies reviewed assume that expectations are formed rationally.

25. The countries included the United States, Canada, France, Germany, Italy, Sweden, and the United Kingdom.

26. As Cumby and Obstfeld note, tests using onshore money market rates do not compare assets with the same default and political risk characteristics. Rejection may, therefore, be due to actual or anticipated changes in these characteristics.

27. In the comparison of the United States and Japan, equality of real interest rates was rejected in tests that used the wholesale price index, but not in tests that used the consumer price index.

of Canada, Germany, Italy, the Netherlands, and the United Kingdom. He found monetary factors as well as past rates of inflation to be important in predicting the ex post real interest differentials. Mark (1985a) also incorporated the effects of taxation in his analysis and tested for the equality of net-of-tax real rates of interest.[28] Results were similar to those for pre-tax real interest rates. In a second paper Mark (1985b) studied the same group of countries for the longer sample period 1973M5-1984M8 using time series techniques and again rejected the equality of pre-tax real interest rates in the United States and Europe. Tests with Germany as the reference country also strongly rejected equality with the real rates of the other European countries.The equality of U.S. and Canadian real rates, however, could not be rejected in most instances.

Gaab et al. (1986) tested for the equality of ex ante real interest rates in Switzerland with those in the United States, Germany, the United Kingdom, and France for the period 1975M1-1984M8. Monthly data on one-, two-, three-, six-, and twelve-month Eurocurrency interest rates and consumer price indexes were used. The hypothesis that the ex ante real interest rate differential is zero was rejected for all countries and interest rates. Moreover, variations in the real rate differential exceeded variations in the expected inflation differential (except for the Switzerland/United Kingdom comparison). However, they could not reject the weaker hypothesis that, on average over time, the six- and twelve-month nominal interest differentials equal the corresponding inflation differentials.

When considering the role of monetary policy, it is important to know the extent to which real rates in the major industrial countries move together. This is a more general question than that of whether real rates are equal across countries, and an important aspect of it in practice is the degree of linkage between U.S. real rates and those in other countries. Cumby and Mishkin (1986) studied these issues using data on

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28. The tax rates used were 1977 corporate tax rates since the formulation of the arbitrage conditions used more clearly approximate the environment facing multinational firms than that facing individuals. The difference is due to the fact that taxes are not imposed at source in the Eurocurrency market.

three-month Eurocurrency deposit rates and domestic money market rates for the United States, Canada, France, Germany, Italy, the Netherlands, Switzerland, and the United Kingdom for the period June 1973 to December 1983. They rejected the hypothesis that real rates in each country equal real rates in the United States in all cases except France for Euromarket rates and Canada for domestic money market rates. They did, however, find strong evidence of a positive relationship between the movements of real rates in the United States and those in Europe and Canada. For Euromarket rates and domestic money market rates they rejected the hypothesis of no linkage for all countries except Switzerland, while the hypothesis of full linkage was rejected for all countries except Canada and the United Kingdom. The relationship between European real rates and German real rates was not found to be any closer than that of European real rates with U.S. real rates.

We have conducted bilateral tests of the equality of real interest rates similar to those of Cumby and Obstfeld (1984) and Mark (1985a). Before we describe the results, however, it may be of interest to examine the average differentials of the 1970s and 1980s.

5.2 Real Interest Rate Differentials in the 1970s and 1980s

The top half of Table 10 shows the mean differentials between the U.S. ex post real interest rate and the corresponding rate for Canada, France, Germany, Japan, the Netherlands, and the United Kingdom. The nominal interest rates are one-month Eurocurrency rates and the inflation rates are measured using consumer price indexes. For the 1973M6-1985M6 period the mean differential vis-à-vis the U.S. was small for Canada and France, but was rather large for the United Kingdom, Japan, and the Netherlands. These differentials, however, mask a number of features. First, in the 1970s real interest rates in the United States were lower than those in other countries except the United Kingdom and Japan; but higher than in the other six countries in the 1980s. The small differentials for the 1973M6-1985M6 period as a whole for some countries

Table 10

MEAN MONTHLY REAL INTEREST DIFFERENTIALS[1]
(per cent per annum)

Countries	Period 1973M6-1985M6	1973M6-1979M12	1980M1-1985M6
U.S. - Canada	0.05	-0.67	0.93
U.S. - France	-0.08	-0.92	0.91
U.S. - Germany	0.37	-1.36	2.46
U.S. - Japan	1.45[2]	0.25[2]	1.96
U.S. - Netherlands	0.85	-0.64	2.65
U.S. - U.K.	1.76	2.00	1.47
Germany - France	-0.45	0.44	-1.55
Germany - Netherlands	0.48	0.72	0.19
Germany - U.K.	1.39	3.36	-0.99

1. Real interest rates are actual rates defined as the one-month Eurocurrency interest rate minus the rate of change of the CPI over the following month.
2. Period starts 1977M9.

mask large differentials of opposite sign in the 1970s and 1980s. Second, real interest rate differentials were generally higher, in absolute value, in the 1980s compared with the 1970s. It should also be remarked that whereas the variability of nominal interest rates -- as measured by standard deviations -- was similar across the seven countries examined, the variability of inflation rates (and hence real interest rates) in the United Kingdom and Japan was about double that in the other countries (figures not shown).

As the bottom half of Table 10 shows, even within Europe there were sizable average differentials. In the 1970s Germany had higher real rates than the United Kingdom, and in the 1980s France had higher real rates than Germany.

5.3 New Evidence on the International Equality of Ex Ante Real Interest Rates

In this section we present additional evidence on the equality of short-run ex ante real interest rates across countries. We examine the period 1973M7-1985M6 and two subperiods, 1973M7-1979M12 and 1980M1-1985M6, in order to determine whether there has been any change in the relationship between short-run real interest rates.

As noted in section 5.1, sufficient conditions for the international equality of ex ante real interest rates are that uncovered interest rate parity (UIP) and ex ante PPP hold. UIP must hold when bonds differing only in their currency of denomination are perfect substitutes. Ex ante PPP is a commodity market equilibrium condition which, following Roll (1979), may be viewed as a consequence of the efficiency of intertemporal and international commodity arbitrage.

Under the assumption of rational expectations, UIP and ex ante PPP are given by equations (14) and (15), respectively:

$$ {}_n i_t - {}_n i^*_t = E_t(\ln(S_{t+n}/S_t)) \quad (14) $$

$$ E_t(\ln(S_{t+n}/S_t)) = E_t(\pi_{t+n} - \pi^*_{t+n}) \quad (15) $$

where ${}_n i_t$ is the nominal interest rate on an n-month bond issued at t which matures at t+n;

$\pi_{t+n} = \ln(P_{t+n}/P_t)$ is the rate of change of the price level from t to t+n;

$\ln(S_{t+n}/S_t)$ is the rate of change of the exchange rate, defined as the home-currency price of foreign exchange;

$E_t(\cdot)$ is the conditional expectation operator, based on information available at t; and

$*$ denotes foreign-country variables.

If (14) and (15) hold, it follows that ex ante real interest rates will be equal:

$$E_t({}_n r_t) = E_t({}_n r_t^*) \tag{16}$$

where ${}_n r_t = {}_n i_t - \pi_{t+n}$ is the ex post real interest rate.

A bilateral test of the hypothesis that ex ante real interest rates are equal across countries may be derived by assuming rational expectations, so that from equations (14) and (15) we obtain

$$\pi_{t+n} - \pi^*_{t+n} = {}_n i_t - {}_n i_t^* + v_{t+n} \tag{17}$$

where v_{t+n} is the difference between the domestic and foreign inflation forecast errors which have zero means. Hence, a test of the hypothesis a=0, b=1 in the regression equation

$$\pi_{t+n} - \pi^*_{t+n} = a + b\,({}_n i_t - {}_n i_t^*) + v_{t+n} \tag{18}$$

is a test of the hypothesis of the equality of expected real interest rates in the domestic and foreign country under the hypothesis of rational expectations. Since v_{t+n} is uncorrelated with ${}_n i_t$ and ${}_n i_t^*$ the parameters a and b can be consistently estimated using ordinary least squares.

An alternative test may be derived, following Mark (1985a), by assuming that individuals' forecasts are based on optimal linear prediction rules, so that conditional expectations coincide with linear least squares projections. In this framework, variables in the individuals' information set at time t should not be useful in predicting ex post real differentials at t+1. In forming the information set we considered one- and two-period lagged values of the real differential ${}_nr_t - {}_nr^*_t$, and a linear trend (T) as a proxy for other variables. Therefore, non-zero estimates for a, b, c, and d in

$$ {}_nr_t - {}_nr^*_t = a + b({}_nr_{t-1} - {}_nr^*_{t-1}) + c({}_nr_{t-2} - {}_nr^*_{t-2}) + dT + u_{t+n} \quad (19) $$

are evidence against the null hypothesis. A less restrictive test allows the real differential to differ from zero and tests only the predictive ability of the lagged differentials and the other variables proxied by the linear trend.

Equations (18) and (19) were estimated using one-month Eurocurrency interest rates and the rate of change of consumer prices. Bilateral tests of equality were conducted between the U.S. real rate and those of Canada, France, Germany, Japan, the Netherlands, and the United Kingdom, and between the German real rate and those of France, the Netherlands, and the United Kingdom. Eurocurrency rates were used initially because they have similar risk characteristics and would not have to be adjusted for non-comparable regulations and capital controls. All regressions include a vector of eleven seasonal dummy variables.

Overall, the results, shown in Tables 11 to 13, agree with those of previous studies in rejecting the hypothesis of equality of short-run real interest rates across countries. On the basis of equation (18), for the full sample period (1973M7-1985M6), the hypothesis that a=0 and b=1 is rejected at the 5 per cent level for all pairs of countries shown except Canada vis-à-vis the United States. When the sample is split -- see Tables 12 and 13 -- equality of short-run real rates can be rejected for the 1973M7-1979M12 period for Canada, France, and Germany vis-à-vis the

Table 11

TEST OF EQUALITY OF MONTHLY REAL EUROCURRENCY INTEREST RATES:
July 1973-June 1985

Equation[1] : $\pi_{t+1} - \pi^*_{t+1} = a + b\ (i_t - i^*_t) + e'D$

Countries	$\hat{a}$ (standard error)	$\hat{b}$ (standard error)	F-stat.[3]
U.S. - Canada	-0.4138 (0.3958)	0.5232++ (0.1991)	2.88
U.S. - France	-1.8380+ (0.4064)	0.2928++ (0.0804)	38.64
U.S. - Germany	1.7483 (0.6249)	0.3957++ (0.1489)	8.79
U.S. - Japan[2]	0.5669 (1.1534)	0.6083++ (0.1889)	5.29
U.S. - Netherlands	0.7972 (0.5958)	0.3426++ (0.1570)	10.60
U.S. - U.K.	-2.0214+ (0.7846)	0.9129 (0.1756)	3.86
Germany - France	-5.2159+ (0.5826)	0.0878++ (0.0797)	66.43
Germany - Netherlands	-1.3879+ (0.3923)	0.0871++ (0.1689)	15.54
Germany - U.K.	-0.7573 (1.3685)	1.1176 (0.2099)	3.16
$F_{0.05}(2,131)$			3.07

1. e'D is a vector of 11 seasonal dummies. Coefficient estimates are not reported.
2. Sample period starts 1977M10; $F_{0.05}(2,80)=3.11$.
3. F-test for Hn: a=0, b=1.

\+ Reject Hn: a=0 at α = 0.95.

++ Reject Hn: b_1 =1 at α = 0.95.

Table 12

TEST OF EQUALITY OF MONTHLY REAL EUROCURRENCY INTEREST RATES:
July 1973-December 1979

Equation[1] : $\pi_{t+1} - \pi^*_{t+1} = a + b\ (i_t - i^*_t) + e'D$

Countries	$\hat{a}$	$\hat{b}$	F-stat.[3]
	(standard error)		
U.S. - Canada	-0.0224 (0.5173)	0.3054^{++} (0.2478)	4.73
U.S. - France	-0.9027 (0.5968)	0.2984^{++} (0.1372)	15.97
U.S. - Germany	2.2095^{+} (0.7604)	0.6546 (0.2165)	4.74
U.S. - Japan[2]	1.9766 (3.9961)	0.6296 (0.5950)	0.26
U.S. - Netherlands	1.0533 (0.7485)	0.5682 (0.2619)	1.69
U.S. - U.K.	-1.2422 (1.7429)	1.1976 (0.3267)	1.92
Germany - France	-4.7407^{+} (0.8923)	0.1788^{++} (0.1456)	16.02
Germany - Netherlands	-2.5204^{+} (0.6422)	-0.1582^{++} (0.2203)	14.69
Germany - U.K.	-4.2806 (2.4330)	0.8613 (0.3297)	6.75
$F_{0.05}(2,65)$			3.14

See notes to Table 11. For Japan $F_{0.05}(2,14) = 3.74$

Table 13

TEST OF EQUALITY OF MONTHLY REAL EUROCURRENCY INTEREST RATES:
January 1980-June 1985

Equation[1] : $\pi_{t+1} - \pi^*_{t+1} = a + b\,(i_t - i^*_t) + e'D$

Countries	$\hat{a}$ (standard error)	$\hat{b}$ (standard error)	F-stat.[3]
U.S. - Canada	-0.8979 (0.6239)	0.8858 (0.3442)	1.04
U.S. - France	-2.7775+ (0.5659)	0.3592++ (0.1001)	22.83
U.S. - Germany	-0.2682 (1.0300)	0.5179++ (0.2134)	17.84
U.S. - Japan[2]	0.5633 (1.2102)	0.4642++ (0.2085)	7.22
U.S. - Netherlands	0.3470 (1.1053)	0.2820++ (0.2403)	17.92
U.S. - U.K.	-1.8269 (0.6034)	0.3104++ (0.1929)	9.84
Germany - France	-4.9877+ (0.9046)	0.1049++ (0.1067)	38.37
Germany - Netherlands	-0.3259 (0.3450)	0.6093 (0.2970)	1.07
Germany - U.K.	-0.6747 (1.3861)	0.6881 (0.2603)	1.54
$F_{0.05}(2,53)$			3.17

See notes to Table 11.

United States; for Germany vis-à-vis the other European countries; and for all pairs except Canada-United States, Germany-Netherlands and Germany-United Kingdom in the 1980M1-1985M6 period. Furthermore, the point estimates of b for the United States vis-à-vis Germany, Japan, the Netherlands, and the United Kingdom, are smaller in the 1980s than in the 1970s. For the United States-France the point estimate of b is somewhat larger in the 1980s, but is still within one standard deviation of the estimate for the 1970s. In contrast, for the United States-Canada the point estimate of b is considerably larger in the 1980s and by more than one standard deviation.

A test of stability rejected the equality of a and b in the two subperiods for the United States vis-à-vis France and Germany at the 5 per cent level and for the United States vis-à-vis the United Kingdom and Canada at the 10 per cent level. For France and Germany this result is essentially due to large shifts in the intercepts, whereas for the United Kingdom and Canada it is mainly due to shifts in the slopes. In addition, for the United Kingdom, Germany and France the shift seems to be away from acceptance of the null hypothesis of short-run real rate equalization; for Canada the shift is towards acceptance of the null hypothesis. The results for Canada are in keeping with its close links with the United States in both financial and goods markets, and the relatively high weight that Canadian monetary policy attached to the U.S. dollar exchange rate after 1979.

Equation (18) was also estimated using one-month domestic money market rates. The results, shown in Table 14, are very similar to those using Euromarket rates.

Results for the tests based on equation (19), shown in Table 15, are similar to those based on equation (18). From this second set of tests it also appears that lagged ex post real differentials and a time trend (as a proxy for other variables) are important in predicting the current ex post real differential for all countries vis-à-vis the United States except Japan and to a lesser extent Canada.

The inequality in international short-run real interest rates may be due to the failure of one or both of the two underlying parity

Table 14

TEST OF EQUALITY OF MONTHLY REAL DOMESTIC MONEY MARKET RATES

Equation: $\pi_{t+1} - \pi^*_{t+1} = a + b\,(i_t - i^*_t) + e'D$

Countries	$\hat{a}$ (standard error)	$\hat{b}$ (standard error)	F-stat.
	Sample Period: 1974M2-1985M6		
U.S. - Canada	0.1334 (0.4858)	0.6871 (0.2178)	2.27
U.S. - France	-1.8708^{+} (0.4095)	0.5053^{++} (0.1374)	11.32
U.S. - Germany	2.0694^{+} (0.5819)	0.3778^{++} (0.1648)	7.49
U.S. - Netherlands	1.3109^{+} (0.5434)	0.2204^{++} (0.1547)	12.78
U.S. - U.K.	-2.0437^{+} (0.8496)	1.0015 (0.2242)	4.34
	$F_{0.05}$ (2,124)		3.07
	Sample Period: 1974M2-1979M12		
U.S. - Canada	0.1693 (0.6793)	0.3577^{++} (0.3177)	4.82
U.S. - France	-0.8003 (0.5450)	0.5404^{++} (0.1858)	3.06
U.S. - Germany	2.4476^{+} (0.7213)	0.7261 (0.2467)	8.57
U.S. - Netherlands	1.5093^{+} (0.7530)	0.4037^{++} (0.2617)	4.06
U.S. - U.K.	-1.1562 (1.9180)	1.6175 (0.4611)	4.52
	$F_{0.05}$ (2,58)		3.16
	Sample Period: 1980M1-1985M6		
U.S. - Canada	-0.0801 (0.7292)	0.9549 (0.3174)	0.01
U.S. - France	-2.8270^{+} (0.6031)	0.5907^{++} (0.2032)	11.08
U.S. - Germany	0.5251 (0.8724)	0.4253^{++} (0.2172)	9.12
U.S. - Netherlands	1.1758 (0.9114)	0.0980^{++} (0.2267)	14.52
U.S. - U.K.	-1.6305^{+} (0.6296)	0.3[illegible]49^{++} (0.[illegible]00)	2.49
	$F_{0.05}$ (2,53)		3.17

Table 14 (continued)

Countries	$\hat{a}$ (standard error)	$\hat{b}$	F-stat.
	Sample Period: 1974M2-1985M6		
Germany - France	-6.9427+ (0.8559)	-0.2477++ (0.1787)	34.25
Germany - Netherlands	-1.3681+ (0.3937)	0.1619++ (0.1557)	15.42
Germany - U.K.	-2.1579 (1.4715)	1.0364 (0.2642)	6.92
	$F_{0.05}$ (2,124)		3.07
	Sample Period: 1974M2-1979M12		
Germany - France	-6.6113+ (1.1719)	-0.1950++ (0.2803)	23.76
Germany - Netherlands	-2.5766+ (0.6919)	-0.0837++ (0.2149)	13.18
Germany - U.K.	-6.2332+ (2.6224)	0.7789 (0.4400)	13.39
	$F_{0.05}$ (2,58)		3.16
	Sample Period: 1980M1-1985M6		
Germany - France	-6.4098+ (1.3926)	-0.1375++ (0.2597)	10.63
Germany - Netherlands	-0.4378 (0.3397)	0.4690 (0.2676)	2.56
Germany - U.K.	-0.8704 (1.3411)	0.6845 (0.2640)	1.09
	$F_{0.05}$ (2,53)		3.17

+ Reject Hn: a=0 at $t_{0.975}$
++ Reject Hn: b=1 at $t_{0.975}$

Table 15

TEST OF EQUALITY OF MONTHLY REAL EUROCURRENCY INTEREST RATES:

Equation: $r_{t+1} - r^*_{t+1} = a + b\ (r_t - r^*_t) + c\ (r_{t-1} - r^*_{t-1}) + dT + e'D$

Countries	F-statistic for sample period		
	1973M8-1985M6	1973M8-1979M12	1980M1-1985M6
	Hn: a=b=c=d=0		
U.S. - Canada	1.66	2.58++	1.29
U.S. - France	3.12++	1.35	2.14+
U.S. - Germany	10.93++	2.67++	13.52++
U.S. - Japan[1]	2.18++	1.41	2.10+
U.S. - Netherlands	5.39++	4.37++	7.67++
U.S. - U.K.	5.04++	3.13++	2.14+
	Hn: b=c=d=0		
U.S. - Canada	2.17+	2.61+	0.84
U.S. - France	4.15++	0.70	2.14
U.S. - Germany	13.83++	0.90	3.50++
U.S. - Japan[1]	0.52	1.77	0.28
U.S. - Netherlands	5.60++	5.64++	0.88
U.S. - U.K.	3.68++	2.56+	1.30

1. Sample period starts 1977M11.
\+ Reject Hn at 10% significance level.
++ Reject Hn at 5 % significance level.

conditions. The empirical evidence indicates that neither parity condition has held over the flexible exchange rate period. The literature on UIP has already been described in Section 4.1.2. The available evidence for ex ante PPP is not conclusive. Researchers, such as Roll (1979), Frenkel (1981), Darby (1980), Pippenger (1982), Solnik (1982), Adler and Lehman (1983), and MacDonald (1985) were not able to reject the hypothesis that real exchange rates follow a random walk. Hakkio (1984), however, argues that failure to reject the random-walk hypothesis may be due partly to the low power of the test statistics employed. Frankel (1985b) using 116 years of data on the U.S. - U.K. exchange rate rejects ex ante PPP. Longworth (1986), making use of the observation that the relevant information set used in forming expectations about deviations of the forward exchange rate from the future spot rate, the real interest rate, and the change in the real exchange rate should be the same, rejects ex ante PPP for the seven major industrial countries for the period 1973-1985, with the rejections being concentrated in the post-1979 period. In any event, expected exchange rate changes have been very poor predictors of relative inflation rates over the floating rate period, and tests by Cumby and Obstfeld (1984), Mishkin (1984b), and Gaab et al. (1986), do not support the efficient markets version of PPP.

In conclusion, although capital mobility and substitutability may be high, the empirical evidence indicates that real interest rates are not equalized across countries, perhaps because of sticky goods prices (as in Dornbusch, 1976b and Mussa, 1982). The effectiveness of monetary policy in influencing the economy through the real interest rate channel cannot be ruled out, at least in the short run.

6. SUMMARY

In this paper we have surveyed existing research and described our own research into various aspects of capital market integration. In particular, we sought evidence on how the degree of capital mobility and substitutability between financial assets in the larger industrial countries may have changed in recent years as a result of changes in controls and regulatory policies.

Capital mobility differs from capital substitutability in that mobility refers to the ease with which funds may be shifted from one financial centre to another, whereas substitutability refers to the willingness of investors to move between assets denominated in different currencies. A measure of the degree of immobility is provided for a given currency by the size of the differentials between domestic interest rates and Euromarket interest rates. Capital controls have been the main identifiable barrier to mobility, so measured, and the general removal of controls in the past 15 years has been the most obvious stimulus to increased mobility. At the time of writing, only France and Italy, of the G-7 countries, still had widespread capital controls, and those of France were being relaxed.

Regulations other than capital controls have also created spreads between domestic interbank rates and Euromarket rates. Such regulations include domestic interest rate ceilings, reserve requirements, deposit insurance premiums and other domestic banking regulations.

Factors other than controls and regulations that have been thought to be barriers to mobility were not found to be empirically significant, in particular political risk -- defined as the concern that controls will be imposed or stiffened -- and transactions costs. Our empirical work with portfolio-balance type models does not suggest that political risk has had significant effects in the expected direction on interest rate spreads. Also theory and evidence suggest that transactions costs can account for only small deviations from interest parity.

While transactions costs in foreign exchange markets have been quite low for the most actively traded currencies, and do not create significant interest differentials, there is no evidence that they have declined in recent years. In fact, since bid-ask spreads are positively related to price volatility, which has increased in the 1980s, those costs may have risen. To the extent that deregulation, the creation of new instruments, and other financial innovations have opened cheaper ways of doing business, it is possible that transactions costs for the financial business of non-banks have been reduced, despite the effect of increased interest rate volatility on bid-ask spreads.

Changes in the costs of intermediation via the commercial banking system are somewhat more difficult to gauge. On the one hand, such costs have been reduced by the trend towards banking deregulation and by banking innovations. On the other hand, increased concerns about default risk and capital adequacy since 1982 have caused the spreads between borrowing and lending rates in various banking systems to widen. Large non-bank entities, partly in consequence, have resorted to channels that by-pass the traditional commercial banking system. On balance costs of borrowing may have declined somewhat for those non-banks that can "securitize" their financial dealings, which generally means those non-banks most active in international markets.[29]

The findings of high capital mobility and substitutability that we report do not imply that ex ante real interest rates are equalized. This would happen only if expected exchange rate changes always reflect expected changes in purchasing power parity. Our tests confirm the finding that ex ante real interest rates are not equalized in the short run and that average ex post real differentials have been sizable for lengthy periods. Moreover there has been no more tendency towards equality internationally in the 1980s than in the 1970s. Cost and price stickiness is the most ready explanation for the findings in this area, although the failure of expectations to be rational may also be a factor.

The results from tests of international asset substitutability using both a portfolio-balance approach and the savings-investment framework are not straightforward to judge and likely lack statistical power. They are, however, consistent with high substitutability for financial assets. Tests of portfolio-balance models reported in this paper suggest that a high level of substitutability has existed throughout the period 1973-84, but the results are not precise enough to determine whether there was an increase in the 1980s.

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29. An illustration of the potential savings is provided by Mills (1985), who found for a small sample of large borrowers that the borrowing cost on a note issuance facility (NIF), adjusted for the annual facility fee, was 10-50 basis points less than that on a regular Eurocredit.

Therefore, the main change that we have been able to identify that has caused greater capital market integration is the removal of official controls. Where no capital controls exist, the results of virtually all empirical studies are consistent with high degrees of both mobility and substitutability between the biggest industrial countries. The financing of the large U.S. current account deficits over the past few years, at the same time as the U.S. dollar was appreciating, might be viewed as additional new evidence consistent with very high capital mobility and substitutability.[30]

30. Cf. Frankel (1985) and Sachs (1985) in the Brookings symposium on the U.S. dollar.

APPENDIX A

Data Sources and Construction

In this appendix we describe the data used in the study. In the first part, we indicate data sources for interest rates, exchange rates an prices series. In the second part, we describe the derivation of asset stocks and wealth data.

1. Interest Rates, Exchange Rates and Prices -- Sources

One-Month Euromarket Rates

Canada:	73M6-77M8 - calculated from $U.S. exchange rate and 30 day forward rate of the $Can.
	77M9-85M6 - BIS
France:	DRI (@FACS, FRDØ1B)
Germany:	BIS
Japan:	77M9-85M6 - BIS
U.K.:	BIS
U.S.:	BIS
Netherlands:	BIS

Three-Month Euromarket Rates

Canada:	73M6-77M8 - calculated from $U.S. exchange rate and 90 day forward rate of the $Can.
	77M9-85M6 - U.K. Financial Times (month end, average of Bid-Ask)
France:	BIS
Germany:	BIS
Japan:	77M9-85M6 - BIS
U.K.:	BIS
U.S.:	BIS
Netherlands:	BIS

One-Month Commercial Paper Rate

Canada:	Cansim B14039
U.S.:	Cansim B54416

One-Month Certificate of Deposit Rate

Canada:	Bank of Canada data base
France:	DRI (@FACS, INT1ØF)
Germany:	DRI (except 80M8-80M10 from World Financial Markets) (@FACS, INTØ1G)

U.K.: DRI (except 80M9-80M10 from World Financial Markets) (@FACS, INTØ1V)
U.S.: DRI (@USCEN, RMCD1SECNS)

Three-Month Commercial Paper Rate

Canada: Cansim B14017
Japan: DRI (@FACS,DØ3J)
U.S.: Cansim B54412

Three-Month Certificate of Deposit Rate

Canada: Bank of Canada data base
U.S.: Cansim B54414
Other Countries: World Financial Markets - Morgan Guaranty Trust.

Long-Term Domestic Rates

All Countries: World Financial Markets - Morgan Guaranty Trust.

Spot Exchange Rates

Canada: Cansim B3414
Other Countries: calculated using $Can rate and data from Bank of Canada data base.

Consumer Price Index

All Countries: DRI (@IMF,L64@C)

2. Asset Stocks and Wealth Data -- Sources and Construction

Main Source: International Financial Statistics (IFS), International Monetary Fund.

Asset Stocks (..B)

Stocks of outside government liabilities are defined as:
total government debt,
plus monetary base,
minus debt held by central bank,
minus holdings of local-currency assets by foreign central banks.

Germany (GB); billions of marks, end of month

GB = GCDEF + GH - GDHCB - GOFER
GCDEF = cumulation of government deficits (negative of IFS, line 80), on a December 1972 benchmark for total debt (IFS, line 88)

GH = monetary base (IFS, line 14)
GDHCB = Federal Bank's claims on government (IFS, line 12a)
GOFER = holdings of mark assets by foreign central banks as foreign exchange reserves
GOFE = GSHAR*OFEALL,
where GSHAR = estimated share of marks in total official foreign exchange holdings (described below)
OFEALL= total official holdings of foreign exchange reserves (IFS, line 1ds), in millions of SDRs
GOFER = (GOFE*SDRS*GS)/1000,
where SDRS = $US/SDR exchange rate (IFS, line sa)
GS = mark/$US exchange rate

Japan (JB); billions of yen, end of month

JB = JCDEF + JH - JDHCB - JOFER
JCDEF = cumulation of central government deficits (BIS, Source: Bank of Japan Economic Statistics Monthly), on a December 1972 benchmark for Yen-debt (IFS, line 88b)
monthly data for the government deficit not available; they are interpolated by dividing quarterly data by three.
JH = monetary base (IFS, line 14)
JDHCB = Monetary Authorities claims on government (IFS, line 12a)
JOFER = holdings of yen assets by foreign central banks as foreign exchange reserves
JOFE = JSHAR*OFEALL,
where JSHAR = estimated share of yen in total official foreign exchange holdings (described below)
JOFER = (JOFE*SDRS*JS)/1000,
where JS= Yen/$US exchange rate

United States (USB); billions of U.S. dollars

USB = USCDEF + USH - USDHCB - USOFER
USCDEF = cumulation of government deficits (negative of IFS, line 80) on a December 1972 benchmark for debt (total debt-intragovernmental debt, IFS line 88 - line 88s)
USH = monetary base (IFS, line 14)
USDHCB = total debt held by Monetary Authorities (IFS, line 88aa)
USOFER = holdings of U.S. dollar assets by foreign central banks as foreign exchange reserves
USOFE = USSHAR*OFEALL,
where USSHAR= estimated share of U.S. dollar in total official foreign exchange holdings (described below)
USOFER = (USOFE*SDRS)/1000

Canada (CB); billions of Can. dollars

CB	=	CCDEF + CH - CDHCB
CCDEF	=	from 73M1 to 76M3, CCDEF = total debt-intra-governmental debt (IFS, line 88 - line 88s) from 76M4 onwards, CCDEF = cumulation of government deficits (negative of IFS, line 80) on a March 1976 benchmark for debt
CH	=	monetary base (IFS, line 14)
CDHCB	=	total debt held by Bank of Canada (IFS, line 88aa)

United Kingdom (UKB); billions of pounds

UKB	=	UKCDEF + UKH - UKDHCB - UKOFER
UKCDEF	=	cumulation of government deficits (negative of IFS, line 80) on a December 1972 benchmark (estimated from data for March 1973 in U.N. Statistical Yearbook 1977, Public Finance Table no. 202) monthly data not available; they are interpolated by dividing quarterly data by three.
UKH	=	monetary base (IFS, line 14) monthly data obtained by linear interpolation of quarterly data
UKDHCB	=	Monetary Authorities' Claims on Government (IFS, line 12a) monthly data obtained by linear interpolation of quarterly data
UKOFER	=	holdings of pound assets by foreign central banks as foreign exchange reserves UKOFE = UKSHAR*OFEALL, where UKSHAR= estimated share of pound in total official foreign exchange holdings (described below) UKOFER = (UKOFE*SDRS*UKS)/1000, where UKS = pound/$US exchange rate

Currency Composition of Total Official Foreign Exchange Holdings (..SHAR)

A few figures (in general, for the last month of the year) for the currency composition of official holdings of foreign exchange reserves are reported in several issues of the IMF Annual Report.
These figures were used to infer the share of local currencies in total identified holdings (see Table A.1).
Monthly data ratios were then obtained by linear interpolation.
The ratio was assumed to be constant after 1983M12.

Cumulated Current Account (..CCA) **and Wealth** (..W)

Frankel's procedure (1982a) was followed to get monthly estimates of the current account for each country.

Data were obtained by subtracting from the current account for a given quarter, the balance of trade for that quarter to obtain the balance on services and transfers. This number was divided by three to get a monthly estimate and was then added to the balance of trade, which is available monthly.

Sources: Current account: for all countries, IFS line 77a.d (data are converted to local currencies using the appropriate local currency/$U.S. exchange rate).
Merchandise balance: for all countries, IFS line 70 - line 71

The benchmarks used to cumulate current account data were derived from Frankel's benchmarks for wealth. These are based on debt stocks, monetary bases, and net claims on foreigners (for the United States and Germany; benchmarks for other countries are based on the U.S. estimate).
From the December 1972 benchmark value for wealth used by Frankel, we subtracted total government debt (..CDEF) and the monetary base (..H) to get a very rough estimate of net claims on foreigners at that time. The benchmarks are then 95.4 billion U.S. dollars for the United States, 46.2 billion marks for Germany, 15,471.5 billion yen for Japan, 0.067 billion Can. dollars for Canada, 140.8 billion francs for France, and -19.456 billion pounds for the United Kingdom.

Domestic wealth series are constructed by adding asset stocks to the cumulated current account for each country. These three series are expressed in billions of local currency:

GW = GB + GCCA
JW = JB + JCCA
USW = USB + USCCA
CW = CB + CCCA
FW = FB + FCCA
UKW = UKB + UKCCA

Aggregate world wealth is obtained by adding the domestic wealth of the six countries. It is expressed in billions of U.S. dollars:

AGRW = (GW/GS) + (JW/JS) + USW + (CW/CS) + (FW/FS) + (UKW/UKS)

Table A.1

DATA FOR OFFICIAL HOLDINGS OF FOREIGN EXCHANGE RESERVES (MILLIONS OF SDRS)

Total Holdings (all countries)	U.S. Dollar Holdings	Estimated Share of U.S.$ (USSHAR)	Pound Sterling Holdings	Estimated Share of Pound (UKSHAR)	DM Holdings	Estimated Share of DM (GSHAR)	Yen Holdings	Estimated Share of Yen (JSHAR)	French Franc Holdings	Estimated Share of FF (FSHAR)	Source: Annual Report, IMF Year	Observation Point (end-of-period
98,285	75,151	.7646	6,236	.0634	5,192	.0528	-	.0	909	.0092	1980	73I
114,400	86,007	.7518	6,233	.0545	6,748	.0590	-	.0	1,052	.0092	1980	74II
138,718	104,028	.7499	5,055	.0364	8,212	.0592	673	.0049	1,526	.0110	1982	75IV
161,660	120,576	.7459	3,010	.0186	10,662	.0660	1,082	.0067	1,327	.0082	1982	76IV
203,606	150,393	.7386	3,062	.0150	15,610	.0767	2,219	.0109	1,828	.0090	1983	77IV
224,172	169,424	.7558	3,782	.0169	24,556	.1095	7,107	.0317	2,705	.0121	1984	78IV
249,855	155,369	.6218	4,474	.0179	28,664	.1147	7,887	.0316	3,107	.0124	1984	79IV
293,123	161,211	.5500	7,478	.0255	38,141	.1301	10,689	.0365	4,370	.0149	1984	80IV
299,013	173,706	.5809	5,879	.0197	35,470	.1186	10,931	.0366	3,885	.0130	1984	81IV
287,822	167,852	.5832	6,377	.0222	32,617	.1133	11,037	.0383	3,574	.0124	1984	82IV
310,095	182,272	.5878	7,306	.0236	32,985	.1064	11,742	.0379	3,206	.0103	1984	83IV

APPENDIX B

Long-Term Interest Rate Differentials

In the main body of this study we dealt with relationships among short-term interest rates on assets denominated in various currencies. Theoretically, one can establish similar relationships among long-term interest rates. In particular, perfect international asset substitutability implies that:

$$i_d^L = i_{us}^L + \Delta s^e \qquad (B.1)$$

where i_d^L is the domestic long-term interest rate for k years,

i_{us}^L is the U.S. long-term interest rate for k years,

and Δs^e is the expected percentage depreciation of the domestic currency over the next k years.

In principle equation B.1 could be transformed under the assumption of rational expectations to test uncovered interest parity against the alternative hypothesis that relative asset stocks and wealth cause deviations from interest parity. Such a test would lead to the estimation of the following equation, which is similar to equation (12) in the text:

$$i_d^L - i_{us}^L - \Delta s_{t+k} = a' + b'[(B/S)/W] + c'[(W_d/S)/W] + d'(W_{us}/W) \qquad (B.2)$$

One problem in testing the hypothesis is an insufficient number of years of floating rates, since with k=10, 10 years of data are lost, leaving few degrees of freedom.

Alternatively one can choose proxies for exchange rate expectations. Logical candidates include a distributed lag on past exchange rate changes, the short-term interest rate differential (Beenstock and

Longbottom, 1981), or distributed lags on past interest rates (domestic and foreign, long and short) as in Boothe et al. (1985). In this appendix we adopt a modified form of this latter procedure in which we also allow inflation rates to affect exchange rate expectations. We realize that it is hard to interpret the coefficients on the explanatory variables when using proxies for expectations. Therefore, rather than formally testing for perfect substitutability we seek evidence on subsidiary questions such as:

i) are domestic and foreign asset and wealth variables significant determinants of domestic long-term interest rates?

ii) do U.S. long-term interest rates directly affect other long-term interest rates?

iii) do U.S. short-term interest rates directly affect long-term interest rates in other countries?

The modified equation (Boothe et al. 1985) that we use is:

$$
\begin{aligned}
i_d^L = a_0 &+ \sum_{j=0}^{1} b_j\, i^L_{us,t-j} + \sum_{j=0}^{1} c_j\, i_{d,t-j} + \sum_{j=0}^{1} d_j\, i_{us,t-j} \\
&+ \sum_{j=0}^{1} e_j [(B/S)/W]_{t-j} + \sum_{j=0}^{1} f_j [(W_d/S)/W]_{t-j} \\
&+ \sum_{j=0}^{1} g_j [W_{us}/W]_{t-j} + \sum_{j=0}^{1} h_j\, \pi_{d,t-j} \\
&+ \sum_{j=0}^{1} k_j\, \pi_{us,t-j} + \sum_{j=1}^{2} m_j\, i^L_{d,t-j} \qquad \text{(B.3)}
\end{aligned}
$$

where π_d and π_{us} are the domestic and U.S. twelve-month inflation rates. Estimation results are listed in Table B.1.

Asset and wealth variables are insignificant except perhaps in the case of the United Kingdom, where the relative domestic bond variable has the incorrect sign, and that of Japan, where domestic wealth has the expected sign but U.S. wealth has the incorrect sign. Insignificant asset and wealth variables favour the hypothesis of perfect substitutability.

When the asset and stock variables are dropped (see the second column), the only inflation variable with the correct sign and a t-ratio greater than 2 is the domestic variable in the equation for Japan. Thus, we can concentrate on the third column, where the inflation rates are dropped. In that column, the U.S. long-term bond rate has a significant positive long-term impact only in the case of Canada. It has a small estimated positive short-run effect in the case of Germany. Short-term U.S. rates, however, have a small but significant positive impact on rates in Germany, Japan and (in the short run only) France. Overall the connection between U.S. interest rates and long-term interest rates in other countries is weak in the short run except in the case of Canada.

Table B.1

ESTIMATES OF LONG-TERM INTEREST RATE EQUATION (B-3)
1973M7-1984M12

Variable	Canada			France			U.K.		
Constant	1.41	-0.39	0.13	1.16	-0.06	0.23	-0.54	1.30	1.01
	(2.30)	(2.14)	(1.16)	(1.56)	(0.37)	(1.97)	(0.48)	(2.46)	(2.08)
$i^L_{us,t}$	0.72	0.70	0.67	-0.07	-0.03	-0.03	0.15	0.12	0.12
	(11.94)	(11.91)	(10.97)	(1.10)	(0.59)	(0.53)	(1.20)	(1.00)	(0.96)
$i^L_{us,t-1}$	-0.25	-0.28	-0.33	0.14	0.14	0.10	-0.21	-0.19	-0.19
	(2.97)	(3.38)	(3.95)	(2.38)	(2.38)	(1.71)	(1.70)	(1.55)	(1.57)
$i_{d,t}$	0.11	0.14	0.14	0.24	0.24	0.23	0.27	0.29	0.29
	(2.88)	(4.01)	(3.86)	(8.94)	(9.38)	(8.70)	(6.20)	(6.54)	(6.50)
$i_{d,t-1}$	-0.02	-0.02	-0.01	-0.16	-0.18	0.17	-0.25	-0.29	-0.28
	(0.49)	(0.61)	(0.16)	(5.04)	(6.39)	(6.22)	(5.18)	(6.28)	(6.26)
$i_{us,t}$	0.02	0.01	0.04	0.07	0.06	0.07	0.06	0.06	0.05
	(0.71)	(0.32)	(1.27)	(2.63)	(2.43)	(2.77)	(1.12)	(1.13)	(1.03)
$i_{us,t-1}$	-0.09	-0.12	-0.12	-0.10	0.10	-0.08	0.01	0.02	0.00
	(2.80)	(3.77)	(3.71)	(3.83)	(4.08)	(3.16)	(0.13)	(0.30)	(0.08)
$(B/SW)_t$	-36.89			-2.51			-74.30		
	(0.61)			(0.08)			(2.02)		
$(B/SW)_{t-1}$	45.43			-10.30			70.97		
	(0.73)			(0.33)			(2.01)		
$(W_d/SW)_t$	56.19			-5.81			44.55		
	(0.80)			(0.20)			(0.86)		
$(W_d/SW)_{t-1}$	-71.31			5.57			-46.71		
	(1.04)			(0.20)			(0.90)		
$(W_{us}/W)_t$	0.84			-0.03			-6.53		
	(0.37)			(0.01)			(1.36)		
$(W_{us}/W)_{t-1}$	2.31			0.19			11.08		
	(0.93)			(0.07)			(2.43)		
$\pi_{d,t}$	0.07	-0.05		0.07	-0.02		0.03	0.07	
	(1.20)	(0.87)		(1.05)	(0.69)		(0.57)	(1.17)	
$\pi_{d,t-1}$	0.12	0.09		0.08	0.04		0.04	-0.04	
	(2.17)	(1.74)		(1.23)	(0.66)		(0.73)	(0.69)	
$\pi_{us,t}$	0.22	0.20		-0.01	0.01		0.04	-0.06	
	(3.35)	(3.17)		(0.23)	(0.25)		(0.29)	(0.52)	
$\pi_{us,t-1}$	-0.19	-0.20		0.05	0.02		0.07	0.04	
	(2.98)	(3.16)		(0.84)	(0.36)		(0.54)	(0.34)	
$i^L_{d,t-1}$	0.52	0.60	0.64	0.93	0.99	1.00	0.65	0.73	0.77
	(6.66)	(8.43)	(8.85)	(11.97)	(13.60)	(13.50)	(8.26)	(9.34)	(10.08)
$i^L_{d,t-2}$	-0.01	-0.02	-0.03	-0.11	-0.11	-0.11	0.20	0.14	0.16
	(0.16)	(0.35)	(0.52)	(1.60)	(1.65)	(1.61)	(2.59)	(1.82)	(2.13)
$\bar{R}^2$	.989	.989	.988	.990	.990	.990	.887	.875	.883
DW	2.133	2.189	2.166	2.054	2.075	1.970	2.042	1.975	1.983
SEE	.254	.257	.269	.238	.238	.245	.495	.520	.521

Table B.1 (Continued)

Variable	Japan[1]			Germany		
Constant	2.68 (2.34)	0.25 (1.17)	0.38 (1.98)	2.11 (2.78)	0.12 (0.55)	0.17 (0.97)
$i^L_{us,t}$	0.04 (0.85)	0.04 (0.72)	0.03 (0.60)	0.08 (1.31)	0.10 (1.78)	0.09 (1.56)
$i^L_{us,t-1}$	-0.01 (0.27)	-0.05 (0.99)	-0.05 (1.09)	-0.07 (1.17)	-0.10 (1.68)	-0.11 (1.89)
$i_{d,t}$	0.07 (2.45)	0.08 (2.43)	0.09 (2.80)	0.18 (4.82)	0.18 (4.73)	0.18 (4.59)
$i_{d,t-1}$	-0.03 (0.85)	-0.06 (1.83)	-0.06 (1.95)	-0.20 (5.18)	-0.20 (5.43)	-0.18 (4.81)
$i_{us,t}$	0.07 (3.59)	0.07 (3.19)	0.07 (3.51)	0.06 (2.49)	0.07 (2.77)	0.08 (3.18)
$i_{us,t-1}$	-0.05 (2.62)	-0.05 (2.30)	-0.05 (2.31)	-0.04 (1.46)	-0.04 (1.48)	-0.05 (1.94)
$(B/SW)_t$	3.21 (0.27)			-5.87 (0.27)		
$(B/SW)_{t-1}$	-2.21 (0.19)			-8.46 (0.38)		
$(W_d/SW)_t$	-20.38 (1.94)			-0.97 (0.06)		
$(W_d/SW)_{t-1}$	15.04 (1.48)			2.98 (0.17)		
$(W_{us}/W)_t$	-5.56 (2.03)			2.30 (0.90)		
$(W_{us}/W)_{t-1}$	3.03 (1.07)			-3.21 (1.28)		
$\pi_{d,t}$	0.04 (1.96)	0.05 (2.30)		0.11 (1.40)	0.09 (1.19)	
$\pi_{d,t-1}$	-0.04 (2.02)	-0.04 (2.07)		0.27 (0.37)	0.01 (0.11)	
$\pi_{us,t}$	0.04 (0.92)	0.02 (0.36)		0.12 (1.93)	0.10 (1.64)	
$\pi_{us,t-1}$	-0.07 (1.48)	-0.02 (0.42)		-0.10 (1.75)	-0.12 (1.95)	
$i^L_{d,t-1}$	0.98 (12.14)	1.05 (12.36)	1.06 (12.58)	0.93 (11.20)	1.00 (13.01)	1.01 (13.28)
$i^L_{d,t-2}$	-0.13 (1.57)	-0.11 (1.31)	-0.13 (1.55)	-0.10 (1.36)	-0.08 (1.06)	-0.05 (0.65)
$\bar{R}^2$	.963	.956	.954	.972	.969	.970
DW	2.181	2.179	2.161	2.032	1.997	2.006
SEE	.191	.218	.220	.242	.254	.260

1. The sample period is 1977M10-1984M12 in regressions for Japan.

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