INTERNATIONALISATION OF FINANCIAL MARKETS AND THE ALLOCATION OF CAPITAL

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CONTENTS

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INTRODUCTION AND SUMMARY

The liberalisation of international capital account transactions in most major countries over the past decade or so has given rise to the rapid development of an integrated international capital market. Euro and domestic interest rates have converged for most major currencies. Furthermore, there appears to be a tendency for real interest rate differentials between countries, averaged over periods of several years, to have narrowed, although with considerable volatility of these differentials over shorter time periods.

These developments raise various questions about the effects of the internationalisation of financial markets. This paper presents analyses and empirical findings relevant to consideration of the following questions:

- How did the removal of exchange controls affect the determinants of domestic interest rates in relation to the Euro-currency market?
- How strong is the tendency towards convergence of real interest rates, especially among financially open countries?
- To what extent does the increased integration of financial markets improve the international allocation of capital?
- What are the effects on the allocation of capital of domestic tax incentives for investment when capital is highly mobile?

Part I provides some historical, theoretical and empirical background relating to the process of convergence of domestic and Euro interest rates and also of real interest rates in recent years. It shows that increasing capital market integration strengthens convergence between domestic and Euro market interest rates and indicates that internationalisation of capital markets tends to produce convergence of real returns on financial assets across countries. An important mechanism for real interest rate convergence is the long-run tendency of exchange rates to follow purchasing power parity. Of course, exchange rates diverge from purchasing power parity levels and, correspondingly, expected changes in exchange rates can differ from expected inflation differentials. If such changes in real exchange rates take place, current account positions will be affected, with corresponding effects on net capital flows. Such capital flows will tend to reduce real interest rate differentials by subtracting savings from surplus countries and adding them to deficit countries.

Part II deals with the long-term implications for the international allocation of capital. There is some theoretical presumption that the tendency towards international equalisation of real interest rates through capital movements improves the allocation of resources and raises the level of welfare if there are no other distortions. However, the different tax treatment of capital formation in individual countries can be expected to distort the international allocation of capital when financial markets are more closely integrated. The analysis shows that the corporate tax system of each country generates a wedge specific to that country between real interest rates and the real costs of capital. Therefore, even if real interest rates were equalised across countries, real costs of capital would normally differ significantly among them. Personal income tax systems also create an important distortion in the cost of capital for housing investment. The different tax treatment of interest payments on mortgages and imputed income from owner-occupied housing generates differences in the cost of owner-occupied housing, which in some cases are large, even with **internationally-equalised** real interest rates.

It is also shown that tax-induced differences in the costs of capital can induce significant movements of capital under integrated financial markets. When a country adopts a tax incentive for investment, it might be able to raise its output temporarily through increased investment. However, in the long run, the marginal product of capital of a tax-induced investment may not cover the costs of before-tax real interest rates. Thus, in a world of high capital mobility, the introduction of tax incentives tends to draw in capital from abroad and, if exchange rates are freely floating, there will be an associated movement of the trade balance towards deficit. In the absence of other distorting factors, the welfare of the country is lowered by the difference between the low marginal product of capital and the high cost of foreign capital.

The above analysis raises the important question of whether domestic tax measures which are designed to influence domestic investment by affecting the after-tax cost of capital can also influence world-wide resource allocation by fostering international movements of capital. If resource allocation is to be improved on a world-wide basis, international financial integration may need to be accompanied by greater international harmonization of those aspects of tax systems that relate to investment and saving.

I. INTERNATIONAL INTEGRATION OF FINANCIAL MARKETS

During the past 25 years or *so,* international financial transactions have grown at a very rapid pace. The expansion of international credit has in part resulted from

increased international integration of goods markets and from the multinational presence of a large number of enterprises. Import and export shares in GNP have doubled in many countries, necessitating a substantial increase in lending simply to satisfy the needs of current account transactions. But the growth of international financial markets, their increasing sophistication and the closer integration of national markets has gone well beyond the accommodation of trade. In **1960,** foreign assets of deposit banks (i.e. commercial banks) in OECD countries amounted to only **$16.2** billion **(1.5** per cent of area GDP). By **1984,** this had increased to **$1 835** billion, or nearly **17** per cent of GDP. Banks have also greatly expanded their presence in other countries through branches and subsidiaries, initially at least to service the needs of major multinational clients. Traditional foreign bond issues were almost as important as bank lending prior to **1960,** but their role lagged behind during the expansion of international banking during the **1960s** and first half of the **1970s.** Gross international bond issues have increased rapidly since then, with renewed growth of traditional international issues in national markets and the development of an important Eurobond market.

The following sections examine the process of international integration of financial markets and its effects on the relationship between interest rates in various markets. After clarifying the significance of financial integration in Section A, Section B examines the relationships between exchange controls and Euro-domestic interest rate differentials for selected OECD countries. The recent movements in real interest rates are then analysed in Section C. This shows that the process of dismantling barriers and the accompanying rapid expansion of international financial transactions have enhanced the level of integration among the financial markets of OECD countries.

A. Significance of financial integration

If each domestic financial market were separated from the others by effective exchange controls, the interest rate in a country would be determined by the interaction of real and financial forces solely within that country. Even under this segmentation of individual financial markets, international trade tends to work to reduce the international difference in the marginal product of capital through the well-known factor-price-equalisation process. However, given large international differences in technology and other institutional factors, this tendency towards factor price equalisation would be far from perfect in the absence of direct arbitrage among domestic financial markets and flows of funds between them. The international integration of financial markets is therefore necessary for a better international allocation of capital.

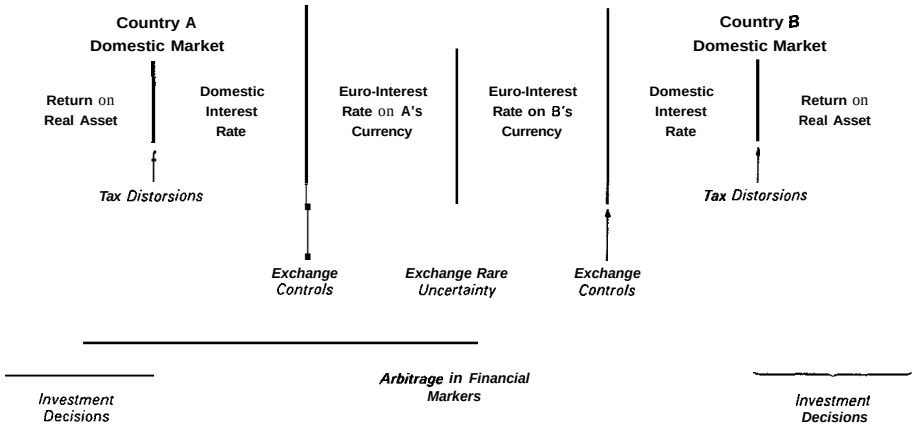
International capital market integration means that savers of different nationalities can obtain more nearly equal returns on their financial holdings and that those seeking to raise funds in financial markets face more nearly equal costs if they entail the same risks. Thus it is useful to look at the relationships among rates of return across markets and the forces that tend either to reduce differentials or to maintain them.

Diagram 1 illustrates these relationships among segments of national and international markets. Within Country A, the domestic market interest rate works as an indicator of the opportunity cost of capital. If Country A maintains exchange controls, foreigners may not be able to lend or borrow at this market rate. Rather, the effective interest rate on Country A s currency for foreigners is the rate in the external financial market (Euro-interest rate – when a currency is used for financial transactions outside of its issuing country, these are called Euro-transactions). Since the countries which host these Euro-transactions do not usually impose any exchange controls on them, the difference between Euro and domestic interest rates of the same currency can be used to measure the effects of exchange controls in the country concerned.

Exchange rate movements also complicate the process of international financial intermediation. Within a single country, nominal as well as real returns on various financial assets tend to converge through straight arbitrage processes. In the

DIAGRAM 1

SCHEMA FOR DOMESTIC AND INTERNATIONAL FINANCIAL RELATIONSHIPS



international context, by comparison, increasing financial market integration tends to narrow differentials in expected nominal returns on financial assets across currencies. Because of the existence of exchange rate uncertainty, the interest rate on currency A is not necessarily equal to the expected yield on currency B which consists of the interest rate on currency B and the expected rate of appreciation of currency B against currency A[1]. However, smaller changes in relative yields will be required to eliminate excess supplies or demands that may arise in a national market from a range of disturbances if portfolio holders are able and willing to shift into higher yielding assets across national borders. Therefore, there is a tendency for expected nominal yields to asset holders to be kept more closely in line with each other at all times if markets are integrated internationally. If this is the case, the following equation tends to hold:

(Currency A's interest rate) = (Currency B's interest rate)
+ (Expected rate of appreciation of currency B against currency A) [1]

This tendency will not necessarily mean that real interest rates facing different national users of funds will be kept closely in line in the short run, however. An additional condition for the real interest rate convergence is a tendency for exchange rates to follow purchasing power parity. If the future movements of exchange rates between the two countries are expected to correspond to inflation rate differentials, the following equation results:

(Expected rate of appreciation of currency B against currency A)
= (Expected inflation in Country A) – (Expected inflation in Country B) [2]

If these two relationships hold, the real interest rates of the two countries will show convergence. From equations [1] and [2] an equation showing equalisation of real interest rates can be derived:

(Currency A's interest rate) – (Expected inflation in Country A)
= (Currency B's interest rate) – (Expected inflation in Country B) [3]

Although there is a long-run tendency for exchange rates to fluctuate around purchasing power parity, exchange rates often diverge from purchasing power parity levels. Expected exchange rate changes may then differ from expected inflation differentials. To the extent that this can occur (it results from stickiness of prices and inelastic trade flows in the short run), equalisation of the expected nominal yield on assets to a given holder will be consistent with real interest rate differentials across currencies and countries (see Annex A for more detailed discussion on this matter).

Nevertheless, the displacement of the real exchange rate from its long term real level would set in train some combination of two other adjustments, which would tend to bring the real exchange rate back to its long-term equilibrium value over time and produce convergence of real interest rates. The possibility emerges to the extent that such exchange rate displacement produces current account imbalances and capital movements. For instance, a stronger real exchange rate will contribute to the emergence of a current account deficit with corresponding capital inflow in the high real interest rate country. Over time, the inflow of funds from abroad will add to investment and tend to bring down the real interest rate to the world level. In addition, monetary policy may respond to moderate the movement of exchange rates by keeping real interest differentials with the rest of the world from moving widely.

The integration of financial markets thus generates an increased convergence in real interest rates across countries. If there were no distorting factors, this convergence of real returns would improve international allocation of capital. In the presence of distortions it may still do *so,* but a better resource allocation can no longer be assumed.

B. Exchange controls and Euro-domestic interest differentials

As explained above, the differential between domestic and Euro-market interest rates on the same currency provides a useful summary indicator of the impact of capital controls and related measures in insulating domestic interest rates from international market forces[2]. In the absence of restrictions, these two rates should tend to converge as agents could arbitrage between the rates without exchange risks if differences developed. Regulations will tend to produce volatile differentials reflecting the ebb and flow of market pressures, with a higher rate in the Euromarket indicative of restrictions on capital outflows and a lower rate indicative of restrictions on capital inflows of the issuing country. Euro-deposit rates are quoted only for major currencies. For other currencies, such deposits are priced by using the spot-forward spread of the currency against the dollar and the Eurodollar interest rate. Chart A provides a comparison of domestic and Euro-rates for eleven OECD currencies. In all cases, the Euro-rate is a 3-month inter-bank deposit rate. The domestic rate has been chosen to reflect similar risk characteristics but some small differences can be expected.

In the early 1970s, when capital controls were common, the differential between these two rates was often substantial, reflecting periods when parity changes were anticipated and reflected in Euro rates to a greater extent than in

CHART A

DIFFERENTIAL BETWEEN DOMESTIC AND EURO SHORT-TERM RATES

Euro-currency market
Domestic market

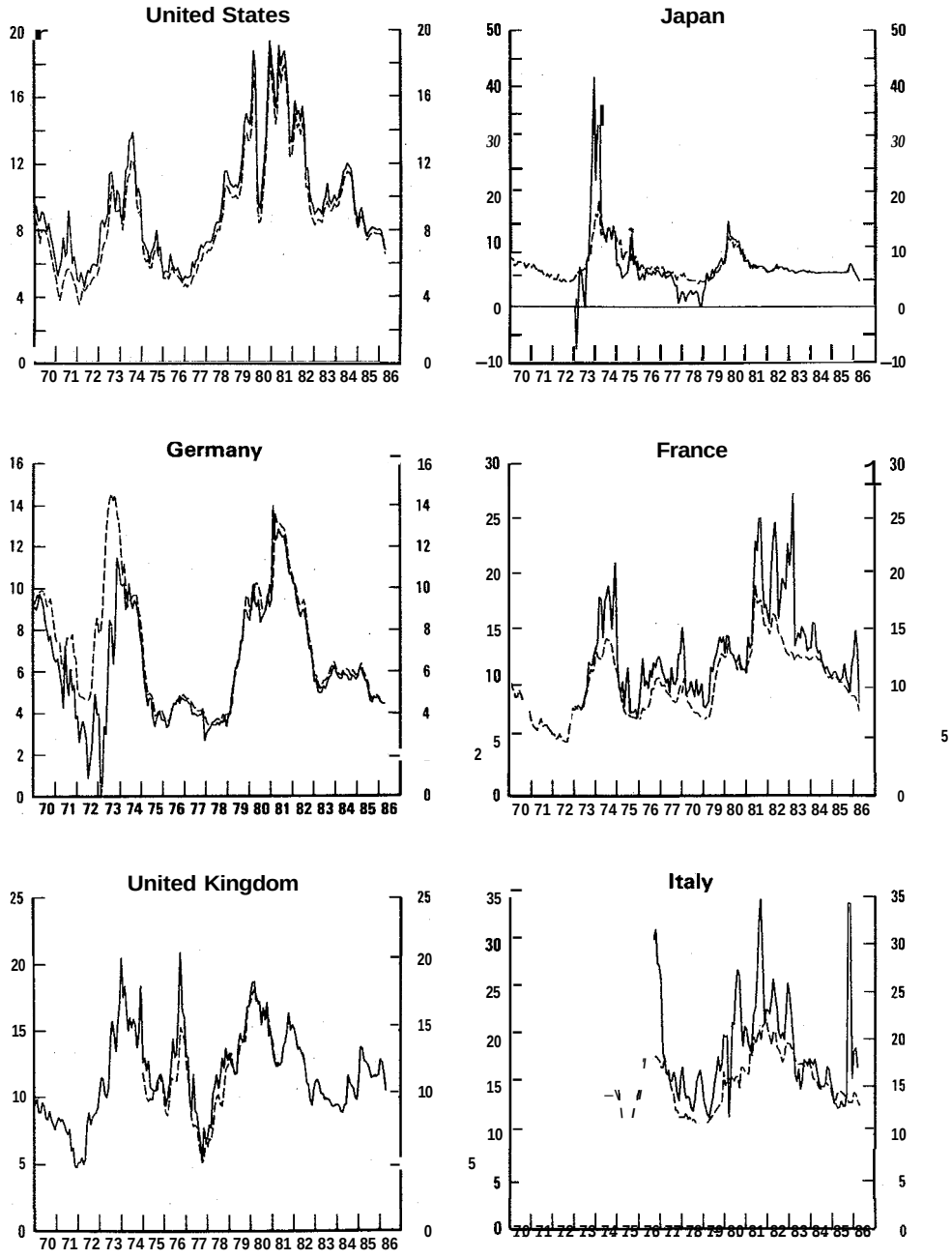
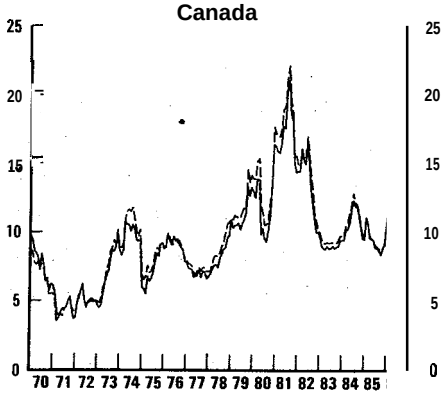


CHART A (continued)

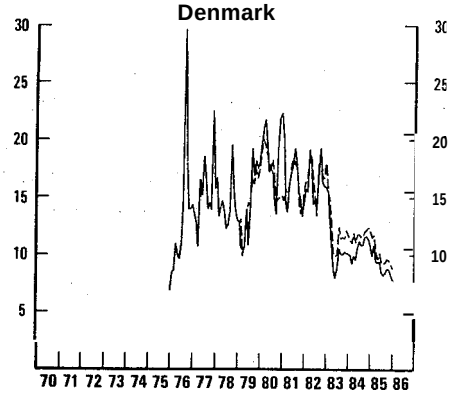
DIFFERENTIAL BETWEEN DOMESTIC AND EURO SHORT-TERM RATES

Euro-currency market
Domestic market

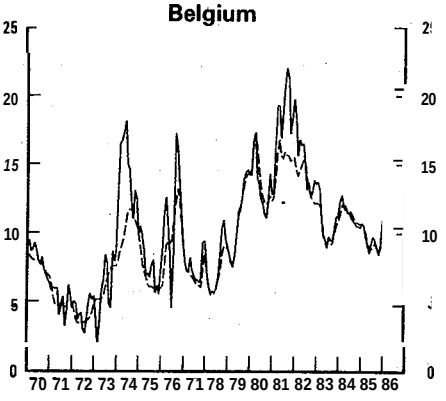
Canada



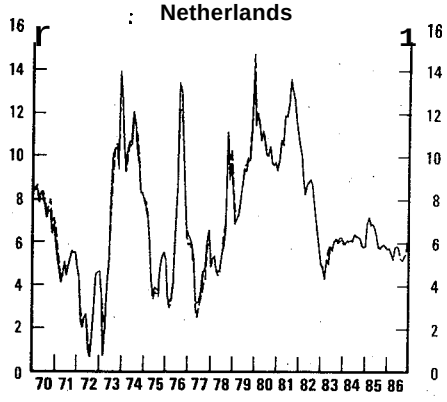
Denmark



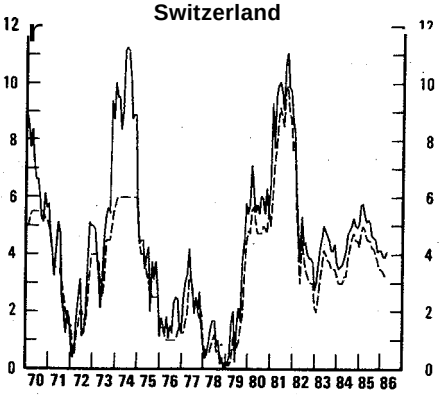
Belgium



Netherlands



Switzerland



Note: Interest rates used are:

Euro rate: United States, Japan, Germany, France, United Kingdom, Netherlands, Switzerland: 3-month deposit rate; Italy, Canada, Belgium. Denmark: the formula for. calculations of Euro-rates is as follows:

$$r_t = r_t^* + \left[E_t^f / E_t^s - 1\right] \times 400$$

r_t : Euro rate.
r_t^* : Euro-dollar rate (3-month). For Canada, US commercial.paper rate (90-day).
E_t^f : 3-month forward exchange rate against US dollar.
E_t^s : Spot exchange rate against US dollar.

Domestic rate: United States: 3-month certificates of deposit; Japon: 3-month Gensaki; Germany, France, United Kingdom and Denmark: 3-month interbank loans; Italy and Belgium: 3-month treasury bills; Canada: 3-month commercial paper; Netherlands: 3-month loans to local authorities; Switzerland: 3-month deposits with major banks.

insulated domestic rates, when policy changes were made or, as happened in the Euro-dollar market in 1974 with the collapse of the Herstatt Bank, when investors' risk assessments changed. For most countries the Euro-rate was higher than the domestic rate, reflecting the fact that most exchange controls were designed to limit capital outflows. As explained below in greater detail, in Germany, however, capital controls introduced in the early 1970s and again in early 1978 were designed to restrict capital inflows by imposing high reserve deposit requirements on deposits by non-residents or on foreign borrowings by residents[3]. The Euro-deposit rate fell below the domestic money market rate but there was no incentive for domestic banks to raise funds in the Euro-market because of the penalty associated with the high reserve deposit requirement. A similar differential also appeared for Japan from late 1977 to 1978 when the yen was subject to intensive upward pressure as explained below[4].

In countries where capital controls have been dropped, the interest rate differential has fallen markedly. For example, following the repeal of exchange controls by the United Kingdom in late 1979, the Euro and domestic interest rates have become virtually indistinguishable (the data of domestic rate starts in 1975). For some countries, such as Germany and the United States, a small differential exists because of the cost to domestic banks of complying with the deposit reserve requirements. Some countries have continued to use capital controls and their impact in recent years is most evident for Italy and France, which have tended to be weak currencies within the EMS. Capital controls in these countries, particularly on outflows, assist in maintaining the exchange rate, at least in the short term, without recourse to sharp increases in domestic interest rates. In contrast, in the Netherlands domestic short-term interest rates were pushed up sharply for short periods during the 1970s to dissuade speculation against the currency. The efficacy of exchange controls in stabilizing domestic interest rates ought not to be exaggerated, however. The extent to which domestic interest rates increased in France and Italy during periods of pressure on the franc and lira is not evident in the charts because of the scale needed to show the extraordinarily large movements of Euro-rates on these currencies.

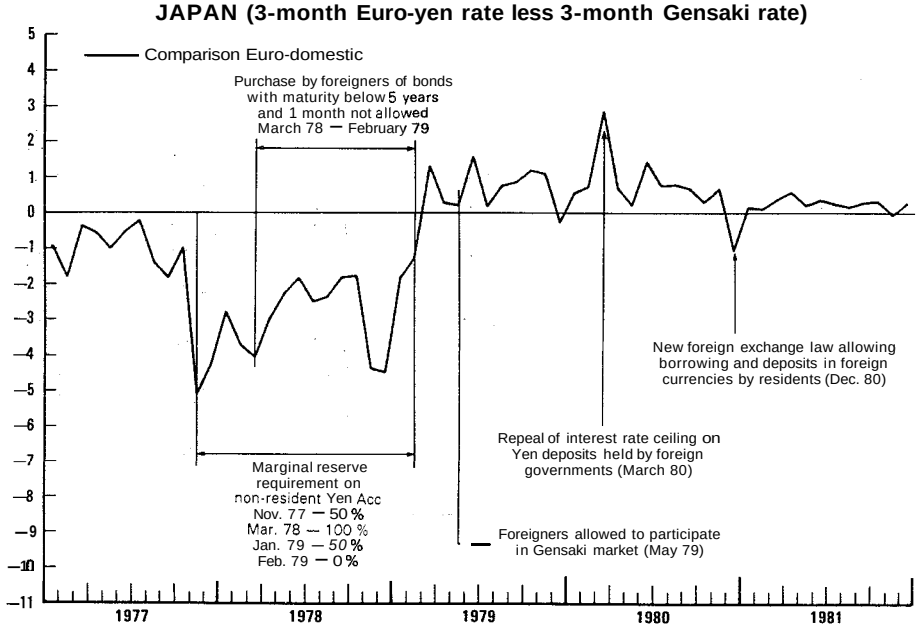
The sensitivity of the differential between the domestic and Euro-rates to policy changes in the presence of capital controls is illustrated in Chart B. For Germany, changes in reserve deposit requirements on foreign liabilities during the early 1970s were quickly followed by an increase in the margin in favour of the domestic rate. Non-banks were unable to arbitrage away the difference by borrowing in the Euro-market and depositing in the domestic market as the reserve deposit requirement applied also to non-banks (Bardepot system). In January 1978, reserve deposit requirements were imposed for banks and this caused an interest rate

CHART B

EXCHANGE CONTROLS AND EURO-DOMESTIC INTEREST RATE DIFFERENTIALS

(Euro rate less domestic rate)

JAPAN (3-month Euro-yen rate less 3-month Gensaki rate)



GERMANY (3-month Euro-DM rate less 3-month interbank rate)

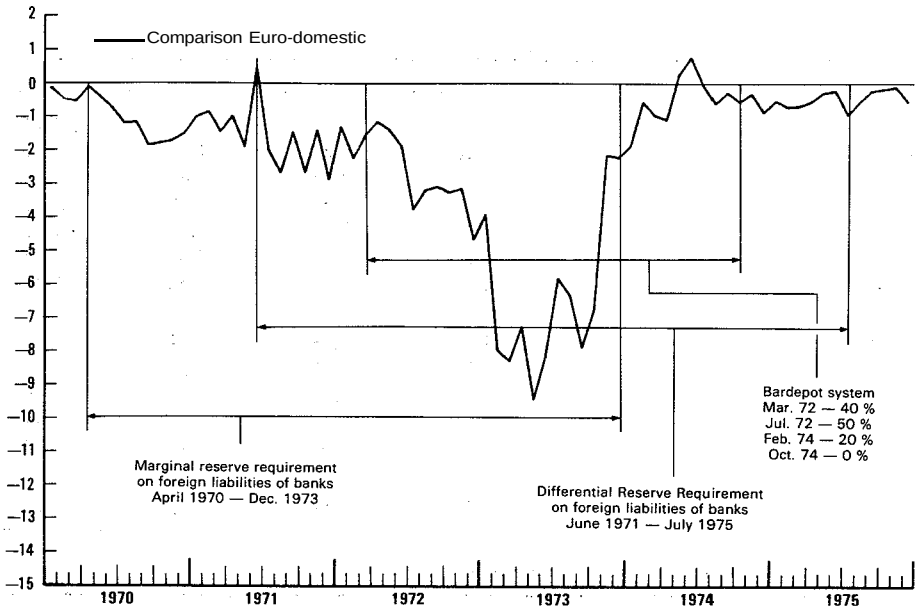


Table 1. **International asset position of selected countries relative to GNP/GDP**

THE UNITED STATES

Per cent

	1970	1975	1980	1985
External assets	16.11	19.14	23.28	23.81
Public sector	4.11	3.16	3.46	3.21
Official reserve	1.46	1.05	1.03	1.08
Other assets	3.25	2.71	2.44	2.19
Private sector	12.00	15.37	19.82	20.60
Direct investment	7.63	8.04	8.26	5.83
Other assets	4.31	1.33	11.55	14.71
Stocks	0.66	0.62	0.74	1.02
External liabilities	10.80	14.32	19.21	26.51
Public sector	2.64	5.64	6.15	5.07
Private sector	8.16	8.69	12.46	21.50
Direct investment	1.34	1.79	3.18	4.59
Other liabilities	6.82	6.89	9.21	16.91
Stocks	2.75	2.31	2.48	3.16
Net external assets	5.91	4.81	4.01	***-2.10***

Source: *Survey* of *Current Business,* United States Department of Commerce.

JAPAN

Per cent

	1973	1975	1980	1985
External assets	13.02	12.14	16.37	28.42
Public sector	4.98	4.30	4.82	4.19
Official reserve	3.36	2.61	2.63	1.80
Other assets	1.63	1.63	2.19	2.39
Private sector	8.05	1.84	11.55	24.23
Direct investment	1.25	1.73	2.01	2.85
Other assets	6.80	6.11	9.53	21.37
Stocks				
External liabilities	9.46	10.68	15.19	19.99
Public sector	0.59	0.63	1.93	2.54
Private sector	8.88	10.05	13.25	11.45
Direct investment	0.44	0.43	0.34	0.31
Other liabilities	8.44	9.61	12.92	11.14
Stocks				
Net external assets	3.57	1.46	1.18	8.43

.. Not available.

Source: *Fiscal and Monetary Statistics Monthly,* Ministry of Finance, Japan.

Table 1 *(continued)*

GERMANY

Per cent

	1974	1975	1980	1985
External assets	28.31	31.55	32.94	44.00
Public sector	12.27	11.26	8.07	8.27
Official reserve	9.09	7.27	5.33	4.53
Other assets	3.18	3.99	2.73	3.74
Private sector	16.04	20.28	24.88	35.72
Direct investment		2.43	3.13	4.1 3
Other assets		17.86	21.76	31.59
Stocks	0.89	0.98	0.71	1.03
External liabilities	19.26	21.50	28.56	35.44
Public sector	0.51	0.98	3.92	7.75
Private sector	18.76	20.52	24.64	27.69
Direct investment		3.73	2.96	2.62
Other liabilities		16.79	21.68	25.07
Stocks	0.68	0.84	1.17	2.02
Net external assets	9.05	10.05	4.38	8.55

Source: *Monthly Report* of *the Deutsche Bundesbank.*

THE UNITED KINGDOM

Per cent

	1970	1975	1980	1985
External assets	67.75	87.80	99.46	170.51
Public sector	4.91	4.60	8.15	5.99
Official reserve	2.30	2.55	5.78	3.78
Other assets	2.61	2.05	2.36	2.1 1
Private sector	62.83	83.20	91.31	164.52
Direct investment	12.54	10.87	14.75	20.99
Other assets	50.30	72.33	76.57	143.53
Stocks				
External liabilities	60.74	89.46	92.04	147.47
Public sector	11.52	10.03	6.46	5.78
Private sector	49.22	79.43	85.58	141.69
Direct investment	6.51	6.63	11.51	11.62
Other liabilities	42.72	72.79	74.07	130.07
Stocks				
Net external assets	7.01	–1.66	7.41	23.04

.. Not available.
Source: *Bank of England Quarterly Bulletin.*

differential to open up once again. However, much less stringent conditions were imposed on non-banks and the differential did not persist. In Japan, reserve requirements on non-resident yen accounts and a ban on the purchase of short- and medium-term paper by foreigners were introduced to counter upward pressure on the yen. This caused domestic rates to exceed Euro-rates by a significant margin between November **1977** and February **1979.** The new foreign exchange law was introduced in December **1980** and the gap between the domestic and the Euro rate has since been small.

As the barriers against efficient international financial transactions are reduced, it has become possible to arbitrage away the differences among yields on domestic and foreign financial assets denominated in different currencies. The scale of international financial transactions, in which arbitrage considerations inevitably play a role, has already reached a significant level among major countries (see Table 1). In proportion to GNP, the gross external assets of the United States, Japan and Germany have reached **24, 28** and 44 per cent respectively (at the end of **1985).** For the United Kingdom, which hosts the major part of the Eurocurrency market, the figure reaches **171** per cent (at the end of **1985).** Although direct investment and portfolio investment in stocks play an important role in these arbitrage activities, the predominant international financial transactions are conducted through credit instruments such as deposits, notes, bonds, loans and branch accounts of banks. For example, the share of outstanding foreign direct investment in total gross external assets is about ¼ for the United States, which is the highest in the major countries. For Japan, Germany and the United Kingdom, the share is much lower and of the order of **9–12** per cent.

In summary, by the early **1980s,** the removal of exchange controls enhanced arbitrage between domestic and external financial markets in some of the major OECD countries. The domestic financial markets of these countries are effectively integrated, forming an international financial market. Several large countries and a number of smaller ones remain somewhat segmented. However, these countries are also moving to open and liberalise their own domestic financial markets. France and Italy are gradually removing exchange controls. This trend toward decontrol will tend to further increase the level of financial integration.

C. Tendency towards international convergence of real interest rates

Increased integration of financial markets not only generates a convergence of domestic and Euro interest rates on the same currency but also tends to bring about a narrowing of real returns on financial assets denominated in different currencies.

As real interest rates are not unambiguously defined, the extent of their convergence is more difficult to assess. This section examines some evidence of this convergence of real rates.

1. The tax system and international investment

Before proceeding to this analysis, some consideration needs to be given to the significance of differences in tax systems between countries, in part because these give rise to the ambiguity of definition of interest rates.

Tax systems give rise to a wedge between the pre-tax return to an investment (i.e. the gross return on real investment less its economic depreciation) and the ultimate return to the saver. This wedge can usually be divided into two elements: one which is legally levied on the business sector (say, through the corporate tax system) and which creates a wedge between the pre-tax return and the market interest rate; and another that is levied on the individual and that creates a wedge between the market interest rate and the return to the saver. Part II contains a discussion of the effect of the first wedge on capital formation when financial markets are fully integrated. The remainder of the analysis focuses on equalisation of the market interest rate and disregards any distortions or ambiguities that may be introduced by the second wedge. It is sensible to disregard this second wedge because, in fact, the wedges for most countries are unlikely to have a significant effect on the relevant international financial flows, namely, interest-bearing bonds and deposits.

Of course, some aspects of the tax system discriminate against foreign investors. For example, Canada and major European countries including Germany, France and the United Kingdom have an imputation system for the tax treatment of corporate dividends. While domestic shareholders can avoid double taxation of corporate and personal taxes on corporate income through the imputation system, foreign individual shareholders often cannot avoid the double taxation of dividends through the corporate and personal income taxes because the imputation system does not always provide tax relief for foreign shareholders.

On the other hand, returns from interest bearing assets like deposits and bonds are not much affected by taxation differences. Generally, interest income on euro-deposits and euro-bonds is not taxed by the countries that host the market. Also, the withholding tax of interest income on other taxable instruments has been abolished in a number of the major countries[5]. Finally, even if interest income is subject to foreign tax, foreign tax liabilities can usually be subtracted from domestic liabilities (i.e. a tax credit can be claimed) thanks to an extensive network of tax treaties among major countries[6]. Therefore the existing tax system would not

appear to discriminate against foreign interest-bearing assets (Alworth, **1984,** for example).

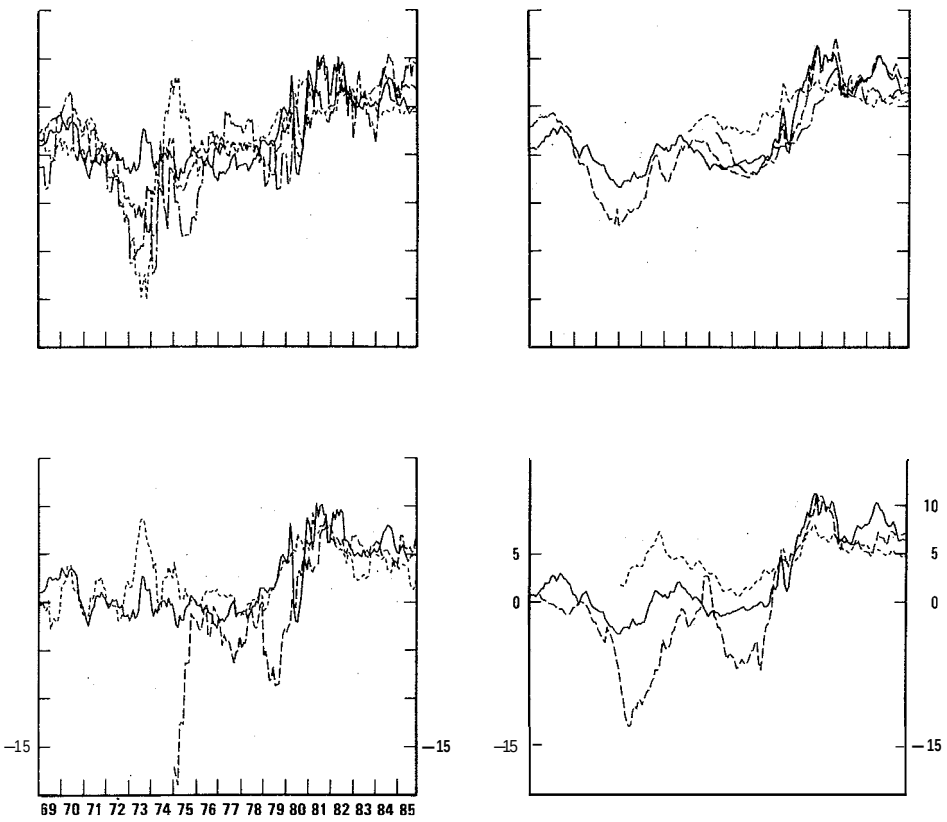
Since tax systems are therefore broadly neutral for the choice of domestic and foreign investment in debt instruments, any tendency for international arbitrage to equalize the expected after-tax returns on domestic and foreign assets should also be reflected in before-tax rates of return (that is, returns prior to personal taxation). Thus, the analysis proceeds on the basis of pre-tax interest rates, i.e. market interest rates. Equalisation of pre-tax rates will mean that borrowers will face different after-tax costs of borrowing to the extent that tax provisions concerning the treatment of interest paid, depreciation and other tax incentives affecting investment differ across countries. The implications of these features of tax systems are addressed in Part II.

2. *Recent movements in real interest rates*

A number of methods for measuring real interest rates have been proposed[7]. The problems are probably more serious for long-term rates because of the difficulty of obtaining a measure of inflation expectations beyond one or two years. Charts C.a–d provide a comparison of long and short-term real rates for eleven OECD countries. Chart C.a compares the real interest rates of the United States and other Pacific basin countries while Chart C.b shows the real rates of the United States and large financially open European countries. Charts C.c and C.d show the rates of Germany and other European countries. Real rates have been calculated by subtracting from nominal rates a forward measure of inflation on the assumption that economic agents correctly predict price movements. For short-term rates, the measure is a smoothed one-quarter-ahead rate of inflation, while for long-term rates the measure is a two-year-ahead rate. For more recent periods, OECD forecasts (Economic Outlook ***39)*** of inflation for **1986** and **1987** have been used.

For short-term real rates, some convergence may be observed since about **1981** for some countries, but uncorrelated wide fluctuations are more apparent. For long-term real rates, there has been a narrowing of margins since about **1981** except for Switzerland which has maintained a relatively low real rate compared with other countries. There is a theoretical reason to expect a stronger tendency towards convergence of long-term, real interest rates than short-term rates under highly integrated financial markets. Given the expected long-run real exchange rates, the real interest differential between domestic and foreign assets will eventually decline as the term to maturity increases (Annex A).

In order to measure the degree of convergence in average real interest rates, the level of significance of bilateral real interest rate differentials has been estimated


10
5
0
–15
–15
69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
Germany
France
Italy
Switzerland

C.c

CHART C (continued)

BEHAVIOUR OF REAL INTEREST RATES

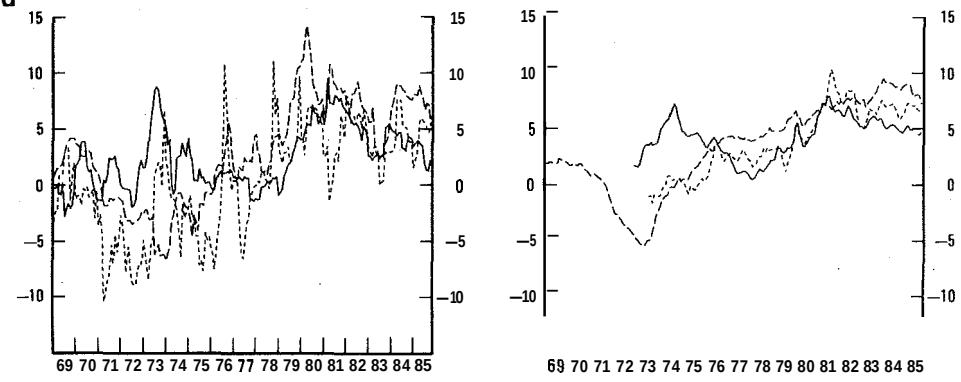
C.d

REAL SHORT-TERM RATES

REAL LONG-TERM RATES

12-year inflation rate)

Germany
Netherlands
Belgium



Short-term nominal interest rates

United States:	3-month certificates of deposit
Japan:	3-month Gensaki
Germany:	3-month interbank loans
France:	3-month interbank loans
United Kingdom:	3-month interbank loans
Italy:	3-month Treasury bills
Canada:	3-month commercial papers
Australia:	3-month commercial papers
Belgium:	3-month Treasury certificates
Netherlands:	The unweighted average of call money
Switzerland:	3-month deposits with major banks

Long-term nominal interest rates

United States:	US government notes and bonds (3-5) years
Japan:	Interest-bearing bank debentures (5 years)
Germany:	Public sector bonds on the secondary market (3-7 years)
France:	Public and semi-public sector bonds on the secondary market
United Kingdom:	Government bonds (5 years)
Italy:	Average yield to redemption on Treasury bonds (4-6 years)
Canada:	Federal government bonds (3-5 years)
Australia:	Commonwealth government bonds (5 years)
Belgium:	Central government bonds (5 years)
Netherlands:	Central government bonds on the secondary market (5-8 years)
Switzerland:	Confederation bonds on the secondary market

Inflation rates

Price indices

GNP/GDP deflators except for Sweden (CPI). For the recent period, OECD forecasts are used. After converting the quarterly series of price indices into the monthly bases by putting the same monthly figures during the corresponding quarters, all price indices at the time t, P_t, are smoothed by using the 3-month moving average method.

The formulae used for calculating the short-term and long-term inflation rates are as follows:

$$\text{Short-term inflation rate} = 100 \times \left[\left(\frac{P_{t+6}}{P_{t-3}} \right)^{4/3} - 1 \right]$$

$$\text{Long-term inflation rate} = 100 \times \left[\left(\frac{P_{t+24}}{P_t} \right)^{1/2} - 1 \right]$$

For the short-term inflation rate, the formula is equivalent to three-quarter moving average of one-quarter-ahead rate of inflation

Table 2. Significance of long-term real interest rate differential t-statistics

	USA	JAP	GER	UKM	CAN	ASL
	Aoril 1973 – December 1980					
USA						
JAP	8.4					
GER	8.4	***0.9***				
UKM	9.4	16.7	17.8			
CAN	***2.8***	10.8	11.2	6.6		
ASL	***0.3***	7.3	7.1	7.3	***2.0***	
	January 1981 – November 1985					
USA						
JAP	8.1					
GER	9.2	***1.1***				
UKM	***4.1***	***4.0***	5.2			
CAN	***0.9***	9.0	10.1	***4.9***		
ASL	6.9	***1.2***	***2.3***	***2.9***	***7.8***	
	GER	FRA	ITA	NET	BLX	SWI
	April 1973 – December 1980					
GER						
FRA	9.6					
ITA	23.4	13.7				
NET	***4.2***	5.3	18.8			
BLX	***2.5***	7.1	20.8	***1.7***		
SWI	6.9	2.8	16.5	***2.6***	***4.3***	
	January 1981 – November 1985					
GER						
FRA	7.2					
ITA	***4.5***	***2.8***				
NET	5.4	***1.9***	***0.9***			
BLX	8.9	***1.7***	***4.4***	***3.5***		
SWI	17.7	24.9	22.2	23.1	26.6	

a) The following regressions, in which the cross-section and time-series data are pooled, are run in order to obtain the four groups of t-statistics:

$$r_{j,t} = a_o + a_1 d_{j,t}^1 + a_2 d_{j,t}^2 + \ldots a_{n-1} d_{j,t}^{n-1} + e_{j,t}$$

$(j = 1, 2, \ldots, n;\ t = 1, 2, \ldots, T)$

where

$r_{j,t}$ = long-term real interest rates of jth country at time t;

$d_{j,t}^k$ = country dummy which is equal to 1 when $k = j$ and is equal to 0 when $k \neq j$;

$e_{j,t}$ = error term for (j, t) observation.

It can be proved that the constant term, a_0 is equal to the average interest rate of Country n, and that a_i is equal to the average interest rate of Country j. By employing the null hypothesis $(H_0 : a_i = a_j,\ i \neq j)$, the equivalence of mean interest rates among countries can be tested. Italicized figures in the table are less than 5.

b) USA = United States: JAP = Japan; GER = Germany; FRA = France; UKM = United Kingdom; CAN = Canada; ITA = Italy; ASL = Australia; BLX = Belgium-Luxembourg; NET = Netherlands; SWI = Switzerland.

by the OECD Secretariat. Table 2 shows the t-statistics for bilateral difference among national dummy variables in a regression of pooled long-term real interest rates for selected countries. A significant differential between two country dummies indicates that the average real interest rates over the period were significantly different between the two countries. The upper panel is for the mutually independently floating major countries and the lower panel is for the European countries. The t-statistics are calculated for the average real interest rates in two periods; the one for April 1973–December 1980 and the other for January 1981–November 1985. As observed in Section B, exchange controls were more prevalent in the earlier period. Although many of the t-statistics are significant at the 5 per cent level, indicating the existence of significant bilateral real interest rate differentials, the level of significance has declined for a number of the independently floating major countries. In the earlier period, only four t-statistics are less than 5; among the United States, Canada and Australia and between Japan and Germany. In the recent period, the number has increased to eight. The large t-statistics appear only between the United States-Canada region and the Japan-Germany-Australia group.

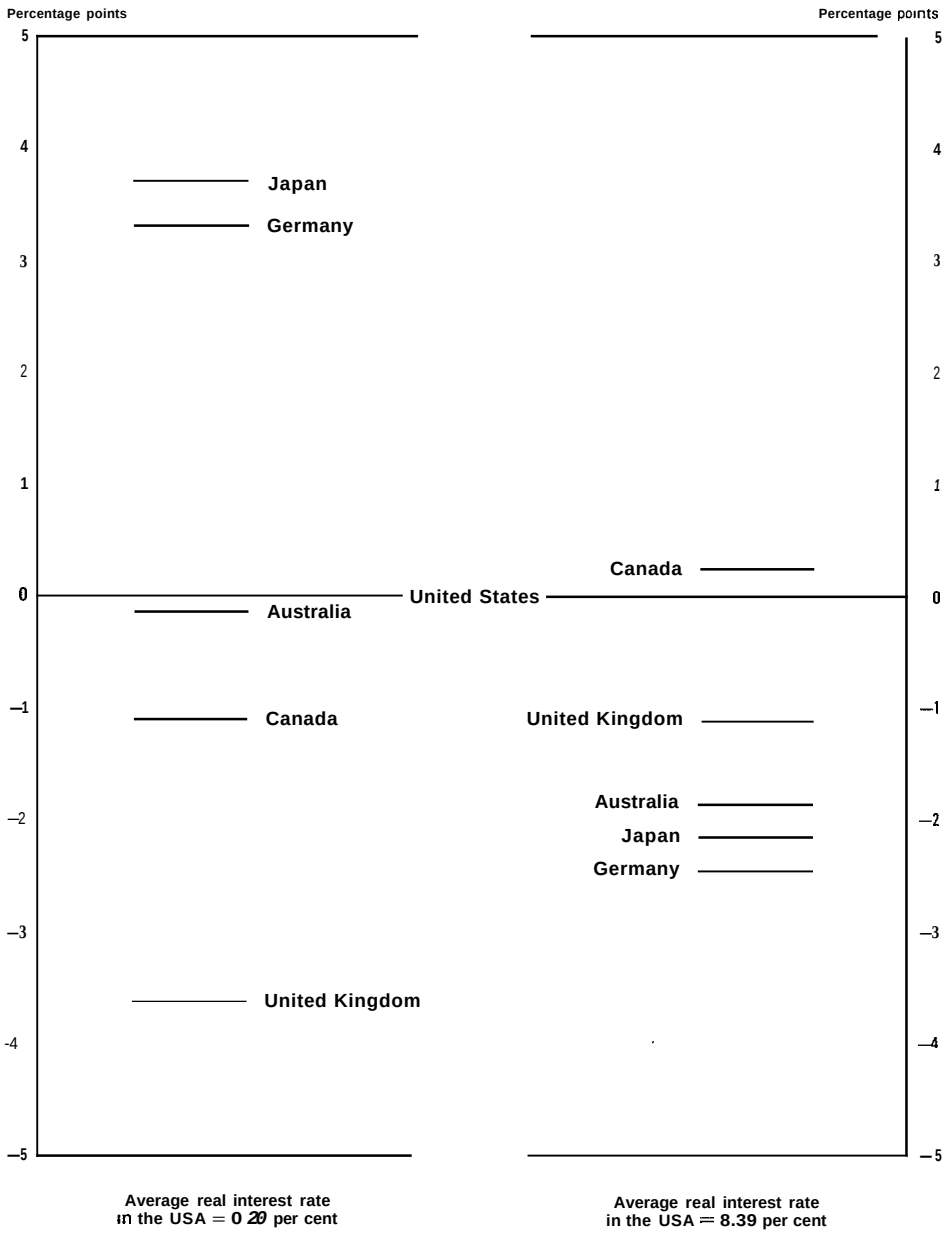
This tendency towards convergence can clearly be seen from Chart D.a. The short horizontal bars in this chart show the average long-term real interest rate differentials of five major countries against the United States. In the recent period, the real interest rate differentials have declined sharply compared with the earlier period. The remaining relatively large differentials between the United States-Canada region and the other five countries have been associated with the large overvaluation of the U.S. dollar in the recent period and the emergence of large net capital flows to the United States. Thus, over time one would expect this differential to narrow, as the dollar overvaluation is corrected and continued capital inflows alter the international allocation of savings.

Regarding European countries, there was a relatively narrow real interest rate differential among countries even in the earlier period except for Italy (see Chart D.b). Especially the real interest rates among former EEC snake countries (Germany, the Netherlands and Belgium) show relatively small differentials*. In the recent period, the real interest rate differentials declined further among France, Italy, the Netherlands and Belgium, although there is a modest differential between this group of countries on the one hand and Germany on the other. Switzerland is a clear outlier among European countries. The real interest rate of this country is significantly lower than the rest of European countries in the recent period.

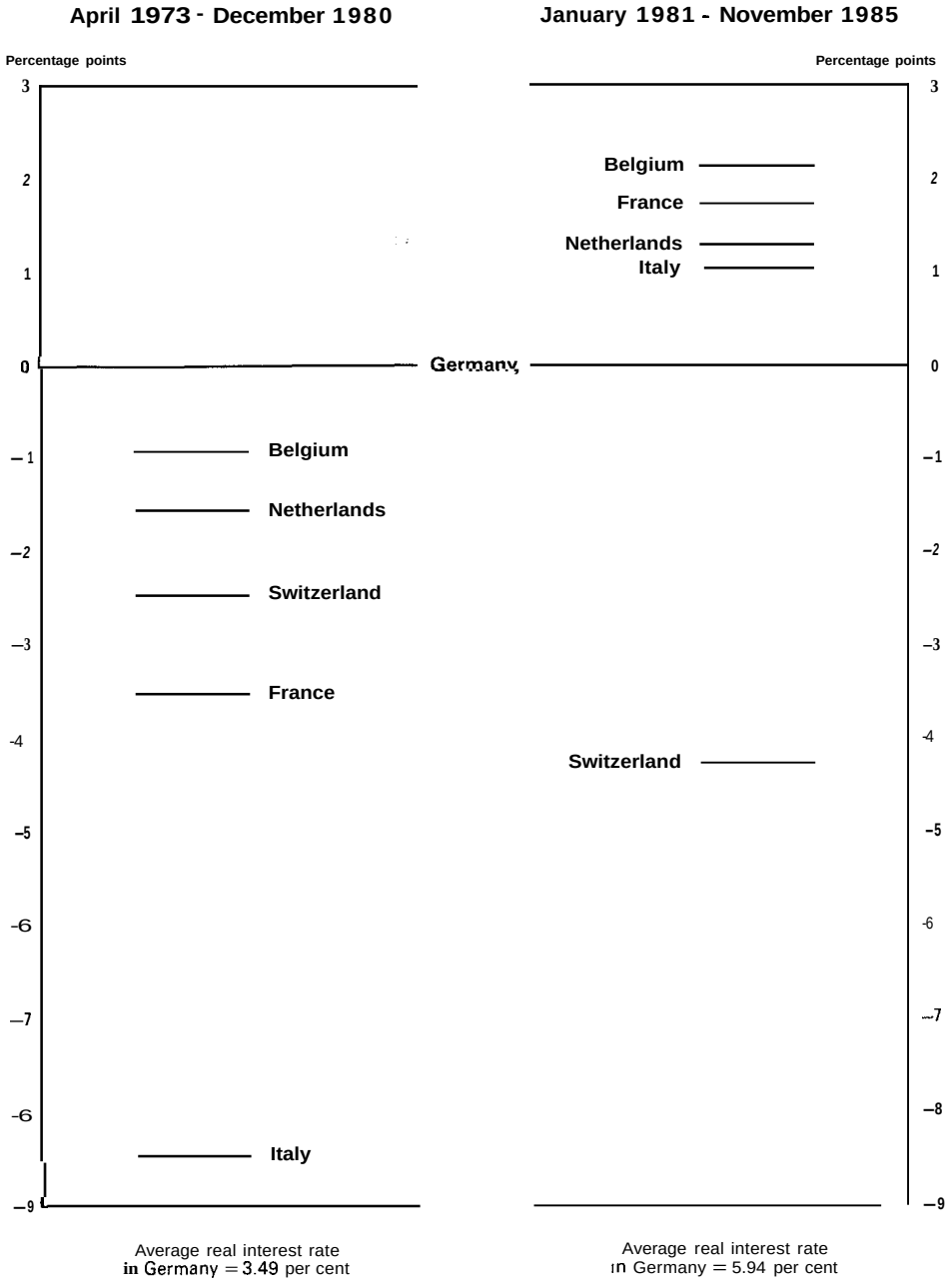
In summary, while interest differentials over the past ten years have often been large, there has been a tendency for real interest rates to converge in the 1980s. The

CHART D a

AVERAGE REAL INTEREST RATE DIFFERENTIAL AGAINST THE USA



AVERAGE REAL INTEREST RATE DIFFERENTIAL AGAINST GERMANY



recent convergence may reflect the fact that inflation has been less volatile in recent years and hence that real interest rates have been easier to define and measure. In any event, it is highly probable that the recent deregulation of exchange controls has led to a greater convergence of real interest rates across countries.

II. TAX SYSTEMS AND THE ALLOCATION OF CAPITAL WHEN FINANCIAL MARKETS ARE INTEGRATED

The section above has shown that real interest rates in OECD countries have had a tendency towards convergence during the recent period of increased internationalisation of financial markets. Provided there were no other distortions, this tendency towards equalisation of real interest rates through international capital movements would improve the global allocation of resources and raise the level of welfare. However, existing tax systems may have unexpected and undesired effects when financial markets are integrated. In this Part, the long-run effects of tax systems on the allocation of capital are analysed with a simple neo-classical framework[g].

The following analysis is limited to the long-run effects of the tax system on the allocation of capital under perfectly-integrated financial markets. It therefore abstracts from other imperfections of the market as well as the dynamic adjustment process. Furthermore, it does not analyse the distorting effects of international financial integration on international resource allocation when there are differences in tax systems. The reasons are twofold. First, it is not the international integration of financial markets per se that distorts international resource allocation. Rather, tax systems might have to make adjustments to the new era of international financial integration, not the other way round. Second, large changes in the tax systems of major OECD countries have actually taken place in the late 1970s and 1980s and more can be expected when financial markets are fully integrated.

A. The effects of tax distortions under integrated financial markets

The effects of tax systems on the international allocation of capital are extremely complicated. This is because differences in personal and corporate tax systems from one country to another, international double taxation and its relief system and so forth all affect investment decisions. First, tax systems affect the destination of direct investment by multinational firms (Boskin and Gale, 1986).

Second, the possible double taxation of investment income affects international portfolio management in bonds and stocks. Third, the corporate and personal tax system of each country affects the investment decisions by the private sector differently even under the same real interest rate.

However, as is explained in Part I, the personal tax system is generally broadly neutral with respect to interest flows arising from international portfolio investment in debt instruments. Since this channel of international capital movement is by far the most important (see Table 1), the analysis in this section will ignore the tax distortions on direct investment and portfolio investment in corporate stocks.

Given that the tax system is neutral for portfolio investment in debt instruments, real interest rates can be presumed to tend to converge across countries, as explained in Part I. However, this tendency towards the equalisation of real interest rates does not necessarily imply the equalisation of the real cost of capital, which is what is necessary for the optimal allocation of capital. The corporate tax system of each country generates a wedge, specific to that country, between the real interest rate and the real cost of capital. The personal income tax also creates an important distortion in the behaviour of households. Different tax treatment of imputed income from owner-occupied housing and interest payments on mortgages can generate a potentially large difference in the real cost of housing, even if real interest rates are equalised internationally.

In the following, the tax wedge between the real interest rate and the real cost of capital for business and housing investment is estimated in order to assess the importance of tax distortions for the international allocation of capital[10].

1. The corporate tax system and the real cost of capital

a) The real cost of capital and its measurement

In analysing the effects of the corporate tax system on the allocation of capital, the concept of real cost of capital is crucial. For a given real interest rate and corporate tax system, there is a minimum pre-tax real rate of return that a firm must earn on an investment project in order to satisfy the holders of financial instruments issued by the firm. This minimum pre-tax rate of return is the real cost of capital, which is similar to the conventional user cost of capital but measured net of depreciation'[1]. In equilibrium, the real cost of capital is equal to the internal rate of return of the marginal project. If the real internal rate of return of the project is higher than the real cost of capital, the firm can make a profit from this project. On the other hand, if the internal rate of return is lower than the cost of capital, the firm would not carry out the project since the return of the project cannot support its financing cost.

The real cost of capital depends not only on the real interest rate but also on the provisions of the tax code on depreciation, deductibility of various costs related to financing the project and so on. Strictly speaking, this cost of capital calculation should incorporate the financial policy of investing firms which involves the optimal selection of financing by borrowing, retention of earnings and new issuance of equity shares. There is no agreed way to do this, however. In principle, after taking account of the risk of bankruptcy, the preference of stockholders and so forth, the real costs of capital from various sources of finance should be equal at the margin. But, in practice, measured costs of capital for debt and equity finance differ by a large amount'[2]. One of the reasons for this is that the measured cost of capital for equity financing depends on the assumed required return on stock investment from the viewpoint of stockholders under a given real interest rate. Thus, the measurement of the cost of equity capital depends on the assumptions regarding the following factors:

i) The degree of risk aversion among investors;
ii) The effective marginal tax rates on dividends and capital gains;
iii) The after-tax return on alternative investments and the after-tax cost of borrowing for investors:
iv) The relationship between the amount of retained earnings and changes in stock prices.

Because of these difficulties in the measurement of cost of capital for equity finance, the analysis is limited to the cost of capital for debt finance, which is more straightforward. Since, as observed above, the cost of capital from various sources should be equal at the margin, the measured cost of debt capital is therefore used as a proxy for the true cost of capital[13].

b) The observed real cost of capital for debt finance

If a firm raises money by issuing debt at the market rate to finance an investment project, the real cost of capital depends on the following factors'[4]:

i) The real interest rate;
ii) The inflation rate;
iii) The "economic" rate of depreciation (i.e. the true rate of depreciation rather than the depreciation allowed by the tax code);
iv) The corporate tax rate;
v) The present value of the depreciation allowance in the tax code accruing to the new investment which is discounted by the nominal interest rate after tax [i.e. (nominal interest rate) x (1 minus the corporate tax rate)]; and

vi) The rate of investment tax credit and/or rate of investment grant.

With no corporate tax system, the real cost of capital is equal to the real interest rate. However, under the corporate tax system, various tax provisions as well as the rate of inflation and the economic rate of depreciation affect the real cost of capital. The difference between the cost of capital and the real interest rate can be called a "tax wedge". Assuming that real interest rates tend to be equalised across countries in the long run, the size of this tax wedge in each country is the focus of interest. If there are significant differences in tax wedges among financially open economies, they will create distortions in the international allocation of capital.

Since, in equilibrium, the real cost of capital is equal to the real internal rate of return of the marginal project, the tax wedge is also relevant to the marginal project. When the real cost of capital is higher than the real interest rate, the tax wedges are said to be positive. In this case, the tax system tends to depress business investment by levying tax on the marginal project over its lifetime. On the other hand, when the real cost of capital is lower than the real interest rate, the tax wedges are said to be negative. If this is the case, the tax system tends to promote investment by providing net subsidies to the marginal project. Since corporate tax systems usually provide net revenue for the government, it might seem peculiar to have negative tax wedges. However, it is possible to give subsidies to marginal projects with the funds raised from the tax on infra-marginal projects[15].

With the parameters estimated for selected OECD countries, the size of tax wedges can be measured under a range of inflation rates and a given real interest rate (see Annex B of Fukao and Hanazaki, 1986 for details). In general, the tax parameters are based on the latest available information at the time of writing (October 1986). Tables 3 to 5 show the size of tax wedges estimated at real interest rates of 3 and 5 per cent for seven major countries and selected smaller countries. Because of the significantly different treatment of investment in machinery and buildings by corporate tax systems in many countries, the relevant tax wedges are shown separately in Tables 3 and 4. Table 5 shows the average size of tax wedges for total business capital aggregated with the estimated weight for each category of capital assets. The United States, the United Kingdom and Canada have recently made major changes in their corporate tax system, so the tax wedges were estimated for both the old and the new systems. For the United States, the old system was in effect until the end of 1985 and the new system is defined by the tax reform bill of 1986. In general, new corporate tax systems will come into effect after July 1987. For the United Kingdom, the old system was in effect before the 1984 budget and the new one has been in full effect since April 1986. For Canada, the old system was in effect before the 1986 budget and the new system will be in full effect after 1989.

As can be seen from these tables, the tax wedges are mostly negative and their size in percentage points becomes larger as the rate of inflation increases at a given real interest rate. This is due to the deductibility of interest payments from taxable corporate income. For a given real interest rate, when the rate of inflation increases the nominal interest rate increases by the same amount. Although the rise in nominal interest rates tends to reduce the present value of an unchanged nominal stream of depreciation allowances, tending to raise the cost of capital, the effect is much more than offset by the increased deduction of interest payments. Therefore, in all cases, the cost of capital is a declining function of the inflation rate.

Regarding tax wedges for machinery (Table 3), the countries which have either a general investment tax credit system [the United States ("old system"), Canada ("old system"), and Spain] or the investment grant system (Belgium, the Netherlands, Sweden) have larger negative tax wedges. The old corporate tax of the United Kingdom, which allowed a 100 per cent write-off in the first year, and Australia's system, which allows firms to write off more than the book value of the investment, also show large negative tax wedges. On the other hand, the other tax

Table 3. The estimated tax wedge for machinery

Percentage points

	Real interest rate							
	3				5			
	Inflation rate				Inflation rate			
	0	5	10	15	0	5	10	15
United States *a)*	–3.25	–4.96	–6.96	–9.19	-4.11	–5.85	–7.86	–10.10
b)	-0.80	–2.34	–4.10	–6.05	–1.29	–2.84	–4.61	–6.56
Japan	-0.70	–2.46	-4.86	–7.78	–1.11	–2.96	–5.42	–8.39
Germany	-0.94	–3.07	–5.79	–9.02	–1.52	–3.72	–6.50	–9.78
France	-0.86	–2.56	–4.55	–6.80	–1.39	–3.11	–5.12	–7.37
United Kingdom *a)*	–1.50	–4.00	–6.50	–9.00	–2.50	–5.00	–7.50	–10.00
b)	-0.74	–2.23	–3.94	–5.84	–1.18	–2.67	–4.38	–6.26
Italy	-0.54	–1.99	–3.99	–6.42	-0.84	–2.35	-4.38	–6.84
Canada *a)*	–2.49	–3.60	–5.36	–7.59	–2.90	–4.12	–5.94	–8.21
b)	-0.43	–1.77	–3.70	–6.05	-0.68	–2.12	-4.10	–6.48
Australia	–5.85	–6.80	–8.04	–9.53	–6.75	–7.72	–8.97	–10.47
Belgium	-4.46	–5.91	–7.48	–9.18	–5.45	–6.89	–8.47	–10.16
Netherlands	–3.58	-4.50	–5.84	–7.51	–4.16	–5.12	–6.48	–8.16
Spain	-4.81	–5.07	–5.84	–6.96	–5.27	–5.62	-6.44	–7.58
Sweden	–6.97	–7.73	–8.96	–10.57	–7.88	–8.70	–9.97	–11.62

a) Old.
b) New.

systems that do not have such incentives for investment tend to have smalier tax wedges [the United States ("new system"), Japan, Germany, France, the United Kingdom ("new system"), Italy, Canada ("new system")].

Table 4. The estimated tax wedge for buildings

Percentage points

	3				5			
	Inflation rate				Inflation rate			
	0	5	10	15	0	5	10	15
United States a)	-0.67	–2.72	–5.58	–9.00	–1.04	–3.20	–6.11	–9.56
b)	0.01	–1.18	–3.40	–6.10	0.20	–1.26	–3.56	–6.28
Japan	–0.09	–2.54	-6.50	–11.22	-0.08	–2.85	–6.91	–11.65
Germany	-0.86	–3.62	–7.51	–12.16	–1.33	-4.26	–8.23	–12.90
France	-0.34	–2.41	-4.97	–7.88	–0.73	–2.85	–5.43	–8.34
United Kingdom a)	1.69	–1.87	–5.49	–9.14	1.15	–2.42	-6.03	–9.69
b)	1.03	–1.03	–3.37	–5.86	0.90	–1.17	–3.51	–5.99
Italy	0.04	–1.65	-4.50	–7.92	0.14	–1.79	-4.72	–8.15
Canada a)	–0.90	–2.72	–5.70	–9.22	–1.04	–3.13	–6.17	–9.70
b)	0.00	–1.97	-4.98	–8.44	0.00	–2.21	–5.27	–8.73
Australia	0.20	–1.57	-4.61	–8.20	0.38	–1.68	–4.80	–8.41
Belgium	–2.26	–3.64	–5.67	–8.12	–2.87	-4.32	–6.37	–8.82
Netherlands	–1.53	–2.73	–5.00	–7.72	–1.70	–3.14	–5.46	–8.19
Spain	–2.19	–2.99	-4.45	–6.18	–2.59	–3.54	–5.02	–6.76
Sweden	–1.86	–3.56	–6.39	–9.91	–2.29	-4.15	–7.04	–10.58

The tax wedges for buildings show a rather different picture (Table 4). Under a low inflation rate, the countries with investment incentives have larger negative tax wedges. Belgium, the Netherlands, Spain and Sweden, which have relatively large investment tax credits or grants, show especially large negative tax wedges. On the other hand, the United Kingdom, which does not allow depreciation for most commercial buildings, shows positive tax wedges. Under a high inflation rate, the countries with high corporate tax rates (Germany and Japan) show larger tax wedges. This is because the income deduction of interest payments tends to reduce the effective interest rates of these countries when inflation is high.

The size of tax wedges for total business capital shows the weighted average effects of the above two components (Table 5). Under a low inflation rate, smaller

Table 5. The estimated tax wedge for total business capital

Percentage points

	3				5			
	Inflation rate				Inflation rate			
	0	5	10	15	0	5	10	15
United States *a)*	–1.43	–3.38	–5.98	–9.05	–1.94	–3.98	–6.63	–9.72
b)	-0.17	–1.52	–3.61	–6.09	-0.24	–1.13	–3.87	–6.36
Japan	-0.28	–2.51	–5.98	–10.12	-0.41	–2.88	–6.44	–10.61
Germany	-0.91	–3.29	-6.50	–10.33	–1.44	–3.94	–7.22	–11.08
France	-0.54	–2.47	-4.81	–1.45	-0.99	–2.96	–5.31	–7.96
United Kingdom *a)*	-0.17	–3.12	–6.08	–9.06	-0.99	–3.93	–6.89	–9.87
b)	0.00	–1.13	–3.71	–5.85	-0.31	–2.05	–4.02	–6.15
Italy	-0.22	–1.80	-4.28	–7.26	-0.29	–2.03	-4.57	–1.58
Canada *a)*	–1.53	–3.01	–5.57	–8.57	–1.71	–3.52	–6.08	–9.11
b)	-0.17	–1.89	–4.47	–1.49	-0.21	–2.17	-4.81	–7.84
Australia	–2.45	–3.86	–6.11	–8.18	–2.74	-4.32	–6.63	–9.31
Belgium	–3.22	-4.63	–6.46	–8.58	-4.00	–5.44	–7.29	–9.41
Netherlands	–2.43	–3.51	–5.37	–1.63	–2.17	–4.00	–5.91	–8.18
Spain	–3.34	–3.90	–5.06	–6.52	–3.16	-4.45	–5.64	–1.12
Sweden	-4.35	–5.59	–7.64	–10.23	–5.01	–6.37	–8.41	–11.08

European countries (Belgium, the Netherlands, Spain, Sweden) and Australia have the largest negative tax wedges, followed by the United States and Canada ("old systems" in both cases). Under a high inflation rate, the countries with high corporate tax rates also show large tax wedges (Germany and Japan).

The tax wedges evaluated under the rate of inflation in 1985 (GNP/GDP deflator) are reported in Table 6. Under a common real interest rate of 5 per cent, there are large international differentials in the cost of capital. The United States' and Canada's new systems and Japan have the highest cost of capital with negative tax wedges of less than 2 percentage points for total business capital. At the other extreme, Sweden, Belgium and Spain have the lowest cost of capital with negative tax wedges of more than 5 per cent. Among major countries, the United States' old system, France and Italy have the largest negative tax wedges. Although the United Kingdom would have the largest negative tax wedge under the old system, the new system has significantly reduced its size. A similar reduction in the tax wedge is observed for the new U.S. system and a less pronounced reduction is observed for

Table 6. **The estimated tax wedge at 5 per cent real interest rate and 1985 inflation rate**

Percentage points

	Machinery	Buildings	Total business capital	Assumed GNP/GDP deflator inflation rate
United States *a)*	–5.26	–2.41	–3.25	3.4
b)	–2.32	-0.68	–1.16	3.4
Japan	–1.67	-0.81	–1.08	1.7
Germany	–2.37	–2.40	–2.38	2.1
France	–3.45	–3.29	–3.35	5.9
United Kingdom *a)*	–5.55	–3.21	–4.58	6.1
b)	–3.03	–1.67	–2.46	6.1
Italy	–3.85	–3.95	–3.91	8.8
Canada *a)*	–3.61	–2.22	–2.77	3.2
b)	–1.53	–1.28	–1.38	3.2
Australia	–7.98	–2.31	-4.78	6.1
Belgium	–6.95	-4.39	–5.51	5.2
Netherlands	-4.52	–2.17	–3.20	2.2
Spain	–6.21	-4.64	–5.32	8.8
Sweden	–9.11	–5.09	–7.05	6.8

a) Old.
b) New.

the new Canadian system. Current tax wedges are about the order of –1 to –4 percentage points among major countries and **–3 to** –7 percentage points among other selected countries in the table.

Although the cost of capital and the tax wedge are useful summary measures of the effect of the tax system, they may still have some limitations. First, they do not allow for the effects of taxes on cash flow. Even if a high corporate tax rate reduces the cost of capital under a high inflation rate, it also adversely affects the current net cash flow of the firm. If the firm regards outside funds as more expensive than retained earnings, the high corporate tax rate discourages investment. Second, it is assumed that the investment tax credit and depreciation allowances can be fully charged to either current tax liabilities or current taxable income. However, once a firm exhausts all its tax liabilities, these investment incentives lose their efficacy. These so-called tax-exhausted firms became important under the old U.K. system. According to an analysis by Devereux and Mayer (1984), almost one half of approximately 4 000 major U.K. firms had progressively exhausted their tax liabilities by 1981. For these effectively tax-exempt firms, the cost of capital was

equal to the real interest rate with no tax wedges by that time. In this regard, many of the U.K. firms had the highest cost of capital among the selected countries even under the old tax system[16].

2. *The personal tax system and the cost of housing investment*

Although less important than corporate investment, housing investment plays an important role as a use of saving. Since the personal tax system affects the financing cost of housing investment, it too can generate a distortion in the allocation of capital. The tax wedge between the real interest rate and the real financing cost of housing investment is estimated in this section.

In addition to the cost of finance, various factors affect the total cost of housing investment. Government policy towards urban planning and land use, regulations on housing construction, and property and wealth taxes all affect housing investment[17]. However, in the following, the analysis concentrates on the relationship between the personal tax system and the financing cost of housing investment in order to provide a quantitative comparison of the real cost of housing investment among selected OECD countries.

First, consider the case where housing investment is entirely financed by borrowing. The basic features of tax systems that affect the borrowing cost of housing investment are:

- Whether the interest payments on mortgages are deductible from taxable income, and if *so,* whether there are limits on the allowed period of deduction or the deductible amount;
- Whether tax credits or subsidised loans by the government are available;
- Whether the imputed income from owner-occupied housing is added to taxable income.

Taking account of these factors, the tax wedges for selected OECD countries have been estimated (see Annex C of Fukao and Hanazaki, 1986 for details).

The estimated tax wedges between the real interest rate and the after-tax real cost of housing investment are shown for the borrowing case in Table 7. Since the United States is going to reduce the marginal tax rate on personal income significantly (the tax reform bill of 1986), the tax wedges are estimated for both the old system and the new system.

As the inflation rate gets higher, the tax wedge becomes larger for the United States ("old" as well as "new" system), the United Kingdom and Sweden due to the deductibility of interest payments. Under a given real interest rate, the deductible interest payments increase as the inflation rate rises. This tends to increase the size

Table 7. The estimated tax wedge for housing

Percentage points

	Real interest rate							
	3				5			
	Inflation rate				Inflation rate			
	0	5	10	15	0	5	10	15
	Borrowing case							
United States *a)*	-0.79	–2.11	–3.43	-4.74	–1.32	–2.64	–3.95	–5.27
b)	-0.45	–1.20	–1.95	–2.70	-0.75	–1.50	–2.25	–3.00
Japan	-0.23	-0.23	-0.23	-0.23	-0.35	-0.35	-0.35	-0.35
Germany	-0.06	-0.11	-0.11	-0.11	-0.15	-0.18	-0.18	-0.18
France	-0.03	–0.09	-0.15	-0.18	-0.10	-0.19	-0.29	-0.29
United Kingdom	-0.71	–1.90	–3.10	-4.29	–1.19	–2.38	–3.57	–4.76
Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Australia	-0.13	-0.33	-0.54	-0.75	-0.33	-0.66	–1.00	–1.33
Sweden	-0.53	–1.86	–3.19	-4.52	–1.06	–2.39	–3.72	–5.05
	«Asset draw down» case							
United States *a)*	-0.79	–2.11	–3.43	-4.74	–1.32	–2.64	–3.95	–5.27
b)	-0.45	–1.20	–1.95	–2.70	-0.75	–1.50	–2.25	–3.00
Japan	-0.42	–1.12	–1.82	–2.52	-0.70	–1.40	–2.10	–2.80
Germany	-0.66	–1.76	–2.86	–3.96	–1.10	–2.20	–3.30	–4.40
France	-0.30	-0.80	–1.30	–1.80	-0.50	–1.00	–1.50	–2.00
United Kingdom	–0.90	–2.40	–3.90	–5.40	–1.50	–3.00	-4.50	–6.00
Canada	-0.88	–2.35	–3.82	–5.29	–1.47	–2.94	-4.41	–5.88
Australia	-0.90	–2.40	–3.90	–5.40	–1.50	–3.00	-4.50	–6.00
Sweden	–1.59	–4.25	–6.91	–9.57	–2.66	–5.32	–7.97	–10.63

a) Old.
b) New.

of negative tax wedges under a high inflation rate in these countries. On the other hand, the tax wedge is insensitive to the rate of inflation and is much smaller in Japan, Germany, France and Australia. This is because the binding upper limit of tax reliefs makes the tax wedge insensitive to the rate of inflation. In addition, the limited duration of tax relief in these countries makes the wedge small. Since there is no tax relief for housing investment in Canada, the tax wedge is always zero and the real financing cost always coincides with the real interest rate.

Second, consider the case where housing investment is entirely financed by drawing down assets (i.e. liquidation of financial assets). In this case, the

opportunity cost of housing investment depends on the marginal tax rates on interest income. In general, the part of nominal income receipts which compensates the anticipated rate of inflation is treated by the tax system in the same way as the real component of nominal interest rates. Therefore, the taxation of interest income tends to reduce the after-tax real yields on financial assets held by households under a high inflation rate. Thus, the opportunity cost of housing investment measured by the after-tax real yield on financial assets would be lower in a country which has a high marginal personal income tax rate and a high inflation rate than in a country which has a low tax rate and a low inflation rate.

The "asset draw down" case shown in Table 7 indicates the estimated tax wedges between the real interest rate and the after tax real interest rate (i.e. the opportunity cost of housing investment) at real interest rates of 3 and 5 per cent[18]. Sweden, the United Kingdom, Australia, Canada and Germany have relatively large tax wedges at a high inflation rate due to higher marginal income tax rates. In contrast, Japan and France have relatively low tax wedges. In the United States, the size of its tax wedge has declined significantly with the tax reform bill of 1986.

The estimated tax wedges at 5 per cent real interest rate for an average production worker are shown in Table 8. These figures are calculated at the actual GNP/GDP deflator inflation rates in 1985. In the case of borrowing, the tax wedges are between –2 and **–3** per cent for the United Kingdom and Sweden, the large negative tax wedge countries. Although the old tax system of the United States belongs to this group, the new system reduces the tax wedge considerably. On the

Table 8. **The estimated tax wedge for housing investment at 5 per cent real interest rate and 1985 inflation rate**

Percentage points

	Tax wedges		Assumed GNP/GDP deflator inflation rate
	Borrowing case	Asset draw down case	
United States a)	–2.21	–2.21	3.4
b)	–1.26	–1.26	3.4
Japan	-0.35	-0.94	1.7
Germany	**-0.18**	–1.56	2.1
France	-0.21	–1.09	5.9
United Kingdom	–2.64	–3.33	6.1
Canada	0.0	–2.41	3.2
Australia	-0.74	–3.33	6.1
Sweden	–2.87	–6.27	6.8

other hand, for Japan, Germany, France and Australia, the tax wedges are generally small in size and for Canada it is zero. The absolute value of the difference in the tax wedge between the two groups is around 2 per cent at the real interest rate of 5 per cent. The tax wedges for the "asset draw down" case are also shown in the table. In most countries except the United States, the upper binding limits of tax reliefs for borrowing cause the tax wedges for the asset draw down case to be higher than those for the borrowing case. The tax wedges differ considerably between the two cases, especially in Germany, Canada, Australia and Sweden.

B. The tax system and the allocation of capital in the long run

As seen above, the current corporate and personal tax systems create tax wedges between real interest rates and the real cost of capital that are significantly different from one country to another. Given these tax distortions, some of the expected resource-allocation benefits of integrated financial markets may not be realised. Distortions to the incentive to invest resulting from different tax systems might even be such that increased integration of financial markets could worsen the allocation of capital. In that case, achieving a better allocation of capital would require international moves to eliminate tax distortions as well as barriers to capital movements. This section measures the long-run effects of the interaction between financial integration and the tax wedges created by the corporate tax system.

If a country is small and open, the world real interest rate can be assumed to be given. However, if a country has a large and open economy, its policy affects the world real interest rate. In the following analysis, the effects of tax wedges are estimated first under the small country assumption, and then under the large country assumption by allowing for changes in the world real interest rate. Comparison of the two results indicates the size of the feedback effect through the increase in the world real interest rate.

1. The effects of tax wedges under the small country assumption

Under the small country assumption, the real interest rate is considered to be given to the economy. The real cost of capital for business investment is then determined by the following three factors: the parameters of the corporate tax system, the exogenous real interest rate, and the trend inflation rate (A. 1.b. of this Part). In the long run, the capital stock for production is determined by the marginal product of capital schedule and the real cost of capital. If the real cost of capital is reduced by the introduction of a tax incentive for investment or by an increase in the trend inflation rate, the demand for real capital will increase. Under the given real

interest rate and given labour supply, the external net asset position of the economy will deteriorate by the amount of the increased capital stock, because the accumulated domestic saving (i.e. the consolidated net worth of the economy) would not be affected under an unchanged real interest rate. In other words, the increased capital stock is financed by foreign borrowing (or by a reduction in external assets).

The long-run relationship between the real cost of capital and the demand for real capital by the corporate sector can be estimated using the production functions for the seven major countries in the OECD Secretariat's INTERLINK model[19]. Since the production functions have three factors (labour, capital and energy) and one output, the estimate is of the effect of a one percentage point reduction in the real cost of capital on the demand for capital stock under given labour supply and given real energy cost (see Annex D of Fukao and Hanazaki, **1986** for details). This **1** percentage point reduction in the real cost of capital corresponds broadly to the introduction of a 4 per cent tax credit for all business investment or of a **3** to 4 percentage point increase in the trend inflation rate.

The results of the simulations are shown in Table **9.** In the case of the United States, a 1 percentage point decline in the real cost of capital increases the demand for capital stock by about **$365** billion (**1985** value). This is about 7 per cent of the U.S. business capital stock and over **9** per cent of the U.S. GNP in 1985. Although this amount might seem large, it is to be interpreted as a once-and-for-all change in the demand for capital stock between two steady state equilibria. It should also be noted that the change in the real cost of capital is assumed to be permanent. If the change were regarded as temporary, its effect would be much smaller.

Table 9. The effects of one percentage point decrease in real cost of capital on the demand for capital

	Change in the demand for capital			Elasticity of capital demand against the real user cost of capital
	Relative to business capital stock %	Relative to GNP/GDP %	In $ billion[a]	
United States	6.9	9.2	365	1.49
Japan	7.0	9.8	131	1.02
Germany	10.4	16.4	103	1.41
France	8.1	11.8	61	1.21
United Kingdom	8.4	16.0	73	0.83
Italy	12.5	22.5	80	1.02
Canada	16.8	47.2	157	1.72

a/ In **1985** dollars.

The changes in the demand for capital stock in the seven major countries range from about 7 per cent to nearly 17 per cent of the business capital stock. Since the real user cost of capital is in the range of 9 to 20 per cent, the elasticity of the change in capital to the real user cost is of the order of one, with Canada having the highest elasticity of 1.7 and the United Kingdom the lowest of 0.8. Relative to GNP, the changes in the capital stock are between 9 and 23 per cent except for Canada which has by far the largest, 47 per cent. This high estimate for Canada arises from a large semi-elasticity of capital demand with respect to the change in real capital cost and a large capital/GNP ratio[20].

2. *The effects of tax wedges under the large country assumption*

In order to estimate the effects of changes in the tax wedges for large open countries, some additional assumptions are required. First, when the world real interest rate increases it will affect not only corporate business investment, but also housing investment. However, as there are no reliable estimates available on the elasticity of demand for housing stock with respect to the real financing cost of housing investment, it is assumed that the stock of housing is not affected by the change in the world real interest rate. Second, when there is an increase in the real interest rate, some increase in saving is likely to occur. However, since many empirical studies have been unable to detect significant effects of real interest rates on savings, it is assumed that the accumulated world saving is not affected by the change in the real interest rate. Third, when there is an increase in the demand for capital by a large country, the real energy cost would also be affected. Here again, it is assumed that the real energy price would be kept constant. Finally, it is assumed that the financial markets of the OECD countries are perfectly integrated while the net saving of the rest of the world is exogenously determined. Under these assumptions, the total capital stock of the OECD corporate sector would not change, although an individual country could attract capital from other OECD countries.

The relationships between the real interest rate and the demand for capital of each country can be derived from the estimated real cost of capital function, which relates the real cost of capital to the real interest rate, and the estimated relationships between the capital demand and the real cost of capital in Table 9. By aggregating the capital demand schedule of each country, it is possible to derive the relationship between the world demand for capital and the world real interest rate. Using this relationship, the effects of changes in tax wedges on the world real interest rate and the external asset position of each country can be estimated (see Annex D of Fukao and Hanazaki, 1986 for details). Table 10 summarizes the results

Table 10. The effects of tax incentives equivalent to a one percentage point cut in the real cost of capital

Stimulating country	USA	JAP	GER	FRA	UKM	ITA	CAN
Increase in world real interest rate (Percentage point)	0.41	0.15	0.12	0.07	0.08	0.09	0.18
Effects on external asset position (1985 US$ billion)							
USA	−256	39	31	18	22	24	47
JAP	48	−114	14	8	10	11	21
GER	30	11	−95	5	6	7	13
FRA	19	7	5	−57	4	4	8
UKM	25	9	7	4	−68	6	11
ITA	29	10	8	5	6	−74	12
CAN	52	19	15	9	10	11	−134
ROW	52	19	15	9	10	11	22
Reference							
Increase in domestic real interest rate when financial markets are segmented (Percentage point)	1.37	1.11	1.39	1.30	1.18	1.15	1.23
GNP share in 1985 (%)	45.8	15.3	7.2	5.9	5.2	4.1	3.8

a) USA = United States; JAP = Japan, GER = Germany; FRA = France; UKM = United Kingdom, CAN = Canada; ITA = Italy; ROW = Rest of world.

of this simulation. If the United States introduced a tax measure equivalent to a cut in the real cost of capital by 1 percentage point at any level of the real interest rate, the world real interest rate would rise by 0.41 percentage points. The net external asset position of the United States would decline by about $260 billion (1985 value), while the rest of the countries would improve their positions. The dampening effect of the induced increase in the world real interest rate can be observed by comparing this result with that of Table 9, which showed a decline of about $370 billion under an unchanged world real interest rate.

For the other major countries, the effects of changes in tax wedges on the world real interest rate are much smaller: from 0.07 to 0.18 percentage points. This difference reflects the GNP share of the United States in the OECD total (46 per cent). Even the second largest economy, Japan, has only 15 per cent of the total OECD GNP followed by Germany's 7 per cent. However, because of the large absolute value of the change in the net external asset position, the size of induced capital movements is still significant for the other major countries.

The above results indicate that the recent tax reform in the United States might exert a favourable effect on the world real interest rate. As shown in Table 6, this tax reform would reduce the tax wedge by about 2 percentage points. Consequently, the world real interest rate would decline by about 0.8 percentage points. However, given the assumptions made in these calculations, this result as well as the numbers in Tables 9 and 10 should be regarded as no more than a rough indication of the order of magnitude of the possible effects.

C. Cost of tax distortions

As indicated in the previous section, tax wedges may create a large international reallocation or misallocation of capital with an integrated financial market. When a country adopts a tax incentive for investment, it can raise output temporarily with increased investment. However, in the long run, the marginal product of capital of the tax-induced investments cannot cover the true costs of finance. With capital highly mobile, the introduction of the tax incentive tends to worsen the external asset position of this country. Since the opportunity cost of tax-induced investment is the world real interest rate, there would be a loss of net national product equal to the difference between the world real interest rate and the internal rate of return of the marginal investment project. This loss of output inevitably involves a reduction of national welfare[21].

The size of the loss of output can be calculated from the estimated elasticity of capital movements. Suppose that a small country introduces a tax incentive for investment which is equivalent to a 2 percentage point reduction in the real cost of capital at any real interest rate. This is roughly equal to an introduction of an 8 per cent investment tax credit for all investment. As we have seen in Table 9, this tax incentive increases the capital stock by about 20 to 40 per cent of GNP in the long run, implying increases in capital stock/GNP ratios of about 14 to 25 per cent (excluding Canada). If there are no other distortions at the beginning, the loss of output can be calculated as follows:

(Loss of output) = (Change in capital stock) x (Size of tax wedge)/2.

The division by 2 is due to the fact that the average difference between the real interest rate and the marginal product of capital schedule is about one half of the tax wedge at the margin. Therefore, the size of loss of output from this policy is about 0.2 to 0.4 per cent of GNP.

Although this output cost appears to be small compared with the size of capital movement, the size of tax wedges becomes extremely large under high rate of

inflation. Under a 10 per cent trend inflation rate, the size of the tax wedge is about 4 to 8 per cent for total business capital (see Table 5). In this case, the size of output loss could exceed 1 per cent of GNP.

CONCLUSIONS

The liberalisation of international financial transactions in most major OECD countries has given rise to a highly-integrated international capital market. The removal of capital controls has made it possible to observe a close convergence of Euro and domestic interest rates on some of the major currencies, including the U.S. dollar, the yen, the Deutschemark, the pound and the Canadian dollar. Theoretically speaking, increased integration of financial markets also tends to bring about a convergence of real interest rates across financially open countries, especially at the long end of the term structure. As real interest rates are not unambiguously defined, the extent of this convergence is more difficult to assess. However, the evidence in Part I indicates that there has been a tendency for real interest rates to converge in the 1980s.

International integration of financial markets has important implications for the international allocation of capital. Provided there are no other distortions, the tendency towards convergence of real interest rates through international capital movements should improve the allocation of resources and raise the level of welfare. However, the corporate and personal tax system of each country generate wedges specific to that country between real interest rates and the real after-tax cost of capital for corporate and housing investment. Since tax systems are usually not indexed to prices, these tax wedges depend not only on tax parameters but also on the rate of inflation. The estimates in Part II show that the countries with tax incentives for investment and/or with high inflation tend to have wide tax wedges. Therefore, even if real interest rates were equalized across countries, real costs of capital would differ significantly among them, thus generating a distorted allocation of capital.

According to the simulation presented in Part II, the potential magnitude of the misallocation of capital by these distortions can be very large under integrated financial markets. A change in the after-tax costs of capital by 1 percentage point can change the capital stock of the business sector by 7 to 13 per cent in the long run. Since 2 to 3 percentage point differences are observed among the estimated tax wedges of the corporate tax system, existing tax distortions could generate a

large imbalance in the net external asset position involving a significant welfare cost. In this regard, recent tax reforms, especially by the United States (1986), the United Kingdom (1984 budget) and Canada (1986 budget), are important steps towards a more harmonized corporate tax system and a more efficient allocation of capital across countries. However, even if corporate tax systems were harmonized, the size of tax wedges would still depend on the trend rate of inflation unless the tax system was fully indexed. Therefore, lower and stable inflation rates would be another important necessary condition for the efficient allocation of capital under integrated financial markets.

NOTES

1 Here, we consider the case in which foreign asset holdings are not covered by forward contracts. Although it is always possible for each investor to hedge his exchange risk with forward markets, it is not possible for all the investors to hedge their consolidated foreign exchange exposures. See Fukao (1983).

2. Doley and Isard (1980). Claassen and Wyplosz (1982), Ito (1983), Otani and Tiwari (1981), Caramazza *et al.* (1986).

3. See Deutsche Bundesbank (1985) for the history of exchange controls in Germany.

4. See Economic Planning Agency of Japan (1984) for the history of exchange controls in Japan.

5. The United States, Germany and France abolished the withholding tax on government bonds held by foreigners in 1984.

6. Under most tax treaties, the withholding tax is either waved or reduced to 5–15 per cent of the interest income and the tax paid to foreign authorities can be credited against domestic tax liabilities. However, there are a few situations where the international tax system works against foreign investment. For example, tax exempt investors such as U.S. pension funds do not have domestic tax liabilities to credit against foreign tax. See ***International Bureau*** of ***Fiscal Documentation*** (1985) for more details.

7. For various measures of real interest rates, see Atkinson and Chouraqui (1985).

8. Under a perfectly fixed exchange rate system, the nominal interest rates are equalised even in the short run. If this is the case, the two countries have only one currency and the two central banks have no independence in their conduct of monetary policy. In this extreme case, the two countries are in fact a single country from the viewpoint of financial transactions. The equalisation process of real interest rates between the two countries is exactly the same as the process between two regions in a single country. Under an actual adjustable peg system such as the EMS, the nominal interest rates are not equalised in the short run. This divergence of interest rates is due to the allowed margin of movements in the exchange rates and possible future changes in the parity rates. In practice, the past realignments in the EMS mainly reflected the difference in inflation rates among member countries. Because of this, convergence of real interest rates can be observed even among the EMS countries.

9. Although the rough framework of the analysis is explained in Annex B, the details of the estimation of tax wedges and the simulation procedure with the supply block of the INTERLINK system are found in the Annexes of Fukao and Hanazaki (1986) which is available on request from the Department of Economics and Statistics at OECD.

10. Household savings in each country might also respond to tax incentives or disincentives for saving, creating yet another distortion in resource allocation. Although this is a very important issue, it is not taken account of explicitly in the following analysis. This is because the saving rate is usually regarded as relatively insensitive to a change in real interest rates. See Sturm (1983) for a recent survey on this matter.

11. For the concept of the cost of capital, see Auerbach (1983) and King and Fullerton (1984).

12. McKee et a/. (1986) and King and Fullerton (1984) report estimated tax wedges for various sources of funds for corporate investment. They show a significant difference in the cost of capital between debt finance and equity finance.

13. In a so-called Miller equilibrium, the cost of debt finance is equal to the true marginal cost of capital, (Miller, 1977). However, in other models, the true cost of capital depends not only on the cost of debt finance but also on the cost of equity finance. See Auerbach (1983).

14. See Fukao and Hanazaki (1986), Annex B or Chapter 2 of King and Fullerton (1984).

15. For example, investment tax credits are subsidies to new capital goods financed by the tax on the existing capital. Since the actual corporate tax system is a mixture of levies, not only on the physical capital but also on the monopoly rents, managerial skills and so forth, it can generate tax revenues and stimulate marginal investments at the same time. To the extent that the corporate tax system is a levy on managerial skills, it also distorts the international allocation of this factor. While the cost of capital, which is a marginal concept, is relevant to the allocation of physical capital, the average tax would be more relevant to that of managerial skills. Although this is potentially an important problem, it is not analysed here. This is because direct investments are still much less important than the flows of debt instruments (see Table 1).

16. For the United States, tax-exhausted firms are not so important. Auerbach and Poterba (1986) report that firms which had tax losses to carry over accounted for less than 3 per cent of the market value of the non-financial corporate sector in 1984.

17. As can be seen in in Annex C of Fukao and Hanazaki (1986) or McKee et al. (1986), the property and wealth tax rates are readily observable. However, the estimated value of housing for taxation often differs very much from its actual market value. Since information on this matter was unobtainable for many countries, no account has been taken of these taxes in the following analysis.

18. In this analysis, favourable tax treatments for savings such as tax-exemption of interest income on small savings in Japan are not taken into account.

19. Another way to estimate the relationship between the cost of capital and the demand for capital is to use an estimated investment function with a user cost of capital. There are numerous articles on this relationship. Jorgenson (1963) introduced the neoclassical model for the analysis of taxation's effects on investment. Hall and Jorgenson (1967, 1969, 1971) extended the analysis. Since these analyses are only concerned with the transitory effects of tax policy on the flow of investment, we do not use this method here.

20. The capital/GNP ratio of Canada (accumulated business investment minus accumulated scrapping) is 2.8 in 1985. This is much higher than the other major countries which have

ratios in a range of 1.3–1.9. This high capital/GNP ratio is often attributed to the high weights of resource-based and transportation sectors in the Canadian economy, since these sectors tend to have a high capital intensity and to use long-lived capital. The longevity of capital in Canada means that adjustment takes place more slowly than in other countries. Therefore, even if the estimated long-run change in Canadian capital stock is larger than that of some of the larger countries, it does not necessarily mean that the short-run change is larger.

21. In this analysis, it is assumed that the capital movement takes the form of international borrowing by this country. However, if the capital movement takes the form of direct investment from abroad, it is necessary to take account of the corporate tax revenue of this country on the direct investment. This tends to reduce the welfare loss by this country, although the net welfare loss of the world economy remains the same.

Annex A

EQUALISATION OF REAL INTEREST RATES UNDER HIGH CAPITAL MOBILITY

1. Arbitrage condition in the integrated financial markei

Theoretically speaking, there are two aspects to the international integration of financial markets; international capital mobility and substitutability among assets denominated in different currencies. Mobility refers to the ease of shifting funds between financial centres. Substitutability refers to the ease of switching between different denominations of assets in a given market (i.e. the "depth" of the market).

There has been a marked increase in the *mobility* of capital, and the increased ease with which funds may be transferred across borders is clearly evident in reduced differentials between Euro- and domestic interest rates (see Part I.B). On the other hand, the degree of substitutability among assets depends on various factors. It first depends on the level of uncertainty and risks in the financial market. If the variability of exchange rates is expected to be high, uncovered holding of foreign currency assets becomes very risky. Under this condition, domestic and foreign assets would become less substitutable. However, if the exchange rate between two currencies is expected to be stable, financial assets denominated in these two currencies would become good substitutes. The degree of substitutability depends also on the level of liberalisation in financial markets. If financial transactions among countries are heavily regulated, the number of participants in a given market would be small. This would make it difficult for each participant to buy or sell a large amount of assets without affecting prevailing market prices. Therefore, the liberalisation of financial markets is also expected to increase the substitutability among assets denominated in different currencies.

Under a floating exchange rate system, it is obvious that the assets denominated in different currencies are, ***a priori,*** imperfect substitutes due to exchange rate risk. However, if there are a large number of participants in a market who are willing to bear a large amount of risk (i.e. the degree of risk aversion is low) the substitutability among financial assets traded in this market would be high. At the extreme, the assets denominated in different currencies become ***perfect substitutes*** if one can make a large amount of transactions in this market without changing the market prices at all. If this is the case, investors arbitrage away any differentials in expected returns, so that speculation forces equality on expected yields on assets of different currency denominations; i.e. there are no currency risk premiums.

Empirical tests of substitutability necessarily have to specify a process by which expectations are formed. Usually the most convenient assumption is rational expectations (or, for most

purposes, "efficient markets"). However, the joint hypothesis of rational expectations and no risk premiums has been rejected in recent tests'. Therefore, either expectations are irrational or assets are imperfect substitutes, and this is a subject with arguments on both sides. If investors are risk-averse and wish to diversify their portfolios (hence do not entirely arbitrage away expected return differentials), there could be risk premiums and differences in expected returns. Empirical variables, such as a proxy for the supplies of outside assets that have to be held in investors' portfolios, explain little of those "risk premiums", although related magnitudes such as cumulative current account imbalances are sometimes significant[2]. In particular, *ex post* uncovered yield differentials, adjusted for movements in future spot exchange rates, appear to be insensitive to changes in outstanding asset stocks. Thus, for the purposes of the present discussion the important point is that the evidence does not contradict the very high substitutability among assets denominated in different currencies[3]. Therefore, this Annex shows the relationship between domestic and foreign real interest rates under perfect capital mobility and perfect asset substitutability[4]. In particular, long-term real interest rates are shown to be equalised among countries even in the short run if the real exchange rate is expected to converge to a long-run equilibrium level.

Symbols:

- i_s = The domestic instantaneous nominal interest rate at time s.
- π_s = The domestic instantaneous inflation rate at time s.
- r_s = The domestic instantaneous real interest rate at time s.
- p_s = The general price level of the domestic economy at time s.
- x_s = The expected instantaneous rate of appreciation of the nominal exchange rate at time s (price of the foreign currency in terms of the domestic currency).
- e_s = The nominal exchange rate expressed in the domestic currency.
- y_s = The expected instantaneous rate of appreciation of the real exchange rate at time s.
- g_s = The real exchange rate at time s.
- (*) Denotes foreign variables; all variables are expressed in natural logarithms.

Under perfectly-integrated financial markets, the expected nominal returns on domestic and foreign bonds would be equalized. The following instantaneous arbitrage condition will hold:

$$i_s = i_s^* + x_s \qquad [1]$$

From the definition of the real exchange rate, we have:

$$g_s = e_s + p_s^* - p_s \qquad [2]$$

By differentiating the above equation with respect to time, we can obtain the following expression for x_s:

$$x_s = y_s + \pi_s - \pi_s^* \qquad [3]$$

By replacing x_s in equation [1] with the right hand side of [3], we have:

$$(i_s - \pi_s) = (i_s^* - \pi_s^*) + y_s \qquad [4]$$

By the definition of real interest rates, r_s, r^*_s, we have the following arbitrage condition expressed in real variables:

$$r_s = r^*_s + y_s \qquad [5]$$

This equation shows that the domestic real interest rate, r_s, is equal to the foreign real interest rate, r^*_s, plus the expected change in the real exchange rate y_s.

By integrating both sides of equation [5] from time zero to infinity and rearranging terms, we have

$$\int_o^\infty y_s ds = \int_o^\infty (r_s - r^*_s)\, ds. \qquad [6]$$

The left-hand side of this equation can be expressed as $(\bar{g} - g_o)$, if the real exchange rate is expected to converge to a finite number $\bar{g}$. Thus, the current real exchange rate g_o can be expressed as follows:

$$g_o = \bar{g} + \int_o^\infty (r^*_s - r_s)\, ds. \qquad [7]$$

This equation shows that the current real exchange rate, g_o, diverges from the equilibrium rate, $\bar{g}$, by the area between the domestic and foreign expected future real interest rates,

$$\int_o^\infty (r^*_s - r_s)\, ds.$$

Since equation [7] is expressed in terms of instantaneous real interest rates, we can transform it in terms of the term structure of interest rates and the real exchange rate. Let $R_o(T)$ and $R^*_o(T)$ be the domestic and foreign real interest rates for maturity of T years at time zero. If domestic arbitrage between the instantaneous interest rate and the interest rate with a finite maturity is perfect, the following arbitrage condition holds[5]:

$$R_o(T) = 1/T \int_o^T r_s\, ds. \qquad [8]$$

By integrating [6] from time zero to T, we have

$$g_o = g_T + \int_o^T (r^*_s - r_s)\, ds.$$
$$= g_T + T[R^*_o(T) - R_o(T)].$$

By rearranging terms, we have

$$R_o(T) = R^*_o(T) + (g_T - g_o)/T \qquad [9]$$

This equation shows that the real interest rates of domestic and foreign countries with maturity T can diverge by the expected rate of real appreciation during the period between the present and the date of maturity. If the expected future real exchange rate, g_T, does not diverge from g_o as T gets larger, the real interest rate differential between domestic and foreign bonds declines as the maturity lengthens.

2. Published empirical studies

The question of whether real interest rates are equalised or at least move together in different countries has been widely investigated in recent years. Studies on this issue involve a joint test of a PPP condition and of a hypothesis about the formation of expectations of inflation, as well as of

asset substitutability. If real interest rate equality does not hold, it cannot be inferred that financial markets are not closely integrated, in the sense of having high mobility and substitutability. On the other hand, these tests do relate directly to the basic policy question of how much scope there might be for independent movements of real interest rates.

Much of the emphasis in the tests has been on short-term real interest rates. Mishkin (1984a, 1984b) analysed movements in short-term rates (3-month Euro-rates) over the period 1967-79 and rejected the hypotheses of equality and of collinearity of real rates. Similar results were obtained even when estimation was confined to the period of floating exchange rates, i.e. post-1973. Cumby and Obstfeld (1982) carried out bilateral tests of equality of short-term rates for six countries for the period 1976-81 and also rejected the hypotheses. Mark (1985) obtained similar results for tax adjusted interest rates. Caramazza ***et al.*** (1986) replicate the findings that ***ex ante*** real interest differentials have been sizeable for lengthy periods and suggest that there has been no more tendency towards equality in the first half of the 1980s than in the 1970s. However, more recent work by Cumby and Mishkin (1986) for the period 1973-83 found a positive association between movements in U.S. short-term real rates and those in other countries. In two cases (France using Euro-rates and Canada using domestic money market rates) it was not possible to reject the hypotheses of equality, while for Canada and the United Kingdom (in both Euro- and domestic markets) the hypothesis of full linkage to U.S. rates could not be rejected. Important linkages were also established for the Netherlands, France and West Germany; Switzerland was the only country where the link was found to be weak.

Less attention has been paid to the question of equality of long-term real interest rates at least partly because such rates are difficult to measure either ***ex ante*** or ***ex post.*** Boothe ***et al.*** (1985) estimated equations for the nominal Canadian bond rate that included the U.S. long-term bond rate, but no measure of the inflation differential between Canada and the United States was taken into account. They obtained a coefficient on the U.S. long-term rate close to unity, especially for very long maturities, indicating the close link between Canadian and U.S. ***nominal*** long-term rates. Fukao and Okubo (1984) performed a similar study for Japan, but with the inclusion of a one-year-ahead inflation differential to capture expected nominal exchange rate appreciation. They obtained significant results, but only after the estimation period was extended to include the period since the liberalisation of foreign exchange regulations in Japan. They concluded that a change in the expected rate of return on dollar assets of 1 per cent would give rise to a change in the domestic long-term yen interest rate (either nominal or real) of from 0.2 to 0.3 per cent. A recent study by the Economic Planning Agency (1984) obtained similar results for Japan since liberalisation, and stronger results for Germany (a cumulative three-month impact of nearly 0.4 per cent). For the United Kingdom, a strong link was established with the United States after 1979.

NOTES

1. See, for example, Hansen and Hodrick (1980). Longworth et ***al.*** (1983) provide a series of such tests and a survey of the relevant research.
2. See, for example, Frankel (1982), Danker et ***al.*** (1985), Shafer and Loopesko (1983), and Tryon (1983). New tests by Caramazza et ***al.*** (1986) confirm the lack of success of empirical risk proxies Bilson (1981), Frankel (1986) and Hodrick and Srivastava (1984) discuss this point theoretically. For an example of an explicit risk premium variable, see Fukao (1985).
3. It might be noted that Feldstein, who had seen much immobility in international capital markets (Feldstein, 1983). later recognized a much higher degree of mobility (Feldstein et ***al.,*** 1984). The experience of the United States in attracting huge volumes of capital in the 1980s constitutes important new evidence in favour of high substitutability (Sachs, 1985)
4. The following analysis owes much to the papers by Porter (1971), Dufey and Giddy (1978) and Isard (1982)
5. Strictly speaking, this equation is valid only for zero-coupon bonds. Although this equation is not precise for ordinary bonds, this is often used as an approximation for empirical analysis

Annex B

A NEO-CLASSICAL ANALYSIS OF THE ALLOCATION OF CAPITAL

This Annex describes the analytical framework for the international allocation of capital, which is the basis of Part II of the main text'.

Figure B. 1 shows the marginal product of capital schedule (net of depreciation) in a country. Suppose, for instance, that the country is closed financially and there are no distortions caused by the tax system. Then the equilibrium marginal product of capital (net of depreciation in the following analysis) is determined by the existing capital stock, K_o. The real interest rate is equal to this marginal product of capital[2]. The net capital income is equal to the area of rectangle *EBCD*. The

FIGURE B.1

EQUILIBRIUM IN A FINANCIALLY CLOSED ECONOMY

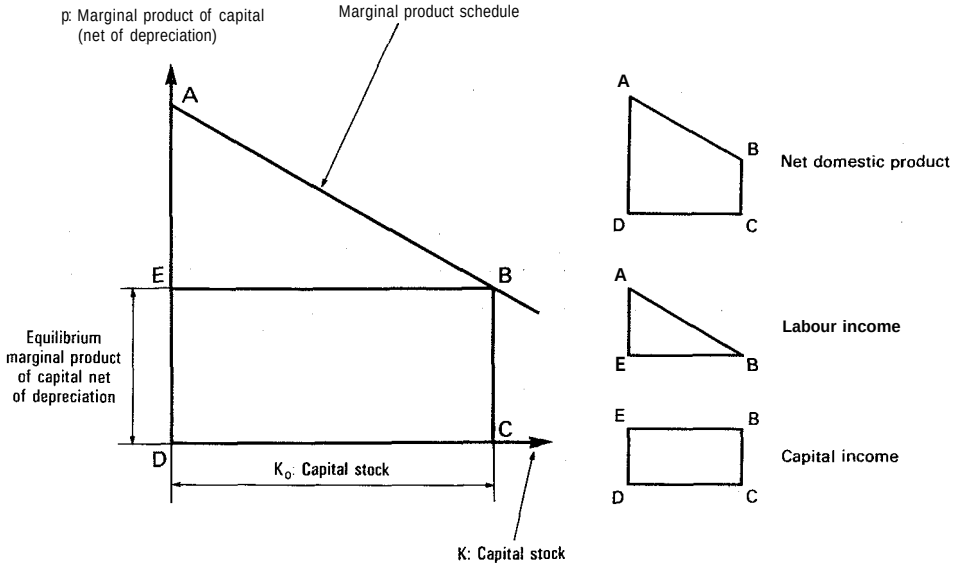
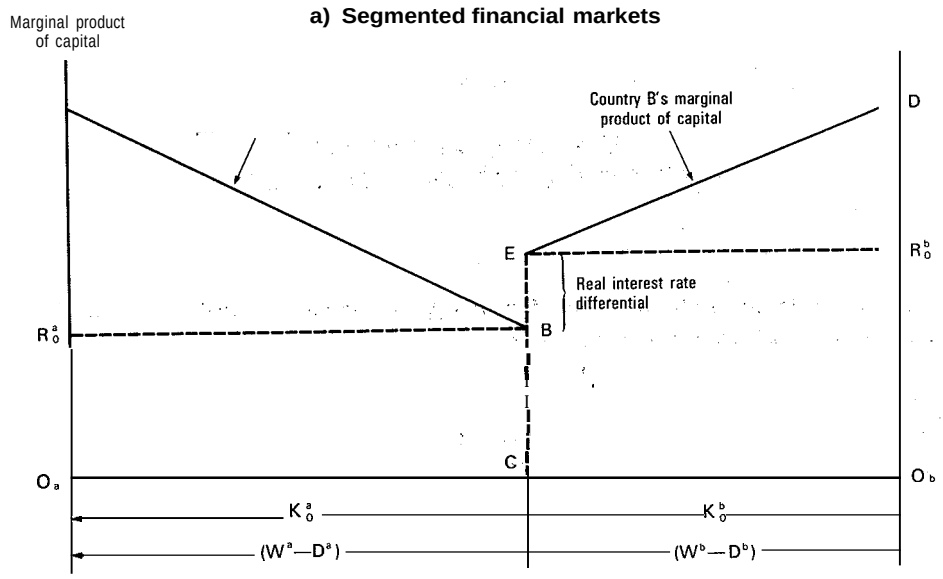
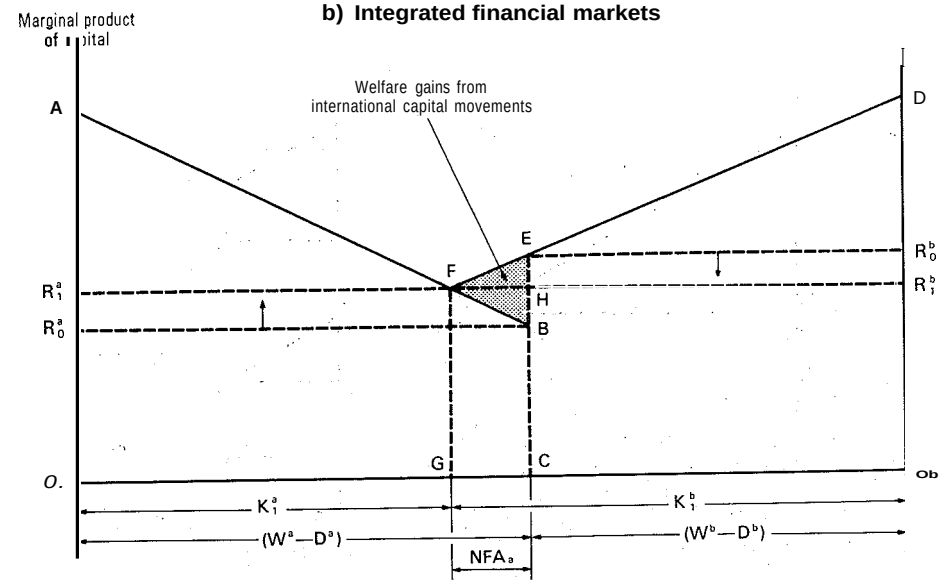


FIGURE 8.2

TWO COUNTRY CASE





net domestic product is the area under the marginal product of capital schedule from *D* to *C* and is equal to the area of trapezoid ***ABCD.*** Therefore, labour income is equal to the area of triangle ***ABE.***

The above analysis can be easily extended to the case of two countries (Figure B.2). The investment-saving balance of an economy, in general, can be expressed as follows:

$$S = I + (G - T) + CB \qquad [1]$$

Where

S = Net saving of the private sector;
I = Net private investment;
G = Government expenditure;
T = Government tax revenue; and
CB = Current account balance.

This equation shows that net saving, S, is equal to the sum of net private investment, ***I,*** the budget deficit, $(G - T)$, and the current account balance, ***CB.*** Integrating the equation over time:

$$W = K + D + NFA \qquad [2]$$

Where

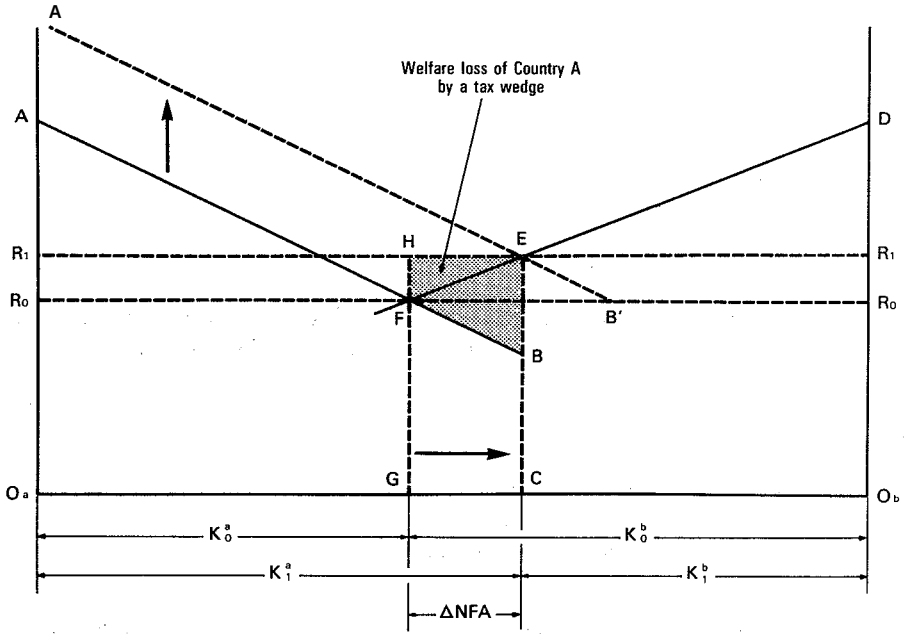
W = Accumulated savings of the private sector;
K = Capital stock of the private sector;
D = Outstanding debt of the government sector; and
NFA = Net foreign assets.

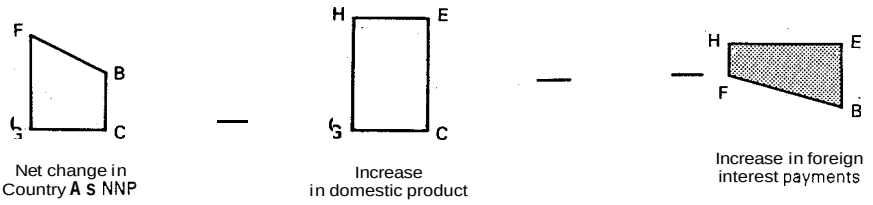
When financial markets of two Countries A and B are segmented by exchange control measures and other factors and the governments are not involved in the finance of balance-of-payments imbalances, current account imbalances cannot emerge. If the current account of the economy has been in balance, there is no net foreign asset and the capital stock, K, is equal to the difference between the accumulated saving, W, and the outstanding government debt, *D.* Under this condition, the domestic saving of each country is used for domestic investment. This situation in the two Countries A and B is shown in the upper panel of Figure B.2. If there are no distortions from the tax system, the real interest rate of each country is equal to its own marginal product of capital. However, because of the segmentation of financial markets, a real interest rate differential between the two countries may persist.

If the two countries relax exchange control measures, capital will begin to flow from the low real interest rate country to the high real interest rate country. If the real interest rate of Country B is higher than that of Country A initially, the integration creates an incipient capital flow from Country A to Country B. However, capital cannot move instantaneously. In the short run, this pressure will be absorbed partly by a real depreciation of Country A's currency under the floating rate system. If this real depreciation generates an expectation of future real appreciation of Country A's currency, the real interest rate in Country A can stay lower than that in Country B. At the same time, to the extent that real interest rates do adjust, investment in Country A would be retarded. Through these movements in the real exchange rate and real interest rates, the current account balance of Country A will show a surplus against Country B. This imbalance in the current account will be associated with a capital flow from Country A to Country B, with further

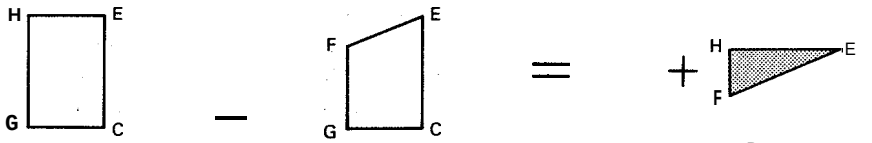
FIGURE B.3

THE TAX WEDGE AND THE ALLOCATION OF CAPITAL





Net change in Country A's NNP — Increase in domestic product — Increase in foreign interest payments



Net change in Country B's NNP — Increase in investment income = Decrease in domestic product

convergence of real interest rates between the two countries over time. It will also reduce over time the extent to which the exchange rate is displaced from its long-run equilibrium real value.

In the long run, the real interest rates of the two countries will tend to be equalised (see the lower panel of Figure B.2). The capital stock of Country A declines from K_0^a to K_1^a by the amount of its net foreign asset, ***NFA$_a$***. Corresponding to this, the capital stock of Country B increases from K_0^b to K_1^b. The real interest rate of Country A increases from R_0^a to R_1^a while that of Country B decreases from R_0^a to R_1^a. The net domestic product of Country A declines from the area of ***ABCO,*** to the area of ***AFGO,***. The net national product of this country is larger than the net domestic product in the new equilibrium by the amount of investment income from abroad, which is equal to the area of ***FHCG.*** Therefore, the net national product of Country A increases by the triangle area of ***FHB.*** On the other hand, the net domestic product of Country B increases from the area of DO_bCE to the area of ***DO$_b$GF,*** increasing by the area of ***ECGF.*** The increase in the net national product is equal to the triangle area of ***EHF*** due to interest payments abroad (the area of ***FHCG).*** The total increase in the world net national product is equal to the shaded area of EBF, which may be regarded as a welfare gain by the two countries. This welfare gain is created by the improved allocation of capital through the international equalisation of the marginal product of capital.

In the meantime, real wage rates would be altered by this reallocation of capital. The movement of capital from Country A to Country B tends to raise the real wage rate of Country B while it tends to lower that of Country A.

However, if there are distortions from the tax system, the welfare loss would be generated. The effect of a tax wedge on the allocation of capital in a hypothetical two-country world is illustrated in Figure B.3. Suppose that there are no tax distortions initially. Then the world real interest rate, R_o, is deterrninated by the intersection of the marginal product of capital schedules (net of depreciation) of the two countries, *F*. The world capital stock is optimally allocated: K_0^a for Country A and K_0^b for Country B. This situation is exactly the same as the optimal equilibrium shown in Figure B.2.

Then, suppose that Country A introduces a tax incentive which raises the tax-adjusted marginal product of capital schedule from AB to A'B'. The intersection of the two marginal product schedules moves from ***F*** to E and the world real interest rises from R_o to R_1. In the long run, the capital stock of Country A increases from K_0^a to K_1^a. Corresponding to this, the capital stock of Country B declines from K_0^b to K_1^b. By this capital movement from Country B to Country A, the net domestic product *(NDP)* of Country A increases by the area of ***FBCG.*** However, since the actual marginal product of capital is lower than the real interest rate, this increase in the *NDP* cannot cover the cost of foreign interest payments, which is equal to the area of ***HECG.*** Thus, Country A's net national product ***(NNP)*** actually declines by the area of ***HEBF.***

On the other hand, the decline of the capital stock in Country B reduces its NDP by the area of ***FECG.*** However, the increased investment income from Country A, which is equal to the area of ***HECG,*** is larger than the loss in NDP. Consequently, the *NNP* of Country B increases by the area of *HEF.* Therefore, for the world economy as a whole, the net output loss is equal to the area of triangle EBF^3.

In the meantime, real wages would also be affected by this reallocation of capital. The movement of capital from Country B to Country A tends to raise the real wage rate of Country A while it tends to lower that of Country B.

NOTES

1. Applications of this neo-classical framework for the question of international factor mobility can be found in MacDougall **(1968)** and Hamada **(1976).**

2. Strictly speaking, the relative price of capital goods and output goods has to be allowed for. In equilibrium:

P_q MPC = $P_i(r + d)$,

Where

P_q = output price;
MPC = gross marginal product of capital;
P_i = capital goods price;
r = real cost of capital which is equal to the market real interest rate under no tax distortions; and
d = economic rate of depreciation.

However, if we choose the unit of measurement of prices appropriately, we can set $P_i = P_q = 1$. Then, we have MPC – d = r. This equation shows that the marginal product of capital net of depreciation is equal to the real interest rate if there are no tax distortions.

3. See note **21** of the main text.

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