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Hans Christiansen,

Charles Pigott

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LONG-TERM INTEREST RATES IN GLOBALISED MARKETS

by
Hans Christiansen and Charles Pigott

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This paper addresses the issue of whether covariation of long-term interest rates across G10 countries has increased in recent years and whether, as a consequence, interest rates have become less subject to the influence of national monetary authorities and domestic fundamentals. A conceptual framework based on the standard parity relations among country interest rates is described, and it is argued that historical trends in interest rates and their relations across countries can be understood reasonably well under this framework as the result of changing fundamentals and shifts in (internationally-priced) risk premia. The main empirical findings are that bilateral covariation of long-term interest rates has gone up in the 1990s among some European countries but there is no evidence of any substantial increase for countries with floating exchange rates. Variance decompositions and country-specific interest rate equations show little evidence of increasing interdependence of domestic and foreign long-term rates, except in the case of some ERM countries. Nor is there any strong evidence in favour of a reduced impact from domestic short to long-term interest rates. The estimated equations thus suggest that the alleged "uncoupling" of European long-term rates from domestic fundamentals in the mid-1990s may have been overstated. It seems that domestic long-term rates continue to reflect US long-term rates and domestic short-term rates largely to the same extent as before.

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Cet article étudie dans quelle mesure la covariation des taux d'intérêt à long terme dans les pays du G10 a augmenté ces dernières années et si, en conséquence, les taux d'intérêt sont devenus moins perméables à l'influence des autorités monétaires nationales et aux évolutions fondamentales internes. Après la description du cadre conceptuel basé sur les relations habituelles de parité des taux d'intérêt entre pays, il est démontré que, dans ce cadre, les évolutions historiques des taux d'intérêt et de leurs relations entre pays s'interprètent assez bien comme le résultat d'un changement des évolutions économiques fondamentales et des primes de risque (sur les marchés internationaux). Les principales conclusions empiriques sont que la covariation bilatérale des taux d'intérêt à long terme, s'est accrue dans les années 90 parmi quelques pays européens mais qu'il n'y a aucun signe d'accroissement pour les pays à taux de change flottants. Les décompositions de la variance et des équations de taux d'intérêt propres à chaque pays montrent que l'interdépendance entre les taux d'intérêt domestiques et étrangers à long terme ne s'est pas accrue de manière sensible, sauf dans le cas de quelques pays de l'UEM. Il n'y a pas non plus d'indication claire en faveur d'une baisse de l'influence des taux domestiques courts sur les taux longs. Ainsi, les équations estimées suggèrent que le soi-disant "découplage" des taux d'intérêt européens à long terme des conditions économiques fondamentales internes au milieu des années 90 est sans doute exagéré. Il semble plutôt que les taux longs domestiques continuent de refléter dans une large mesure autant qu'auparavant les taux longs américains et les taux courts domestiques.

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LONG-TERM INTEREST RATES IN GLOBALISED MARKETS

Hans Christiansen and Charles Pigott[1]

I. Questions raised by interest rate movements during the mid-1990s

1. Developments in bond markets over the past several years have raised questions asss to relations among long-term interest rates in an environment of globalised financial markets. Long-term interest rates moved together quite closely across the three major economies during most of 1993-1995 despite different business cycle positions; and in 1994, real long-term interest rates in Europe and Japan rose in the wake of US monetary tightening to levels that were high given the early and fragile states of their recoveries. Together, these developments seem to suggest that long-term interest rates were responding more to external factors than domestic economic conditions and, if so, might be less free, even under floating exchange rates, to vary independently across the major regions than earlier believed.

2. These developments raise two basic questions bearing on the conduct of monetary policy in an era of globalised financial markets:

- First, how and to what extent do external factors constrain the freedom of long-term interest rates to vary with domestic fundamentals?

- Second, to what extent has the ability of the monetary authorities to influence long-term interest rates been impaired?

3. The discussion is organised as follows. Section II delineates a common benchmark view of the relations among long-term interest rates in globalised financial markets along with modifications to that view suggested by theoretical considerations and market developments. Section III then briefly examines historical developments in interest rates and how they compare to the theoretical descriptions. The following sections then consider two empirical questions: the degree to which the synchronisation of long-term interest rate movements, on a near-term as well as a longer-term basis, has increased with globalisation; and the degree to which relations between domestic short-term interest rates (that authorities, presumably, can control) and long-term rates have been weakened or otherwise affected by globalisation. The discussion concludes with implications for the conduct of monetary policy.

1. The authors would like to acknowledge the helpful comments received from Michael Feiner, Mike Kennedy, Paul Atkinson, Robert Ford, John Thornton and other members of the Economics Department, as well as the excellent statistical assistance of Laure Meuro and Josette Rabesona.

II. Conceptual views of long-term interest rate relations

4. The international integration of financial markets, or "globalisation", has increased markedly during the 1980s and 1990s (Caramazza *et al.*, 1986; Blundell-Wignall and Browne, 1991; Frankel, 1992; Goldstein and Mussa, 1993). One manifestation of this trend is that bond holdings have become more internationally diversified (Table 1), (Tesar and Warner, 1992; Davis, 1991) and trading in bond markets has become closely linked. While this globalisation process is not fully complete (Akhtar and Weiller, 1981; Frankel, 1992), it has gone far enough to produce a high degree of mobility of capital among OECD financial markets.

5. The potential effects of this globalisation on interest rate relations can be described in terms of the standard interest parity relation stating that the difference between any two countries' nominal interest rates equals the expected depreciation of the first country's currency against the second's (over the life of the instrument) plus a risk premium. It will help for the following discussion to break up the second country's nominal interest rate into its real and expected inflation components and write the relation as:

$$(1) \qquad I(j) = R^W + \pi^W + E|\Delta S(j) + \sigma(j)$$

where I(j) is country j's nominal interest rate; R^W is the world real rate of interest (the "world" taken as the second country); $E|\Delta S(j)$ is the expected rate of depreciation of country j's currency versus the "world" currency; π^W is the (anticipated) world inflation rate; and $\sigma(j)$ is the risk premium on country j bonds. Here the "world" could be thought of as a large benchmark country, such as the United States, or alternatively, as averages of external country values. A corresponding relation holds for real interest rates: country j's real interest rate equals the world real interest rate; plus the expected real exchange rate change; plus the risk premium[2].

6. At least for countries with flexible exchange rates, domestic real interest rates and inflation rates are commonly viewed as determined by domestic economic fundamentals. In particular, long-term interest rates are most often modelled as averages of current and expected future short-term interest rates (along with a liquidity risk premium), which in turn are determined by domestic inflation, real income, monetary policy actions and (in some cases) other variables such as actual or proxies for anticipated future budget deficits. This is the approach taken in the OECD INTERLINK and most other large empirical macroeconomic models.

7. This common "benchmark" view has the following implications for relations among long-term interest rates in globalised markets:

Under fixed exchange rates

- Globalisation implies a high degree of convergence of interest rates (short and long-term) and synchronisation of their movements over time. Interest rates are determined by conditions in the fixed rate region as whole, rather than in individual countries, and there is correspondingly reduced scope for independent monetary policy by any single country.

2. To derive this relation, subtract the expected inflation rate for country j from both sides of (1) and note that the expected real exchange rate change for country j is its nominal rate change less the difference between world and country j expected inflation.

Under floating exchange rates

- Interest rates can differ across countries and their movements can be imperfectly synchronised in both real and nominal terms, because the resulting pressures on financial markets are absorbed by movements (actual and expected) in the countries' currencies. A rise in one country's interest rate relative to that of a partner is effectively offset by an expected future depreciation of the former's currency.

- Long-term interest rates in individual countries are mainly determined by domestic economic conditions, particularly expectations about future inflation, the stance of monetary policy and factors shaping the demand for, and supply of, domestic saving.

- It follows that, if long-term interest rate movements are synchronised, it is due largely to similar movements in their fundamental domestic determinants. Long-term interest rate differentials across countries result from differences in these fundamental determinants.

- Monetary authorities retain the ability to influence domestic long-term interest rates.

8. However, there are at least three reasons to believe that this benchmark view may provide a somewhat oversimplified view of international interest rate relations. First, it has been argued that real interest rates are determined not only by individual country conditions but also by factors operating at the "world" level that determine the *aggregate* demand and supply for world savings. In terms of relation (1), this implies that the "world" real interest rate is a function of aggregate world variables, at least in part. There is some empirical support for this view, in particular that real interest rates are influenced by longer-term world stock returns (Barro and Sala-i-Martin, 1990) or world public debt levels (Ford and Laxton, 1995). Evidence suggesting that real interest rates tend to converge over time, although not necessarily completely or very quickly, is consistent with this view[3]. If real interest rates are partly determined by such variables, a change in net demand for world savings in principle will alter real interest rates even in countries adhering to floating exchange rates and where the demand for *national* savings is unchanged.

9. Second, most theories of the pricing of risk (which imply that risk premia on bonds and other securities reflect the degree to which they add to the overall risk borne by a "representative" investor[4]) imply that when portfolios can be internationally diversified, individual risk premia are determined by common factors in globalised markets rather than by country specific risks alone. This view can be described in the most general terms (Ross, 1976) as follows:

$$(2) \qquad \sigma(j) = \Sigma s_i(j) \times P_i$$

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3. See Mishkin (1984) and Brunner and Kaminsky (1994). Cavaglia (1991) and Gagnon and Unferth (1995) find evidence of somewhat faster convergence. Note, however, that convergence of real interest rates does not necessarily imply their direct determination by aggregate world conditions. Such convergence could occur via adjustments in the real economy, for example via flows of savings across national borders in response to differences in the return to capital. Such adjustments can take a good deal of time. However the more rapid convergence found in recent years could simply reflect smaller shocks to real interest rates themselves.
4. These include the capital asset pricing model of Sharpe and Lintner (1964) in their international forms (see Solknik, 1976); the consumption based capital asset model (see Breedon, 1979); and more general "arbitrage pricing" models (Ross, 1976) in which there are several latent risk factors, whose covariances with the returns on individual assets (betas) determine relative risk premia. All these models imply that with globally integrated markets, individual risk premia are simultaneously determined by the same set of underlying factors, rather than by individual country conditions alone.

Here the P_i are world risk factors, such as those arising from inflation, fluctuations in real growth, or other conditions, and the $s_i(j)$ are sensitivities (analogous to "betas") of the country j bond risk premium to these factors.

10. The risk factors, P, can be thought of as prices that globalised markets charge for a given source of risk and these prices can change over time. A shift in risk factor, P_i, increases the relative risk premia on bonds that have a relatively high sensitivity, $s_i(j)$, to that factor. To take a concrete example, suppose that investors perceive that inflation poses a greater risk than earlier, so that the price of the risk factor for inflation rises. Then interest rates will rise most in countries that are relatively sensitive to that risk factor, even if there has been no change in their own inflation prospects. It is also possible to imagine shifts in risk factors that increase risk premia on all bonds; for example, an increase in concerns about future inflation (relative to other sources of risk) might raise risk premia on fixed income instruments relative to real assets[5]. This view of the "global" pricing of risk differs from what would be expected when markets are isolated: in that case the risk premium would be a function of country-specific risk factors (e.g. fluctuations in the market portfolio of assets issued by that country). There is some evidence, although largely for equities, that risks of internationally traded assets are priced in terms of "world factors" (for example, Harvey, 1991). A recent study by Sutton (1996) indicating that "excess" holding period returns on bonds relative to short-term interest rates have tended to vary together across the United States, the United Kingdom and Canada is also at least consistent with this view.

11. Third, spillovers, particularly in the near term, among bond markets resulting from "market dynamics" are plausible in globalised markets for several reasons. Bond traders not infrequently react to rate movements in major markets rather than to fundamentals, particularly in the very near term; portfolio trading strategies of international investors can prompt rapid shifts among markets when conditions in one major market change; and authorities have at times limited movements in their currencies through official intervention or changes in domestic short-term interest rates. In fact, "noise trading" (Summers, 1986) and related paradigms of market speculation imply that price changes, particularly in the near term, are determined in part by expectations based on their past movements (so-called momentum) rather than purely on the basis of economic fundamentals. Such behaviour could be justified by the fact that true "equilibria" are not known with any precision so that price movements themselves may provide a better guide to underlying trends in market supply and demand than do currently known fundamentals. For the same reason, "noise-traders" would tend to use price movements in a major market, such as the US bond market, as a guide to their trading activities in other related markets, say in bond markets in Europe or Japan. Partly for this reason, international portfolio shifts in response to new market developments might initially result in a temporary departure from "equilibrium" in which the usual parity relations do not hold: for example, portfolio rebalancing in response to a sudden rise in US bond interest rates may produce pressures that lead to a temporary rise in interest rates in Europe and Japan[6]. Such behaviour is probably most plausible for very near-term price movements, which tend to be less easy to explain in terms of fundamentals than movements over longer periods.

12. Together, these three considerations suggest that, in addition to situations when their underlying domestic determinants are moving together, long-term interest rates will tend to vary across countries in response to the following developments:

– changes in the aggregate factors determining the world real interest rate;

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5. Although there is evidence that higher inflation increases the risk premia on equities versus bonds: see Blanchard, (1993).
6. In practice, though, such disequilibrium behaviour is virtually impossible to distinguish operationally from the other possibilities mentioned in the text.

– shifts in risk factors common to bonds as a group; and

– spillovers in the near term arising from market portfolio dynamics or when markets perceive that authorities will act to counter exchange rate movements.

Note also that changes in relative risks and portfolio dynamics may also act to push long-term interest rates apart, as when markets come to believe that risks on some countries' bonds have increased relative to others, or when near-term market reactions lead to a "flight" to quality into some bonds.

13. Together these considerations also point to a broader potential effect of globalised bond markets in terms of the information used by investors in making their portfolio decisions. Even if bond interest rates continue to be determined largely by country conditions, there is likely to be a natural tendency for investors to look to developments in major markets in assessing underlying conditions that may also be affecting other markets. This is particularly plausible given the historical tendency (see Section III below) for macroeconomic factors affecting long-term interest rates to be positively correlated across countries. Because of this, interest rates in major countries may appear to be influencing rates elsewhere even when there is no direct linkage via the effects described above.

14. Finally, while these factors probably affect interest rates to some degree, the key question is how important they are from a policy perspective. In particular, do these factors undercut the benchmark paradigm as a description of interest rate relations over periods most relevant for monetary policy, and have these or other factors weakened relations between domestic fundamentals and long-term interest rates enough to undermine the effectiveness of monetary policy? The next three sections examine some evidence on these broader questions.

III. How these views compare with historical developments

15. Over much of the period since the mid-1970s, long-term interest rates in the major regions have tended to move together in nominal and, even more so, real terms (Figure 1), despite the fact that most countries have maintained floating exchange rates. However, this pattern reflects in good part similarities in the trends in several of their key economic determinants, particularly inflation. For example, the secular rise in OECD real long-term interest rates between the 1960s and 1980s resulted in part from declines in national savings rates due to rising public sector deficits and from increases in inflation risk premia that occurred in virtually all OECD countries (Group of Ten, 1995; and Orr *et al*., 1996). Many countries experienced further upward pressures on interest rates during the late 1970s when inflation pressures rose and monetary policy was tightened. Since the early 1980s, nominal interest rates have gradually come down and there has been a marked convergence of both nominal and real long-term interest rates among the larger countries. This trend also corresponds broadly to the declining trend in inflation during this period and the reduction in inflation divergences across the major regions (Figure 2).

16. On the other hand, when fundamentals have differed, long-term interest rates across the major regions have been pushed apart, often with accompanying movements in exchange rates. At the end of the 1970s, countries experiencing the largest inflation increases, such as the United States, the United Kingdom, France and Italy, saw the levels of their nominal long-term interest rates rise relative to Germany, while their currencies generally fell *vis-à-vis* the Deutschemark and the yen. US long-term interest rates rose in both real and nominal terms between 1982 and mid-1984 as interest rates in Europe and Japan were falling, due in part to the effects of US fiscal expansion in raising the demand for domestic savings relative to its supply. The pressures resulting from this divergence in real long-term interest rates

were reflected in the sharp appreciation of the dollar during this period, as well as by the reversal of that appreciation that began in 1985 and occurred as US interest rates in general were falling back.

17. Over time, longer-term interest rate differentials also accord broadly with relative inflation performances of countries. During the 1980s, long-term interest rates in the United Kingdom, France and Italy, where inflation was higher on average, remained above those of Germany and Japan (Figure 3), where inflation was lower. Currently, countries with the highest levels of long-term rates are generally those whose average inflation over the past ten years also has been relatively high (Figure 4). The convergence of inflation rates during this decade has been accompanied by shifts in some traditional interest rate configurations in 1996; these include the virtual closure of the long-standing bond interest rate gap between France and Germany, and the fall of Canadian 10-year bond rates to just below US 10-year bond rates for the first time since the 1950s[7] (as of April 1997).

18. In view of this historical experience, it is the circumstances surrounding the 1994 increases in long-term interest rates, and not the mere fact that they moved together, that seem most unusual. The long-term interest rate increases in Europe and Japan followed a prolonged period during which policy and short-term market rates had been declining and occurred as economic activity remained quite weak. At the time, long-term interest rates, especially in real terms, were below recent average levels during the early 1990s. The increases then reflected in part a return to what might have been considered more normal levels. To some degree, the increases can also be attributed to perceptions that the recoveries in Europe and Japan were gaining momentum (OECD, 1994a and 1994b): indeed policy interest rates in Japan levelled off in early 1994 and short-term market interest rates began to edge up. This suggests that expectations about future short-term rates -- which typically most concern bond markets -- were more aligned across the major regions than conditions at the time seemed to suggest. Nevertheless, these factors provide at best a partial explanation of the 1994 developments. International factors, in the form of sales of European and Japanese bonds by highly-leveraged investors to cover their losses in the US market, apparently helped to spread, and may have exaggerated, the bond market reactions to US monetary tightening (Borio and McCauley, 1996).

19. Overall, the benchmark view appears to provide a reasonably accurate view of the broad movements in interest rates over the past three decades. At the same time, the developments in 1994, as well as earlier episodes when interest rates seem to have moved together more than national fundamentals alone would have seemed to indicate, strongly suggest that the modifications described above can be of some importance, at least at certain times. For example, the especially large increases in long-term interest rates experienced in 1994 by countries such as Italy and Sweden, with relatively high public deficit or debt-to-GDP ratios (Figure 5) are consistent with the view of the global determination of bond risk premia described in Section II. The increases appeared to reflect an increased market sensitivity to global inflation risks which particularly hit countries with a history of high inflation and large public sector financial imbalances. This experience suggests that shifts in investor perceptions about global inflation or other risks may alter risk premia, and therefore long-term interest rates, even in countries whose own inflation prospects are unchanged.

20. Furthermore, the historical experience is not necessarily inconsistent with views that long-term real interest rates are at least influenced by aggregate world factors. The general rise in real interest rates from the 1970s to the 1980s could be explained in terms of the aggregate pressure on world savings generated in large part by rising public deficits -- although the increases can also be explained by individual country developments, given the widespread nature of the deficit expansions. Overall, a plausible supposition is that aggregate international factors influence long-term interest rates in globalised

7. Based on monthly average data available to the Secretariat.

markets, but are not their only determinants. Moreover, factors such as the world saving-investment balance or world stocks of debt change rather slowly and so are likely to be most important in affecting real interest rates over the longer run. This suggests that there remains room for national factors, such as monetary policy, inflation or government budget deficits to affect individual country's long-term interest rates, in both real and nominal terms[8]. This view is consistent with the history reviewed above, which has recorded significant divergences in national real interest rates in recent year -- for example during the late 1980s.

IV. Have interest rate movements become more synchronised?

21. Partly because of the 1994 and analogous earlier episodes, the perception has become widespread among market participants as well as analysts that globalisation has led to an increase in the tendency for interest rates to move together. This view also has been fostered by the marked compression of longer-term interest differentials among G10 countries since the 1980s, even though this trend does not by itself imply that interest rate movements have become more correlated. Given the portfolio strategies described above, the view that synchronisation has increased seems most plausible for very near-term movements in bond markets. Thus it is useful to distinguish questions about relations among bond interest rates along the following lines:

- Has there been a *general* increase in the tendency for interest rate changes in major bond markets to spill over to bond markets in other countries on a very near-term basis, such as over a day or week? Alternatively, has the tendency for such spillovers increased on a conditional basis, that is under certain circumstances only, rather than generally?

- And has there been any general increase in the synchronisation of bond interest rate movements over the medium term?

22. In examining the evidence on these questions, we can note that three empirical stylised facts do suggest that some direct linkages, or spillovers, are operative in world bond markets, without necessarily indicating that they have become stronger over time. First, since the latter half of the 1980s, periods of unusually high volatility have tended to occur together across the major bond markets (Borio and McCauley, 1996). Second, changes in one major bond market are statistically significant in helping to predict subsequent changes in other markets (Remolona, 1991), (Table 2). Third, a number of studies have found that US bond rates help to explain monthly or quarterly changes in bond rates in Germany, other European countries and Japan, even after controlling for movements in short-term interest rates and inflation in these countries[9].

23. Evidence on the degree to which long-term interest rates have become more synchronised with globalisation is based primarily on two statistical measures: correlations of their changes and the average magnitude of the response of the rate change in a given bond market associated with a change in one of the major markets, in most cases the United States or Germany, over the same period. The tendency noted earlier, for traders to react initially to rate movements in their own and related markets, might suggest that such spillovers would be especially strong in the very near term, say, over a day or week. However, on

8. See, for example, Hutchison and Pigott (1981); Hutchison and Pyle (1984); Throop (1994); and Orr *et al*. (1995).
9. See, in particular, BIS (1989), especially articles by Friedmann and Hermann on Germany and by Nambara and Fukao on Japan; Gebauer *et al*., (1993); and Bisignano (1983).

more detailed examination, such near-term linkages among the markets do not appear to be very strong. Looking at a variety of the measures at the daily level shows the following:

- Only a small fraction of the daily changes in non-US long-term interest rates can be accounted for statistically by changes in US long-term interest rates (Table 3)[10].

- Large daily changes in US long-term interest rates (15 basis points or more), which have been far more common in the United States than in Germany or Japan (Figure 6), have occurred in all three markets simultaneously on only three occasions since 1983 -- all during the 1980s decade (Table 4). On only about one-fifth of such days of large changes in the US market has there been a large associated response in one (but not both) of the other two markets during the present decade[11]. This lack of coincidence could reflect the fact that large daily changes in US markets often have been quite short-lived: for example, four large "shocks" to US long-term interest rates occurred in May 1994, but the cumulative increase over the entire month was only six basis points.

- Changes in policy-controlled short-term interest rates in the United States have only infrequently set off large changes in bond markets in Germany or Japan, even when they have led to above-average responses in the US bond market (Table 5). On such occasions less than one quarter of the changes coincided with any large change in markets in Germany or Japan.

24. Looking at these measures over monthly intervals reveals the following:

- The correlations of long-term interest rates among the three major economies were higher on average in the 1980s and 1990s than during the 1970s (Frankel, 1989; BIS, 1989; and Morton, 1996).

- However, there seems to have been no further increase in the synchronisation of long-term interest rates, by this measure, since the early 1980s (Figure 7a).

- These correlations have varied considerably over time; from this perspective, rates were relatively highly correlated over the last few years, but generally no more so than in the 1980s.

25. In contrast, there does appear to have been some increase in synchronisation of bond interest rates among European countries since the 1980s:

- Correlations between German bond rates and the bond rates of most other European countries have increased (Figure 7b), as has the magnitude of the responses of the European rates to changes in the German market (Table 6)[12]. Now they are nearly one-for-one.

- However, correlations among European long-term rates have not been noticeably higher on average during the 1990s than those among US, German and Japanese rates.

- There also is no apparent relation across the European countries between the increase in synchronisation of long-term interest rates with Germany and the extent to which countries have

10. It is assumed that US rates affect Japanese and German rates on the following day, and that German rates affect Japanese rates on the following day.
11. The likelihood of any change in US rates being accompanied by a large change in German rates has been higher during the 1990s than during the 1980s, but still not very high.
12. The increases in the European responses during the 1990s are statistically significant. The increases in the responses of German and Japanese bond rates to US rates are not statistically significant, however.

limited fluctuations in their exchange rates *vis-à-vis* the Deutschemark[13]: for example, the synchronisation of UK with German interest rates has risen greatly and is now nearly as high as that of Belgium and the Netherlands.

26. Overall, the evidence suggests that while globalisation may have helped to raise the synchronisation of long-term interest rates from the 1970s to the early 1980s, it has not led to any greater synchronisation since then. Admittedly, the measures presented above are only descriptive: they do not reveal the extent to which globalisation versus movements in domestic determinants is responsible for the trends in synchronisation. Globalisation may be at least partly responsible for the fact that bond interest rate increases were relatively highly synchronised in 1994 even though business cycles in the major regions were relatively unsynchronised.

V. Linkages between long and short-term interest rates

27. The last issue to be considered concerns the ability of monetary authorities to influence movements in domestic long-term interest rates in globalised financial markets sufficiently to be able to achieve monetary policy objectives. Such an ability is presumably important in countries, such as Germany, where long-term interest rates are particularly important to monetary transmission (BIS, 1989). The issue actually involves two questions:

- To what extent has the response between long-term interest rates and domestic short-term interest rates become weaker? and

- To what degree have external disturbances to long-term interest rates, and their traditional relations with short-term rates and other domestic economic determinants, increased?

28. In principle, the first question is the most critical: since authorities can (presumably) control the path of short-term interest rates, they should also be able to influence the broad movements in long-term interest rates sufficiently for policy objectives, provided traditional term structure relations hold up reasonably well. This does not require that the classical term structure theory hold exactly -- as it certainly does not -- but only that expectations about future short-term interest rates have a major influence on long-term rates, as is suggested by traditional studies of the term structure (Shiller, 1987). Such a linkage does not enable authorities to "control" long-term interest rates in any precise sense but, in theory at least, it would allow them to offset shocks to those rates sufficiently to shape their medium-term path. However, if those shocks were sufficiently great, the practical ability of authorities to influence long-term rates could be seriously impaired.

29. As indicated below, most direct evidence on these questions comes from statistical relations among domestic long-term interest rates, short-term interest rates, other domestic determinants such as inflation, and some indicator of "external" influences. In relations for non-US rates, "external influences" are typically proxied by US long or short-term interest rates (or, in the case of European countries, German interest rates) and/or exchange rates. However, as explained further below, such statistical relations are inevitably subject to a number of interpretations. For example, domestic long-term interest rates in Europe or Japan could be statistically related to US interest rate movements because:

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13. It should, however, be noted that a narrowing of interest rate differentials leads to a temporary weakening of the measured correlations. The recent lowering of correlations among Germany and France and Italy is partly attributable to this factor.

– US rate movements reflect ("signal") common changes in domestic determinants of long-term interest rates; or

– Authorities are expected to prevent exchange rates from moving in response to the change in US rates; or

– US rates directly affect the determination of long-term rates abroad, perhaps via their influence on the "global" factors discussed earlier.

30. Statistical associations between US and foreign long-term interest rates that arise from the first two sets of conditions do not necessarily imply that the authorities ability to affect domestic long-term interest rates has been impaired. Thus the statistical relations do not carry unambiguous implications for policy and need to be interpreted with caution and in the light of other evidence.

Evidence on the relations

31. Finally, the evidence does not suggest that the effects of globalisation have been so great as to prevent monetary authorities from being able to achieve their fundamental objectives. As for the average effect of domestic and foreign factors, the empirical evidence is mixed. Most of the studies cited earlier suggest that domestic short-term interest rates have a greater impact on long-term interest rates than do US interest rates, at least for European countries (Gebauer *et al*., 1993)[14]. Other studies, however, point to a relatively low immediate impact of short-term interest rates on long-term rates in some European countries, notably Germany (Hardy,1996) and Hammersland and Vikøren, 1997). Moreover, while the pure "expectations theory" of the term structure does not hold in any precise sense (Mankiw, 1986; Shiller, 1987), a recent paper (Gerlach, 1995) suggests that expectations about future short-term interest rates, conditional on the outlook for inflation, real growth and other factors bearing on the supply and demand for domestic savings, do appear to broadly shape the movements in long-term rates over the medium and longer term. Indeed, for most countries, the gap between domestic long-term and short-term rates is stable in the long run (Table 7); this indicates that long-term interest rates are ultimately linked to short-term interest rates. Through their influence on the supply of liquidity to markets, authorities remain capable of controlling the evolution of short-term interest rates over these horizons[15]. Thus, at least in principle, authorities should be able to compensate for external disturbances to long-term interest rates when they occur.

32. There is also little systematic evidence in support of a decrease in the response of long-term rates to domestic short-term rates in the latest decade. On the contrary, evidence suggests that the impact of short-term on long-term interest rates increased for Japan during the 1980s (Kasman and Rodrigues, 1991) and for Germany in the 1990s (Skinner and Zettelmeyer, 1996). Table 8 summarises an empirical (vector-autoregression) analysis of the pattern of covariation between domestic long-term rates, domestic short-term rates, foreign long-term rates and exchange rates. The results are mixed. The portion of the variation in long-term interest rates which can be ascribed to variation in domestic short-rates is generally around 1/3. With the exception of Japan, the position of the long-rate variation "accounted" for by short rate variation drops over the second half of the period for the four major countries outside the United States that have maintained floating exchange rates. Whereas exchange rate expectations are crucial in explaining interest rate differentials, actual exchange rate movements seem to explain little of the variation

14. An exception is Nambara and Fukao (1989), some of whose statistical evidence suggests that US interest rates and the yen-dollar exchange rate were the dominant determinant of Japanese long-term rates during the 1980s.
15. See, for example, Radecki and Reinhart (1989) on the United States and Kasman and Rodrigues (1991) on Japan.

in long-term rates, except possibly in the case of Japan. However, in most of the G10 countries variance analysis shows that the impact of US and German long-term rates on domestic long rates has gone up somewhat during the last decade.

33. As a further attempt of quantification, individual country equations have been estimated, linking changes in domestic long-term rates to domestic short rates and foreign long rates, as well as bilateral exchange rates and inflation. Consistent with the above finding that long-term rates are generally co-integrated with domestic short-rates but usually not with foreign long-term rates, attempts to include foreign long-term rates in the error correction terms failed in almost all cases, whereas for all countries a co-integrating relationship between domestic long and short rates -- and in some cases inflation, but more curiously not exchange rates -- was found[16] (Table 9). The main observations of Table 9 are twofold: the estimated immediate impact of changes in foreign long-term rates is much larger than the effect of changes in domestic short-term rates; but the longer-run effect of short-term rate changes is considerable whereas virtually no durable effect of changes in foreign long-term rates is detected[17].

34. The stability of the long-term relation between domestic short-term and long-term rates is considerable over time for most countries. When the estimation period is gradually expanded from 1970-1981 to 1970-1996, the estimated long-run impact of short to long rates increases in the case of Switzerland and particularly Japan, whereas some decreases are detected for Italy and France (Figure 8). In the case of Germany, the long-run impact from short to long rates has remained remarkably stable -- and remarkably low -- for the whole period under consideration. This does, of course, raise the question of whether changes in the relationship between domestic and foreign rates have taken place over time. For example, one could imagine that domestic and foreign long-term rates have, as of lately, become cointegrated so that the estimated equation is in fact no longer representative. Indeed, the findings of Hammerstad and Vikøren for a comparatively short recent time period could be taken to indicate this, as could the narrowing of interest rate differentials between Germany and the United States. However, detecting co-integration over a period of less than seven years is notoriously difficult. There is thus little evidence that globalisation has greatly reduced the strength of linkages between domestic short-term interest rates and long-term interest rates, even if it has increased the influence of US long-term rates on those of other major countries (or of German long-term rates on other European markets).

35. The question about the influence of domestic fundamentals in the longer run has been approached by estimating a set of alternative equations, linking long-term domestic real rates to long-term foreign real rates, domestic short-term real rates and the domestic output gap[18] (Table 10). It appears that the relationship between output gaps and long-term real interest rates is statistically rather robust, and there is little evidence that it is weaker during the last 17 years than for the whole period since 1970 except for the case of Japan and certain European countries which have linked their currencies closer to the Deutschemark.

36. Summing up, it seems that domestic factors such as monetary policy and the output gap do matter for long-term interest rates, and that the evidence is at least unclear that the influence from these factors has diminished over time -- except for some ERM-participants. What the evidence does suggest is that short-term interest rates have a smaller statistical impact on long-term rates in Germany than do shifts in US long-term interest rates and that many other European long rates have become more responsive to

16. The specification of the estimated equation is largely due to Hammersland and Vikøren (1997). Estimating their model for the relatively limited period 1990 to 1996, they are able to include long-term US interest rates into the error correction mechanism for Germany.
17. The only case where foreign long-term interest rate changes seem to permanently move domestic long rates relates to Canada's dependence on US rates.
18. Attempts to include real exchange rates in the equation have generally failed.

German bond rates changes in recent years. This, in turn, raises the question of why German long-term rates seem to depend so unusually little on domestic short-term rates. According to the equations for long-term nominal interest rates (Table 9) countries with an unusually low impact from short to long rates tend to be those (Germany, Switzerland, the Netherlands) that have historically been low-inflation countries[19] (Figure 9). Conversely, countries with a particularly large impact from monetary policy (Italy, the United Kingdom) tend to be those where inflation has been high on occasion in the past. It is thus conceivable that the low impact of short-term rates in core-ERM countries reflects a high degree of credibility of the monetary authorities' inflation targets, leading to market expectations that any change in monetary policy will be short-lived. If so, near-term changes in short-term interest rates will tend to be relatively short-lived, and thus provide little information about the course of short-term rates and (therefore) long rates over the medium term.

37. The implication is that when exchange rates are allowed to vary, considerable independence in shaping interest rate movements over medium and longer-term horizons is retained. This conclusion is consistent with simulations of large empirical macroeconomic models: for example increases in long-term interest rates in the United States arising from fiscal expansion lead to substantially smaller increases in long rates in Europe and Japan (Bryant, Helliwell and Hooper, 1989).

VI. Overall assessment and implications for monetary policy

38. The historical record together with the evidence reviewed here clearly does not provide precise answers to the questions raised by bond market developments over the past several years concerning relations among long-term interest rates. However it does suggest the following tentative conclusions:

- Globalisation has affected the behaviour of interest rates and their relations across countries. Long-term interest rates are influenced by common external factors to some degree. Disturbances in major bond markets spill-over on occasions to other markets and movements in US long-term interest rates have some influence on long-term interest rates in the other two major regions. Globalised markets can at times impose different and more stringent "performance standards" in the determination of long-term interest rates: investors now have more choices among bonds from various countries than before and the international investor community may assess individual country circumstances in a different light than do domestic investors. International factors seem to affect bond risk premia.

- Nevertheless, domestic economic fundamentals continue to be key factors shaping movements in long-term interest rates among the countries that maintain floating exchange rates in particular the major three economies over the medium term. Short-term interest rate movements, actual and anticipated, are important determinants of the path of long-term interest rates; and monetary authorities retain sufficient influence on long-term interest rates to achieve their basic goals. Indeed, the relative success countries have had in first bringing down and then containing inflation during this decade attests to the continued effectiveness of monetary policy in this regard.

19. Canada also has a very low impact from short-term interest rates. This is due to the very high degree of dependence on US rates: if long-term US rates were excluded from the interest rate relation, Canada would be on the regression line in Figure 2.

Table 1. **International investment positions**[a]
(gross claims as per cent of domestic GDP)

	1970	1975	1980	1985	1990	1995
United States						
Direct investment	n.a.	n.a.	13.6	9.2	10.8	14.9
Portfolio investment	n.a.	n.a.	2.2	2.7	4.0	12.2
Stocks	n.a.	n.a.	0.7	1.0	1.7	6.9
Bonds	n.a.	n.a.	1.5	1.8	2.3	5.3
Japan						
Direct investment	0.7	1.6	1.7	2.8	6.0	6.3
Portfolio investment	0.1	0.8	1.8	9.2	16.8	17.9
Germany[b]						
Direct investment	1.9	2.3	3.1	4.3	6.0	7.3
Portfolio investment	2.4	1.5	1.9	5.9	10.3	13.0
United Kingdom[b]						
Direct investment	12.5	11.2	13.7	19.1	22.8	30.5
Portfolio investment	10.3	5.9	7.9	27.1	33.3	47.4
Stocks	n.a.	n.a.	5.5	15.5	19.2	30.6
Bonds	n.a.	n.a.	2.3	11.7	14.2	16.8
Canada						
Direct investment	6.8	5.8	8.3	11.0	12.6	18.3
Portfolio investment	3.1	2.4	2.7	3.6	6.8	12.2
Stocks	2.5	2.0	2.5	2.7	5.3	9.4
Bonds	0.6	0.4	0.3	1.0	1.5	2.8

a) Private sector.
b) Excluding assets by the banking sector.

Source: Tesar and Werner (1992), national sources and OECD Secretariat.

Table 2. **Tests of causality among daily changes in long-term interest rates**[a]

(Period : 1983-1996. Asterisks denote a causal relation)

	Influence from:					
	United States	Japan	Germany	France[b]	United Kingdom	Canada[b]
Impact on:						
United States					*	*
Japan	*		**	*		
Germany	**			**	**	**
France[b]	**	**	**		**	
United Kingdom	**			**		**
Canada[b]	**	*	*		**	

a) Granger-Sims test based on five lags. Significant causality is denoted by one asterisk on a 5 per cent significance level and two asterisks on a 1 per cent level. North American interest rates are assumed to affect Japanese, German and French rates on the following day. European rates are assumed to affect Japanese rates on the following day.
b) Data start in 1985.

Source: Datastream and OECD Secretariat.

Table 3. **Direct impact of daily changes in long-term interest rates abroad**[a]

	Estimated impact of interest rate changes in:						R^2	
	United States		Japan		Germany			
	1983-89	1990-96	1983-89	1990-96	1983-89	1990-96	1983-89	1990-96
Impact on:								
Japan	0.05	0.13			0.07		0.04	0.05
Germany	0.12	0.24	0.14	0.16			0.14	0.13
France					0.29	0.68	0.06	0.30
United Kingdom	0.16	0.29			0.44	0.42	0.05	0.09
Switzerland					0.04	0.25	0.01	0.04
Memorandum item:								
United States				0.08	0.19	0.14	0.02	0.02

a) The following equation is estimated. $\Delta IRL_t(i) = \alpha_1 \Delta IRL_t(US) + \alpha_2 \Delta IRL_t(GERMANY) + \alpha_3 \Delta IRL_t(JAPAN) + \beta_1 \Delta IRL_{t-1}$ (i) where i is the country listed in the first column and IRL denotes long-term interest rates. The parameters α are listed above; insignificant parameters are dropped. Period: 1983 to 1996, except for France (1985 to 1996) and Switzerland (1981 to 1996).

Source: Datastream and OECD Secretariat

Table 4. **Dates of co-incident large changes in long-term interest rates among G-3 countries**[a]

United States versus Japan		United States versus Germany	
Increase	Decrease	Increase	Decrease
29 May 84	1 June 84		
	4 June 84		
		12 May 86	31 March 86
16 May 86		16 May 86	
29 May 86			
			13 June 86
15 May 87	30 April 87		
		14 Oct. 87	19 Oct. 87
	20 Oct. 87		20 Oct. 87
	5 Nov. 87		
16 June 88		16 June 88	
10 Aug. 88	13 Oct. 89		
			4 May 90
6 Aug. 90	17 Jan. 91		
		18 April 94	
		23 May 94	
		8 March 96	
		2 May 96	

a) Large changes are defined as daily increases or decreases exceeding 15 basis points. Large changes took place simultaneously in Japan and Germany, but not in the United States, on two occasions: 19 August 1991 and 2 March 1994. Both were increases in interest rates.

Source: Datastream.

Table 5. **Changes in long-term interest rates on the day of changes in US official rates: G3 countries**[a]

Date	US official rates	Change in long-term rates		
		United States[b]	Japan[c]	Germany[c]
Above-average response of long US rates				
6 Apr. 1984	+	-0.14	-0.01	0.00
17 May 1985	-	-0.33	0.00	-0.04
6 Mar. 1986	-	-0.11	0.00	0.04
9 Aug. 1988	+	0.23	0.33	0.10
1 Feb. 1991	-	-0.16	0.01	-0.04
6 Nov. 1991	-	-0.10	-0.03	-0.07
20 Dec. 1991	-	-0.23	0.00	0.01
2 July 1992	-	-0.17	-0.06	-0.05
4 Feb. 1994	+	0.16	0.00	0.06
22 Mar. 1994	+	-0.12	-0.12	-0.05
18 Apr. 1994	+	0.13	0.07	0.18
17 May 1994	+	-0.22	-0.06	-0.07
16 Aug. 1994	+	-0.13	0.03	-0.08
6 July 1995	-	-0.15	-0.13	-0.13
Average absolute change		0.18	0.06	0.06
Below-average response of long US rates				
21 Nov. 1984	-	-0.07	0.00	-0.05
21 Dec. 1984	-	0.00	0.00	0.00
18 Apr. 1986	-	-0.01	0.00	0.01
10 July 1986	-	0.02	0.07	0.02
20 Aug. 1986	-	-0.08	0.00	0.00
4 Sept. 1987	+	0.01	0.49	0.11
24 Feb. 1989	+	0.02	0.10	0.01
18 Dec. 1990	-	-0.03	-0.01	-0.02
30 Apr. 1991	-	-0.01	-0.06	0.00
13 Sept. 1991	-	-0.05	0.00	0.02
15 Nov. 1994	+	0.03	0.02	0.00
1 Feb. 1995	+	0.08	0.03	0.04
19 Dec. 1995	-	-0.10	-0.01	-0.03
31 Jan. 1996	-	-0.01	0.01	0.02
Average absolute change		0.03	0.02[d]	0.03

a) Boxes indicate relatively large changes of 10 basis points or more in the foreign market.
b) Change from the day before the official rate change to the day after.
c) Change from the day of the official US rate change to the following day.
d) Not including the extreme value in September 1987. Otherwise the average absolute change is 0.06.

Source: Skinner and Zettelmeyer ,1996 and OECD Secretariat.

Table 6. **Average response to changes in long term interest rates in the United States and Germany**[a]
(monthly data)

						Testing for structural break in relation[b]	
	1970-74	1975-79	1980-84	1985-89	1990-96	1980	1990
Effect of change in the United States on:							
Japan	0.09	0.23	0.39	0.44	0.69		
Germany	0.59	0.46	0.35	0.37	0.62		
Canada	0.90	0.80	1.07	0.86	1.24		
Effect of change in Germany on:							
Japan	0.00	0.39	0.57	1.02	0.38	*	
France	0.18	0.12	0.69	0.81	0.96	**	*
Italy	0.58	0.18	0.34	0.30	0.71		
United Kingdom	0.16	0.96	0.42	0.87	0.81		
Netherlands	0.43	0.75	0.99	0.85	0.91	**	
Belgium	-0.06	0.11	0.36	0.65	0.84	**	**
Switzerland	0.25	0.37	0.40	0.32	0.61		*
Sweden	0.01	-0.01	0.24	0.58	1.03	**	**

a) The following relation is estimated: $\Delta irl(i) = \alpha_1 \Delta irl(j) + \alpha_2$. Where irl denotes long-term interest rates and i and j denote the affected and affecting countries. The parameter α_1 is reported above.

b) Chow-tests for structural break in January 1980 and January 1990. One asterisk denotes a break significant on a five per cent significance level; two asterisks denote a break significant on a one per cent level.

Source: OECD Secretariat.

Table 7. **Testing the relationship between long-term and short-term interest rates: G-7 countries**[a]

	Stationarity of the yield gap[b]			Cointegration[c]		
	1970-96	1974-96	1980-96	1970-96	1974-96	1980-96
United States	*	*	*	**	**	*
Japan	*	**	*		**	
Germany[d]	*	*	*	*	*	
France	**	**	*			
Italy	**	**	**	*	*	
United Kingdom						
Canada	*	*	*	*		

a) Based on monthly data since 1970. One asterisk denotes significant stationarity or co-integration on a five per cent significance level; two asterisks denote significance on a one per cent level.
b) AR(2)-augmented Dickey-Fuller test of the difference between long and short-term interest rates.
c) Johansen test of the relation between long and short-term interest rates. Two lags are included; no deterministic trend.
d) Assuming a structural shift after German unification.

Source: OECD Secretariat.

Table 8. **Variance decomposition of long-term interest rates by VARs**

A. Influence from US long-term interest rates[1]
(Per cent of total variation explained by each of four factors)

Effect on long-term interest rates in:	Estimation period:	Independent variables			
		Domestic long rates	Domestic short rates	US long rates	Exchange rates
Japan	1970-84	64	4	3	29
	1985-96	41	23	20	16
Germany	1970-84	38	46	12	4
	1985-96	27	35	37	1
United Kingdom[2]	1970-84	41	25	7	6
	1985-96	26	22	23	5
Canada	1970-84	11	66	22	1
	1985-96	19	17	48	16

1. Monthly data. For each country "x" the following equation is estimated:
$IRL_t(x) = \Sigma\alpha_i IRS_{t-i}(x) + \Sigma\beta_i IRL_{t-i}(US) + \Sigma\phi_i EXCH_{t-i} + \Sigma\delta_i IRL_{t-i}(x) + const.$, for i=1 to 6 where IRL is long-term interest rates; IRS is short-term interest rate; and EXCH is the logarithm of bilateral exchange rates. The table reports long-term impacts, measured as the effect ten months after a permanent change in one of the explanatory variables.
2. The equation also includes an influence from German long-term rates and bilateral exchange rates *vis-à-vis* Germany. They are broadly unchanged at 18 per cent and 4 per cent between the two estimation periods.

Table 8. (continued) **Variance decomposition of long-term interest rates by VARs**

B. Influence from German long-term interest rates[1]
(Per cent of total variation explained by each of four factors)

Effect on long-term interest rates in:	Estimation period:	Independent variables			
		Domestic long rates	Domestic short rates	US long rates	Exchange rates
France	1970-84	25	66	9	0
	1985-96	37	26	35	3
Italy	1970-84	39	47	14	0
	1985-96	41	18	32	9
Netherlands	1970-84	22	25	46	6
	1985-96	18	35	43	4
Belgium	1970-84	50	38	12	0
	1985-96	58	8	32	2
Sweden	1970-84	25	46	21	7
	1985-96	59	11	25	5
Switzerland	1970-84	37	42	13	8
	1985-96	34	56	9	1

1. Monthly data. For each country "x" the following equation is estimated:
$IRL_t(x) = \Sigma\alpha_i IRS_{t-i}(x) + \Sigma\beta_i IRL_{t-i}(Germany) + \Sigma\phi_i EXCH_{t-i} + \Sigma\delta_i IRL_{t-i}(x) + const.$, for i=1 to 6 where IRL is long-term interest rates; IRS is short-term interest rate; and EXCH is the logarithm of bilateral exchange rates. The table reports long-term impacts, measured as the effect ten months after a permanent change in one of the explanatory variables.

Table 9. **Factors causing changes in long-term interest rates: estimation results**[1]
(Monthly data 1970 to 1996, t-values in parentheses)

	Monthly changes					Error correction term					*Memorandum item:*
	Short-term interest rates	Foreign long-term interest rates		Bilateral exchange rates	Lagged dependent	Lagged dependent	Short-term interest rates	Inflation	Constant	R-sq.	Long-term effect of increase in short-term interest rates
		US	Germany								
Japan	0. 07	0.25	0.27	0.02		-0.046	0.021		0.17	0.22	0.46
	(2.92)	(3.53)	(3.03)	(3.19)		(-2.87)	(2.32)		(2.26)		
Germany[2]	0.13	0.27		0.01	0.21	-0.045	0.013		0.17	0.49	0.29
	(6.06)	(7.62)		(2.86)	(4.12)	(-3.58)	(2.53)		(2.45)		
France	0.17		0.48			-0.044	0.022	0.017	0.12	0.32	0.50
	(6.26)		(7.22)			(-3.57)	(2.18)	(3.65)	(1.82)		
Italy	0.23		0.36	0.03	0.28	-0.037	0.034		0.02	0.48	0.92
	(9.81)		(4.71)	(3.58)	(5.67)	(-3.51)	(3.68)		(0.33)		
United Kingdom	0.09	0.35	0.26	0.04	0.21	-0.038	0.027		0.12	0.33	0.71
	(3.27)	(4.51)	(2.44)	(4.44)	(4.23)	(-3.39)	(3.29)		(1.23)		
Canada[3]	0.06	0.96			0.19	-0.128	0.021		0.11	0.76	0.16
	(3.79)	(25.50)			(3.50)	(-4.91)	(3.59)		(2.14)		
Netherlands	0.12		0.73		0.16	-0.061	0.023	0.014	0.26	0.62	0.38
	(8.93)		(14.81)		(2.81)	(-3.79)	(3.60)	(2.93)	(3.16)		
Belgium	0.05		0.32		0.11	-0.037	0.023	0.006	0.11	0.31	0.62
	(2.90)		(6.70)		(2.21)	(-3.44)	(3.38)	(1.98)	(1.85)		
Switzerland	0.08		0.31	0.02		-0.062	0.021	0.011	0.16	0.42	0.34
	(4.65)		(7.19)	(2.75)		(-4.15)	(3.59)	(2.03)	(3.06)		

1. The following equation is estimated:
$\Delta IRL_t(\text{domestic}) = \alpha_1 \Delta IRS_t(\text{domestic}) + \alpha_2 \Delta IRL_t(\text{US}) + \alpha_3 \Delta IRL_t(\text{Germany}) + \alpha_4 RBER_t + \alpha_5 \Delta IRL_{t-1}(\text{domestic}) + \beta_1 IRL_{t-1}(\text{domestic}) + \beta_2 IRS_{t-1}(\text{domestic}) + \beta_3 \text{Inflation}_{t-1} + \beta_4$
where IRL is long-term interest rates; IRS is short-term interest rates; and RBER is relative changes in bilateral exchange rates. Statistically insignificant variables have been excluded from the equation. In some cases lagged variables of IRS (domestic) and IRL (foreign) have been included.
2. Includes the bilateral exchange rate DEM/USD in the error correction term..
3. Includes the US long-term interest rate in the error correction term.

Table 10 Panel A. **Factors causing changes in domestic real long-term interest rates: estimation results**
(semi-annual data 1971 to 1996, t-values in parentheses)

	Estimation period	Semi-annual changes		Error correction mechanism				R^2	*Memorandum items:*	
		Domestic short-term interest rates	US long-term interest rates	Output gap	Domestic short-term interest rates	Lagged endogenous	Constant		Long-term effect of output gap	Long-term effect of domestic short rates
Japan	1971-96	1.03	0.37	-0.24	0.40	-0.35	-0.03	0.80	-0.69	1.14
		(11.20)	(2.15)	(-3.34)	(3.30)	(-3.88)	(-0.13)			
	1980-96	0.63	0.28	-0.08	0.16	-0.59	1.84	0.67	-0.14	0.27
		(4.96)	(2.06)	(-1.26)	(1.24)	(-4.23)	(3.91)			
Germany	1971-96	0.36	0.27	-0.22	0.17	-0.47	1.41	0.65	-0.47	0.36
		(5.30)	(2.90)	(-4.03)	(3.03)	(-5.52)	(5.27)			
	1980-96	0.56	0.24	-0.19	0.07	-0.33	1.17	0.79	-0.58	0.21
		(6.62)	(2.48)	(-3.58)	(0.98)	(-3.76)	(3.38)			
Canada	1971-96	0.60	0.13	-0.23	0.40	-0.43	0.30	0.62	-0.53	0.93
		(6.39)	(0.84)	(-3.76)	(4.46)	(-3.75)	(1.43)			
	1980-96	0.36	0.47	-0.11	0.24	-0.25	0.25	0.75	-0.44	0.96
		(4.69)	(3.03)	(-2.25)	(2.94)	(-2.99)	(0.57)			

The following equation is estimated:

$\Delta RIRL_t(\text{domestic}) = \alpha_1 \Delta RIRS_t(\text{domestic}) + \alpha_2 \Delta RIRL_t(\text{US}) + \beta_1 GAP_{t-1} + \beta_2 RIRS_{t-1}(\text{domestic}) + \beta_3 RIRL_{t-1}(\text{domestic}) + \beta_4$

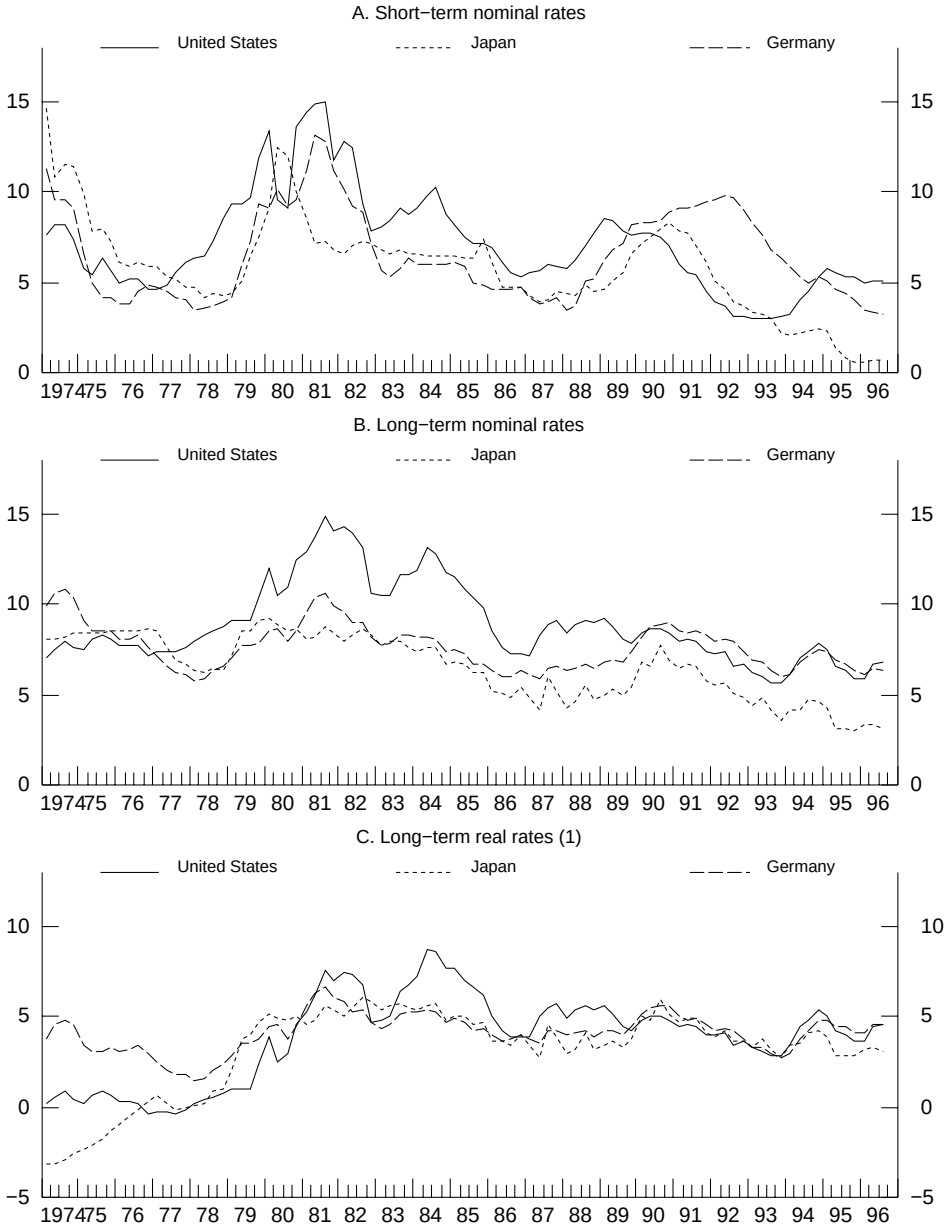
where RIRL is real long-term interest rates; RIRS is real short-term interest rates; and GAP is the estimated output gap.

Table 10 Panel B. **Factors causing changes in domestic real long-term interest rates: estimation results**
(semi-annual data 1971 to 1996, t-values in parentheses)

		Semi-annual changes		Error correction mechanism					*Memorandum items:*	
	Estimation period	Domestic short-term interest rates	Foreign long-term interest rates Germany	Output gap	Domestic short-term interest rates	Lagged endogenous	Constant	R^2	Long-term effect of output gap	Long-term effect of domestic short rates
France	1971-96	0.67	0.26	-0.18	0.24	-0.34	0.58	0.74	-0.53	0.71
		(10.03)	(2.16)	(-2.54)	(2.72)	(-3.35)	(2.74)			
	1980-96	0.71	0.27	-0.07	0.21	-0.47	1.64	0.82	-0.15	0.45
		(8.09)	(2.02)	(-1.04)	(2.09)	(-3.71)	(3.65)			
Italy	1971-96	0.79	0.29	(0.00)	0.48	-0.43	-0.17	0.65	0.00	1.12
		(8.43)	(1.38)	(0.06)	(3.70)	(-3.80)	(-0.82)			
	1980-96	0.77	0.36	0.16	0.50	-0.40	-0.39	0.72	0.40	1.25
		(7.16)	(1.78)	(1.41)	(3.14)	(-3.00)	(-1.11)			
United Kingdom	1971-96	0.79	0.24	-0.27	0.35	-0.42	0.34	0.91	-0.64	0.83
		(18.77)	(1.59)	(-5.04)	(4.64)	(-4.79)	(2.16)			
	1980-96	0.85	0.63	-0.29	0.49	-0.48	-0.06	0.86	-0.60	1.02
		(9.82)	(4.09)	(-5.06)	(4.56)	(5.31)	(-0.23)			
Netherlands	1973-96	0.43	0.26	-0.04	0.18	-0.27	0.64	0.67	-0.15	0.67
		(7.42)	(2.04)	(-0.43)	(2.06)	(-2.53)	(2.44)			
	1980-96	0.65	0.27	-0.03	0.08	-0.44	2.18	6.92	-0.07	0.18
		(11.79)	(3.18)	(-0.46)	(1.15)	(-5.06)	(5.16)			
Belgium	1973-96	0.49	0.25	-0.22	0.35	-0.41	0.48	0.60	-0.54	0.85
		(6.51)	(1.70)	(-2.44)	(3.12)	(-3.39)	(2.07)			
	1980-96	0.49	0.44	-0.09	0.26	-0.36	0.72	0.69	-0.25	0.72
		(4.76)	(3.14)	(-0.78)	(2.27)	(-2.95)	(2.27)			
Switzerland	1974-96	0.50	-0.11	-0.45	0.34	-0.58	0.29	0.79	-0.78	0.59
		(8.81)	(-1.09)	(-4.80)	(3.33)	(-5.35)	(2.18)			
	1980-96	0.51	-0.12	-0.48	0.30	-0.47`	0.19	0.79	-1.02	0.64
		(7.12)	(-1.31)	(-3.91)	(2.36)	(3.54)	(1.15)			
Sweden	1982-96	0.73	0.37	-0.09	0.31	-0.40	0.78	0.84	-0.23	0.78
		(9.00)	(1.57)	(-1.44)	(2.40)	(-2.58)	(1.32)			

The following equation is estimated: $\Delta RIRL_t(\text{domestic}) = \alpha_1 \Delta RIRS_t(\text{domestic}) + \alpha_2 \Delta RIRL_t(\text{Germany}) + \beta_1 GAP_{t-1} + \beta_2 RIRS_{t-1}(\text{domestic}) + \beta_3 RIRL_{t-1}(\text{domestic}) + \beta_4$
where RIRL is real long-term interest rates; RIRS is real short-term interest rates; and GAP is the estimated output gap.

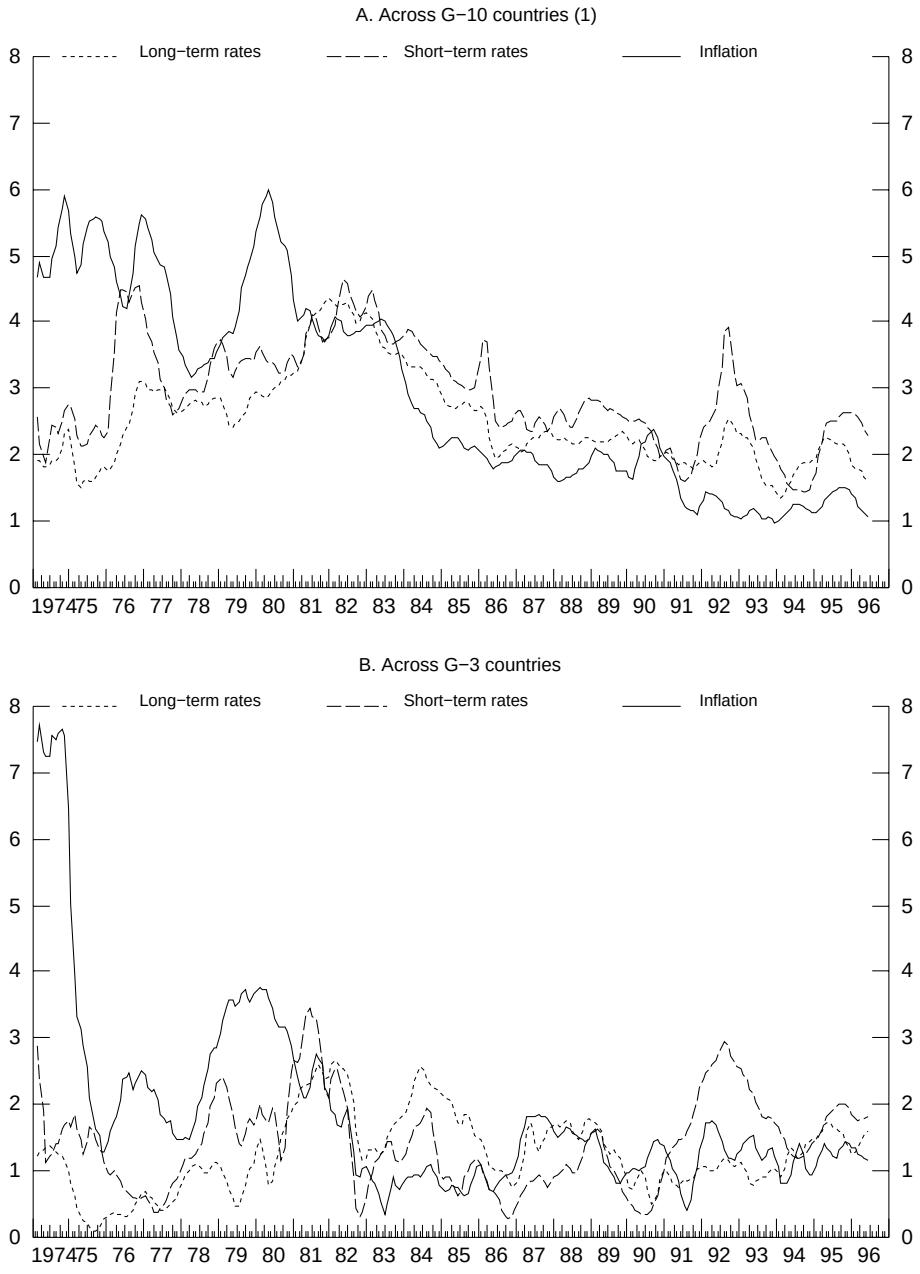
Figure 1. **Interest rates in the G3 countries**



1. Real long−term rates calculated as the difference between the nominal long−term rate and a proxy for expected inflation calculated using a Hodrick−Prescott filter on the growth in the GDP deflator.

Source: OECD Secretariat.

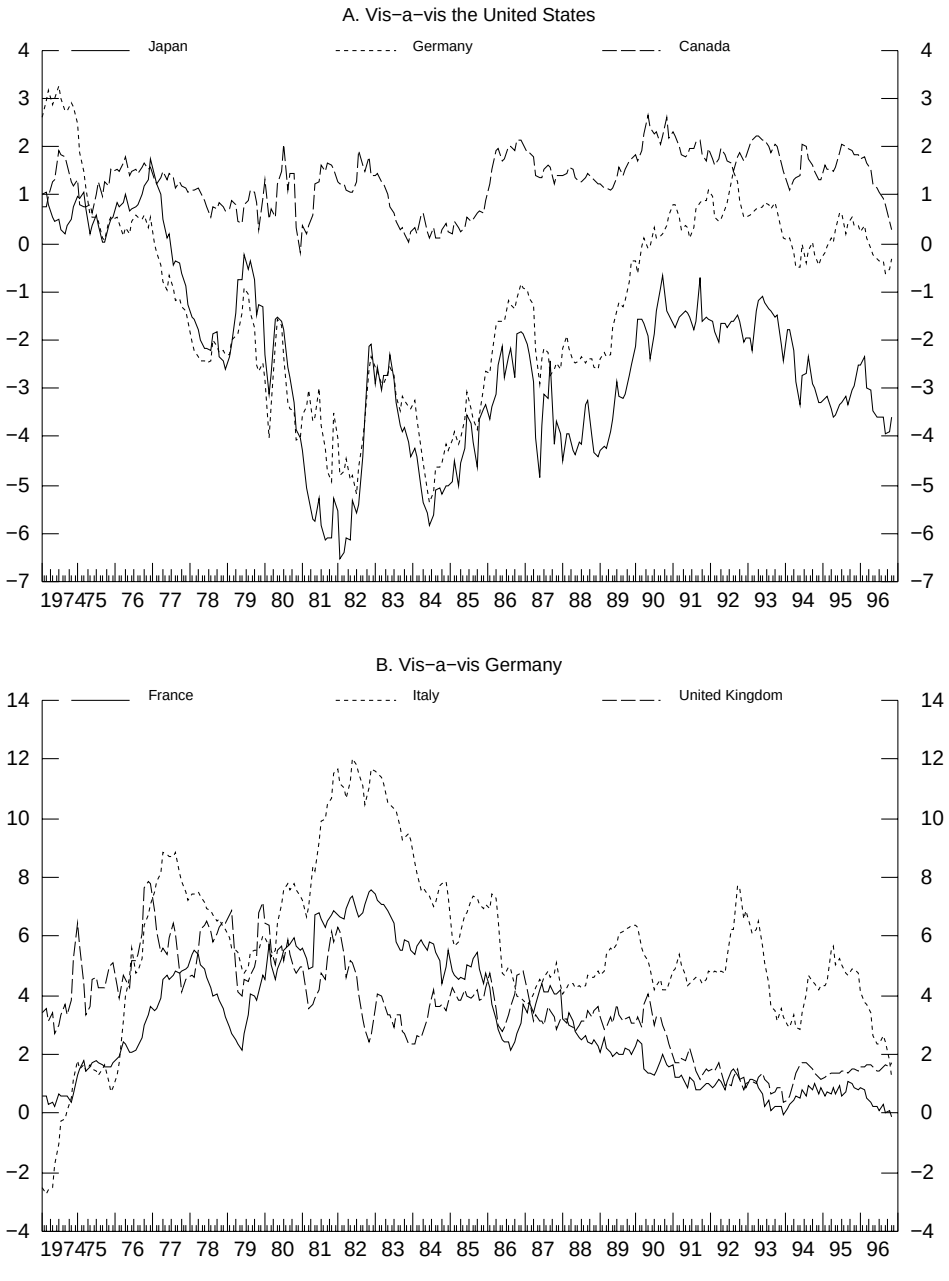
Figure 2. **Dispersion of interest rates and inflation**
(Three months' moving average of standard deviation across the countries)



1. G−7 plus Belgium, Netherlands and Switzerland.

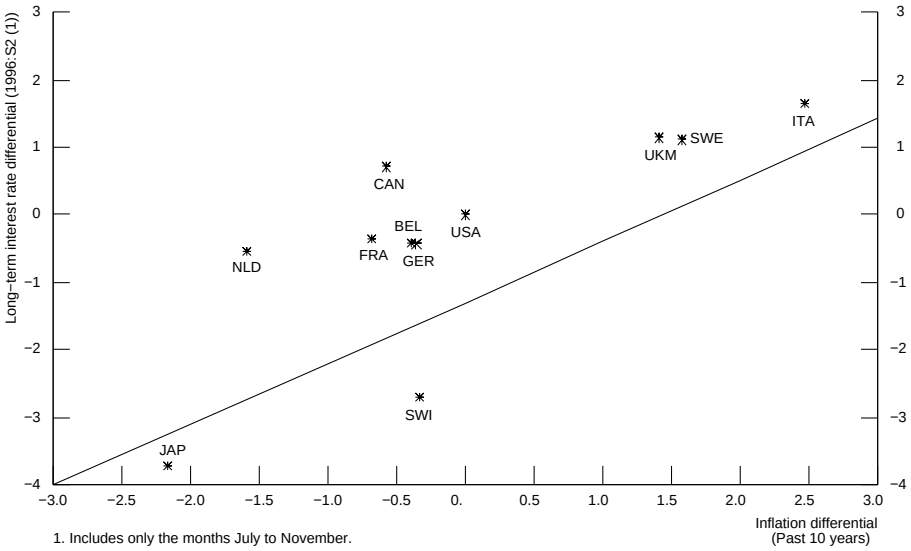
Source: OECD Secretariat.

Figure 3. **Long−term interest rate differentials**



Source: OECD Secretariat.

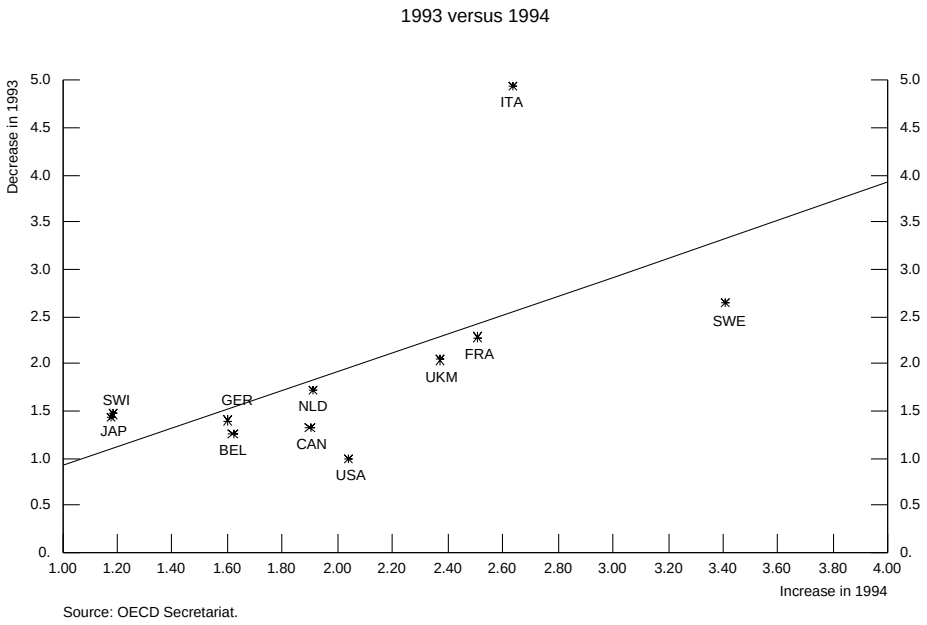
Figure 4. **Interest differentials and inflation performance**
(Differentials vis−a−vis the United States)



1. Includes only the months July to November.

Source: OECD Secretariat.

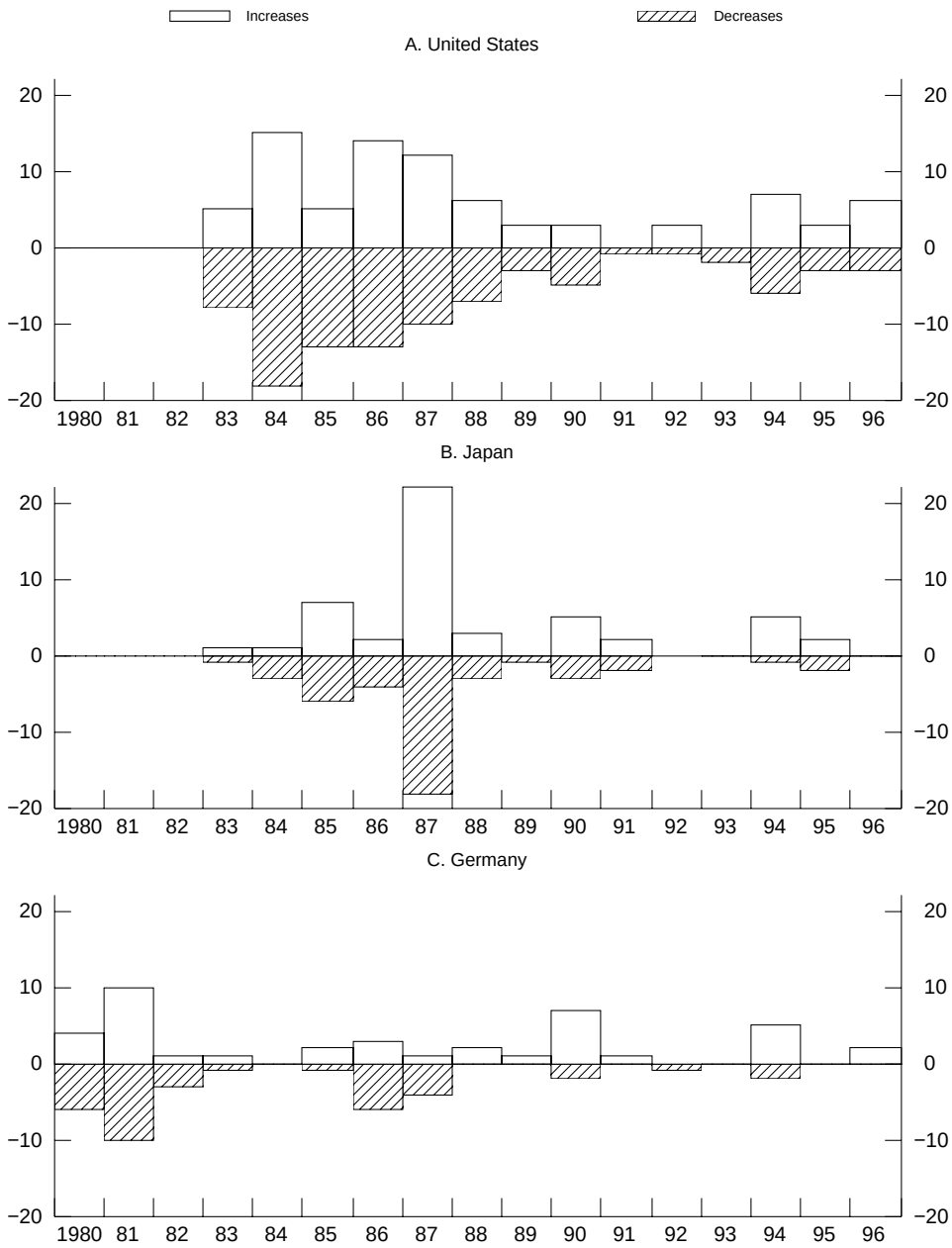
Figure 5. **Changes in long−term interest rates**



Source: OECD Secretariat.

Figure 6. **Large daily changes in long−term interest rates (1)**

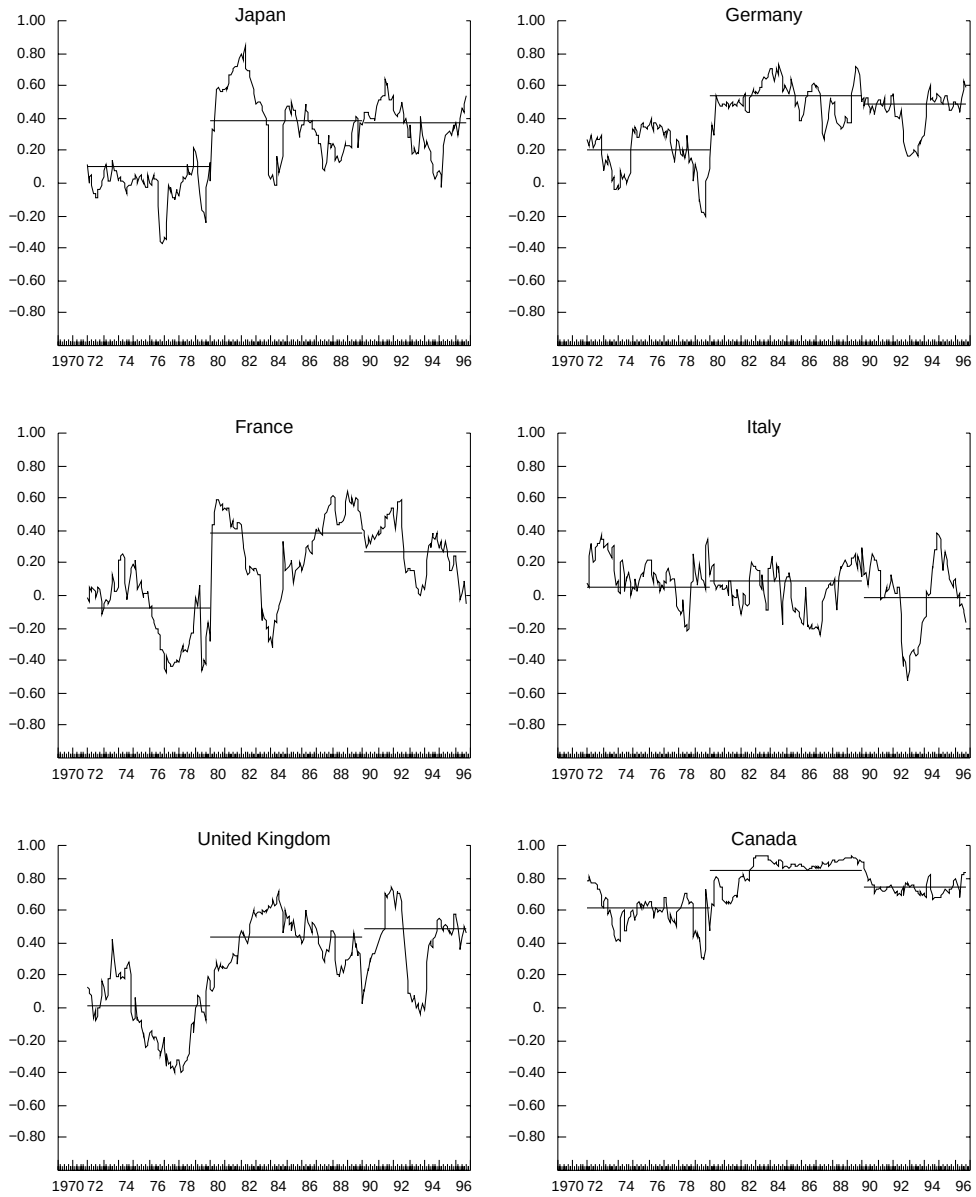
(Number of occurrences per year)



1. Large changes are defined as increases or decreases exceeding 15 basis points.

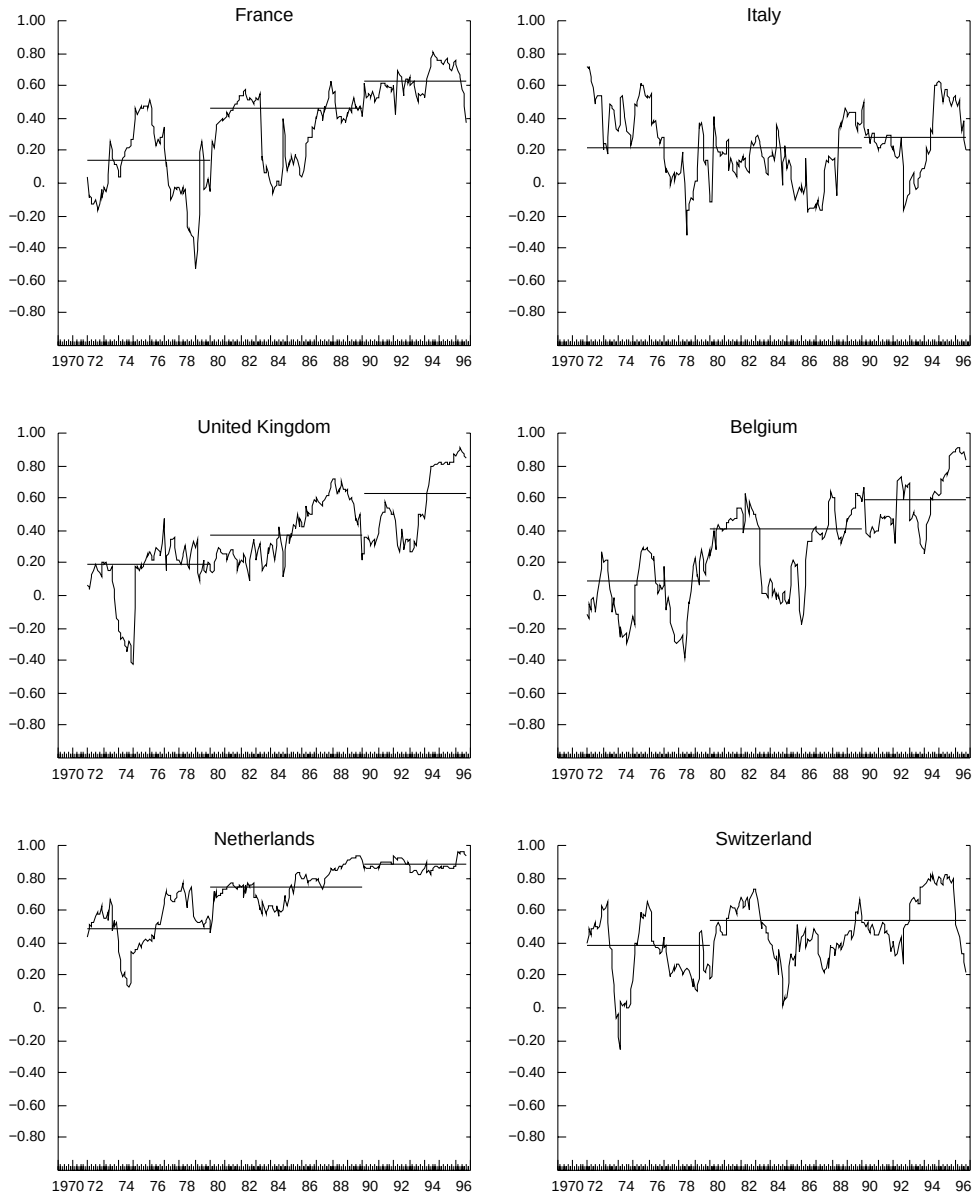
Source: OECD Secretariat.

Figure 7 A. **Co−variation between changes in long−term interest rates: 24 months rolling correlation (1)**
vis−a−vis the United States



1. Covering the 24 months period ending in any given month. Horizontal lines show average correlation in 1970−79, 1980−89 and 1990−96.
Source: OECD Secretariat.

Figure 7 B. **Co−variation between changes in long−term interest rates: 24 months rolling correlation (1)**
vis−a−vis Germany



1. Covering the 24 months period ending in any given month. Horizontal lines show average correlation in 1970−79, 1980−89 and 1990−96.
Source: OECD Secretariat.

Figure 8. **Long−run effect on long−term interest rates of a shift in short−term interest rates**
(recursive estimation, starting in 1970)

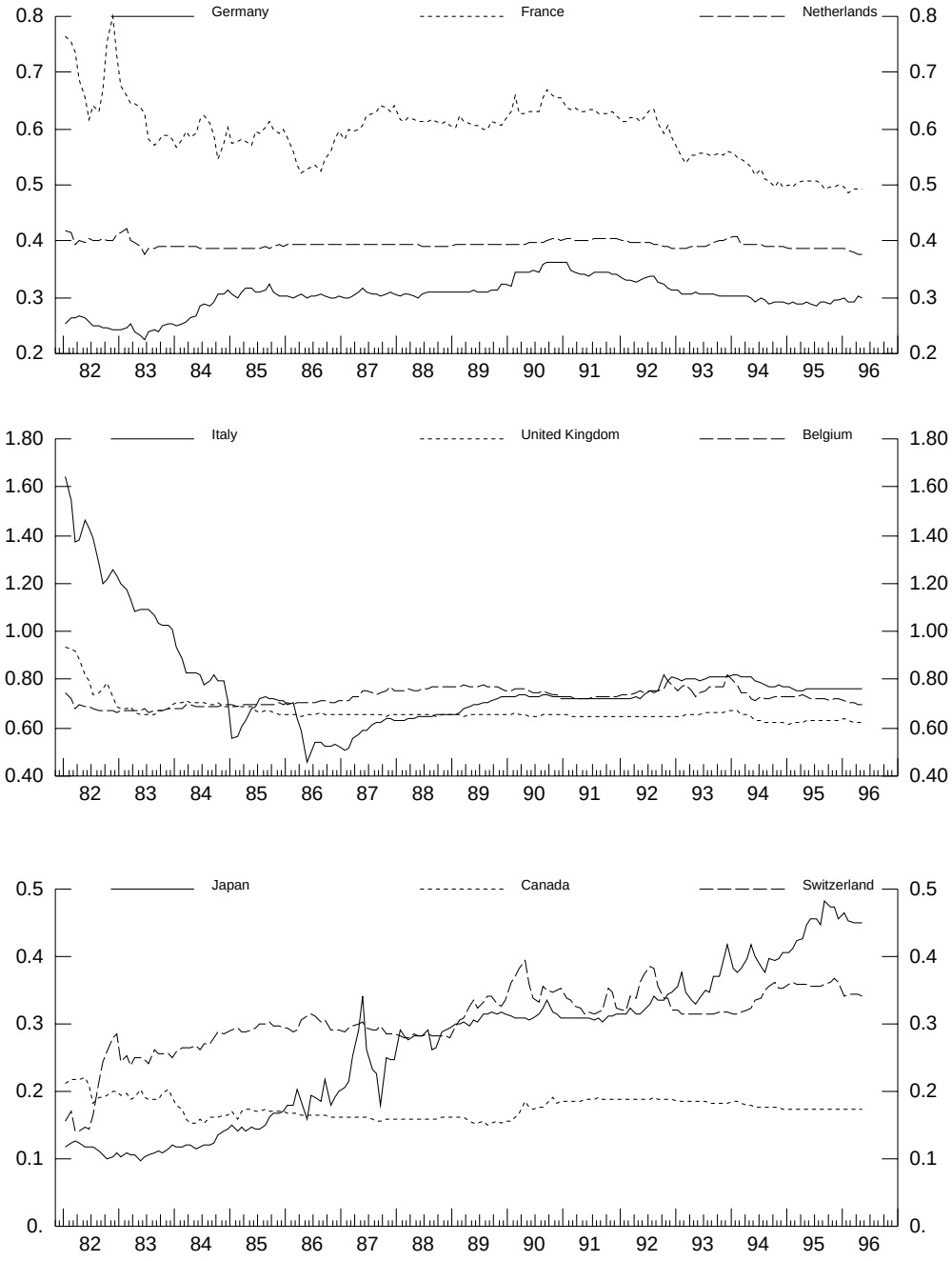
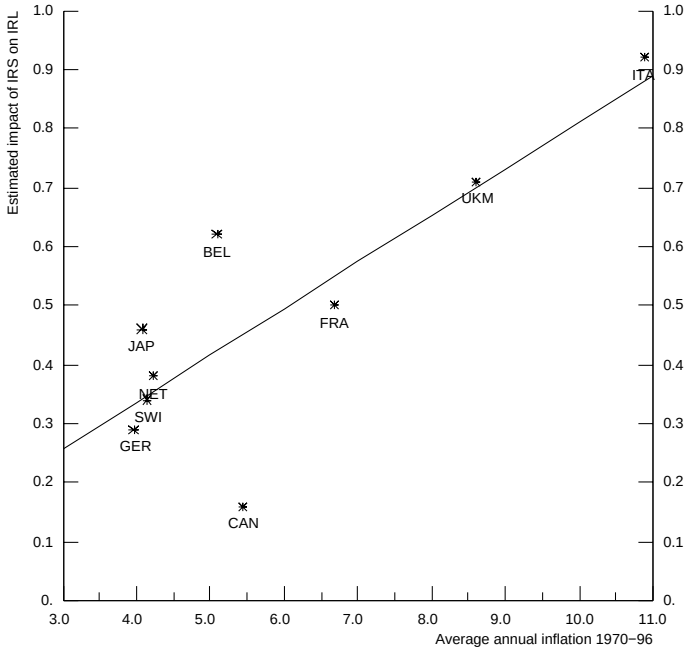


Figure 9. **Effect from short−term interest rates and past inflation**



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