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Internationalisation of Financial Markets: Some Implications for Macroeconomic Policy and for the Allocation of Capital

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SOME IMPLICATIONS FOR MACROECONOMIC POLICY
AND FOR THE ALLOCATION OF CAPITAL

by

Mitsuhiro Fukao and Masaharu Hanazaki

Monetary and Fiscal Policy Division
and Growth Studies Division

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This paper analyses the effects of the internationalisation of financial markets on the conduct of macroeconomic policy and the allocation of capital. It first examines the increased integration between domestic and external (or "Euro") financial markets and the recent tendency towards convergence of real interest rates among financially open countries. After briefly touching on the macro policy consequences of financial internationalisation, the paper then deals with long-term implications for the international allocation of capital, with special emphasis on the existence of tax distortions. Using estimated tax wedges for business investment and the supply block of the INTERLINK system, it shows that, under integrated financial markets, the existing tax distortions could generate a large imbalance in the net external asset position which involves a significant welfare cost.

* * * * * *

Ce document analyse les effets de l'internationalisation des marchés financiers sur la conduite de politique économique et la répartition du capital. Il examine tout d'abord l'intégration croissante entre les marchés financiers domestiques et internationaux (ou Euro-marchés), et la tendance récente à la convergence des taux d'intérêt réels entre les pays financièrement ouverts. Après une brève analyse des conséquences de l'internationalisation financière pour la politique économique, ce document examine les implications à long terme de la répartition internationale du capital en insistant sur l'existence de distorsions fiscales. A partir d'estimations des "coins fiscaux" pour l'investissement et à l'aide du bloc d'offre du modèle INTERLINK, ce document montre que, dans le cadre de marchés financiers intégrés, les distorsions existantes dans les systèmes d'imposition peuvent engendrer un large déséquilibre de la position extérieure nette impliquant un coût social significatif.

INTERNATIONALISATION OF FINANCIAL MARKETS: SOME IMPLICATIONS FOR MACROECONOMIC POLICY AND FOR THE ALLOCATION OF CAPITAL

by

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I. INTRODUCTION

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. This development has enhanced capital mobility and substitutability between domestic and foreign bonds. 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 be smaller, although with considerable volatility of these differentials over shorter time periods (especially at the short- and medium-term part of the spectrum). Increased international capital transactions have also strengthened the interaction between real interest rates and real exchange rates with important long- and short-term implications.

These developments raise the question of various 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?

-- How does the internationalisation of financial markets affect the efficacy of macroeconomic policy instruments?

-- To what extent does the increased integration of financial markets improve the international allocation of capital?

-- What are the effects of domestic tax incentives for investment when capital is highly mobile?

Part II provides some historical, theoretical and empirical background, with special attention to the process of convergence of domestic and Euro interest rates and also of real interest rates in recent years. It demonstrates that increasing capital market integration strengthens convergence between domestic and Euro market interest rates. This Part also indicates that internationalisation of capital markets tend to produce convergence of real returns on financial assets across countries through various mechanisms. An important mechanism for the real interest rate convergence is a long-run tendency of exchange rates to fluctuate around 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 through subtracting savings from surplus countries and adding them to deficit countries.

Integration of capital markets has implications for the efficacy of macroeconomic policies in floating exchange rate regimes. If real long-term interest rates are influenced more by the development of the world real

interest rate than in the past, the efficacy of monetary policy in influencing domestic private investment might be reduced. On the other hand, monetary policy may have stronger effects on net exports and prices of tradeable goods. The impact of fiscal policy on real output might also change depending on whether crowding out through interest rates is stronger than crowding out through the exchange rate. The more closely linked are financial markets, the more nearly equalised the real interest rates, the stronger the exchange rate crowding out effects, the stronger the link between fiscal policy changes and current account imbalances together with corresponding capital flows. It should also be noted that the stronger the financial links, the more policy changes in one country effect other countries. This is particularly important in the case of large countries where policy changes may have consequences that are significant in a global context. Part II briefly touches on these macro policy implications of financial internationalisation.

Part III deals with 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, 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 market real interest rates and the real costs of capital. Therefore, even if market real interest rates are equalised across countries, real costs of capital would normally differ significantly among them. The personal income tax also creates an important distortion in the cost of capital for housing investment. Different tax treatment of interest payments on mortgages and imputed income from owner-occupied housing generate differences in the cost of owner-occupied housing, which in some cases are large, even with internationally equalised real interest rates.

This part also shows that tax-induced differences in costs of capital can induce significant movements of capital which are larger as the degree of financial integration increases. When a country adopts a tax incentive for investment, it might be able to raise its output temporarily with increased investments. 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, with 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 high cost of foreign capital.

The above analysis raises the important question whether domestic tax measures 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 call for international harmonization of those aspects of tax systems that relate to investment and saving.

II. INTERNATIONAL INTEGRATION OF FINANCIAL MARKETS

During the past twenty-five 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 multi-national 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 U.S.$16.2 billion (1.5 per cent of area GDP). By 1984, this had increased to U.S.$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.

This Part examines the above process of international integration of financial markets and its effects on interest rates' relationships among 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 of selected OECD countries. Then, in Section C, the recent movements in real interest rates are analyzed. This shows that the process of dismantling barriers and the accompanying rapid expansion of international financial transactions has enhanced the level of integration among financial markets of OECD countries. Section D briefly discusses the implications of these developments for macro-economic policy.

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 the large international difference in technology and other institutional differences, this tendency toward factor price equalisation would be far from perfect in the absence of direct arbitrage among domestic financial markets and flows of funds between them. Therefore, the international integration of financial markets is 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.

Chart II.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 of its issuing country.

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 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. 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.

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. 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).

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 real 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.

Therefore, the integration of financial markets 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 (1). In the absence of restrictions, these two rates should tend to converge as agents could arbitrage between the rates without exchange risks if significant 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 II.2 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 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 differential was in favour of the Euro-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 (2). 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 (3).

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. 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 (in the United States this also applies to Euro-borrowing of domestic banks from abroad). 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 well illustrated by Chart II.3. 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 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 II.1). In proportion to GNP, the gross external assets of the United States, Japan and Germany have reached 24, 28 and 39 per cent respectively (at the end of 1985 for the United States and Japan and June 1984 for Germany). 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 1/4 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 10-12 per cent.

In summary, by the early 1980s, exchange controls were removed to enable extensive arbitrage between domestic and external financial markets for major OECD countries. The domestic financial markets of these countries are effectively integrated to form a true 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 in the future.

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.

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 business corporations (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 III 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 often 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 investors can avoid double taxation on corporate income through the imputation system, foreign investors cannot usually avoid the double taxation of dividends through the corporate and personal income taxes because the imputation system usually does not provide tax relief for foreign investors.

On the other hand, returns from interest bearing assets like deposits and bonds is 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 (4). 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 (5). Therefore the existing tax system would not appear to discriminate against foreign interest-bearing assets [see Alworth (1984) for example].

Since tax systems therefore are 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 from here

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 III.

1. Some theoretical points

Theoretically speaking, there are two aspects in 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. "depth" of the market).

As is shown above, 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. 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 the 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 the 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 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 (6). 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 proxy of 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 (7). 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 (8).

Increased capital market integration, in the sense of high capital mobility and substitutability, does not necessarily imply that real interest rates converge across countries in the short-to-medium run. Equalisation of real interest rates requires as well the maintenance of purchasing power parity (PPP) and unbiased expectations of inflation. While it appears appropriate to regard PPP as holding in the long run, the weakness of PPP in the short-to-medium run has been widely acknowledged. And in periods of high and volatile inflation such as the 1970s and early 1980s, it is difficult to form accurate forecasts of inflation. Therefore it is hardly surprising to find large and persistent real interest differentials despite increased integration of financial markets in those periods. However, as inflation rates have become lower and more predictable, and with longer run movements towards PPP, it can be conjectured that real interest rates will in the medium term show more convergence than in the 1970s and early 1980s. Furthermore, if changes in real exchange rates take place in the short-to-medium run, current account positions will be affected, with corresponding net capital flows. As is explained in Section A, such capital flows will tend to equate long-term real interest rates by withdrawing savings from surplus countries and augmenting those of deficit countries.

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 1967-1979 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 1976-1981 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 1973-1983 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 U.S. 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 aforementioned 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.

3. Recent movements in real interest rates

A number of methods for measuring real interest rates have been proposed (9). 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 II.4.a-d provide a comparison of long and short-term real rates for eleven OECD 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.

Chart II.4.a compares the real interest rates of the United States and other Pacific basin countries while Chart II.4.b shows the real rates of the United States and large financially open European countries. Charts II.4.c and d show the rates of Germany and other European countries.

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. Uncovered interest parity implies that, 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 by the Secretariat. Table II.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 II.5.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 II.5.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 10 years have often been large, there has been a tendency for real interest rates to converge in the 1980s. The 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 deregulations in exchange controls have strengthened the convergence of real interest rates across countries.

D. Macroeconomic policy under integrated financial markets

Monetary, fiscal and exchange rate policies are all affected by increased international financial integration. Because of the importance of recent marked fluctuations in both nominal and real exchange rates for price stability and output, exchange rate considerations have become a more important factor in macro policy formulation, for monetary policy in particular. In a world of floating exchange rates and high capital mobility, it is important to understand the interaction between policy measures and the exchange rate. Although real interest rate differentials have narrowed in recent years, it is also clear that such differentials can persist despite high capital mobility. In such circumstances, fiscal policy can maintain some independence in terms of its influence on domestic output although its efficacy is partly offset by exchange rate crowding out and adjustment of the current account balance (10). As the degree of integration increases, crowding out tends to shift from interest sensitive expenditure (particularly domestic investment) to net exports. Thus, while some of the conventional effects of fiscal policy may be observed, the impact on the trade-exposed sectors is likely to be perverse.

The impact of monetary policy, especially on the price level, may in fact be enhanced by the internationalisation of financial markets. A monetary expansion for instance will induce a smaller reduction in real long-term interest rates because of financial integration but will be accompanied by an depreciation of the exchange rate. This will influence output through changes in the trade balance and will affect prices both through its impact on the prices of traded goods and through second round price effects associated with reduced output (11). International financial integration and capital mobility could also accelerate the impact of monetary policy, as prices and output may be affected more rapidly through exchange rate changes than through interest rate adjustments. Given the tendency towards long-term interest rate convergence the impact of monetary policy on interest rates will be felt mainly at the short and medium-term end of the term structure.

Interesting possibilities arise for the mix of policies as capital market integration increases, which were spelled out in the prescient article by Mundell (1971). A country can improve its short-run tradeoff between inflation and unemployment by deploying a loose-fiscal/tight-money mix. Indeed, because of the comparatively strong effect of monetary policy on the price level, it is possible to obtain an expansion of output and a decrease in inflation in the short run. Sachs (1985) and others have argued that something like this was achieved by the United States in the first half of the 1980s. Of course, effects of such a policy mix may be short-lived. Inflation gains have to be paid back eventually as the exchange rate returns to its long-run equilibrium level. And those short-run gains are taken at least partially at other countries' expense in terms of their currency depreciation and of induced potential inflation acceleration.

As this discussion makes clear, both monetary and fiscal policies have important effects through their impact on the exchange rate, a development which assumes more importance in the light of the reduced role of exchange controls and lower efficacy of sterilised intervention in influencing the exchange rate. Sterilised intervention has become less effective as the substitutability of assets denominated in different currencies has increased. Because monetary and fiscal policies can strongly influence current account

balances via incipient capital flows and actual exchange rate changes, or, thought about in another way, through changes in domestic spending relative to income, the pattern of current account imbalances can be heavily influenced by macro policies. In this environment the maintenance of stable exchange rates and a sustainable pattern of international balances depends on closer coordination of monetary and fiscal policy than would be necessary in the absence of highly integrated financial markets.

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

In the previous Part, the real interest rates of OECD countries have been shown to have a tendency towards convergence in the recent period of the increased internationalisation of financial markets. Provided there are no other distortions, this tendency towards equalisation of real interest rates through international capital movements would improve the 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 (12).

A. Framework of the analysis

The following analysis examines 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. The analysis also concentrates on the effects of different tax systems on the international allocation of capital with fully integrated financial markets, rather than on those of international financial integration on international resource allocation given the 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 the 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.

Chart III.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_0. The market real interest rate is equal to this marginal product of capital (13). The net capital income is equal to the area of rectangle EBCD. The 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 (Chart III.2). The investment-saving balance of an economy, in general, can be expressed as follows:

$$S = I + (G-T) + CB \qquad (3.1)$$

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:

$$W = K + D + NFA \qquad (3.2)$$

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 Chart III.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 (14). 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 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 Chart III.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^b to R_1^b. The net <u>domestic</u> product of country A declines from the area of $ABCO_a$ to the area of $AFGO_a$. The net <u>national</u> product of this country is larger than the net <u>domestic</u> 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 <u>domestic</u> product of country B increases from the area of DO_bCE to the area of DO_bGF, increasing by the area of ECGF. The increase in the net <u>national</u> 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.

B. <u>The effects of tax distortions with integrated financial markets</u>

The effects of tax systems on the international allocation of capital are extremely complicated. The differences of 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 market real interest rate.

However, as is explained in Part II, 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 II.1), this Section's analysis 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, market real interest rates can be presumed to tend to converge across countries as explained in Part II. However, this tendency towards the equalisation of market 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, for example, generates a wedge, specific to that country, between the market 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 market real interest rates are equalised internationally.

In the following, the tax wedge between the market 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 (15).

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 market 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 (16).

The real cost of capital depends not only on the market 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 stock holders 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 (17). 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 stock holders under a given real interest rate. Thus, the measurement of cost of equity capital depends on the assumptions regarding the following factors:

1) the degree of risk aversion among investors;

2) the effective marginal tax rates on dividends and capital gains;

3) the after-tax return on alternative investments and the after-tax cost of borrowing for investors;

4) 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. As observed above, the cost of capital from various sources should be equal at the margin. Therefore, the measured cost of debt capital might be used as a proxy for the true cost of capital (18).

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 cost of capital depends on the following factors (see Annex B for details):

1) market real interest rate;

2) inflation rate;

3) economic rate of depreciation;

4) corporate tax rate;

5) present value of depreciation allowance by the tax code accruing to the new investment which is discounted by the after corporate tax nominal interest rate [i.e. (nominal interest rate) x (1 minus corporate tax rate)]; and

6) 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 market 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 market 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 create distortions in the international allocation of capital.

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). Tables III.1-III.3 show the size of tax wedges estimated at 3 and 5 per cent real market interest rate 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 tax wedges for machinery and buildings are shown separately in Tables III.1 and III.2. Table III.3 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 made a major change in their corporate tax system, and the tax wedges were estimated for both the old system and the new system. 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 is the current system and the new system will be in full effect after 1989.

As can be clearly seen from these tables, the size of tax wedges 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 the 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 III.1), 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 systems that do not have such incentives for investment tend to have smaller tax wedges [the United States ("new system"), Japan, Germany, France, the United Kingdom ("new system"), Italy, Canada ("new system")].

The tax wedges for buildings show a rather different picture (Table III.2). 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 would tend to reduce the effective interest rates of these countries if inflation were high.

The size of tax wedges for total business capital shows the weighted average effects of the above two components (Table III.3). Under a low inflation rate, smaller 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 III.4. 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. A less pronounced reduction is also observed for the new Canadian system. The size of current tax wedges are about the order of -1 to -3 percentage points among major countries and -1 to -5 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 tax effects 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 the approximately 4000 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 market 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 (19).

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 market 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 structure, property and wealth taxes all affect housing investment (20). 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 perform 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 deductible period 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 for details).

The estimated tax wedges between the market real interest rate and the after-tax real cost of housing investment are shown in Table III.5 (Borrowing case). 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. 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 market 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 in the same way as the real component of nominal interest rates by the tax system. 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.

Table III.5 ("Asset draw down" case) shows the estimated tax wedges between the market real interest rate and the after tax real interest rate (i.e. the opportunity cost of housing investment) at real market interest rates of 3 and 5 per cent (21). 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 by the tax reform bill of 1986.

Table III.6 shows the estimated tax wedges at 5 per cent real interest rate for an average production worker. These figures are calculated at the 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 reduced the tax wedge considerably. On the other hand, for Japan, Germany, France and Australia, the tax wedges are generally small in size and zero in Canada. The absolute value of the difference in tax wedge between the extreme two groups is about the order of 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 for 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. Especially in Germany, Canada, Australia and Sweden, the tax wedges differ considerably between the two cases.

C. 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 market 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 the tax system might even be such that increased integration of financial markets actually worsened the allocation of capital. In that case, achieving a better allocation of capital would require moves internationally to eliminate tax distortions as well as barriers to capital movements. This section measures the long-run effects of interaction between financial integration and the tax wedges created by the corporate tax system.

It must also be noted that while the analysis focusses on distortions in corporate tax systems, the corporate capital stock is a varying percentage of business capital stocks used in the analysis simply because such capital stocks include non-corporate stocks. Thus, the results may overstate the effects insofar as corporate tax rules do not apply to non-corporate taxation.

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, then under the large country assumption by allowing for the 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 market 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 (see Annex B). 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 market 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 market 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 Secretariat's

INTERLINK model (22). 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 change in the real cost of capital on the demand for capital stock under given labour supply and given real energy cost (see Annex D for details). This one percentage point change 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 III.7. For example 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 370 billion dollars (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.

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 (see Table D-2 in Annex D), 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 large 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 (23).

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 could not 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 market real interest rate and the demand for capital of each country can be derived from the analysis of the real cost of capital function in Annex B and the estimated relationships between the

capital demand and the real cost of capital in Table III.7. 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 for details). Table III.8 summarizes the results of this simulation. For example, if the United States introduced a tax measure equivalent to a cut in the real cost of capital by one percentage point at any level of the market real interest rate, the world real interest rate rises by 0.41 percentage points. The net external asset position of the United States declines by about $260 billion (1985 value), while the rest of the countries 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 III.7, 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 in 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 III.4, 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 III.7 and III.8 should be regarded as no more than a rough indication of the order of magnitude of the possible effects.

D. 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.

The effect of a tax wedge on the allocation of capital in a hypothetical two-country world is illustrated in Chart III.3. Suppose that there are no tax distortions initially. Then the world real interest rate, R_0, is determined 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 Chart III.2.

Then, suppose that country A introduced 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_0 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 (24).

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.

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 8 per cent investment tax credit for all investment. As we have seen in Table III.7, 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 by about 14 to 25 per cent (excluding Canada: see Annex D). 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 a high rate of inflation. Under a 10 per cent trend inflation, the size of tax wedge is about 4-8.5 per cent for total business capital (see Table III.3). In this case, the size of output loss could exceed 1 per cent of GNP.

IV. 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 Japanese yen, the German mark, the U.K. 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 II indicates that there has been a tendency for real interest rates to converge in the 1980s.

The internationalisation of financial markets exerts important effects on the efficacy of macroeconomic policy. If domestic real interest rates are affected more by the development of the world real interest rate than in the past, the efficacy of monetary policy in influencing domestic private investment might be reduced. On the other hand, monetary policy may have stronger effects on net exports (exchange rate crowding out) and prices via the exchange rate. The impact of fiscal policy on real output might also change; the more closely linked are financial markets, the stronger are the exchange rate crowding out effects and the weaker are the interest rate crowding out effects, i.e. the stronger the link between fiscal policy changes and current account imbalances together with corresponding capital flows. Since all these changes tend to strengthen the effects of macroeconomic policy instruments on the exchange rate and the current balance, better international co-ordination of macro policies is indispensable for stable exchange rates and for the sustainable international configuration of balance of payments.

International integration of financial markets also has 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 would 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 market real interest rates and the real after tax cost of capital for corporate and housing investments. 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 III show that the countries with tax incentives for investment and/or with high inflation tend to have wide tax wedges. Therefore, even if market real interest rates are equalized across countries, real costs of capital would differ significantly among them generating a distorted allocation of capital.

According to the simulation presented in Part III, 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 one 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, the existing tax distortions could generate a large imbalance in the

net external asset position which involves a significant welfare cost. In this regard, the 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 were 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. Doley and Isard (1980), Claassen and Wyplosz (1982), Ito (1983), Otani and Tiwari (1981), Caramazza et al. (1986).

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

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

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

5. Under most tax treaties, the withholding tax is either waved or reduced to 5-15 per cent of the interest income and the tax payed 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 detail.

6. E.g. Hansen and Horrick (1980). Longworth et al. (1983) provide a series of such tests and a survey of the relevant research.

7. See, e.g., 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 (1983).

8. 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 U.S. in attracting huge volumes of capital in the 1980s constitutes important new evidence in favour of high substitutability [cf. Sachs (1985)].

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

10. The basic implications for monetary and fiscal policy under floating rates can be illustrated within the well known framework of Mundell's model more than twenty years ago [Mundell (1983)]. See Marston (1984) for a survey of development in the literature on this subject. some recent theoretical developments attach a more important role to international debt accumulation via its impact on the risk term. Branson (1985) develops a model which includes consideration of this risk element so that as the stock of debt rises, investors require either a further rise in interest rates or a larger expected appreciation in the currency in order to persuade them to hold the increased stock of debt. A tax cut in such a model gives an initial appreciation but then a gradual depreciation. Sachs and Wyplosy (1984)

give greater attention to the dynamics and conclude that the outcome depends critically on the degree of substitutability of domestic and foreign financial assets (i.e. on capital mobility) and on the initial level fo public debt.

11. Expansionary monetary policy could be more inflationary than fiscal policy as the upward pressure on prices coming from increased demand would be reinforced by the impact of devaluation on import prices [see Ishii et al. (1985)]. Dornbusch and Fisher (1984) concluded that a 10 per cent revaluation of the U.S. dollar would give a rapid reduction in the price level via import prices of one per cent and a further one per cent reduction with a longer delay through lower wages growth associated with increased foreign competition. Thus the Phillips curve tradeoff might be worsened for stimulative monetary policies. Likewise, it has been argued that the domestic short-run tradeoff is improved for contractionary monetary policy. An illustration of this might be provided by the case of the disinflation in the United States in the first half of the 1980s and the rising U.S. dollar [Sachs (1985)].

12. The applications of the neo-classical framework for the question of international factor mobility can be found in MacDougall (1968) and Hamada (1976).

13. 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.

14. 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 (see Chapter II).

15. 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.

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

17. McKee et/al. (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.

18. In a so-called Miller equilibrium, the cost of debt finance is equal to the true marginal cost of capital, [see 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).

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

20. As can be seen in Table C.1 in Annex C 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 for many countries was unobtainable, no account has been taken of these taxes in the following analysis.

21. 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.

22. 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.

23. 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 the ratio 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.

24. In this analysis, we assumed that the capital movement takes the form of international borrowing by country A from country B. However, if the capital movement takes the form of direct investment from B to A, we have to take account of the corporate tax revenue of country A from the direct investment by country B. This tends to reduce the welfare loss by country A and reduce the gain by country B, although the net welfare loss of the world economy remains the same.

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TABLES AND CHARTS

Table II.1

INTERNATIONAL ASSET POSITION OF SELECTED COUNTRIES RELATIVE TO GNP/GDP

THE UNITED STATES

(per cent)

	1970	1975	1980	1985
External assets	16.71	19.14	23.28	23.87
Public sector	4.71	3.76	3.46	3.27
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	4.37	7.33	11.55	14.77
Stocks	0.66	0.62	0.74	1.02
External liabilities	10.80	14.32	19.21	26.57
Public sector	2.64	5.64	6.75	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	9.27	16.91
Stocks	2.75	2.31	2.48	3.16
Net external assets	5.91	4.81	4.07	-2.70

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

JAPAN

(per cent)

	1973	1975	1980	1985
External asset	13.02	12.14	16.37	28.42
Public sector	4.98	4.30	4.82	4.19
Official reserve	3.36	2.67	2.63	1.80
Other assets	1.63	1.63	2.19	2.39
Private sector	8.05	7.84	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	n.a.	n.a.	n.a.	n.a.
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	17.45
Direct investment	0.44	0.43	0.34	0.31
Other liabilities	8.44	9.61	12.92	17.14
Stocks	n.a.	n.a.	n.a.	n.a.
Net external assets	3.57	1.46	1.18	8.43

n.a. = not available.

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

Table II.1 (continued)

GERMANY

(per cent)

	1974	1975	1980	1984 (June)
External asset	28.31	31.55	32.94	38.98
Public sector	12.27	11.26	8.07	9.49
Official reserve	9.09	7.27	5.33	5.21
Other assets	3.18	3.99	2.73	4.28
Private sector	16.04	20.28	24.88	29.48
Direct investment	n.a.	2.43	3.13	4.22
Other assets	n.a.	17.86	21.76	25.26
Stocks	0.89	0.98	0.71	0.98
External liabilities	19.26	21.50	28.56	33.92
Public sector	0.51	0.98	3.92	7.07
Private sector	18.76	20.52	24.64	26.84
Direct investment	n.a.	3.73	2.96	2.73
Other liabilities	n.a.	16.79	21.68	24.11
Stocks	0.68	0.84	1.17	1.52
Net external assets	9.05	10.05	4.38	5.05

Source: Monthly Report of the Deutsche Bundesbank

THE UNITED KINGDOM

(per cent)

	1970	1975	1980	1985
External asset	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	2.11
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	n.a.	n.a.	n.a.	n.a.
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	n.a.	n.a.	n.a.	n.a.
Net external assets	7.01	-1.66	7.41	23.04

n.a. = not available.

Source: Bank of England Quarterly Bulletin

Table II.2

SIGNIFICANCE OF LONG-TERM REAL INTEREST RATE DIFFERENTIAL
(t-statistics)

	USA	JAP	GER	UKM	CAN	ASL
			April 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	

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:

$$r_{j,t} = a_0 + a_1 d^{1}_{j,t} + a_2 d^{2}_{j,t} + \ldots + a_{n-1} d^{n-1}_{j,t} + e_{j,t}$$

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

where

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

$d^{k}_{j,t}$ = 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_j 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. Underlined figures in the table are less than 5.

Table III.1

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

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Table III.2

THE ESTIMATED TAX WEDGE FOR BUILDINGS

(percentage points)

	Real interest rate							
	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

a. Old
b. New

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Table III.3

THE ESTIMATED TAX WEDGE FOR TOTAL BUSINESS CAPITAL

(percentage points)

	Real interest rate							
	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	-1.73	-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	-7.45	-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	-1.73	-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	-7.58
Canada (a)	-1.53	-3.07	-5.57	-8.57	-1.77	-3.52	-6.08	-9.11
(b)	-0.17	-1.89	-4.47	-7.49	-0.27	-2.17	-4.81	-7.84
Australia	-2.45	-3.86	-6.11	-8.78	-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	-7.63	-2.77	-4.00	-5.91	-8.18
Spain	-3.34	-3.90	-5.06	-6.52	-3.76	-4.45	-5.64	-7.12
Sweden	-4.35	-5.59	-7.64	-10.23	-5.01	-6.37	-8.47	-11.08

a. Old
b. New

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Table III.4

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

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Table III.5

THE ESTIMATED TAX WEDGE FOR HOUSING

(Borrowing case)

(percentage points)

	Real interest rates							
	3				5			
	Inflation rate				Inflation rate			
	0	5	10	15	0	5	10	15
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)

	Real interest rates							
	3				5			
	Inflation rate				Inflation rate			
	0	5	10	15	0	5	10	15
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

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Table III.6

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

a. Old
b. New

Table III.7

THE EFFECTS OF ONE PERCENTAGE POINT DECREASE IN REAL COST OF CAPITAL ON THE DEMAND FOR CAPITAL

	Change in the demand for capital			
	Relative to capital stock (per cent)	Relative to GNP/GDP (per cent)	In $US bill. (a)	Elasticity of capital demand against the real user cost of capital
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.

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Table III.8

THE EFFECTS OF TAX INCENTIVE EQUIVALENT TO ONE PERCENTAGE POINT CUT IN 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 (bill. 1985 U.S.$)							
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 (per cent)	45.8	15.3	7.2	5.9	5.2	4.1	3.8

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CHART II.1

Schema for Domestic and International Financial Relationships

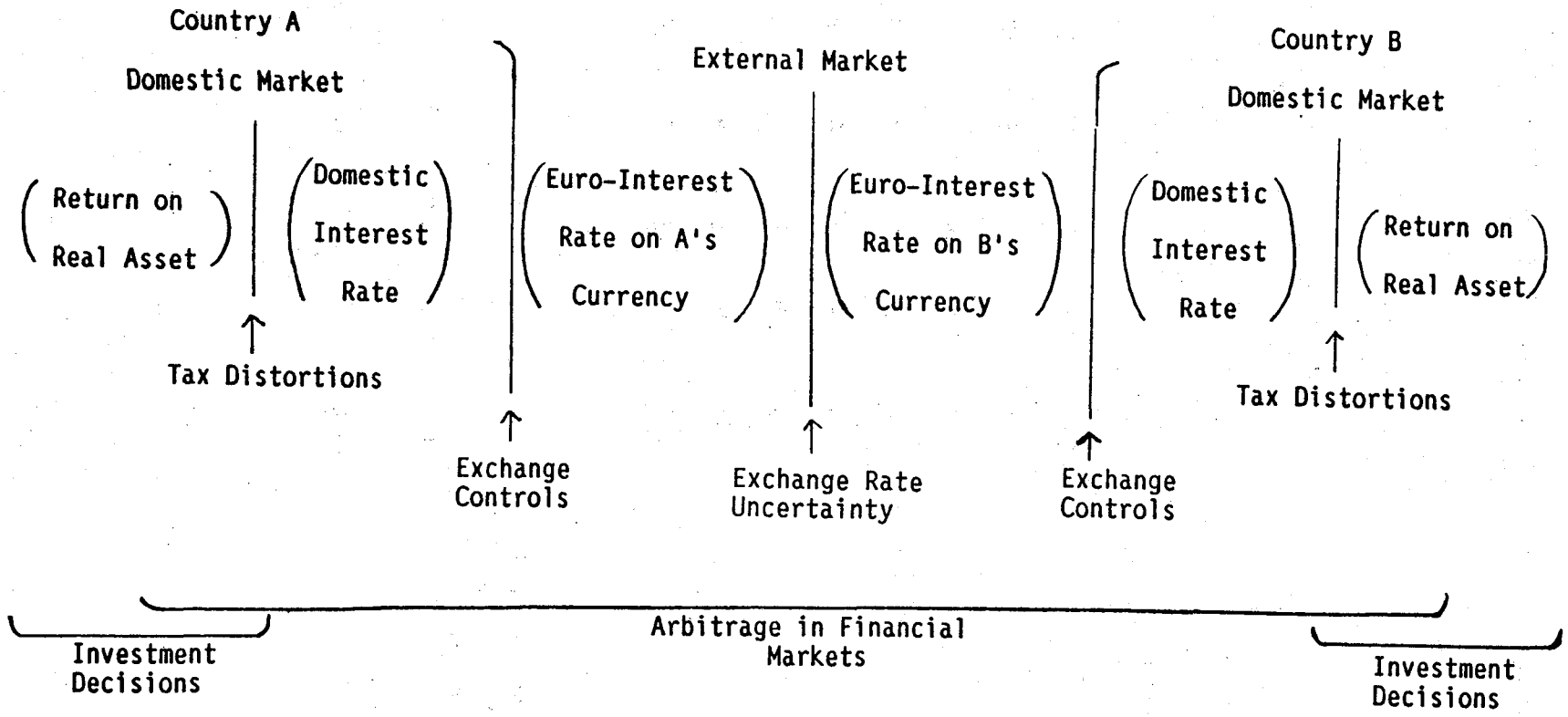


CHART II.2

DIFFERENTIAL BETWEEN DOMESTIC AND EURO SHORT-TERM INTEREST RATES

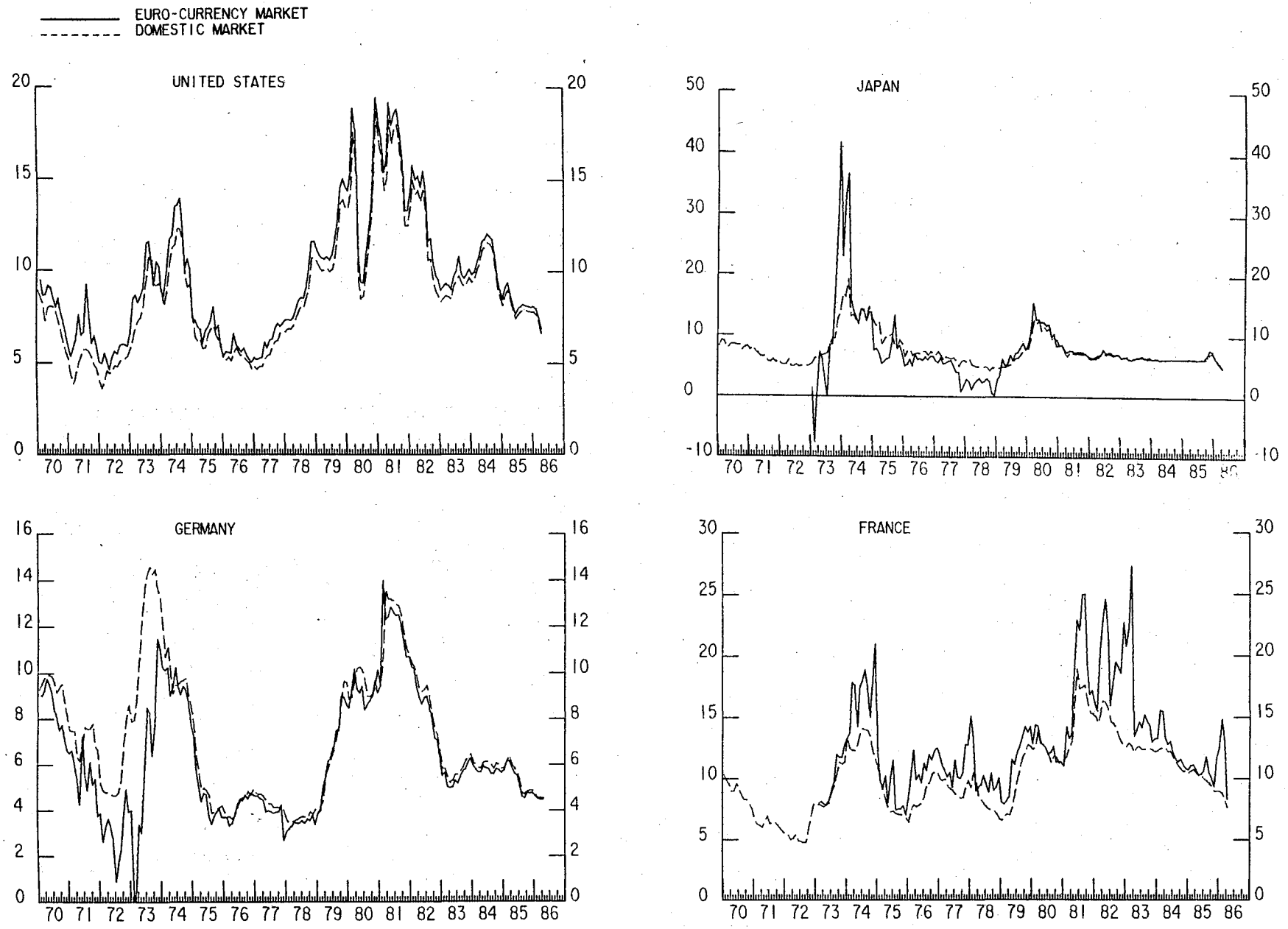


CHART II.2 (continued)

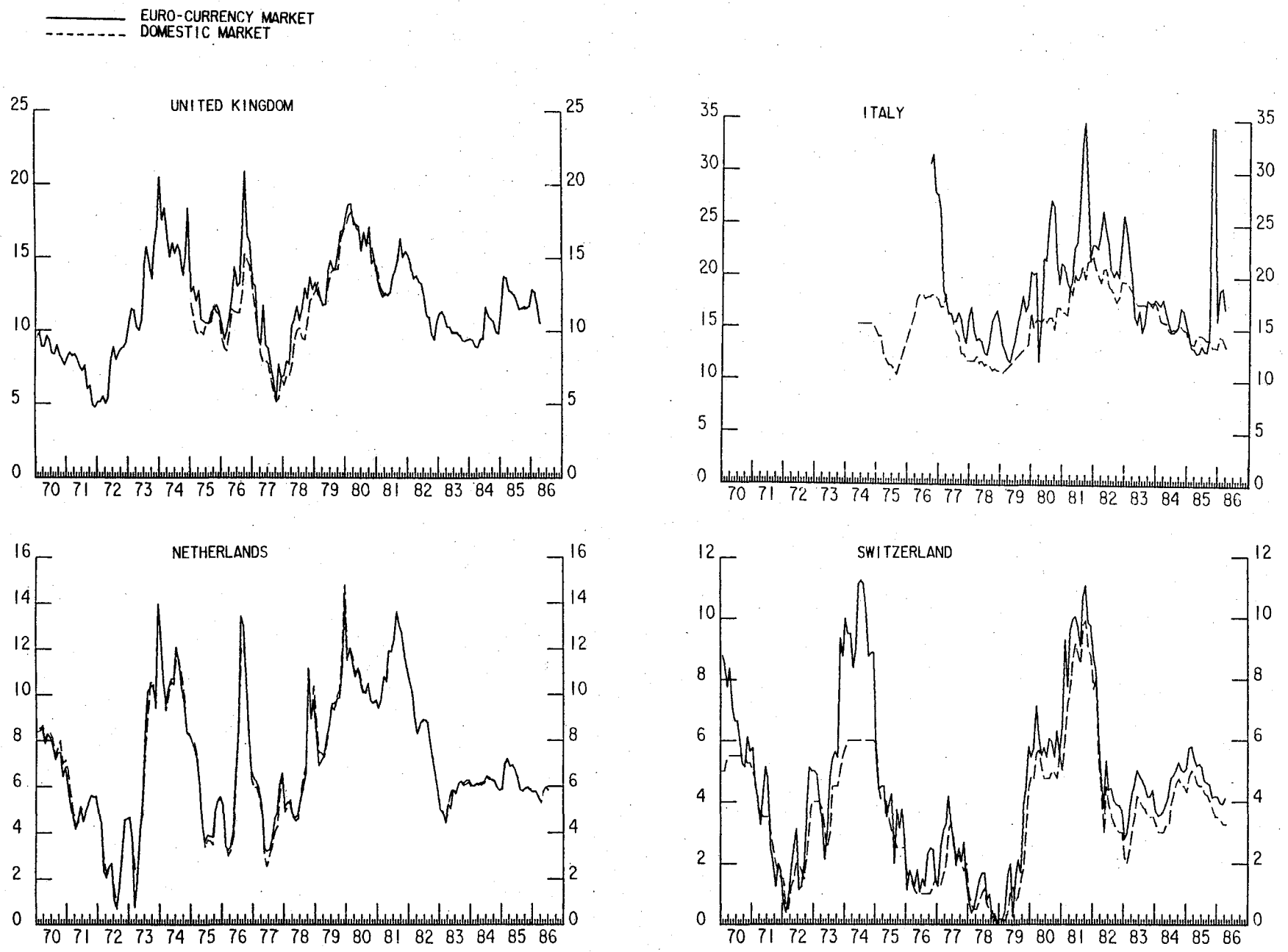
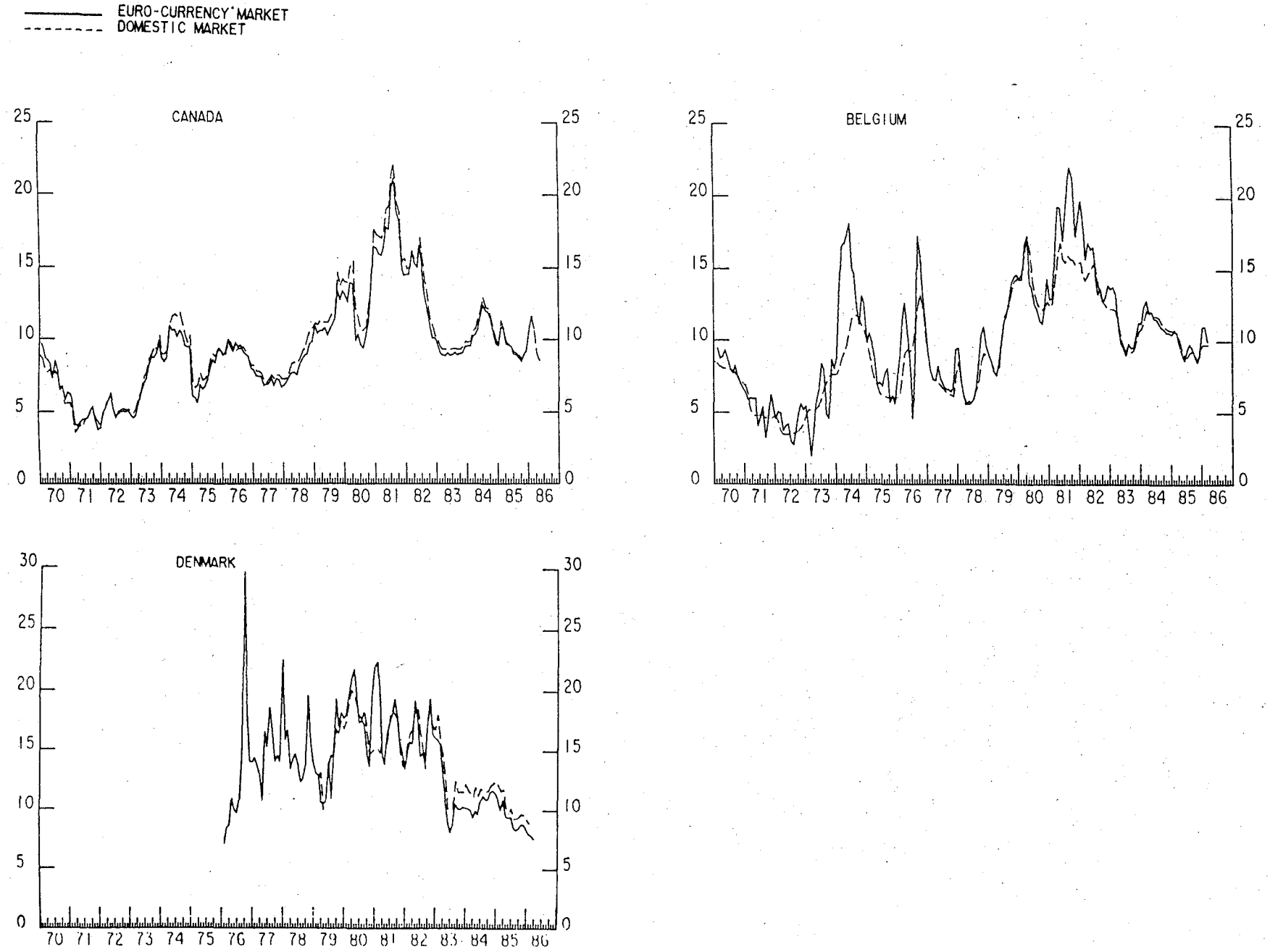


CHART II.2 (continued)



Data for Chart II.2

United States	Euro rate	3-month deposits
	Domestic rate	3-month certificates of deposit
Japan	Euro rate	3-month deposits
	Domestic rate	3-month Gensaki
Germany	Euro rate	3-month deposits
	Domestic rate	3-month interbank loans
France	Euro rate	3-month deposits
	Domestic rate	3-month interbank loans
United Kingdom	Euro rate	3-month deposits
	Domestic rate	3-month interbank loans
Italy	Euro rate	Calculated as below
	Domestic rate	3-month treasury bills
Canada	Euro rate	Calculated as below
	Domestic rate	3-month commercial papers
Belgium	Euro rate	Calculated as below
	Domestic rate	3-month treasury certificates
Denmark	Euro rate	Calculated as below
	Domestic rate	3-month interbank loans
Netherlands	Euro rate	3-month loans to local authorities
	Domestic rate	the unweighted average of call money
Switzerland	Euro rate	3-month deposits
	Domestic rate	3-month deposits with major banks

The formula for calculations of Euro rates in Italy, Canada, Belgium and Denmark

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

r_t: Euro rate

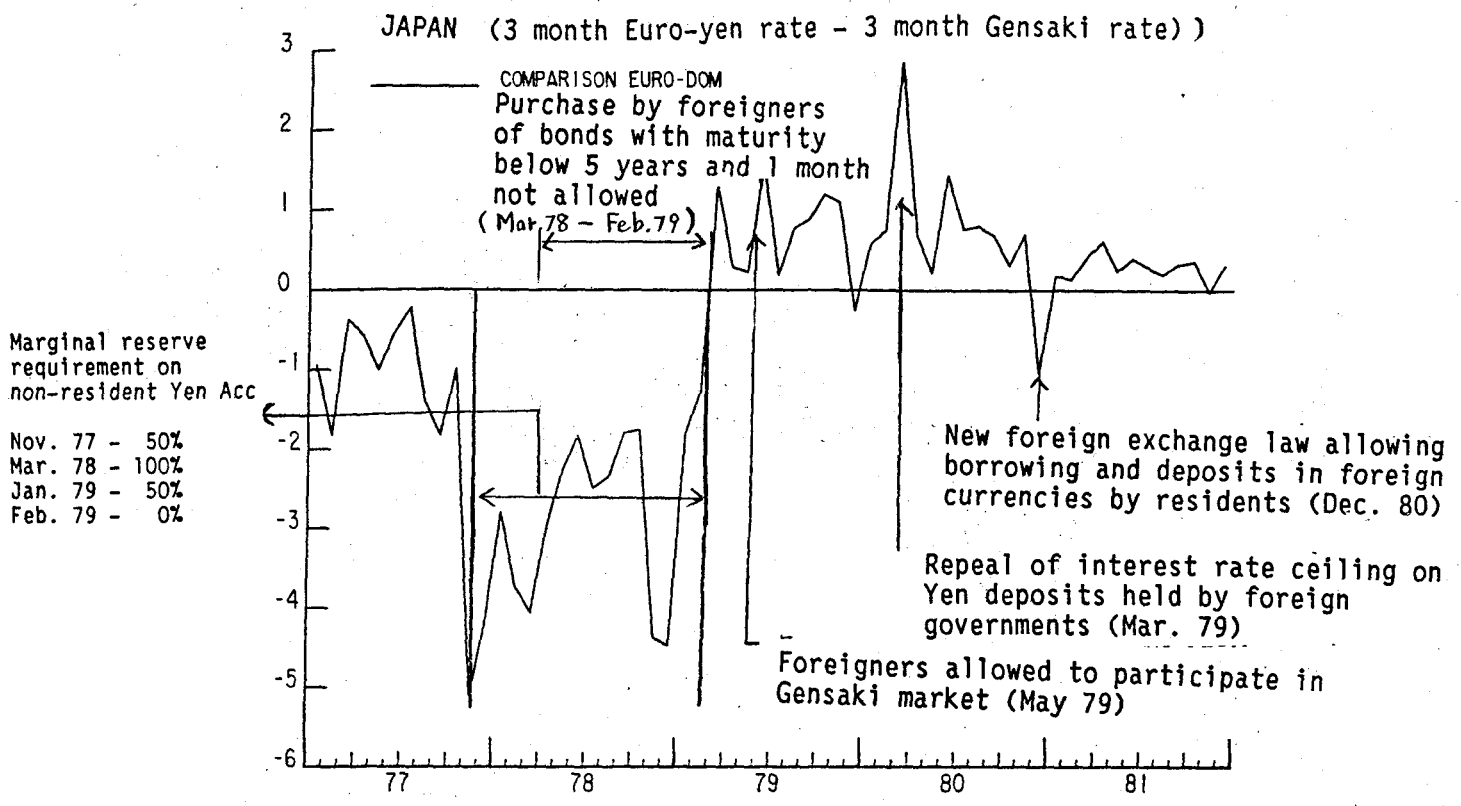
r_t^*: Euro-dollar rate (3-month). For Canada, U.S. commercial paper rate (90-day).

E_t^f: 3-month forward exchange rate against US dollar

E_t^s: Spot exchange rate against U.S. dollar

CHART II.3

EXCHANGE CONTROLS AND EURO-DOMESTIC INTEREST
RATE DIFFERENTIALS [(euro rate)-(domestic rate)]



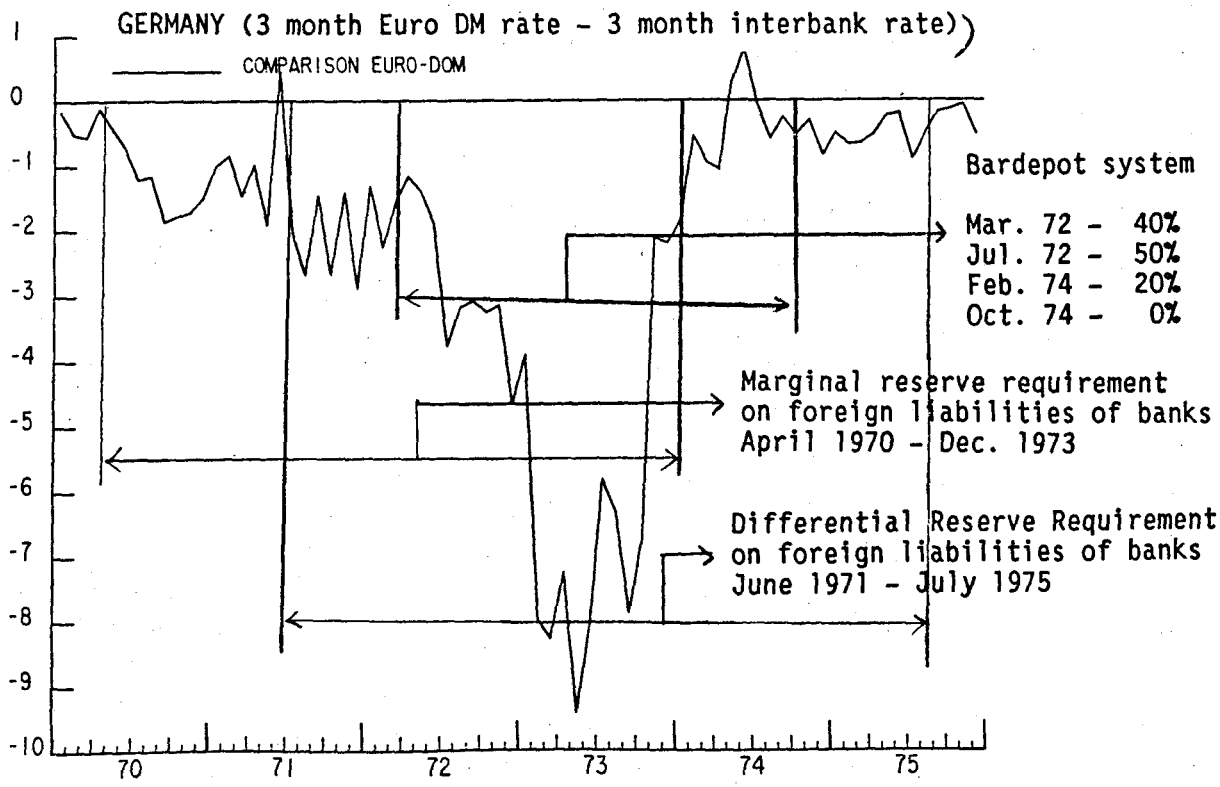
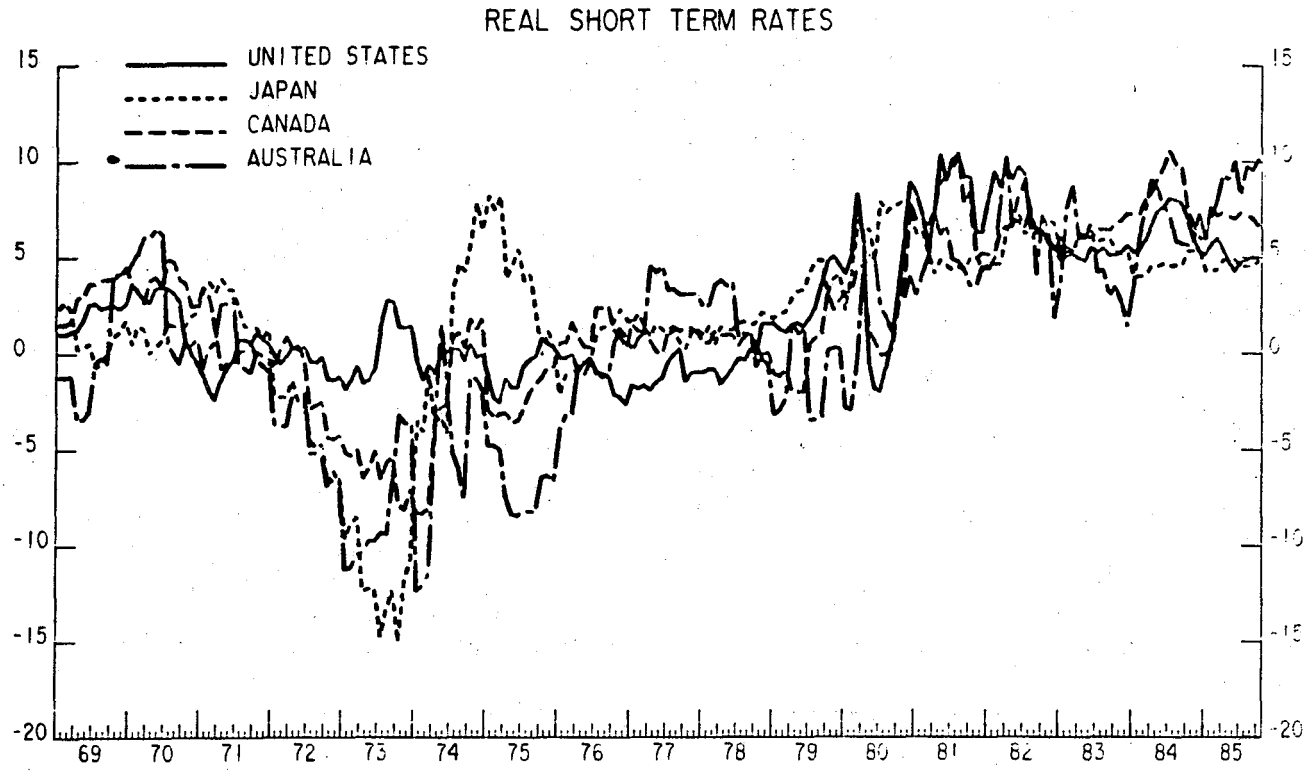


CHART II.4.a

BEHAVIOUR OF REAL INTEREST RATES



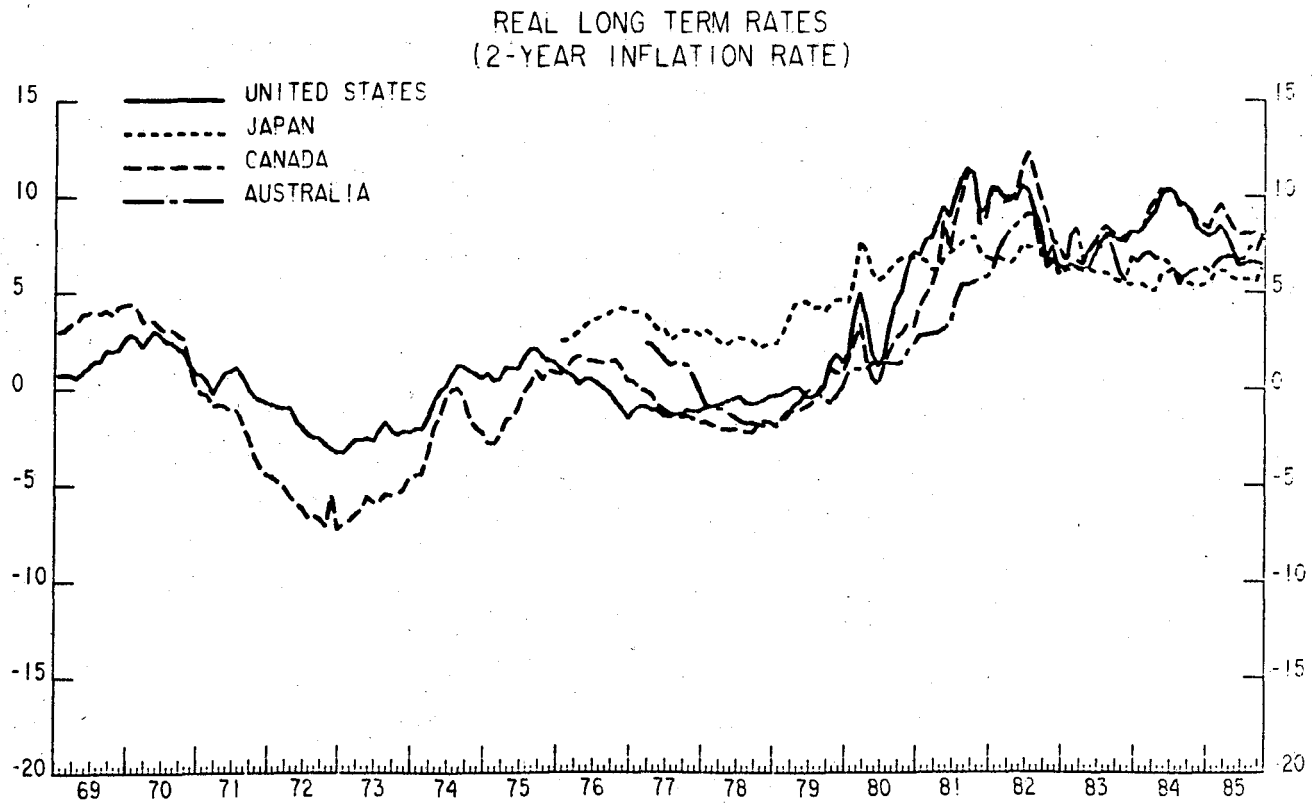
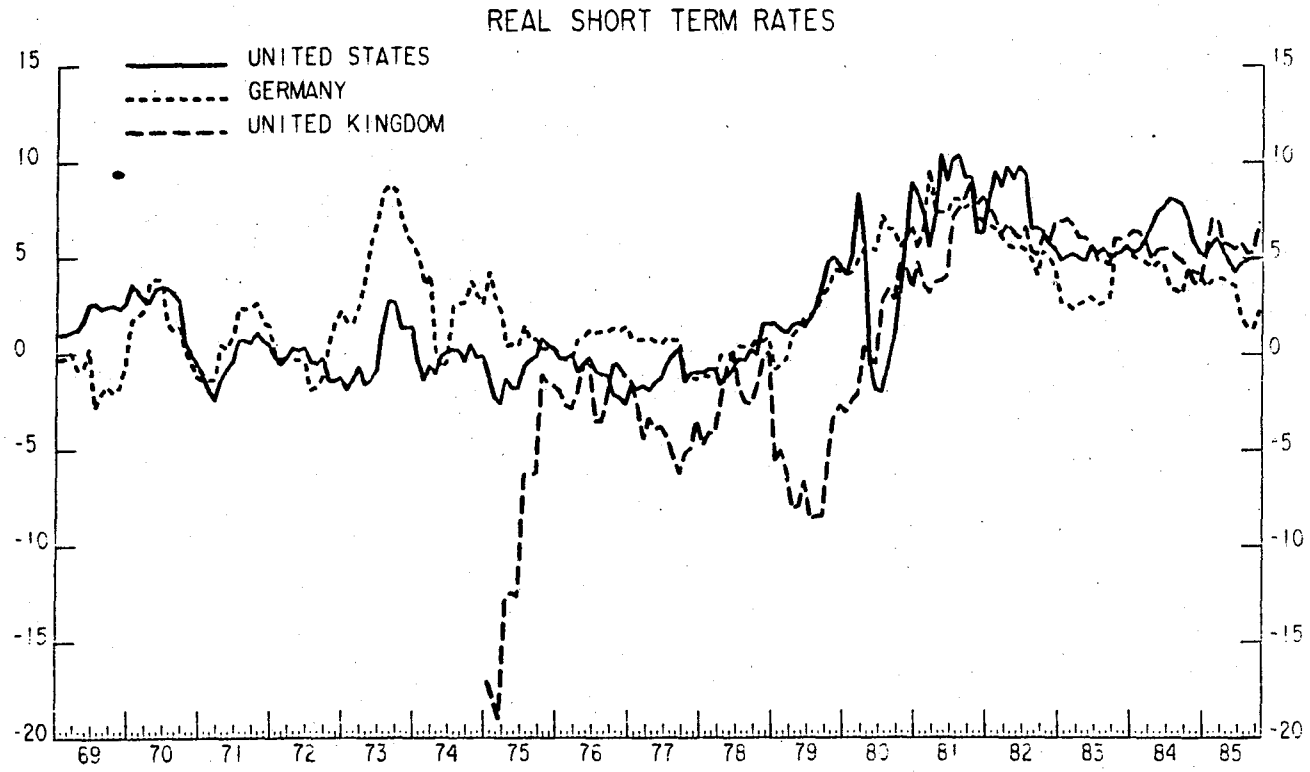


CHART II.4.b

BEHAVIOUR OF REAL INTEREST RATES



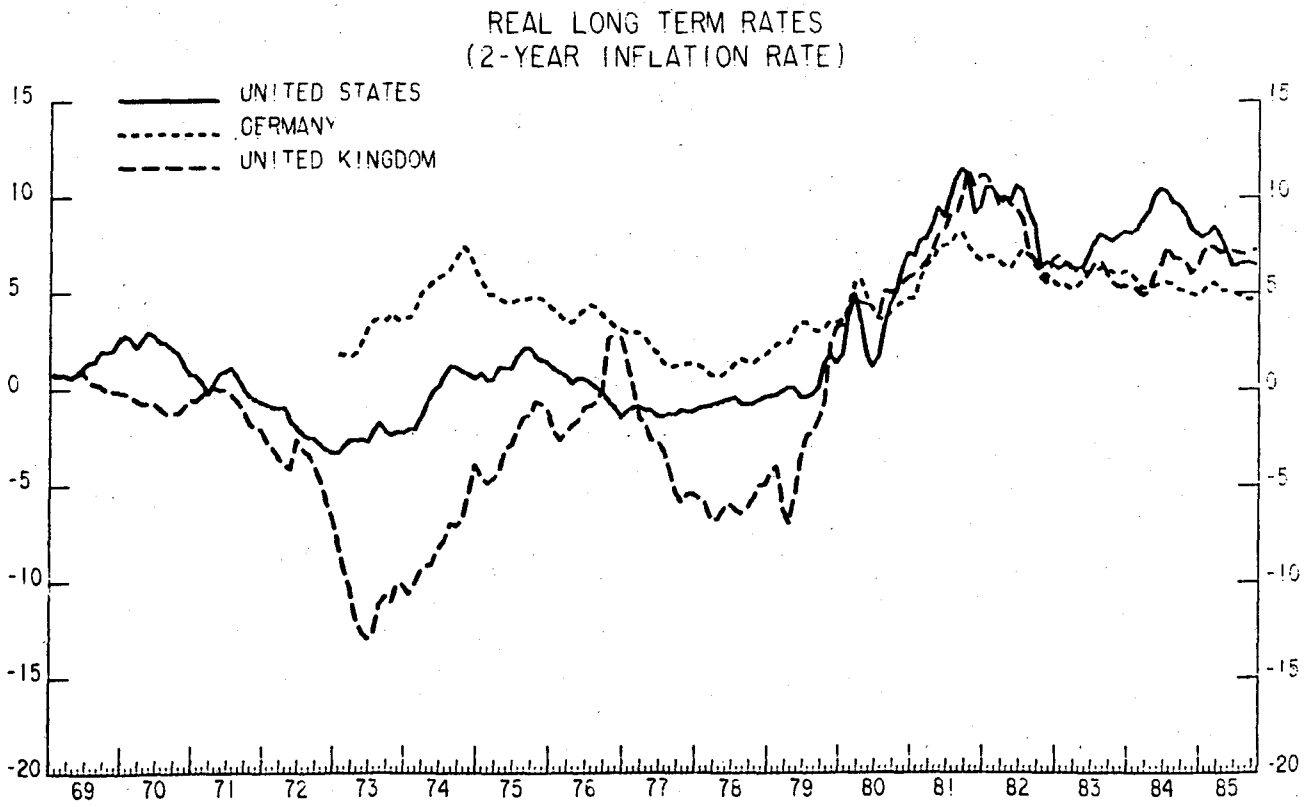
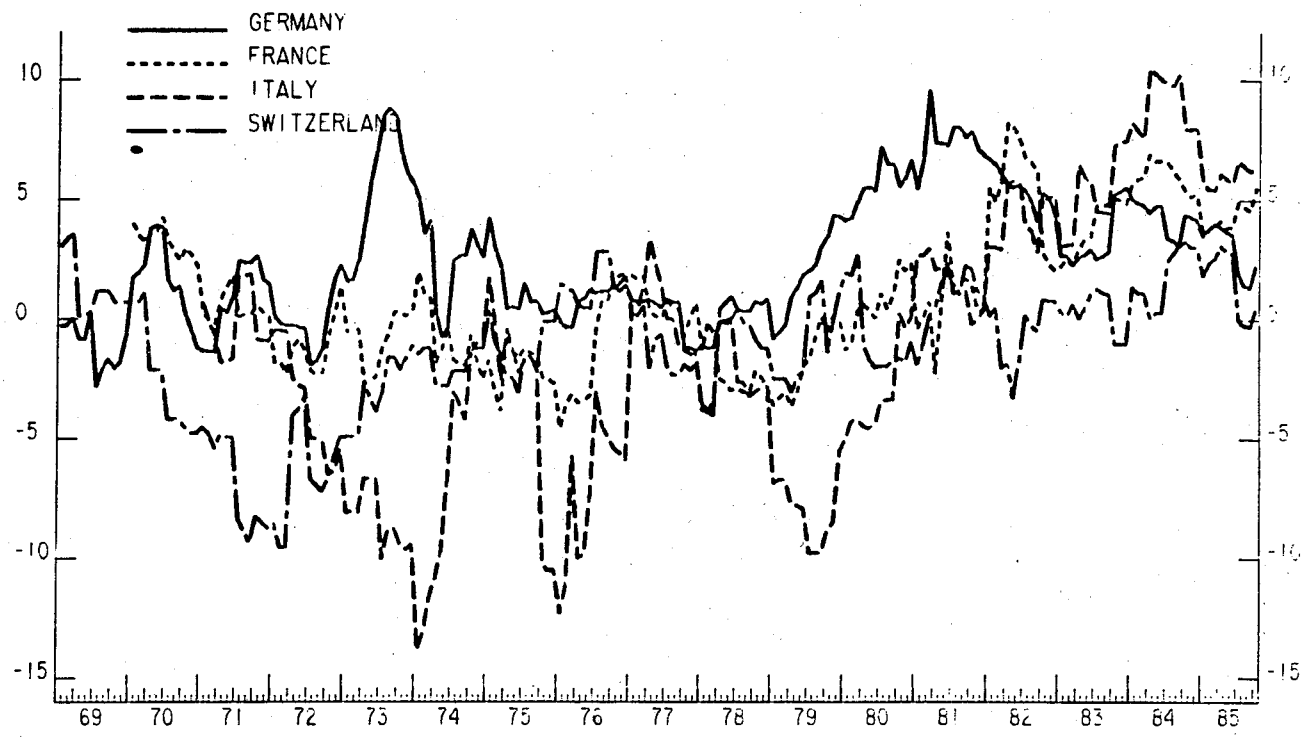


CHART II.4 .c

BEHAVIOUR OF REAL INTEREST RATES

REAL SHORT TERM RATES



REAL LONG TERM RATES
(2-YEAR INFLATION RATE)

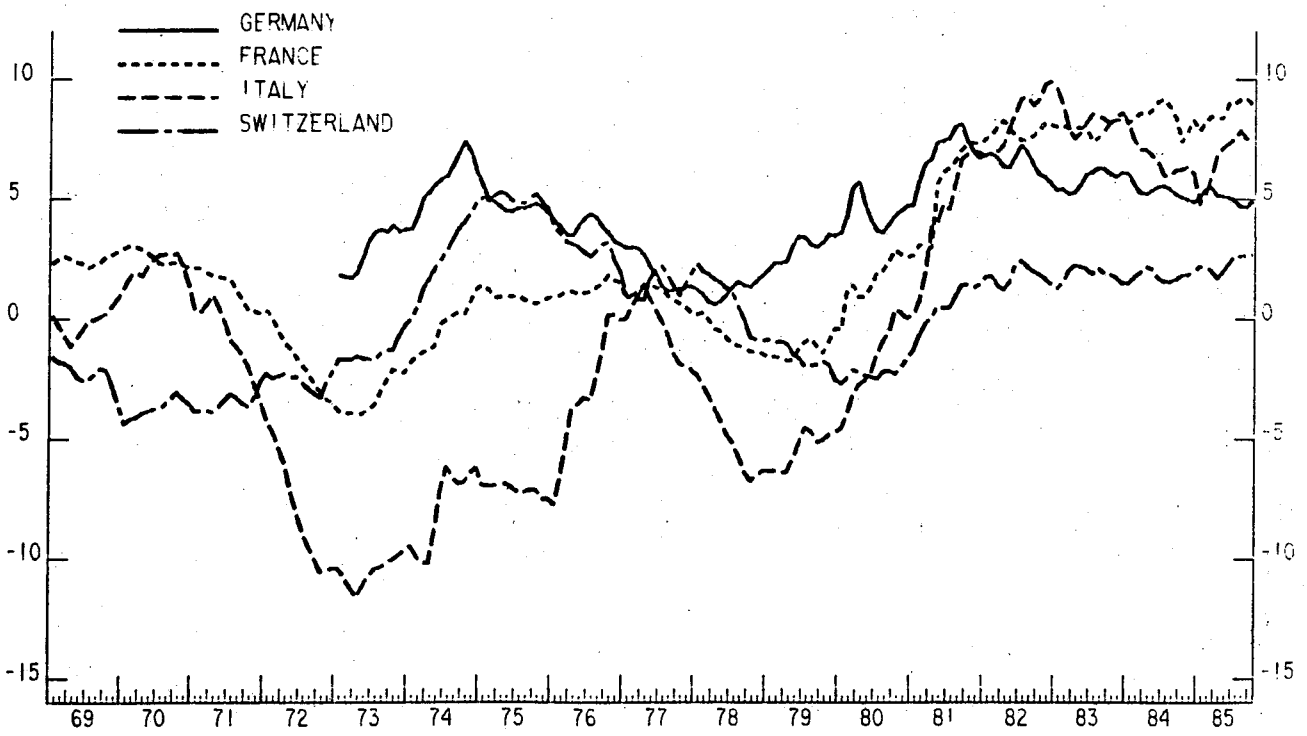
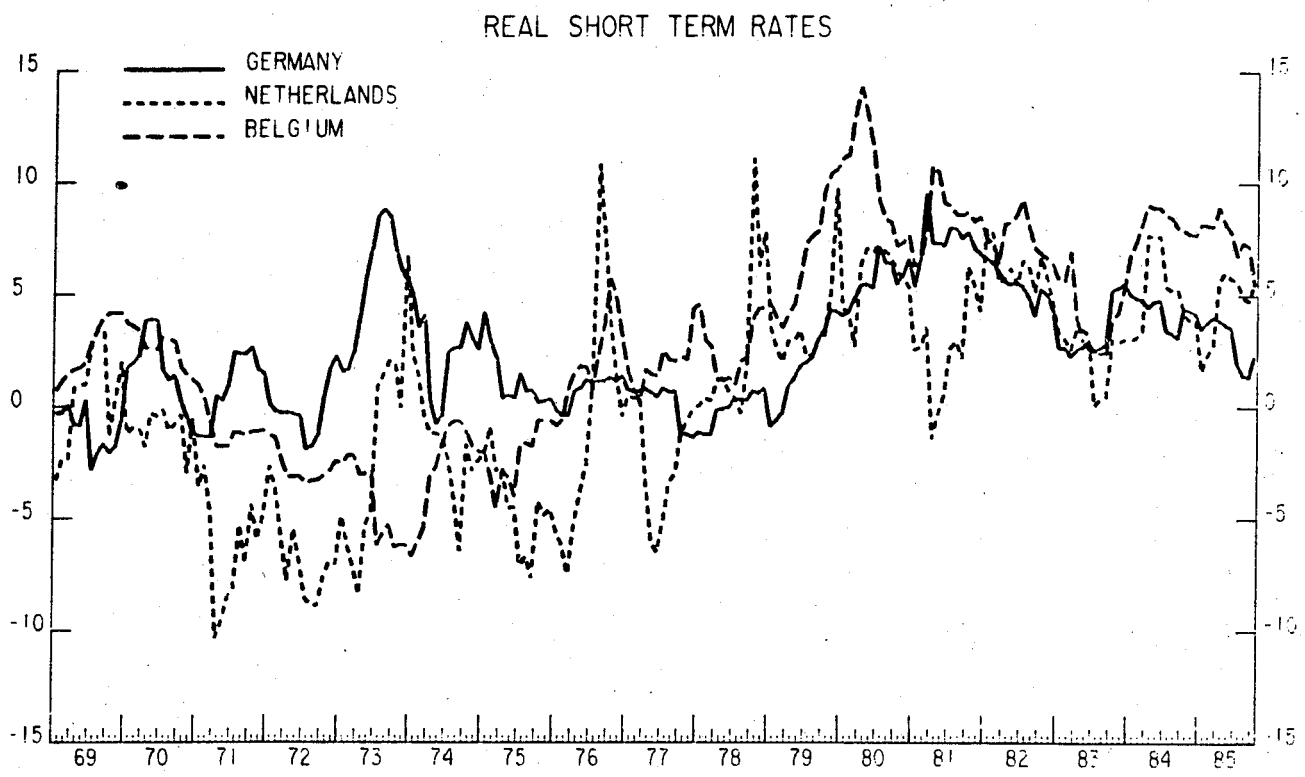
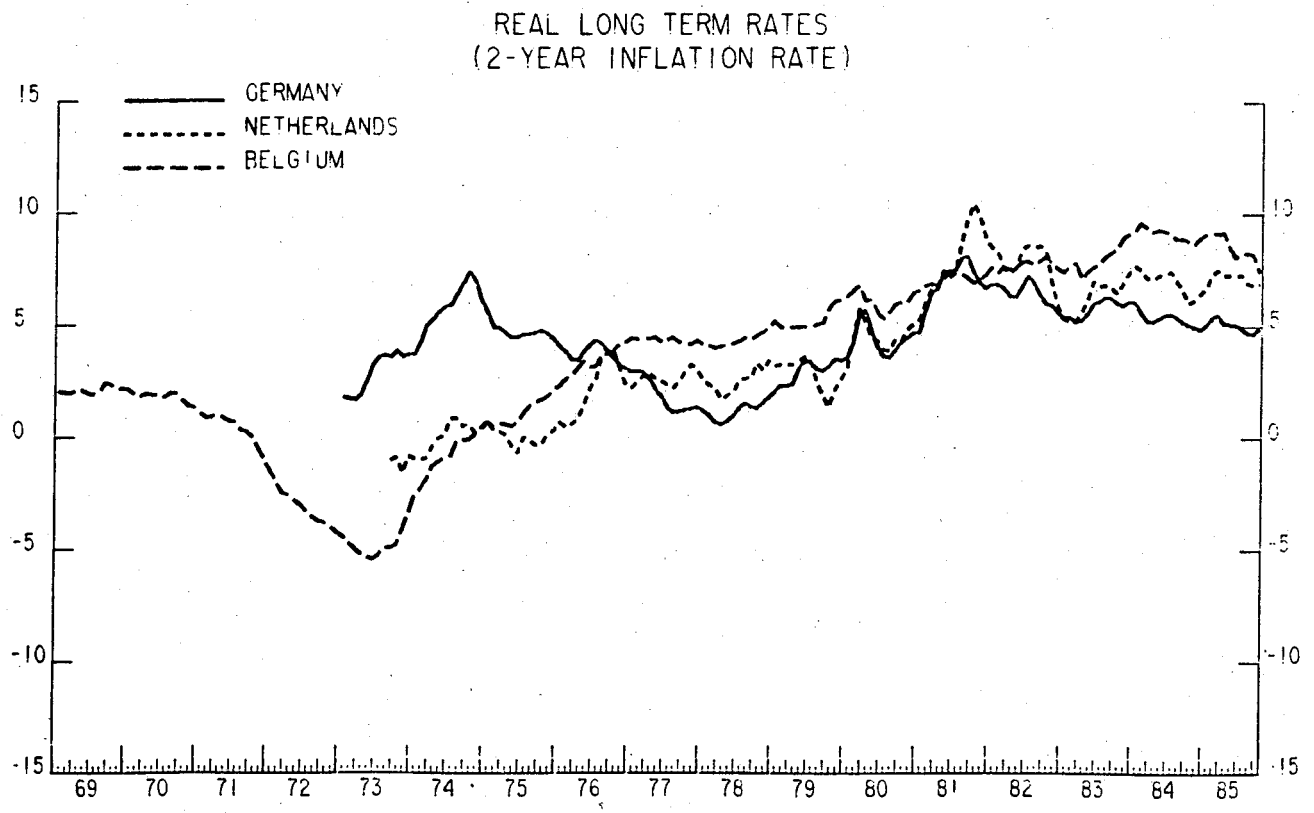


CHART II.4.d

BEHAVIOUR OF REAL INTEREST RATES





DATA FOR CHART II.4

Long-term nominal interest rates

United States:	U.S. 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.

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.

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.

Chart II.5a

AVERAGE REAL INTEREST RATE
DIFFERENTIAL AGAINST THE USA

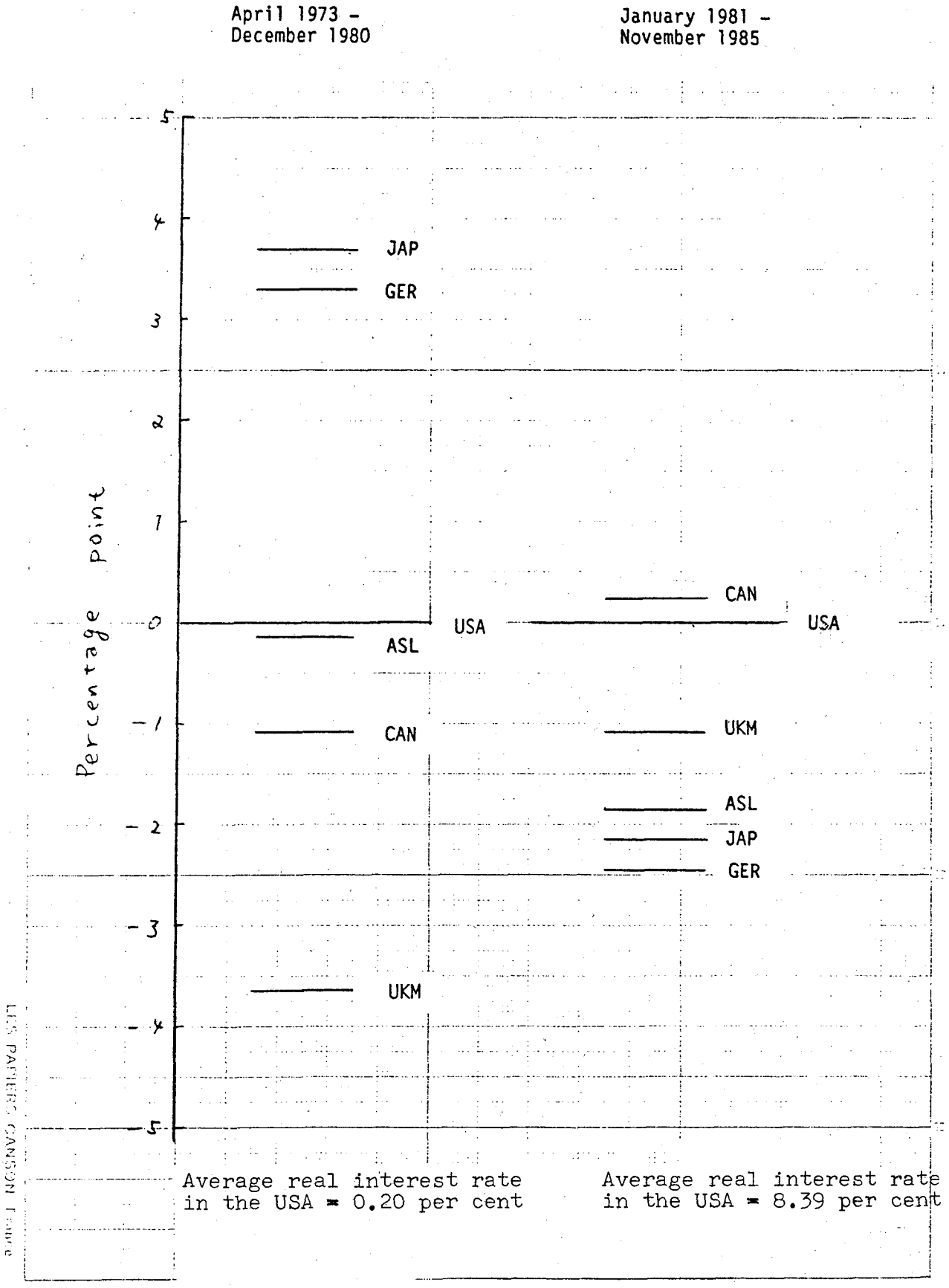


Chart II.5.b

AVERAGE REAL INTEREST RATE
DIFFERENTIAL AGAINST GERMANY

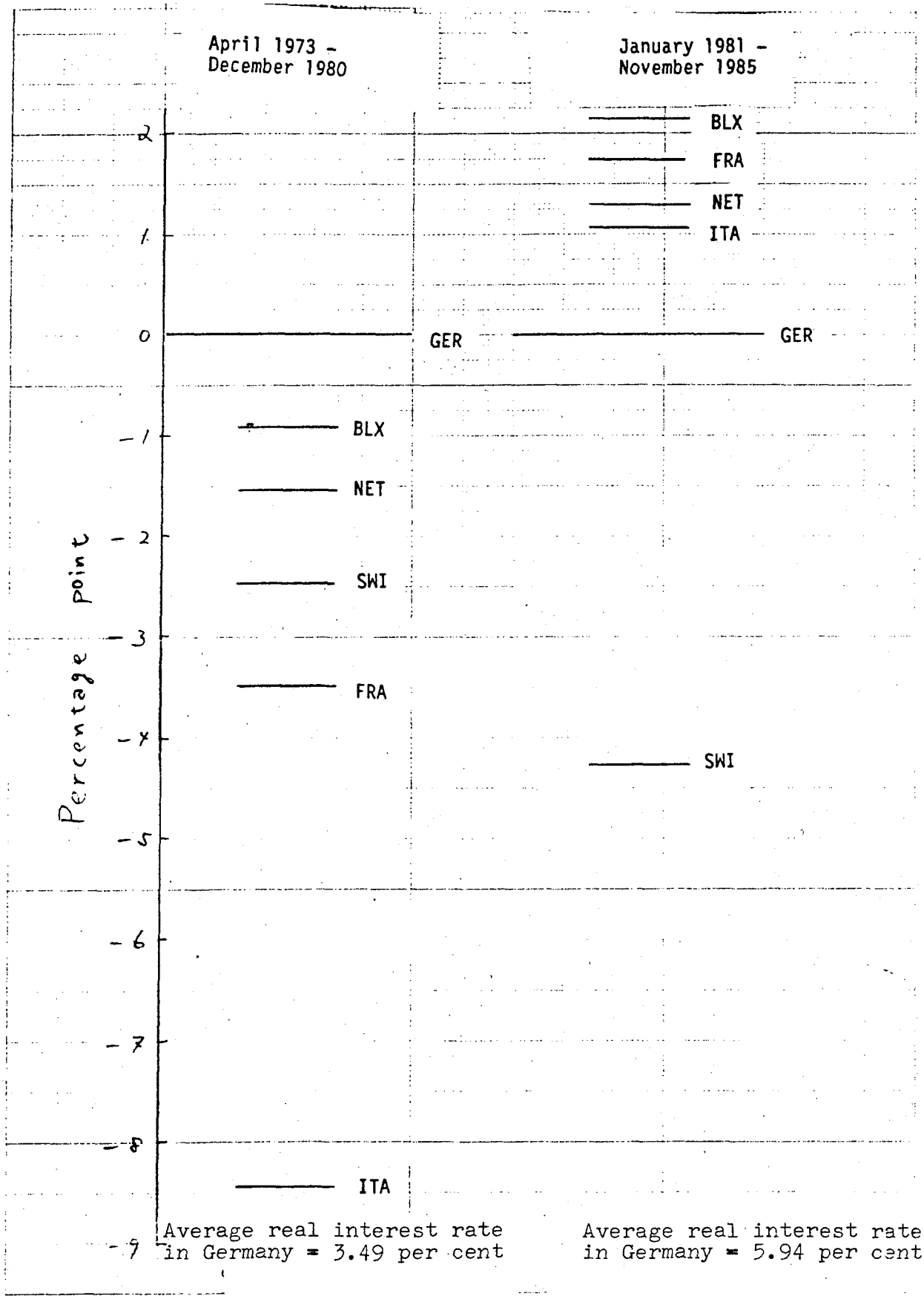
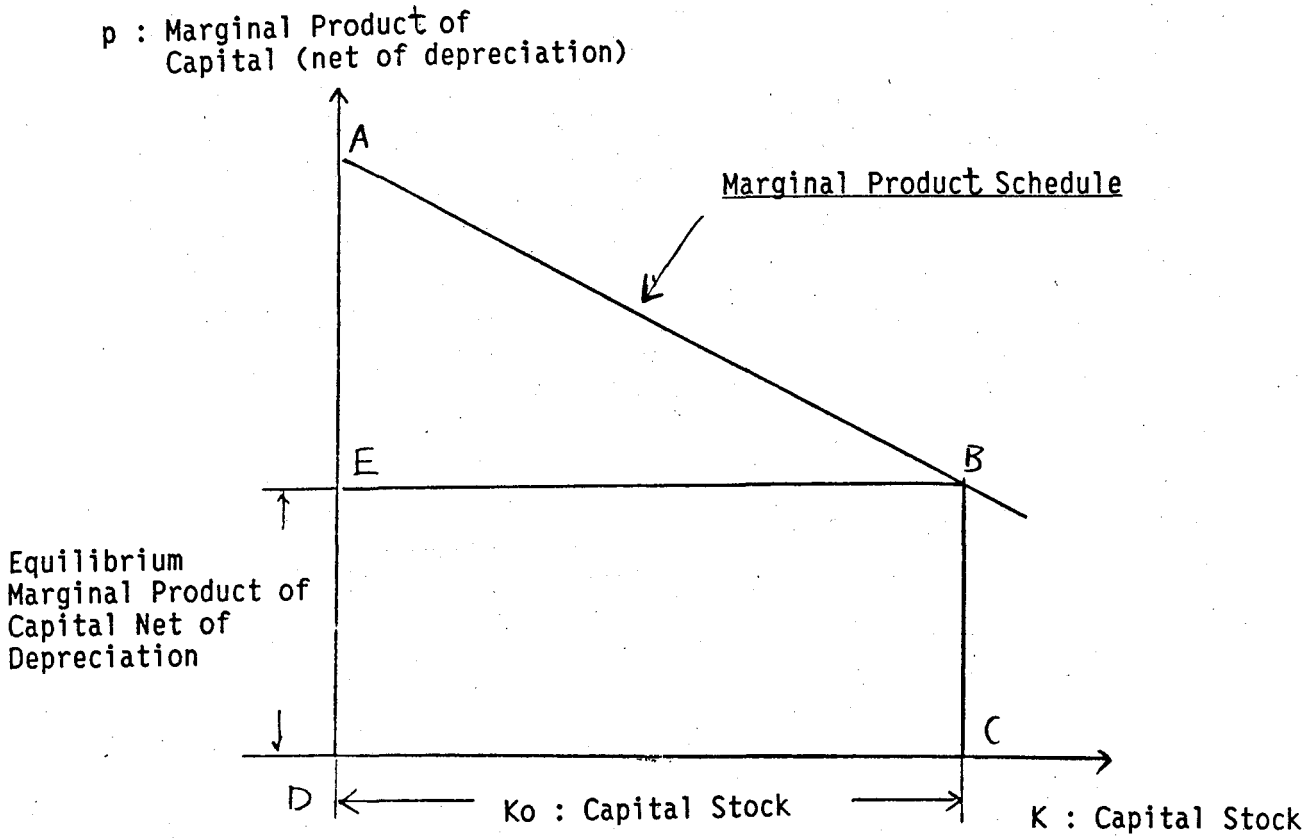
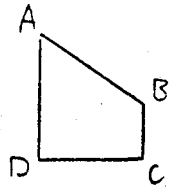


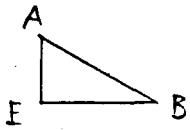
Chart III.1

EQUILIBRIUM IN A FINANCIALLY CLOSED ECONOMY

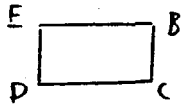




: Net domestic product



: Labour income

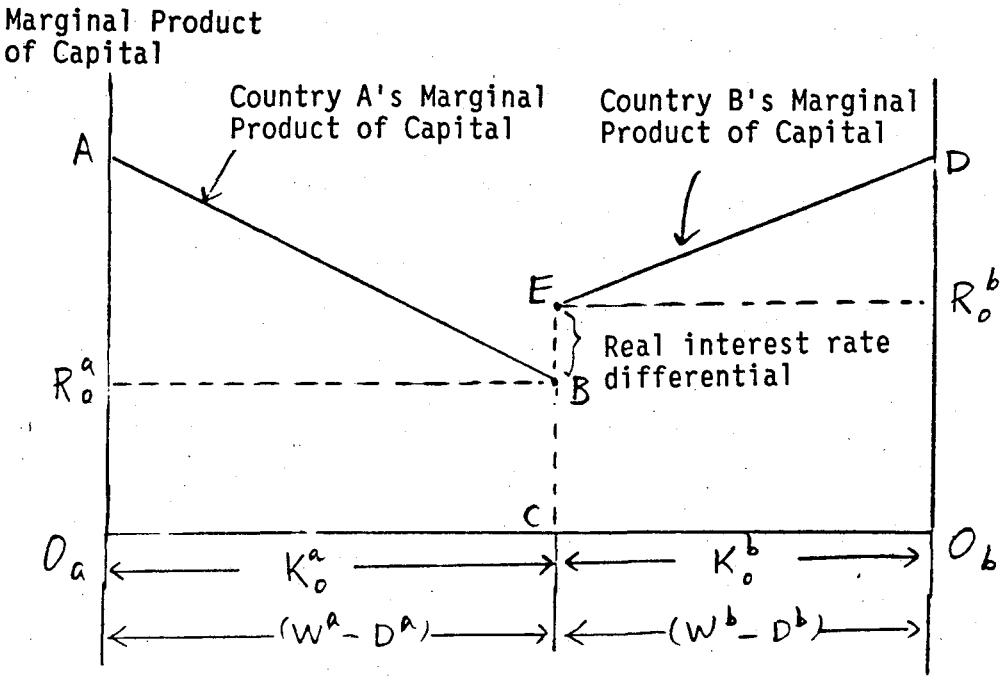


: Capital income

Chart III.2

TWO COUNTRY CASE

a. Segmented Financial Markets



b. Integrated Financial Market

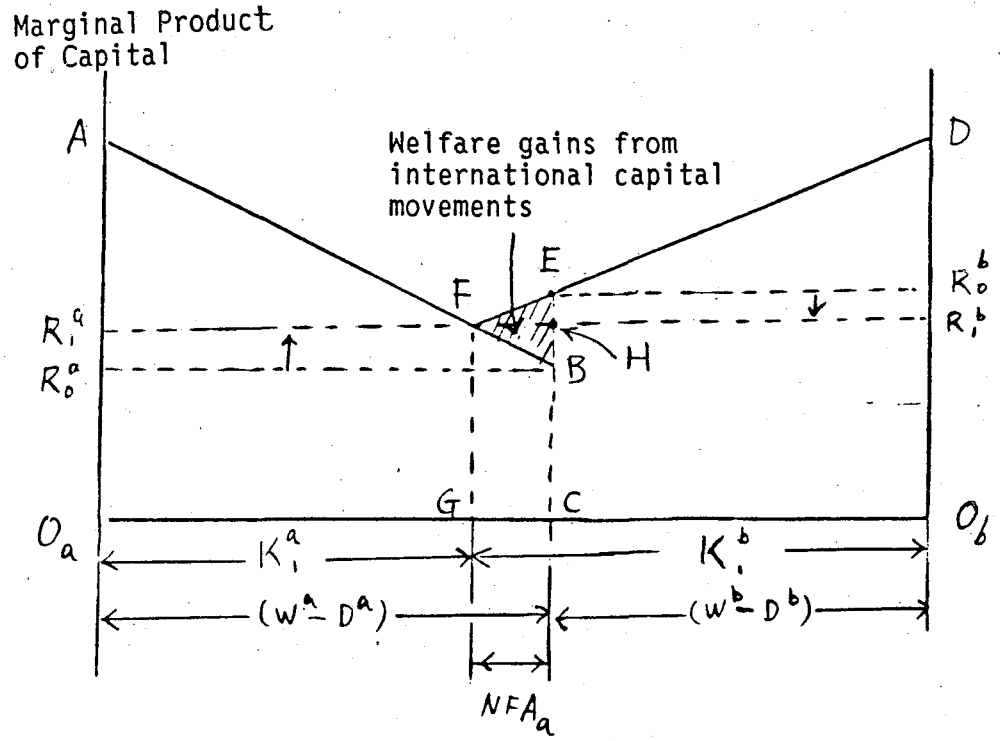
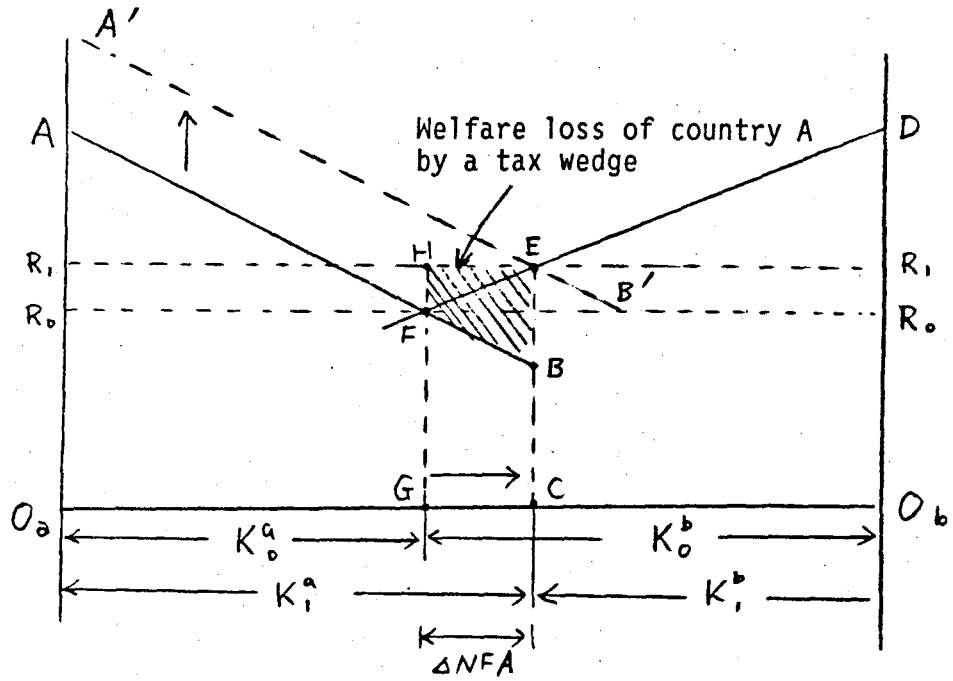


Chart III.3

THE TAX WEDGE AND THE ALLOCATION OF CAPITAL



(Net cha ge in country A's NNP) = (Increase in domestic produc : F B G C)

— (Increase in foreign interest payments : H E G C)

= — H E F B

(Net cha ge in country B's NNP) = (Increase in investment income : H E G C)

— (Decrease in domestic produc : F E G C)

= + H E F

ANNEX A

EQUALISATION OF REAL INTEREST RATES UNDER PERFECT CAPITAL MOBILITY

This Annex shows the relationship between domestic and foreign real interest rates under perfect capital mobility (1). Particularly, 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 perfect capital mobility, 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:

$$(i_s - \pi_s) = (i^*_s - \pi^*_s) + y_s \tag{4}$$

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

$$r_s = r^*_s + y_s \tag{5}$$

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

$$\int_0^\infty y_s ds = \int_0^\infty (r_s - r^*_s)\, ds \tag{6}$$

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:

$$g_o = \bar{g} + \int_0^\infty (r^*_s - r_s) ds \tag{7}$$

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 interests rates,

$$\int_0^\infty (r^*_s - r_s) ds$$

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 (2):

$$R_o(T) = \frac{1}{T} \int_0^T r_s\, ds \tag{8}$$

By integrating (6) from time zero to T, we have

$$g_o = g_T + \int_0^T (r^*_s - r_s) ds$$

$$= g_T + T(R_o^*(T) - R_o(T))$$

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.

NOTES

1. This Annex owes much to the analyses by Porter (1971), Dufey and Giddy (1978) and Isard (1982).

2. 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 in practice.

REFERENCES

Dufey, G. and I.H. Giddy (1978), The International Money Market, Englewood Cliffs: Prentice-Hall.

Isard, Peter (1982), "An Accounting Framework and Some Issues for Modelling How Exchange Rates Respond to the News", International Finance Discussion Papers, No.200, Federal Reserve Board, January.

Porter, Michael (1971), "A theoretical and Empirical Framework for Analyzing the Term Structure of Exchange Rate Expectations", IMF Staff Papers 18, November, pp.613-45.

ANNEX B

CORPORATE TAX SYSTEMS AND THE COST OF CAPITAL

This Annex shows the detailed method of estimation of the cost of capital in selected OECD countries. The theoretical discussion is followed by tables which show corporate tax rates and allowances for individual countries.

1. The cost of capital function for debt finance

The following analysis assumes that there is no uncertainty, no changes in the tax system, and that the inflation rate is uniform and constant over time. The details of the derivation can be found in Chapter 2 of King and Fullerton (1984).

Consider an investment project costing one currency unit. Suppose that the gross marginal real rate of return of the project, MMR, declines at a constant exponential rate of depreciation, d. Since the nominal return increases at the rate of inflation, π, the net tax present discounted value of the profit, V, is given by:

$$V = \int_0^\infty (1-u)MMRe^{(\pi-d)t}e^{-it}dt$$

$$= (1-u)MMR/(i+d-\pi) \qquad (1)$$

where

u = corporate tax rate
i = discount factor used by the firm

On the other hand, the cost of the project, C, which takes account of the present value of the depreciation allowance, z, and the investment tax credit or investment grant, k, is given by:

$$C = 1-k-uz \qquad (2)$$

where

$$z = \int_0^\infty D(t)e^{-it}dt \qquad (3)$$

and D(t) is the depreciation allowance at time t for the project.

At the margin, the present value of the project V has to be at least equal to the cost C. Therefore, we have

$$MMR = (i+d-\pi)(1-k-uz)/(1-u) \qquad (4)$$

for the marginal project. The minimum required real rate of return for a viable project, p, is obtained by subtracting the rate of depreciation, d, from the above equation:

$$p = (i+d-\pi)(1-k-uz)/(1-u) - d \qquad (5)$$

For debt finance, nominal interest payments are usually fully deductible from taxable corporate income. Therefore, the discount factor, i, would be equal to the after tax nominal interest rate:

$$i = (1-u)(r+\pi_e) \tag{6}$$

where

r = real market interest rate.

Thus, the following cost of capital functions for debt finance is obtained:

$$p = [(1-u)(r+\pi_e)+d-\pi_e](1-k-uz)/(1-u)-d \tag{7}$$

where z is calculated by equation (3) with $i = (1-u)(r+\pi_e)$. By assigning parameter values, the cost of capital can be calculated from this equation.

It can be proved that the present value of the depreciation allowance is expressed as follows:

-- Straight line depreciation over period L:

$$z = [1-e^{-(1-u)(r+\pi_e)L}]/[(1-u)(r+\pi_e)L] \tag{8}$$

-- Exponential depreciation at a rate of a:

$$z = a/[a+(1-u)(r+\pi_e)] \tag{9}$$

-- Declining balance depreciation method. Under this method, the tax life time, L, is specified for the capital asset. The firm can depreciate the asset exponentially at a rate of

$$a = x/L$$

where x is the declining balance rate (usually about two times the straight line annual depreciation rate). Furthermore, the firm can shift from the exponential depreciation to the straight line methods at its discretion. The optimal switch-over period, t*, can be expressed as follows:

$$t^* = L(1 - 1/x) \tag{10}$$

For this optimal depreciation,

$$z = x[1-e^{-[(1-u)(r+\pi_e)+x/L]t^*}] / [(1-u)(r+\pi_e)L+x]$$
$$+e^{-(x/L)t^*}[e^{-(1-u)(r+\pi_e)t^*} - e^{-(1-u)(r+\pi_e)L}] /$$
$$[(1-u)(r+\pi_e)(L-t^*)] \tag{11}$$

2. The estimated cost of capital

Equation (7) is applied to the data of selected OECD countries. A full explanation of the numerical assumptions for each country is shown in Table B.1. The data in the table are the latest available figures at the time of writing (October 1986). For the United States, the United Kingdom and Canada the old as well as the new systems are reported. Some simplifying assumptions were required to calculate the size of tax wedges:

-- Only general investment grants or tax credits are included. Regional grants are not included;

-- Firms are assumed to choose the most advantageous depreciation method available;

-- There are no tax-exhausted firms (see text for the case of the United Kingdom).

Tables III.1-III.4 in the main text show the estimated tax wedges, w, which is defined as follows:

$$w = p - r. \qquad (12)$$

REFERENCES

King M.A. and D. Fullerton (1984), The Taxation of Income from Capital: A Comparative Study for the United States, the United Kingdom, Sweden and West Germany, the University of Chicago Press.

Hall, R. and D. Jorgenson (1967), "Tax Policy and Investment Behavior", American Economic Review, Vol.57.

Hulten, C.R. and J.W. Robertson (1983), Differential Effects of the Accelerated Cost Recovery system on Investment: A Survey, with Implications for Understanding Effects on High Technology Investment, National Science Foundation, October.

Table B.1

TAX SYSTEM FOR BUSINESS INVESTMENT*

United States

	1985	1988	Source
Coporate income tax rate	51.18% (1)	40.34% (1)	M

	Machinery		Buildings		
Economic depreciation rates	12.5%		6.7%		A
	1985	1988	1985	1988	
Type of depreciation	ACRS	DB	ACRS	SL	F, M
Tax lifetime (years)	5 (2)	6	19 (3)	30	F, M
Declining balance rate	n.a.	200%	n.a.	n.a.	M
or					
Exponential tax depreciation rates	n.a.	n.a.	n.a.	n.a.	
Switch over from declining balance to straight line	n.a.	yes	n.a.	n.a.	
Investment tax credit and grant rate	10% (4)	0%	0%	0%	E
Weight of capital stock	29.4%		70.6%		C

(1) - National tax rate = 46% (1985); 34% (after July 1987)
- State tax rate = 2 - 12% (in California : 9.6%)
- The state tax is deductible from income assessed for national tax purposes.
- Total tax rate = (1 - 0.096) x 46% + 9.6% = 51.18% (1985)
(1 - 0.096) x 34% + 9.6% = 40.34% (1988)

(2) The yearly recovery percentages are :
1st year 15%
2nd year 22%
3rd - 5th 21%

(3) The percentages for property placed in service in June are :
1st year 6%
2nd year 9%
3rd year 8%
4th - 5th 7%
6th - 7th 6%
8th - 12th 5%
13th - 18th 4%
19th year 2%

(4) One half of the investment tax credit is subtracted from depreciable base.

* See notes at the end of Tables B1.

Japan

		Source
Corporate income tax rate	54.60% (1)	G

	Machinery	Buildings	
Economic depreciation rates	13.3%	5%	A
Type of depreciation	DB	DB	A
Tax lifetime (years)	10	43.5	A
Declining balance rate	200%	200%	A
or			
Exponential tax depreciation rates	n.a.	n.a.	
Switch over from declining balance to straight line	yes	yes	G
Investment tax credit and grant rate(2)	0%	0%	G
Weight of capital stock	31.9%	68.1%	H

(1) - National tax: tax rate on retained profit = 43.3%,
tax rate on dividends = 33.3%, dividend rate = 14%,
national tax rate = 43.3% x 0.86 + 33.3% x 0.14 = 41.90%
- Local tax : inhabitant tax rate = national tax rate x 0.173 = 7.25%
Enterprise tax rate = 12%
- The enterprise tax is deductible (with one year's lag) from taxable income.
- Total tax rate = $\frac{41.90\% + 7.25\% + 12\%}{1 + 0.12}$ = 54.60%

(2) Special treatment for investment tax credit is given to items below:

- Facilities for conservation of resources and energy or diversification of energy sources 7%
- High technology facilities of small- and medium- sized companies 7%

However, these are minor compared with the total magnitude of business investment in Japan.

Germany

			Source
Corporate income tax rate	61.22%(1)		G
	Machinery	Buildings	
Economic depreciation rates	12.5%	4.8%	A
Type of depreciation	DB	SL (2)	A,G
Tax lifetime (years)	10	25	A,G
Declining balance rate	300%	n.a.	A,G
or Exponential tax depreciation rates	n.a.	n.a.	
Switch over from declining balance to straight line	yes	no	A
Investment tax credit and grant rate (3)	0%	0%	A
Weight of capital stock	58.4%	41.6%	C

(1) - National tax : tax rate on retained profit = 56%
tax rate on dividends = 36%, dividend rate = 3%
national tax rate = 56% x 0.97 + 36% x 0.03 = 55.4%
- Local tax rate = 12 - 20% (in Hessen : 15%)
The local tax is deductible (with one year's lag) from taxable income.
- Total tax rate = $\frac{55.4\% + 15\%}{1 + 0.15}$ = 61.22%
- One half of interest payments is deductible from income assesed for local tax purposes.

(2) The yearly depreciation percentages are:

1st-4th 10%
5th-7th 5%
8th-25th 2.5%

(3) On special occasions, such as extraordinary economic slow-down, a 7.5 % investment tax credit is available. However, it has never been executed.

France

			Source
Corporate income tax rate	45%(1)		G
	Machinery	Buildings	
Economic depreciation rates	12.5%	5.7%	A
Type of depreciation	DB	DB	A
Tax lifetime (years)	7.5	20	A
Declining balance rate	250%	250%	A
or Exponential tax depreciation rates	n.a.	n.a.	
Switch over from declining balance to straight line	yes	no	A
Investment tax credit and grant rate	0%	0%	A
Weight of capital stock	39.4%	60.6%	I

(1) National tax only

United Kingdom

					Source
Coporate income tax rate(1)	1983/84 50%	1984/85 45%	1985/86 40%	1986/87 35%	J
	Machinery		Buildings(2)		
Economic depreciation rates	6%		2.5%		A
Type of depreciation (3)	1983/84 100%FYA	1986/87 DB	1983/84 75%FYA+ 4%SL	1986/87 SL	J
Tax lifetime (years)	1	n.a.	7	25	J
Declining balance rate or Exponential tax depreciation rates	n.a. n.a.	n.a. 25%	n.a. n.a.	n.a. n.a.	J
Switch over from declining balance to straight line	n.a.	no	n.a.	n.a.	
Investment tax credit and grant rate	0%	0%	0%	0%	A
Weight of capital stock	58.5%		41.5%(4)		C

(1) National tax only

(2) No depreciation allowances are given for commercial buildings (except for hotels and commercial buildings in enterprise zones).

(3) Changes to the "first year allowance" system are as follows:

	1983/84	1984/85	1985/86	1986/87
Machinery	100%	75%	50%	nil
Industrial buildings	75%	50%	25%	nil

(4) A 41.9 per cent of the whole buildings consists of commercial buildings for which no depreciation allowance is available.

Italy

			Source
Corporate income tax rate	45.6%(1)		D
	Machinery	Buildings	
Economic depreciation rates	11.1%	5.7%	A
Type of depreciation	SL	SL	A
Tax lifetime (years)	10	33.3	A
Declining balance rate or Exponential tax depreciation rates	n.a. n.a.	n.a. n.a.	
Switch over from declining balance to straight line	n.a.	n.a.	
Investment tax credit and grant rate	0%	0%	A
Weight of capital stock(2)	43.7%	56.3%	

(1)
- National tax rate = 36%
- Local tax rate = 15%
- The local tax is deductible from income assesed for national tax purposes.
- Total tax rate = (1 - 0.15) x 36% + 15% = 45.6%

(2) The weight is not available, and is assumed to be the average of the countries whose weights are available.

Canada

	1986	1987	1988	1989	Source
Corporate income tax rate	49%(1)	48%	47%	46%	K
	Machinery		Buildings		
Economic depreciation rates	13.3%		5%		A
Type of depreciation	DB		DB		A
Tax lifetime (years)	n.a.		n.a.		
Declining balance rate or Exponential tax depreciation rates	n.a.		n.a.		
	20%		5%		A
Switch over from declining balance to straight line	no		no		
	1986	1987	1988	1989	
Investment tax credit rate (Both on machinery and buildings)	7%(2)	5%(2)	3%(2)	0%	K
Weight of capital stock	39.5%		60.5%		L

(1) - National tax rate = 46%
- Provincial tax rate = 10 - 16% (average : 13%)
- 10% of income earned in a province is deducted from the national tax liabilities.
- Total tax rate = (46% - 10%) + 13% = 49%

(2) No adjustment to the depreciable base is required.

Australia

			Source
Corporate income tax rate	46%(1)		D
	Machinery	Buildings	
Economic depreciation rates	13.3%	5.4%	A
Type of depreciation	SL	SL	A
Tax lifetime (years)	5	40	A
Declining balance rate or Exponential tax depreciation rates	n.a.	n.a.	
	n.a.	n.a.	
Switch over from declining balance to straight line	n.a.	n.a.	
Investment tax credit and grant rate	18%(2)	0%	A
Weight of capital stock(3)	43.7%	56.3%	

(1) National tax only

(2) The depreciation allowance is larger than the value of investment by this amount. Since this excess depreciation can be charged to the first year taxable income, it is equivalent to an investment tax credit.

(3) The weight is not available, and is assumed to be the average of the countries whose weights are available.

Belgium

			Source
Corporate income tax rate	45%(1)		D
	Machinery	Buildings	
Economic depreciation rates	12.5%	5%	A
Type of depreciation	DB	DB	A
Tax lifetime (years)	3	20	A
Declining balance rate or Exponential tax depreciation rates	200% n.a.	200% n.a.	A
Switch over from declining balance to straight line	yes	yes	A
Investment tax credit and grant rate	13%(2)	13%(2)	A
Weight of capital stock(3)	43.7%	56.3%	

(1) National tax only

(2) Subject to depreciation

(3) The average of the countries whose weights are available.

Netherlands

			Source
Corporate income tax rate	43%(1)		D
	Machinery	Buildings	
Economic depreciation rates	12.5%	4.8%	A
Type of depreciation	SL	SL	A
Tax lifetime (years)	8	40	A
Declining balance rate or Exponential tax depreciation rates	n.a. n.a.	n.a. n.a.	
Switch over from declining balance to straight line	n.a.	n.a.	
Investment tax credit and grant rate	12%(2)	14%(2)	A
Weight of capital stock(3)	43.7%	56.3%	

(1) National tax only

(2) Subject to depreciation

(3) The average of the countries whose weights are available.

Spain

			Source
Corporate income tax rate	35%(1)		D
	Machinery	Buildings	
Economic depreciation rates	13.3%	5%	A
Type of depreciation	DB	DB	A
Tax lifetime (years)	18	50	A
Declining balance rate or Exponential tax depreciation rates	250% n.a.	250% n.a.	A
Switch over from declining balance to straight line	yes	yes	A
Investment tax credit and grant rate	20%(2)	20%(2)	A
Weight of capital stock(3)	43.7%	56.3%	

(1) National tax only

(2) Subject to depreciation

(3) The average of the countries whose weights are available.

Sweden

			Source
Corporate income tax rate	52%(1)		D
	Machinery	Buildings	
Economic depreciation rates	13.3%	5%	A
Type of depreciation	DB	SL	A
Tax lifetime (years)	n.a.	23	A
Declining balance rate or Exponential tax depreciation rates	n.a. 30%	n.a. n.a.	A
Switch over from declining balance to straight line	no	n.a.	
Investment tax credit and grant rate	20%(2)	10%(2)	A
Weight of capital stock(3)	43.7%	56.3%	

Note: The investment funds system, which is one of the features of the Swedish corporate taxation, is not dealt with in our analysis (see King and Fullerton (1984)).

(1) National tax only

(2) Subject to depreciation

(3) The average of the countries whose weights are available.

NOTES TO TABLE B.1

1. The following symbols are used:

   DB = Declining balance
   SL = Straight line
   ACRS = The Accelerated Cost Recovery System
   FYA = "first year allowance"
   n.a. = not applicable

2. The tax parameters are based on the latest available information at the time of writing (October 1986).

Data sources

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ANNEX C

FINANCING COST OF HOUSING INVESTMENT

In the main text, the after tax financing cost of housing investment is compared among selected OECD countries. This annex explains the detailed method of comparison.

1. Estimation method: borrowing case

In order to conduct systematic comparisons of the real financing cost of housing, the following simplifing assumptions are made:

i) One unit of housing is assumed to be equal to six times the annual disposable income of the average production worker (APW, one earner couple with two children) in 1984. The concept of APW is defined in OECD (Data source D in Table C.1).

ii) The real value of the housing at the time of purchase is maintained by the owner (1).

iii) The market value of housing is always fully mortgaged. The amount of borrowing increases as general prices increase due to inflation.

Under these assumptions, the hypothetical purchase of one unit of housing is totally financed by borrowing. Therefore, in the following analysis, we analyse the effect of the personal tax system on the real cost of borrowing for housing investment. However, for some countries, the real after tax cost of borrowing is higher than the real after tax yield on financial assets. In these countries, the house buyers have an incentive to finance the investment by the withdrawal of financial assets as much as possible. Therefore, as a supplementary measure we also estimate the real cost of funds from the after tax yield on financial assets in the next section.

From Table C.1 on the tax system for housing investment we calculated the real cost of finance for housing investment as follows:

i) Calculate the assumed price of one unit of housing, P, if the rate of tax relief depends on the cost of housing.

ii) Calculate the after tax nominal interest rate, i_a, while using all possible tax relief (2).

iii) The after tax rate, i_a, depends on the time passed after the purchase of housing due to the limited duration of tax relief in some countries. Therefore, if necessary, we calculate the equivalent flat nominal interest rate, i_f, which has the same present value as the after tax rate i_a. Under the constant inflation rate of π, the amount of borrowing at time t (t=0 at purchase) is $Pe^{\pi t}$ (see assumption 3). Therefore, the flat interest rate, i_f, can be calculated from the following equation for the nominal market interest rate, i:

$$\int_0^{\infty} i_f \, Pe^{\pi t} e^{-it} \, dt = \int_0^{\infty} i_a(t) \, Pe^{\pi t} \, e^{-it} \, dt$$

or

$$i_f = \frac{\int_0^{\infty} i_a(t) \, e^{-(i-\pi)t} \, dt}{\int_0^{\infty} e^{-(i-\pi)t} \, dt} \qquad (1)$$

where the market rate, i, is assumed to be larger than the inflation rate, π.

iv) Calculate the real financing cost of housing investment, p_h, by subtracting π from i_f as follows:

$$p_h = i_f - \pi \qquad (2)$$

The estimation procedure for each individual country is briefly discussed below.

The United States

Because interest payments are fully deductible, the price of one unit of housing is irrelevant for the calculation. The after tax nominal interest rate, i_a, can be expressed by the market interest rate, i, and the marginal income tax rate, u as follows:

$$i_a = (1-u)i.$$

In this calculation, we used the marginal tax rate excluding social security contributions (base of social security tax is not affected by interest payments). Subtracting the inflation rate, π, we have the following real after tax cost of finance, p_h.

$$p_h = (1-u)\, i - \pi \qquad (3)$$

As the marginal tax rate, u, we used 0.2635 for the old system and 0.15 for the new system after the tax reform of 1986.

Japan

Since the income of an average production worker is Y 2,700,000 we assumed that the unit price of housing is Y 16,200,000. Japan has two systems which reduce the cost of housing investment. The government owned Housing Loan Corporation (HLC) provides low cost mortgages which are effectively subsidised by the general budget of the central government. The interest rate on the subsidised mortgage is lower than the mortgages available from commercial banks by about 1.7 percentage points for the first ten years of the life of the mortgage. After this ten-year period, the interest rate of the HLC rises to a level broadly comparable to that of commercial banks. Also, a system of tax credit against outstanding loans is available for the first three years of mortgage repayments. This tax credit system effectively reduces the cost of mortgages from commercial banks by one percentage point and reduces that from HLS by 0.5 of a percentage point. Although there is a

limit on tax credits, it is not binding compared with the assumed cost of housing.

The combined effects of these two systems can be measured by calculating the equivalent flat nominal interest rate, i_f. At the end of 1985, 65 per cent of the outstanding housing loan is held by the private financial institutions and 35 per cent is held by HLC. Therefore, the after tax-subsidy interest rate, i_a, has the following time pattern:

Year	1-3	4-10	11 -
Private loan (65%)	i - 0.01	i	i
HLC loan (35%)	i - 0.022	i - 0.017	i

i: market interest rate

By using the equation (1) we have

$$i_f = 0.65\,[i - 0.01(1 - e^{-(i-\pi)3})] + 0.35\,[i\,e^{-(i-\pi)10} + (i-0.017)(e^{-(i-\pi)3} - e^{-(i-\pi)10}) + (i - 0.022)(1-e^{-(i-\pi)3})] \quad (4)$$

The real financing cost of housing investment, p_h, can be obtained from the above i_f and equation (2).

Germany

In Germany, interest payments on mortgages are deductible from taxable income up to DM10,000 for 3 years. Compared with the assumed cost of housing of P=DM 170,000, this limit can be binding depending on the level of mortgage interest rate.

If the annual interest payment is lower than DM10,000, i.e.

$$i \leq \frac{10,000}{170,000} = 0.0588$$

the limit is not binding and the equivalent nominal rate, i_f, can be expressed as follows:

$$i_f = [1 - 0.22\,(1-e^{-(i-\pi)3})]\,i \quad (5)$$

where 0.22 is the marginal tax rate excluding social security contributions. If $i > 0.0588$, the limit of DM10,000 is binding and we have

$$i_f = [1-0.22\ (0.0588/i)(1-e^{-(i-\pi)3})]i \qquad (6)$$

In the above calculations, we assumed that the limit on deductions is raised as general prices rise.

The real cost of finance can be calculated by subtracting π from the i_f calculated above.

France

For France, the cost of housing is assumed to be FF 437,000. 20 per cent of interest payments on mortgage can be credited against personal income tax up to FF.13,500 (for a family of four) for two years. Therefore, for the range of nominal interest rate which satisfies the following equation:

$$437{,}000*i*0.2 \leq 13{,}500$$

$$\text{i.e.} \qquad i \leq 0.1544$$

the full 20 per cent tax credit can be obtained.

The equivalent flat nominal interest rates, i_f, are as follows:

$i \leq 0.1544$

$$i_f = [1-0.2(1-e^{-(i-\pi)2})]i \qquad (7)$$

$i > 0.1544$

$$i_f = [1-0.2(0.1544/i)(1-e^{-(i-\pi)2})]i \qquad (8)$$

The real cost of finance can be calculated from the above equations and equation (2).

United Kingdom

The cost of housing is assumed to be £37,800. Interest rate payments on mortgages are deductible up to a maximum borrowing of £30,000. Therefore, this limit is binding in the calculation of after tax cost of mortgage. The equivalent flat nominal interest rate, i_f, is:

$$i_f = [1-0.3\ (30000/37800)]\ i \qquad (9)$$

and the real cost is obtained by subtracting π from i_f. In the above equation, the limit of borrowing is assumed to be indexed to the general price level.

Canada

Canada has no tax reliefs for housing investment. Therefore, the real cost of finance for housing investment is equal to the market real interest rate if the housing is fully mortgaged.

Australia

In Australia, the 30 per cent of interest payments on mortgage can be credited against personal income tax for 5 years. Since there is no limit on this tax relief except for the available total tax liabilities to credit, the assumption on the price of housing is not necessary. The equivalent flat nominal interest rate, i_f, is given by:

$$i_f = [1-0.3(1-e^{-(i-\pi)5})]i \qquad (10)$$

and the real cost is obtained by substracting π from i_f.

Sweden

For Sweden assumptions on the price of housing are not necessary. Interest payments on mortgages are fully deductible up to the amount of imputed income from housing, calculated as 2 per cent of the assessed value of the property. As a rule of thumb, the assessed value of the housing is equal to half of its market price. If the interest payment exceeds this imputed income, only one half of the interest payment in excess of the imputed income can be deducted from taxable income. On the other hand, even if the imputed income exceeds the interest payment, the imputed income net of interest is not taxed. Because of this, imputed income is only used for calculating the floor on interest payments below which interest payments are not deductible (3).

Under this system, if the nominal interest rate is less than one per cent, the real cost of housing investment is equal to the market real interest rate. When the nominal rate exceeds one per cent, the net tax-adjusted nominal interest payment is:

$$i - 0.5315\,(i - 0.01)/2$$

where 0.5315 is the marginal tax rate, excluding social security contributions. Thus, the real cost of finance is:

$$i \leq 1 \quad p_h = i - \pi \qquad (11)$$

$$i > 1 \quad p_h = i - 0.5315(i-0.01)/2 - \pi \qquad (12)$$

2. Estimation method: asset draw down case

The above analysis is based on the assumption that the purchase of housing is entirely financed by borrowing. However, housing investment may be partly or totally financed by a draw down of financial assets. Although the real financing cost of housing investment depends on the mix of borrowing and asset draw down, we assume that the purchase of housing is totally financed by asset draw down to simplify the analysis. Moreover, we assume that interest income is taxable as regular income, although in some countries, such as Japan, tax-exempt savings measures are prevailing.

Under these simplified assumptions, the estimation formula of the real cost of housing investment is given as follows:

$$p_h = (1-u)\, i - \pi \qquad (13)$$

where u is the marginal income tax rate excluding social security contributions in each country shown in Table C.1.

NOTES

1. Alternatively, we could assume that the real value of housing declines by a constant rate of economic depreciation. However, under this alternative assumption, the effect of tax relief depends on this rate of depreciation which differs among countries. Since we could not obtain this economic rate of depreciation, we effectively assumed that housing does not depreciate. Under this assumption, the effects of tax reliefs with limited duration would be underestimated somewhat.

2. We assume that the taxable income and tax liability are always sufficient for tax deductions or tax credits related to housing investment.

3. This Swedish tax system for housing investment is a simplified approximation. The actual system is more complicated due to the different treatment of imputed income in the state income tax and the municipal income tax calculations.

Table C.1

TAX SYSTEM FOR HOUSING INVESTMENT*

United States

		Source
Disposable income of average production workers	US$ 15,096	D
	1984 / After 15th March 1987	
Marginal income tax rate excluding social security contributions	26.35% / 15.00%	A, G
Deductibility of interest payments from taxable income	Fully deductible	C
Taxation of imputed income from home ownership	no	C
Housing investment tax credit	no	C
Property tax(1)	Tax base : the value of land and buildings	B
	Tax rate : 2.3% (av.state-wide rate)	B
	0-3% (combined rates for local purposes)	B

1. Property tax is deductible from income assessed for personal income tax purposes.

* See notes at the end of Tables C.1.

Japan

		Source
Disposable income of average production workers	Y 2,703,233	D
Marginal income tax rate excluding social security contributions	14.0%(1)	A
Deductibility of interest payments from taxable income	no	C
Taxation of imputed income from home ownership	no	C
Housing investment tax credit	A tax credit of 1% of the loan outstanding from private financial institutions and 0.5% of that from public financial institutions(2) is given for the first three years up to a ceiling of Y 200,000. (3)	E
Property tax	Tax base: the value of land (4) and buildings	B
	Tax rate: 1.4%	B

1. 20% before the adjustment for employment income allowance.

2. The Housing Loan Corporation provides low cost mortgages whose interest rates are about 1.7 percentage points lower than that of private financial institutions for the first ten years.

3. This credit has not been applied to taxpayers whose total yearly income exceed Y 10,000,000.

4. A 50% reduction is allowed for the land of residence.

Germany

		Source
Disposable income of average production workers	DM 28,247	D
Marginal income tax rate excluding social security contributions	22.00%	A
Deductibility of interest payments from taxable income years in the case of a new building	Deductible up to a maximum of DM 10,000 per annum for three	C
Taxation of imputed income from home ownership	no	C
Housing investment tax credit	no	C
Property tax	Tax base: 0.26% of the capital value for single family houses	B
	Tax rate: Tax paid is fixed as the "basic tax" multiplied by 2.75	B

France

		Source
Disposable income of average production workers	FF 72,830	D
Marginal income tax rate excluding social security contributions	10.00%	A
Deductibility of interest payments from taxable income	no	C
Taxation of imputed income from home ownership	no	C
Housing investment tax credit	A tax credit of 20% of interest on mortgage for the principal residence is given for the first two years up to a ceiling of FF 9,000 increased by FF 1,500 for each dependant	C
Property tax	Tax base: The rental value of the property	B
	Tax rate:	
	"Land and Buildings Tax" 18.05%(av)(1)	B
	"Property Tax" 16.13%(av)	B
	"Land Tax" 56.8% (av)(2)	B

1. Buildings used as the main dwelling are exempt for 15 years.

2. Permanent exemption is provided for land and grounds liable to "Land and Buildings Tax".

United Kingdom

		Source
Disposable income of average production workers	£ 6,292	D
Marginal income tax rate excluding social security contributions	30.00%	A
Deductibility of interest payments from taxable income	Deductible up to a maximum on the loan of £ 30,000	C
Taxation of imputed income from home ownership	no	C
Housing investment tax credit	no	C
Property tax	Tax base: The value of land and buildings	B
	Tax rate: 0.6% - 1.6%	B

Sweden

		Source
Disposable income of average production workers	SK 69,892	D
Marginal income tax rate excluding social security contributions	53.15%	A
Deductibility of interest payments from taxable income	Deductible from imputed income from home ownership together with the half of interest payments in excess of the imputed income	F
Taxation of imputed income from home ownership	yes (1)	F
Housing investment tax credit	no	F
Property tax	Tax base: the value of land and buildings	F
	Tax rate: 0.5%	F

1. The imputed income is calculated as 2 per cent of a conservatively assessed value of the property which is as a rule of thumb equal to half of the market value.

Canada

		Source
Disposable income of average production workers	C$ 20,175	D
Marginal income tax rate excluding social security contributions	29.40%	A
Deductibility of interest payments from taxable income	no	C
Taxation of imputed income from home ownership	no	C
Housing investment tax credit	no	C
Property tax	Not available	

Australia

		Source
Disposable income of average production workers	A$ 16,934	D
Marginal income tax rate excluding social security contributions	30.00%	A
Deductibility of interest payments from taxable income	no	C
Taxation of imputed income from home ownership	no	C
Housing investment tax credit	A tax credit of 30% of interest paid is given during the first five years of ownership	C
Property tax	Tax base: the value of land	B
	Tax rate: "Rates" 0-3% in metropolitan urban areas: 3-10% in non-metropolitan urban areas	B
	"Land Tax" from 0.3% for the first A$5,000 of taxable value to 2.4% for taxable value in excess of A$130,000	B

NOTES TO TABLE C.1

1. The disposable income of the average production worker (one earner couple with two children) is based on 1984 figures.

2. The marginal income tax rate excluding social security contributions for the above average production worked is calculated from 1983 figures.

3. Other items are based on the latest available information at the time of writing (October 1986).

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ANNEX D

THE REAL COST OF CAPITAL AND THE DEMAND FOR CAPITAL

This Annex analyses the relationships between the real cost of capital and the demand for capital in the long run (1). In the first section, the estimation method of this relationship is explained under the assumption that the market real interest rate is given to the economy (small country assumption).

Once this relationship between the real cost of capital and the demand for capital is estimated for each country, the effects of a change in the cost of capital function can be analysed for a large open economy. The second section explains the estimation method of the effect of an introduction of tax incentives for investment for a large country.

Assuming that the accumulated saving of the world economy is constant, the introduction of additional tax incentives for investment by a country pushes up the world real interest rate. This increase in the real interest rate can be estimated from the relationships between the demand for capital and the real interest rate for each country. Given the estimate of the increase in the world real interest rate, the combined effect of tax policy and the increased interest rate on the capital stock for each country can be estimated.

1. The estimation method under the small country assumption

The production function in the INTERLINK system is based on a double nested CES production function, combining capital, energy and labour to define gross output. The inner function which combines energy and capital has the form:

$$KE = [B_1 * K^{\frac{s-1}{s}} + C_1 * E^{\frac{s-1}{s}}]^{\frac{s}{s-1}} \qquad (1)$$

KE = capital-energy bundle
K = business capital stock
E = business energy requirement
B_1, C_1 = scale factors in the inner CES function
s = elasticity of substitution between energy and capital

in a steady state (2).

The outer function which combines labour and the capital-energy bundle into gross output has the form:

$$Q = [B_0 * (J*L)^{\frac{t-1}{t}} + C_0 * KE^{\frac{t-1}{t}}]^{\frac{t}{t-1}} \qquad (2)$$

Q = gross potential output
J = labor efficiency index
L = total business employment
B_0, C_0 = scale factors in the outer CES function
t = elasticity of substitution between labour and capital-energy bundle

The parameters of these production functions for the seven major countries are shown in Table D.1.

Table D.1

PARAMETER VALUES OF THE PRODUCTION FUNCTION

	USA	JAP	GER	FRA	UKM	ITA	CAN
Inner function							
B_1	0.87886	0.80336	0.79175	0.85941	0.79149	0.78313	0.89544
C_1	0.005451	0.093752	0.009593	0.052978	0.00007	0.004235	0.062945
s	0.500	0.800	0.500	0.800	0.300	0.500	0.900
Outer function							
B_0	0.70388	0.001133	0.57638	0.048114	0.001614	0.018163	0.69644
C_0	0.3630	0.38591	0.3609	0.37916	0.68272	0.2721	0.36089
t	1.0100	0.700	0.990	0.800	0.600	0.800	1.010

By substituting the equation (1) to KE in equation (2), a combined production function which shows the relationships between output, Q, and the three factor inputs, L, K, E can be derived. The combined production functions can be written as follows:

$$Q = F(L, K, E) \quad (3)$$

In a long-run equilibrium with given labour supply, $\bar{L}$, the marginal product of capital and the marginal product of energy will be equal to the real user cost of capital and the real cost of energy respectively.

$$\frac{\partial F}{\partial K}(\bar{L}, K, E) = \frac{C}{P_q} \quad (4)$$

$$\frac{\partial F}{\partial E}(\bar{L}, K, E) = \frac{P_e}{P_q} \quad (5)$$

C = nominal user cost of capital
P_q = output price
P_e = energy price

Therefore, under a given labour supply, $\bar{L}$, these equations (3), (4) define a relationship between two relative prices (C/P_q, P_e/P_q) and 2 quantities (K,E). Using this relationship, we can derive the demand for capital and energy under a given set of relative prices.

In order to estimate the effect of a change in the real cost of capital, we first solved the nonlinear simultaneous equation system of (4) and (5) for K and E with the actual values of L, C, P_q, P_e in 1985. Then, we solved the system for a hypothetical one percentage point decrease in the real cost of capital (3). The data for this simulation are reported in Table D.2. The results are reported in Table III.7 in the main text.

2. The estimation method under the large country assumption

Suppose there are only two countries in the world: country 1 and country 2. Suppose also that the relationships between the real cost of capital (p) and the demand for capital (K) can be described by the following functions:

$$K_i = f_i(p_i) \qquad i = 1,2 \qquad (6)$$

p_i = real cost of capital in country i
K_i = demand for capital by country i

Given the corporate tax system, the relationships between the market real interest rate and the real cost of capital can be described by the cost of capital functions (see equation (7) in Annex B). This function can be written as follows:

$$p_i = C_i(r_i, X_i) \qquad (7)$$

r_i = market real interest rate in country i
X_i = parameter in the cost of capital function

If the real interest rates in the two countries are equalized in the long run and the accumulated saving of each country is not affected by changes in the real interest rate, the following equilibrium condition for the capital market will hold:

$$f_1(C_1(r, X_1)) + f_2(C_2(r, X_2)) = W \qquad (8)$$

W = accumulated saving of the world economy

If the parameter X_1 changes due either to a change in the tax system or a change in the trend inflation rate, the effect on the world real interest can be calculated from the above equation. By differentiating the equation:

$$f_1' \frac{\partial C_1}{\partial r} dr + f_1' \frac{\partial C_1}{\partial X_1} dX_1 + f_2' \frac{\partial C_2}{\partial r} dr = 0$$

Table D.2

THE DATA FOR SIMULATION ON THE REAL COST OF CAPITAL AND THE DEMAND FOR CAPITAL

1985 values

Base year of price data		USA 1982	JAP 1980	GER 1980	FRA 1970	UKM 1980	ITA 1970	CAN 1971
Real user cost of capital	$\frac{C}{P_q}$	0.1968	0.1330	0.1318	0.1317	0.09053	0.09415	0.09754
Real energy price	$\frac{Pe}{P_q}$	0.9239	0.9237	1.1602	1.4855	1.0928	2.19032	1.3541
Real price of investment goods	$\frac{Pi}{P_q}$	0.9127	0.9097	0.9720	0.88203	0.9186	1.1563	0.9535
Total business employment	L	90.86E6	53.02E6	21.49E6	17.46E6	19.05E6	17.27E6	9.1808E6
Labour efficiency index (1971 S1 = 1.0)	J	1.18785	1.46043	1.42442	1.39471	1.18634	1.42597	1.24537

By solving the equation for dr:

$$dr = \frac{-f_1' \frac{\partial C_1}{\partial X_1} dX_1}{f_1' \frac{\partial C_1}{\partial r} + f_2' \frac{\partial C_2}{\partial r}}$$

Since the term $\frac{\partial C_1}{\partial X_1} dX$ is equal to the change in real cost of capital by the shift in X_1, the above equation can be written as follows:

$$dr = \frac{-f_1' \, dp_1}{f_1' \frac{\partial C_1}{\partial r} + f_2' \frac{\partial C_2}{\partial r}}$$

dp_1 = the exogenous change in the real cost of capital by the change in X_1 in country 1.

In general, in the n country world, the change in the real interest rate by an autonomous change in the real cost of capital of country j can be calculated as follows:

$$dr = \frac{-f_j' \, dp_j}{\sum_{i=1}^{n} f_i' \frac{\partial C_i}{\partial r}} \qquad (9)$$

Therefore, countries with large f_j' (i.e. large absolute change in capital demand for a given change in the real cost of capital) have a larger impact on the world real interest rate than countries with small f_j'. The effect of the exogenous change in the real cost of capital in country j on the external position of country k is given by the following equations:

$$dK_k = f_k' \frac{\partial C_k}{\partial r} dr \qquad (10)$$

for k = j

$$dK_j = f_j' \frac{\partial C_j}{\partial r} dr - f_j' \, dp_j \qquad (11)$$

for country j

where dr is given by the equation (9).

If it is abstracted from the real capital assets held by households and the government, f'_K is given by the third column of Table III.7 with minus sign (the figures in this table are calculated for a fall in the real cost of capital).

Regarding $\frac{\partial C_j}{\partial r}$, it can be calculated from the cost of capital equation explained in Annex B. The estimated derivatives are reported in Table D.3. Since the tax system of the United States is changing due to the tax reform act of 1986, before-reform parameters (i.e. 1985 values) are used for this country. Otherwise, the tax parameters in mid-1986 are used for this calculation (i.e. "new system" of the U.K. and "old system" of Canada). The estimated values of these derivatives are not sensitive to the assumed inflation rates.

In order to apply the estimation method explained above, in addition to the parameters of the seven major countries, the parameters of smaller countries are also required. The parameter values of smaller countries are assumed to be equal to the average of six major countries excluding Canada. This is because the change in the capital demand by Canada for a given change in the real costs of capital is by far the largest among the major seven countries. Thus, the case of Canada is regarded to be an outlier (see Table III.7).

The estimation results are reported in Table III.8.

Table D.3

THE RELATIONSHIP BETWEEN THE MARKET REAL INTEREST RATE AND THE REAL COST OF CAPITAL

	$\frac{\partial Ci}{\partial r}$ (a)	Assumed GNP deflator inflation rate (b)
	(percentage point)	(per cent)
USA	0.73	3.4
JAP	0.90	1.7
GER	0.72	2.1
FRA	0.77	5.9
UKM	0.85	6.1
ITA	0.87	8.8
CAN	0.81	3.2

a. The change in the real cost of capital when the market real interest rate increased from 5 to 6 per cent.
b. The rate of inflation in 1985.

NOTES

1. In this Annex, only the real cost of borrowed capital is analysed.

2. The actual inner production function in the INTERLINK system takes account of the vintage effect. In this Annex, the analysis abstracts from this effect. See Helliwell et al. (1985) for more details.

3. The real cost of capital is related to the real user cost of capital in the following manner:

$$\text{(Real user cost of capital)} = \frac{P_i}{P_q} * [\text{(Real cost of capital)} + \text{(Economic rate of depreciation)}]$$

P_i = business investment deflator.

Therefore, the simulation actually made was to reduce the real user cost of capital by

$$0.01 * (\frac{P_i}{P_q})$$

and solved the system for K. See equations (5.21) and (5.22) in Auerbach (1983) for this relationship.

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