ONGOING CHANGES IN THE BUSINESS CYCLE – EVIDENCE AND CAUSES

by Thomas Dalsgaard

Jørgen Elmeskov

Cyn-Young Park

Société Universitaire Européenne de Recherches Financières
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Jørgen Elmeskov
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Abstract

This paper first reviews a number of stylised facts concerning OECD country business cycles over the past four decades. In general, the amplitude of business cycles has fallen, driven mainly by declining fluctuations of domestic demand. As a result, international divergencies of cyclical positions have diminished but, outside the euro area, there is little evidence of increased synchronisation of cycles. The paper then reviews a number of influences on business cycles. The evidence suggests that, on balance, features of macroeconomic policies may have tended to reduce cyclical volatility and structural changes, notably the increased share of the service sector in the economies, have also tended to dampen the cycle. More recently, there are signs that financial market prices have increasingly moved in sympathy across countries, and the final section of the paper illustrates how this could affect the international transmission of cyclical shocks and the associated need for policy response.

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1. Introduction

This paper focuses on how and why the business cycle in OECD countries has changed over the past three to four decades. Over that period, a number of developments have changed the structure of OECD economies, spurred by technology advances and structural reform. At the same time, most countries have come to rely on a stability oriented setting of macroeconomic policies. Together with increased international interdependencies and globalisation of financial markets, some of these developments are likely to have had a substantial influence on the nature of the domestic business cycle and may affect the interaction of cycles across countries.

Possibly among the more important is the shift towards a more service-based economy, which in combination with improved inventory management have reduced the destabilising effect from stockbuilding in the business cycle – though the role of stockbuilding in the recent US slowdown is a sobering reminder that this element of the cycle has not been entirely eliminated. Increased openness to trade and a surge in intra-firm and intra-industry trade may have also contributed to changing the cycle, although the effects are not clear-cut. Financial deepening in the private sector following deregulation of financial markets is another important factor shaping the cycle, while the increasing tendency for asset prices to move in line across countries is frequently thought to strengthen synchronisation. To the extent that monetary policies have increasingly and with greater credibility aimed at low inflation, this is likely to affect the cyclical variation of both inflation and output, which is also influenced by the size of fiscal stabilisers and increased focus on fiscal consolidation in many OECD countries. Ongoing reforms and structural changes in labour and product markets may also have affected the response of both inflation and employment to cyclical variations in output.

Recently, there has been considerable discussion of the impact that a "New Economy" might have on the business cycle. The recent OECD *Growth Study* (OECD, 2001*a*) argued that in some countries, notably the United States, information and communications technology had contributed to a rise in trend growth but the *Growth Study* had little to say on the possible effects of a New Economy on the business cycle. The slowdown in the US economy has, however, put an end to one of the wilder claims about a New Economy: that it would imply the end of the business cycle.

In practice, business cycles are difficult to identify in the data, in particular to the extent they are low-frequency phenomena. It is thus difficult to establish clear causal links between structural changes in the economies and features of the business cycle. There is simply not a sufficient number of observations to test different structural relationships against each other. The present paper is therefore constrained to follow a pragmatic and basically atheoretical approach in identifying changes in the shape of business cycles and their causes.[1] It is also work-in-progress in the sense that the text identifies a number of issues that could merit further study but which have been left unexplored at this point. Section 2 of the paper describes the methodology used for identifying business cycle variations and presents some main stylised facts based on that methodology. Section 3 explores some of the possible mechanisms behind the observed changes in business cycles, while Section 4 discusses the pattern of international synchronisation. Finally, Section 5 outlines a few considerations for policy and Section 6 concludes.

[1] The methodology applied is, however, comparable to that used in some of the real business cycle literature, *e.g.* Kydland and Prescott (1990), Backus and Kehoe (1992) and Christodoulakis *et al.* (1995).

2. Stylised facts about the domestic business cycle and international synchronisation

A basic premise of this paper is that for any economy there is such a thing as a "typical" business cycle, describing the movements around their long-term trends of main macroeconomic variables. In practice there is no neat separation between trend and cycle; rather, the two interact as exemplified in the phenomenon of unemployment persistence. However, for the purpose of this paper, a second basic premise will be that trend and cycle are indeed separable. The crucial issue is then how to separate cyclical from trend movements in time series data. There is a vast amount of literature and research on this topic, offering a wide range of detrending methodologies.[2] However, no single method is able to claim global superiority, and the preference of one methodology over another largely hinges on the specific characteristics of the time series in question and/or the objective of the analysis. In order to derive trend series for GDP and components of demand, this study applies the Hodrick-Prescott (HP) filter, which has a number of attractions, among them its very wide usage in the business cycle literature. The decision to use the HP filter is not uncontroversial, however, and some of the caveats and possible solutions are summarised in the Annex.

The data used for the current study are seasonally adjusted quarterly data from the OECD's Analytical Database.[3] The results are mainly based on a subgroup of 13 OECD countries for which quarterly national accounts data are generally available from 1960q1 to 2000q4.[4] For the purpose of filtering the time series, data have been extended to 2006q4 and backcasted to 1955q1 in order to mitigate potential bias in both ends of the sample. These extensions of the dataset have been constructed by replicating the growth path

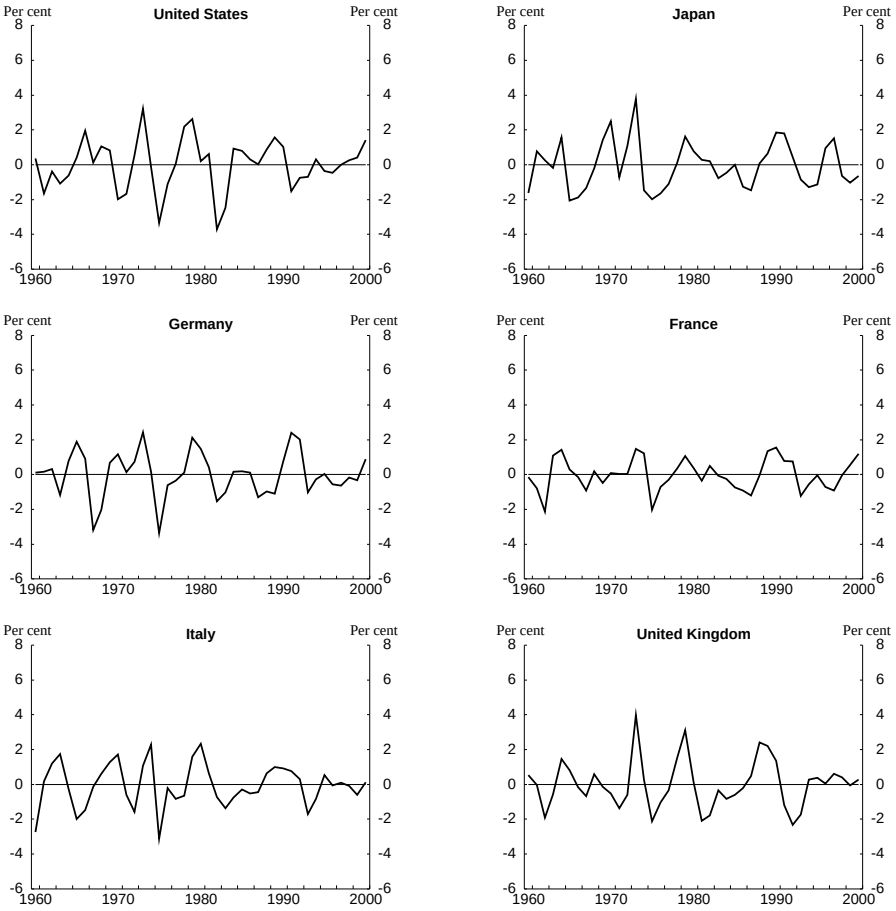
[2] Some of this literature is briefly surveyed in the Annex.

[3] As default, a HP filter with $\lambda = 1600$ is used uniformly across all time series and all countries. Gaps are calculated as 100*(log(X)–HP(log(X))), except for ratios, where the HP filter is applied directly to the ratio. This method is standard in the literature.

[4] These are the major seven OECD countries plus Australia, Austria, New Zealand, Norway, Spain and Sweden. For Norway and New Zealand, the historical movements of the business cycle and its components have at times been radically different from other OECD countries. In order not to blur comparability by such distinctive idiosyncracies, these two countries have generally been omitted from sample averages.

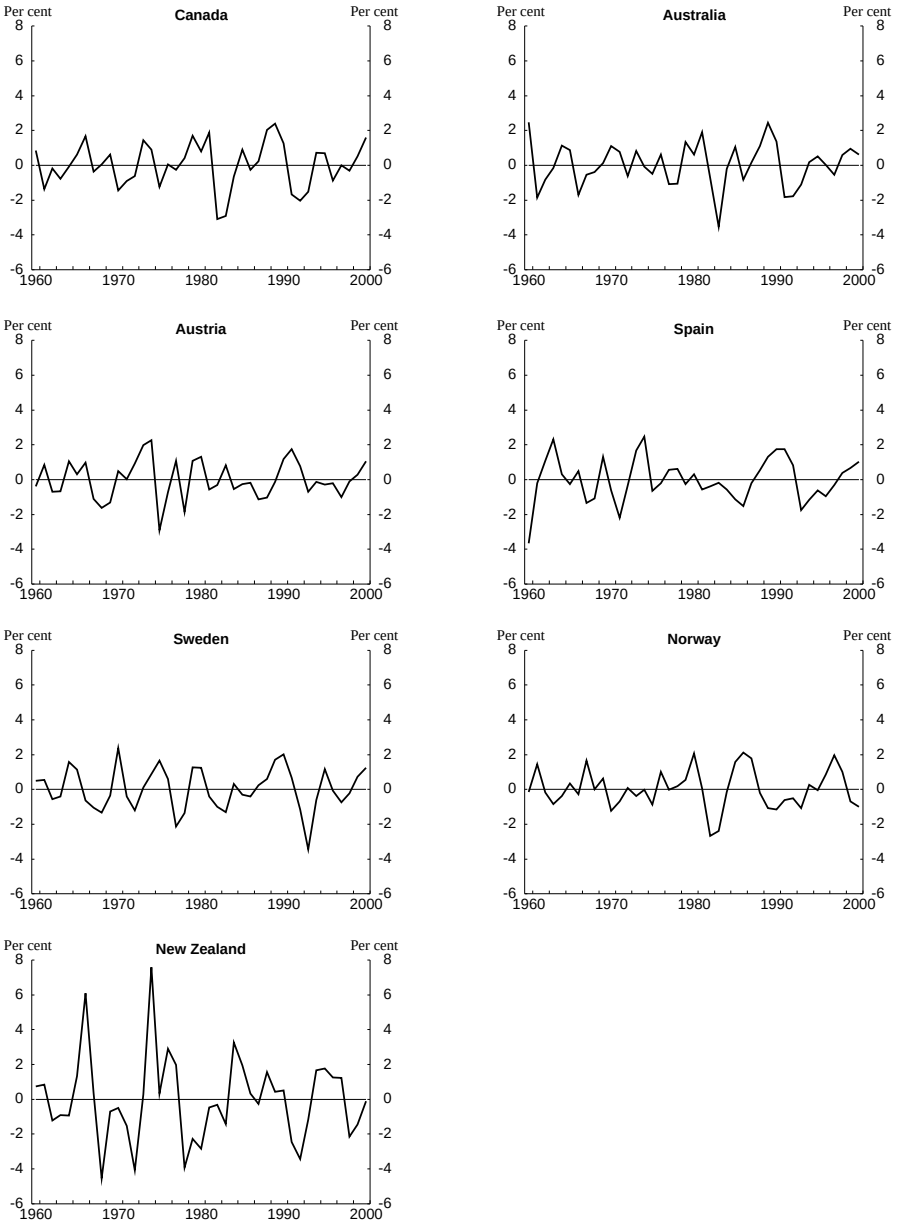
of the previous/next 20 quarters.[5] The resulting gaps for real GDP are shown in Figure 1. These gaps generally trace the pattern of the "standard" OECD gap calculations, although the amplitudes of the gaps are smaller here as growth rates of trend output are generally less smooth. Gaps have also been calculated for the main sub-components of the expenditure accounts in order to identify how these have influenced the overall output gap over time.

Figure 1. Output gaps



[5] Experimentation with alternative end-point adjustments and values of λ shows that the results presented in this paper are robust to changes in these assumptions. Specifically, the calculations of output gap amplitudes, persistence and synchronisation have been replicated using the OECD's Medium Term Reference Scenario (OECD, 2001*b*) as the end-point adjustment as well as for λ = 160 and λ = 16000.

Figure 1 (continued). Output gaps



2.1. The domestic cycle has become smaller over time...

Two main characteristics of the business cycle are its size and duration. One approach in analysing business cycles pins down a sequence of separately identified cycles over a given time span, for instance the post-WWII period. The length of each cycle is then measured by number of quarters from peak to trough and the amplitude is the maximum distance found between positive and negative output gaps within each cycle. However, since the typical business cycle in OECD countries spans over four to six years, there is not a sufficient number of cycles to judge whether systematic changes have taken place in their length or size over the past three to four decades, not to mention the most recent years. Hence, rather than trying to identify specific cycles across OECD countries, this paper focuses on how the output-gap has evolved over time in each country as well as across countries.

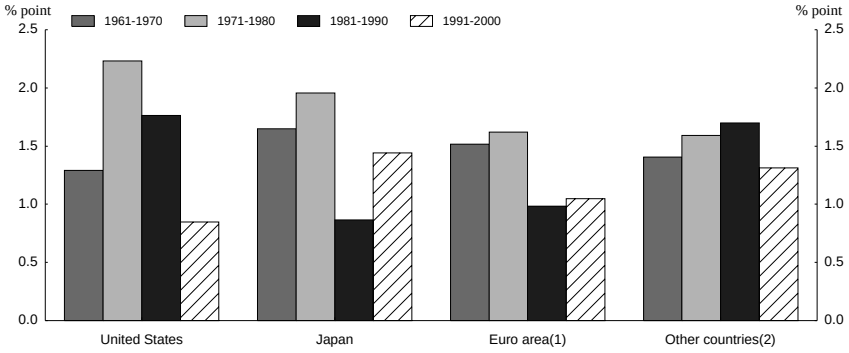
The amplitude of the business cycle of most OECD countries, when proxied by the average size of output gaps over ten-year periods, has declined since the turbulent decade of the 1970s and is now in most cases lower than it was 30 years ago (Figure 2, Panel A and B).[6] In contrast with most other OECD countries, the amplitude of the average output gap in Japan has increased somewhat in the 1990s, implying that the average size of the output gap in Japan over the most recent decade is around 50 per cent higher than that of the United States and one-third higher than that of the euro area. Increases in the size of the output gaps also occurred in Spain and Sweden in the 1990s, but on a more moderate scale.[7]

[6] The average size of the business cycle for each country is calculated using both the standard deviation of the gap within each ten-year overlapping period, as well as the average absolute (numerical) size of the gap. The two methods yield similar results, which are also confirmed by a third measure of the business cycle amplitude, the root mean square (RMS) of output gaps. This is indeed what one would expect looking over the whole sample, since the average gap is zero by definition. However, for sub-periods of the sample, differences between the different measures may arise.

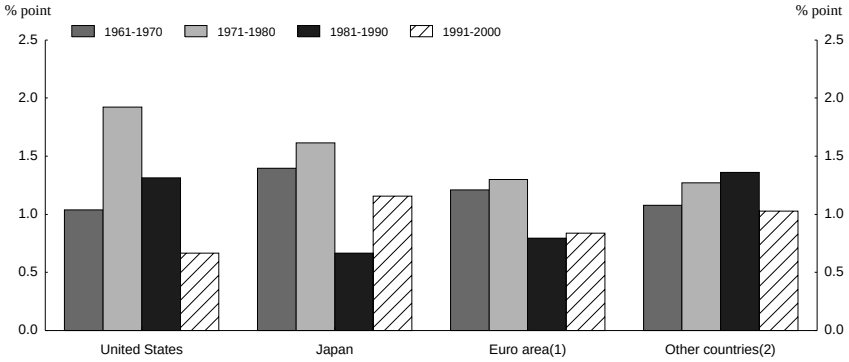
[7] See Figure A1 of the Annex.

Figure 2. The amplitude of output gaps has diminished

Panel A. Standard deviation of output gaps



Panel B. Average absolute size of output gaps



Note: The gap is calculated using an HP1600 filter. Country specific output gap profiles for moving 10-year averages are shown in figure A1 of the Annex.
1. Simple average of Germany, France, Italy, Austria and Spain.
2. Simple average of the United Kingdon, Canada, Australia and Sweden.

The overall decreasing amplitude of output gaps in OECD countries is mainly related to higher stability of domestic demand, despite some slight increase in the variability of domestic demand in Japan and the euro area in the 1990s (Table 1). For most countries, the contribution to economic fluctuations from government consumption and investment is quite small and stable over time. This implies that the thrust of the decrease in volatility stems from a reduction of the cyclicality of private investment and, in particular, private consumption.[8] Stockbuilding also contributes much less to the cycle than it used to do, *cf.* Section 3 below. The contribution from trade to output gap

[8] See Figure A2 of the Annex.

variance has been negative for most countries and in most periods – in other words, trade has generally, and often in a substantial way, acted to dampen the cycle in OECD countries.[9] However, the extent to which this offsetting effect from trade on the cycle in domestic demand has increased or decreased over time varies considerably across countries, as discussed in more detail in Section 3 below.

Table 1. Contributions to the variance of output gaps

Country and period	Total output gap variance	Contribution from total domestic demand	Contribution from trade	Residual
	(1)=(2)+(3)+(4)	(2)	(3)	(4)
United States				
1961-1970	1.8	2.1	-0.2	-0.0
1971-1980	4.6	6.7	-1.6	-0.5
1981-1990	3.1	4.2	-1.0	-0.1
1991-2000	0.7	1.3	-0.6	0.0
Japan				
1961-1970	2.9	2.7	-0.4	0.5
1971-1980	3.3	5.2	-1.8	-0.1
1981-1990	1.1	1.5	-0.3	-0.0
1991-2000	1.8	2.2	-0.4	-0.0
Euro countries[1]				
1961-1970	2.1	3.1	-0.9	-0.1
1971-1980	2.8	4.5	-1.7	0.0
1981-1990	0.9	1.5	-0.6	0.0
1991-2000	1.0	2.0	-1.0	0.0
Other countries[2]				
1961-1970	1.9	2.5	-0.7	0.1
1971-1980	2.8	3.9	-1.3	0.2
1981-1990	2.8	4.7	-2.3	0.4
1991-2000	1.7	2.2	-0.5	0.0

Note: The variance of the output gaps is a proxy for the average size of the gap (since it measures the squared average distance from the gap mean, which is close to zero). The contributions to total output gap variance from the total domestic demand gap and the trade gap are calculated as a weighted average of their individual variances and their covariance. The residual is the discrepancy between the total output variance and the sum of its components, which is due to statistical discrepancies, averaging effects as well as the non-additivity of real expenditure components for countries using chain-weighted accounts. See Table A1 of the Annex for more detail.

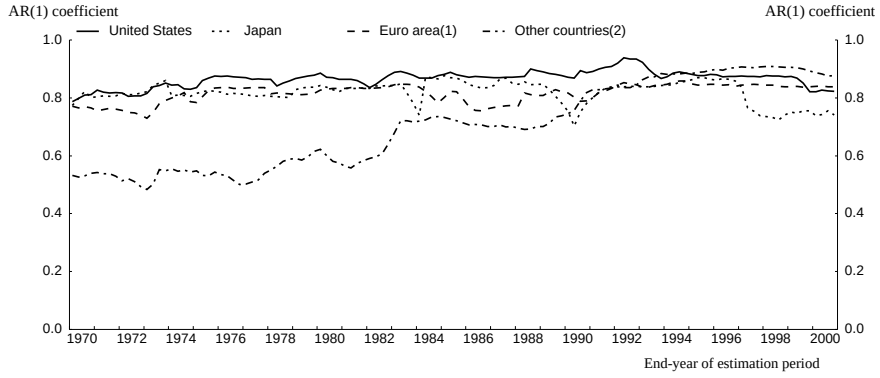
1. Euro countries in the sample include Austria, France, Germany, Italy and Spain. Simple average.
2. Other countries include Canada, Sweden and the United Kingdom (Australia, New Zealand and Norway are not included due to lack of data). Simple average.

[9] The only exception is Austria in the 1990s, where trade contributed slightly to increased output gap variance, and Germany in the 1980s and 1990s, where trade on net did not affect total output gap variance (*cf.* Table A1 of the Annex).

2.2. ...whereas the duration of the cycle has remained almost unchanged in the three major regions

The duration of the cycle is another pertinent feature of the business cycle. As was the case for measuring amplitudes, the lack of a sufficient number of cycles excludes systematic analysis of recent changes to the length of the cycle, measured in quarters. Instead, changes in the duration of the cycle are gauged from changes in the persistence of output gaps.[10] Hence, based on changes to the first order auto-correlation of output gaps, the degree of persistence of the business cycle appears to have been more or less unchanged for the three major regions over the sample period, albeit with a slightly declining tendency for Japan most recently (Figure 3). For the euro area, the relative stability of the persistence over time disguises that persistence, while remaining almost unchanged in Italy and Spain, has increased in Austria and France and decreased slightly in Germany.[11] For other countries (Australia, Canada, New Zealand, Norway, Sweden and the United Kingdom) there is a relatively clear tendency for the previously short duration of the cycle to converge towards the same duration as elsewhere.

Figure 3. The persistence of output gaps is mostly stable



Note: The persistence of the gaps is measured by the first order autocorrelation of the gap. An AR(1) process is fitted to a moving 10-year window.
1. Simple average of Germany, France, Italy, Austria and Spain.
2. Simple average of the United Kingdon, Canada, Australia and Sweden.

[10] The measure of business cycle duration used here – persistence of the output gaps measured by their first order autocorrelations – is akin to the concept used in a number of other business cycle studies (see *e.g.* Christodoulakis *et al.,* 1995, or Barro 1988 in an examination of unemployment persistence). By focusing only on the first-order autocorrelation, no specific assumptions about the dynamic process driving the output-gap are required (other than it contains an autoregressive element, which is clearly the case). See also Greene (1997), page 834.

[11] See Figure A3 of the Annex.

2.3. International divergencies have diminished but synchronisation has not increased

Greater economic integration among a group of countries might be expected to lead to more similar cycles with respect to intensity, duration and timing. The degree of synchronisation has implications for the appropriate policy response to cyclical developments, given that the domestic cycle may be either amplified or mitigated by impulses coming from abroad. This issue is of particular interest for the euro-area countries, where large cyclical divergencies among countries would be difficult to meet with a common monetary response by the ECB and might instead call for domestic counter-cyclical policies.

One measure of the degree of business cycle divergence across countries is the standard deviation of output gaps across countries. This would be zero across all time periods if the business cycle had the same periodicity and amplitude in all countries. Hence, the closer to zero the standard deviation, the less divergent are the cycles. In this sense, cycles indeed seem to have become gradually less divergent over time, most clearly since the early 1990s (Figure 4).[12] However, the reduction in the cross-country dispersion of gaps seems to be related mainly to the fact that output gaps on average have become smaller over time, rather than being the result of business cycles becoming increasingly in phase across countries. At least, a number of potential indicators of business cycle synchronisation did not point to clear trends,[13] except possibly a closer alignment of euro-area business cycles.[14]

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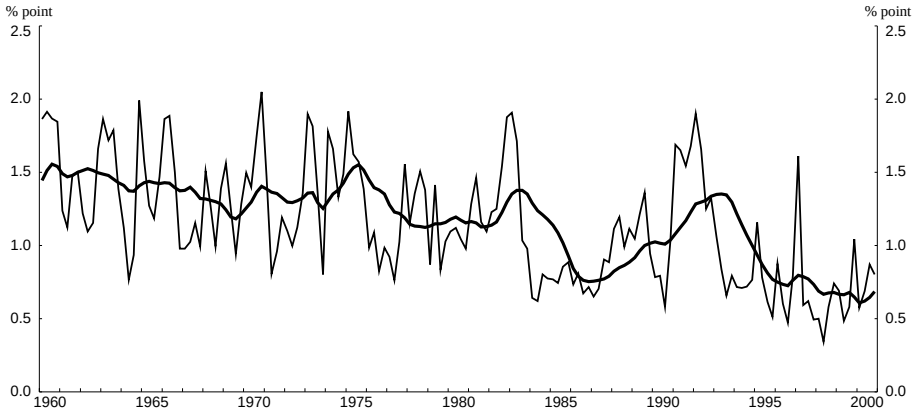
[12] This result is robust to a number of variations in the detrending methodology (using other values for λ in the HP filter as well as using OECD's standard definition of the output gap, *cf.* Giorno *et al.*, 1995). It should also be stressed that the omission of Norway and New Zealand from the sample does not have any effect on the conclusion – in fact, including these two countries would only reinforce the tendency for increased synchronisation over time.

[13] Bilateral correlation coefficients of output gaps were averaged across country pairs. The standard deviation of output gaps was corrected by a moving average of the output gaps. As well, the ratio between the absolute sum of output gaps and the sum of absolute gaps was considered. In neither case could clear trends be identified, except possibly among euro-area countries.

[14] This is also found in a number of other studies, such as Christodoulakis *et al.* (1995) and Wynne and Koo (2000). However, as noted by the latter: "There is a much higher degree of correlation between economic activity in the original six members of the EU than among any countries that joined later. There are some exceptions to this for countries that are geographically proximate".

Figure 4. Reduced divergencies of output gaps

(Cross-country standard deviation of gaps)



Note: The degree of synchronisation is measured by the standard deviation of the gap across 11 OECD countries in each period of time.
The thick line shows the 12 quarter moving average. The gap is calculated using an HP1600 filter.

3. Factors shaping the business cycle

While the 1960s were characterised by steady expansion and relative macroeconomic stability, the 1970s became a much more volatile decade in most OECD countries due to a mix of domestic policy failures and international disturbances, notably the two oil crises. The shift in monetary policy regimes that occurred around 1980 in many OECD countries has presumably been a major factor behind the tendency for smaller output gaps, but other influences may have been important as well. These include the shift towards a more service-based economy, the increasing role of the public sector and better management of inventories. On the other hand, developments such as deregulation and increased globalisation of financial markets as well as financial deepening in the private sector have had conflicting effects on the cycle with the net impact being unclear. "New Economy" effects are also likely to impinge on the business cycle characteristics, but again the effects are uncertain. These and other factors are discussed in more detail below. Ongoing structural changes in other areas – such as labour-market reform, strengthening of competition policies and privatisation and deregulation of network industries in many OECD countries – have undoubtedly also exerted some influence on the business cycle. Exploring such effects, however, is outside the scope of this paper.

3.1. Shifts in economic structure and technological change

Changes in the composition of GDP over time are likely to have reduced output cyclicality

The role of stockbuilding in shaping the business cycle has traditionally attracted much attention among business cycle analysts. This is due, first, to stockbuilding historically having had a strong influence on the cycle, despite being a very small share of total GDP.[15] Second, stockbuilding is highly procyclical and hence a destabilising element in the cycle, in contrast to the predictions of traditional theoretical production smoothing models. While the second issue has been more or less resolved by theoretical developments over

[15] Dornbusch and Fischer (1987) found that declines in stockbuilding accounted for approximately half of the total decline in the output gap on average during recessions in the United States since 1948, even though stockbuilding amounted to around 1 per cent of GDP on average.

the past couple of decades,[16] the question remains whether stockbuilding is as important for the business cycle today as it was in the past. One observation is that the share of stockbuilding in total GDP has been drastically reduced over the past three decades (Figure 5).[17] The declining share of stockbuilding in overall GDP is caused, *inter alia,* by the increasing share of the service sector in OECD countries (private as well as public services).[18] Improved inventory control and increased use of just-in-time production in manufacturing have also contributed, facilitated by increased use of information technology. This reduced share of stockbuilding in GDP leaves less room for inventory cycles to dominate output fluctuations to the same extent as in the past. In principle, such a trend could have been offset by increased procyclicality of stockbuilding but there is no strong evidence of such a tendency except, perhaps, in the United States and the euro area over the 1990s (Figure 6). In combination, these factors imply that stockbuilding cycles have become much less important for the overall business cycle except in the case of Japan (Figure 7).

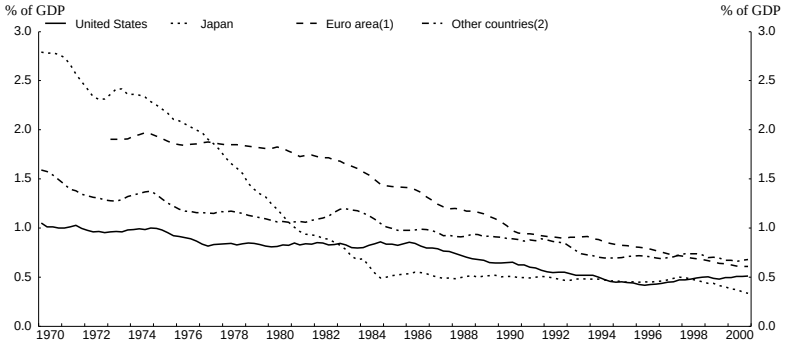
[16] While recognising the importance of production smoothing (if demand varies over time, increasing marginal costs of production provides an incentive to smooth production), recent theoretical models illustrate how other motives may be even more important for the firm and hence lead to the opposite outcome (*i.e.* that the variance of production exceeds the variance of sales). One of these is the motive for firms to bunch production in order to avoid stock-outs, and hence lost sales, when production decisions must be made before demand is fully known (Blanchard and Fischer, 1989). Another model (Blinder, 1986), suggests that production smoothing actually takes place for truly unexpected changes in sales, but that a combination of small cost shocks and strong autocorrelation of demand shocks is sufficient to generate overall procyclicality of stockbuilding.

[17] As illustrated in Figure A2 of the Annex, the size of the inventory gap has also been significantly reduced in the past decades.

[18] The share of services in total GDP increased from 56 per cent in 1970 to 70 per cent in 1999 for a weighted average of 13 OECD countries (the same sample as used throughout this study).

Figure 5. Declining importance of stockbuilding in GDP

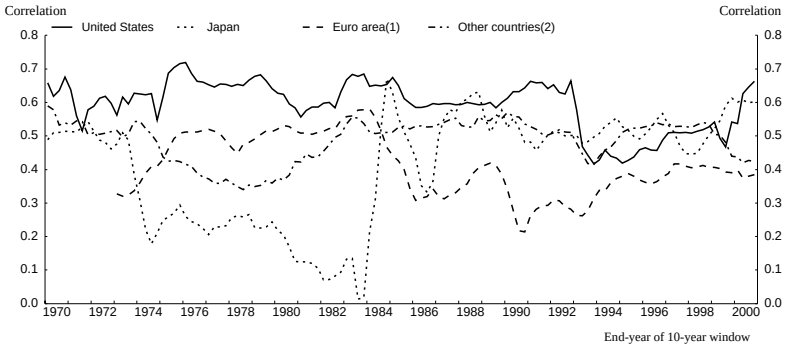
(Stockbuilding as a share of GDP, moving average)



Note: The figure show the average absolute size of stockbuilding in per cent of GDP (10-year moving windows). The ratio of nominal stockbuilding to nominal GDP is shown rather than real shares since these may be flawed for countries using chain-weighted GDP measures, such as the United States. If changes in deflators do not differ too much, the trend in the nominal ratio is a good approximation of the trend in the contribution from stockbuilding to real GDP.
1. Simple average of Germany, France, Italy, Austria and Spain.
2. Simple average of the United Kingdon, Canada, Australia and Sweden.

Figure 6. Stockbuilding: more or less procyclical?

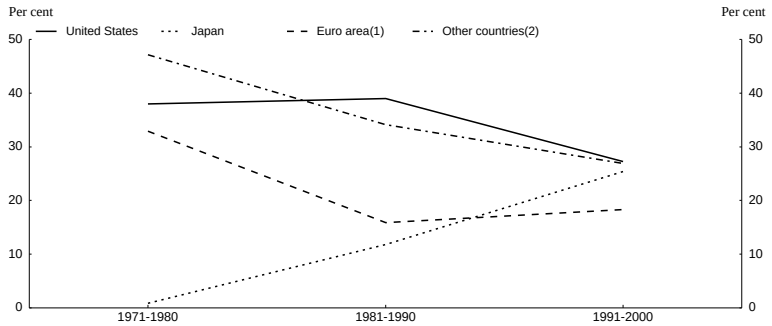
(Correlation between stockbuilding and output gaps)



Note: The figure shows the contemporaneous correlation coefficients between output gaps and stockbuilding gaps (defined as (stockbuilding/GDP) - HP(stockbuilding/GDP)) calculated over 10-year windows.
1. Simple average of Germany, France, Italy, Austria and Spain.
2. Simple average of the United Kingdon, Canada, Australia and Sweden.

Figure 7. Stockbuilding has become less of a destabiliser

(Contribution from stockbuilding to variance of domestic demand)



Note: The figure shows the contribution from stockbuilding to the variance in total domestic demand. The contribution from stockbuilding has been calculated as the residual between the contributions from final and total domestic demand.
1. Simple average of Germany, France, Italy, Austria and Spain.
2. Simple average of the United Kingdon, Canada and Sweden.

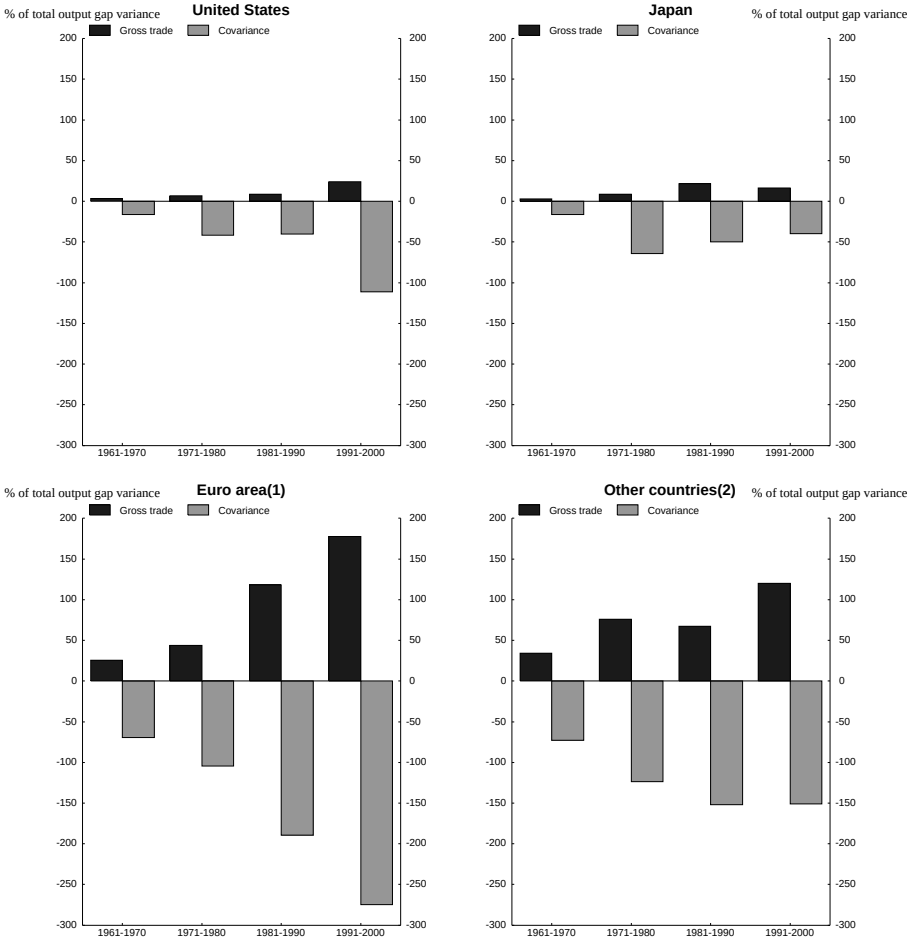
In contrast to stockbuilding, trade acts to stabilise output, as shown in Table 1 above. This stabilisation is the net result of two opposing effects: a positive contribution to output-gap volatility from the volatility in the trade variables themselves, and a cushioning effect from the covariance between domestic demand and imports (and, in principle though less important, exports). Apart from Japan, both effects have become more important over time relative to the total output-gap variance (Figure 8), reflecting the net effect of substantially increased trade shares in GDP on the one hand and lower variance of trade gaps on the other.[19]

From a business cycle perspective, the most interesting question is perhaps whether trade has become more or less important over time in cushioning fluctuations in domestic demand. This can be gauged by the change over time in the net impact from trade on overall output-gap variance. As mentioned above, this differs substantially across countries. For the United States as well as the average euro-area country, trade has to an increasing extent acted to

[19] The contribution from trade to overall output gap variance consists of the weighted variances of the export gap and the import gap minus the covariances between the export and import gaps and the total domestic demand gap. The isolated contribution from the variances of the export and import gaps has increased as both variables have become larger as a share of total output. This is only partly offset by the variance of both gaps having declined over time, in line with the tendency for the overall output gap (Figure A2 of the Annex). Japan differs from most other countries by displaying a slightly increasing amplitude of import gaps over the past two decades.

Figure 8. Trade has gained in importance

(Contribution to output gap variance)



Note: The figure shows the relative contributions to overall variance in the output gap from, respectively, gross trade (i.e. export and import gaps) and the covariance of trade and domestic demand. Country specific details are given in table A1 of the Annex.
1. Simple average of Germany, France, Italy, Austria and Spain.
2. Simple average of the United Kingdon, Canada and Sweden.

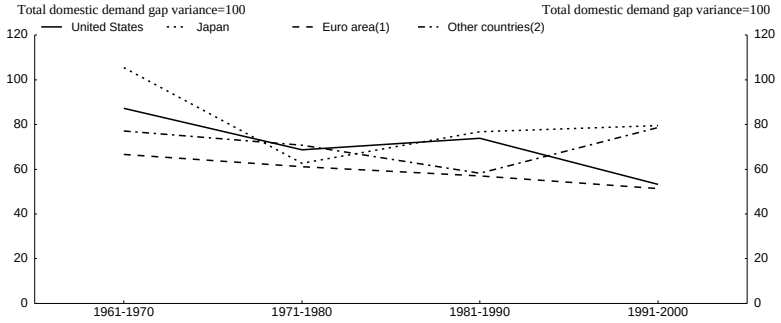
stabilise output over the past four decades (Figure 9). The euro-area average, however, disguises major differences across countries: trade is now less of a stabiliser for Austria and Germany than it was 20–30 years ago, while for Italy and Spain the stabilisation effect have increased substantially.[20] The

[20] See Table A1 of the Annex.

effect for France is almost unchanged over the past three decades. For Japan, there is a tendency for trade to become less stabilising over time. Recently, this has also been the case for Canada, Sweden and the United Kingdom.

Figure 9. Cushioning from trade has increased in some regions

(Output gap variance relative to domestic demand variance)



Note: The figure shows the variance of output gaps relative to that of total domestic demand gaps. It indicates the net cushioning effect from trade on overall output gap variance, i.e. the more distant from 100, the more cushioning. Country specific details are given in table A1 of the Annex.
1. Simple average of Germany, France, Italy, Austria and Spain.
2. Simple average of the United Kingdon, Canada and Sweden.

Ambiguous effects from the New Economy

Whereas the previous sub-section dealt with trends over the past four decades, the influence of the New Economy on the business cycle is a current and/or prospective development and, hence, less amenable to statistical analysis than to armchair reasoning. The term "New Economy" is not well defined but captures among other things the effect that production and use of Information and Communications Technology (ICT) has on the economy. So far, most interest has focused on the role of ICT for trend growth where the evidence, in spite of the current slowdown, points to considerable positive effects for the United States but much more limited effects elsewhere (Box 1). Even so, ICT is also likely to affect the shape of cyclical fluctuations. Two effects may be worth distinguishing: the cyclical developments associated with an increasing role for ICT and rising trend growth, and the effects of ICT use on the "steady-state business cycle".

Box 1. *ICT and recent trends in economic growth*

As part of its Growth Project (OECD, 2001*a*), the OECD has assembled evidence on the role of ICT for trend economic growth (see Bassanini *et al.,* 2000 and Schreyer, 2000). Basically, three channels have been identified in the literature for ICT to boost trend growth:

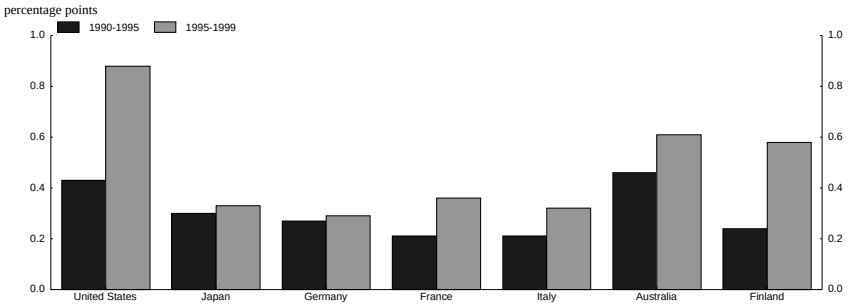
– Technical progress in the ICT producing sector is sufficiently fast for productivity growth in that sector to affect aggregate productivity growth.
– The associated rapid fall in prices of ICT goods gives an incentive for ICT using enterprises to substitute labour by ICT equipment, hence raising labour productivity growth in the ICT using part of the economy.
– The capacity of ICT to generate network effects, restructuring of enterprises and markets etc. raises total factor productivity among users of ICT.

Estimates of the quantitative importance of these channels differ between different sources reflecting different methodologies. However, with all due caution about the uncertainty of the numbers, the split between trend and cycle and the differences across studies, the broad orders of magnitude are as follows. US trend labour productivity, and hence trend output, accelerated by about 1 percentage point per year between the two halves of the 1990s. Approximately half of this was due to substitution of ICT capital for labour with the other two effects amounting to about a quarter each.

Europe has not so far experienced any parallel acceleration in labour productivity. However, to some extent this reflects other factors operating in the opposite direction, such as a slowdown in the capital-for-labour substitution related to real wage moderation and the crowding-in of low-wage/low-productivity workers as a result of a decline in their relative labour costs (caused by payroll tax rebates etc.). Even so, attempts to calculate the contribution from ICT capital to trend growth using a consistent methodology indicate that it has remained much lower than in the United States – at less than half a point against almost a full percentage point in the United States in the second half of the 1990s – and shown much less of a tendency to accelerate (Figure 10). Nevertheless, this does not exclude that over the medium term Europe may experience an acceleration in labour productivity related to ICT (OECD, 2001*b*).

Figure 10. ICT capital has boosted trend growth

(Contribution of ICT capital to average annual GDP growth)



Note: ICT includes both hardware and software.

As for the effects of moving into a New Economy, the US experience may be relevant to other countries insofar as they may emulate US developments.[21] A major macroeconomic issue in this transition phase has been whether the demand-side effects were outpacing the supply effects, *i.e.* pushing towards a positive output gap. The argument is that higher trend growth will imply higher growth in profits which, in turn, will be reflected in share prices (unless the discount rate shifts up correspondingly, as might be expected based on theory). The rise in US trend growth between the first and the second half of the 1990s might on this assumption lead to an increase in share prices by about a third. With equity market capitalisation corresponding broadly to GDP and a marginal propensity to consume out of equity wealth of about 5 per cent (see Boone *et al.,* 1998), the short-term impulse of a sudden, well understood shift to this higher growth rate might be of the order of 1-2 per cent of GDP. In practice, however, shifts in trend growth are neither sudden nor immediately understood. This may, on the one hand, imply that the effect is more spread out over time but, on the other hand, also implies that mistakenly optimistic growth expectations can lead to excessive share price reactions, as seemed to be the case in the United States.

An offsetting effect on consumption may arise to the extent higher output and income growth is slow to feed into household perceptions of permanent income, tending to boost the saving rate. There may also be an off-setting cyclical effect coming from labour markets. Meyer (2000) argues that because real wage aspirations are slow to catch up with higher trend productivity growth, the NAIRU may temporarily have dropped by as much as a full percentage point in the United States.[22] Richardson *et al.* (2000), on the other hand, were not able to identify temporary effects of variations in productivity growth on the NAIRU in a study covering most OECD countries.

The bottom line is that the cyclical impulse of a shift to higher trend growth is uncertain and importantly hinges on the extent to which the stock market overshoots and the reaction of the private sector to such excessive increases in equity prices. For major continental European countries, stock market capitalisation and marginal propensities to consume out of stock market

[21] There are doubts, related *inter alia* to different structural policy settings, as to whether other countries may be able to fully emulate the remarkable US recovery in productivity growth (see Bassanini *et al.,* 2000 and Elmeskov and Scarpetta, 2000).

[22] The implication of the results by Manning (1992) across a number of countries and Akerlof *et al.* (1996) for the United States is also that higher productivity growth will reduce the NAIRU though the effect will be permanent.

wealth are lower than for the United States, suggesting that the wealth-spending effect may be much more subdued should any significant New Economy effects on European growth materialise.

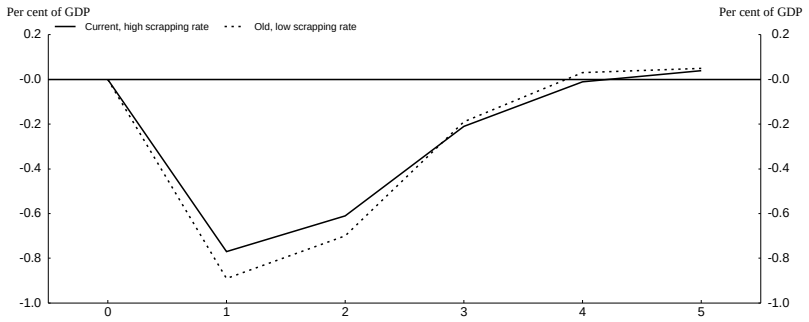
Moving to the effects on the business cycle of a greater role for ICT in the economy, a number of more or less fanciful effects may be conceived but are outside the scope of this paper.[23] A more mundane effect relates to the greater ability to control inventories and the tendency for lower inventories which was discussed above. Another influence relates to the short-lived nature of many ICT goods. There are two effects on domestic demand here. First, a high depreciation rate will, *ceteris paribus,* tend to raise the gross investment rate, hence increasing the weight in GDP of notoriously volatile investment.[24] Second, the volatility of investment may be reduced to the extent more rapid depreciation implies a more rapid return of investment to equilibrium following a shock.

This latter effect is illustrated by means of the OECD Secretariat's INTERLINK model in Figure 11. An autonomous negative demand shock is run on the sub-model for the United States on two different assumptions concerning the depreciation rate. One simulation is based on the current high depreciation rate whereas the other, parallel, simulation is run with a depreciation that is only half, *i.e.* corresponding to the depreciation rate of a decade ago. The results show a moderate, but non-negligible, short-term cushioning effect from higher scrapping rates: in the first and second year following the shock, the effect on real GDP is dampened by 10-15 per cent with the new, higher scrapping rates (Figure 11). After the second year, the difference between real GDP adjustment in the two cases becomes insignificant.

[23] ICT will affect the economy in many subtle ways that will end up having profound effects including on the business cycle. For example, lower communication costs and easier access to information is likely to strengthen the trend towards globalisation. Likewise, to the extent ICT affects menu costs or price transparency of markets, inflation dynamics may be affected.

[24] With capital-output ratios typically in the 2–3 range, a rise in the average depreciation rate by 2–3 percentage points would increase the investment share in GDP by 4–9 percentage points, *ceteris paribus,* corresponding to between less than a fifth and almost a half.

Figure 11. Higher scrapping rates cushion demand shocks



Note: Adjustment of real GDP to a private consumption shock of 1 per cent of GDP for various scrapping rates. Deviations from baseline, simulation with the US sub-model of OECD's Interlink model. The old scrapping rate is around 5 per cent per year, the new scrapping rate is about 10 per cent per year.

An important trade aspect of the current cyclical downturn is also related to ICT goods and their high depreciation rate. Given rapid technological progress, computers and semiconductors have an almost perishable nature which, especially in the case of semi-conductors, in combination with their low marginal but high fixed costs of production, implies that reductions in high-technology spending may lead to aggressive price cuts by producers. In the current downturn, this behaviour has led to substantial terms-of-trade losses for countries that are large exporters of these goods (OECD, 2001*b*). More generally, the semiconductor industry seems to be prone to hog-cycle type adjustment and where it has become large, can increase the cyclical volatility of economies.

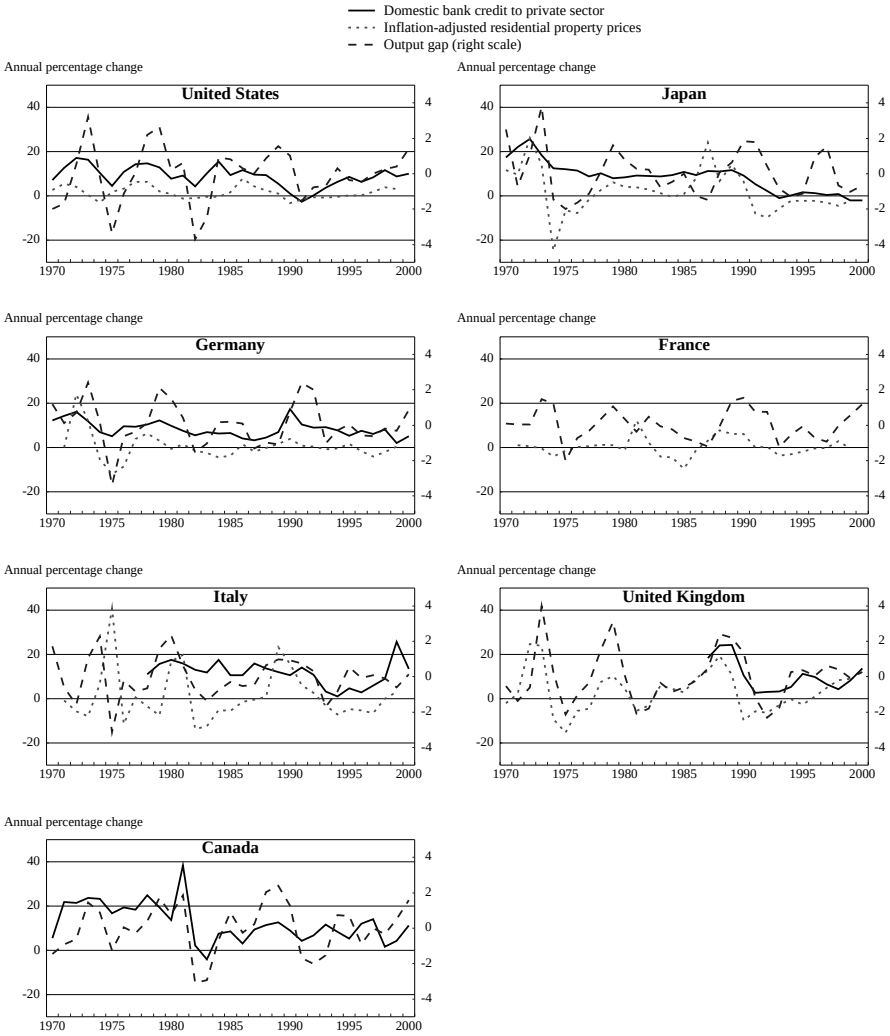
Another characteristic of the ICT industry seems to be vertical supply linkages across borders, emphasising the increasing link between trade cycles and domestic cycles. In the current conjuncture, US export weakness has thus partly been caused by weakness of domestic demand channelled via foreign imports. Although the development of vertical supply linkages is not limited to the ICT sector, the use of ICT often facilitates such developments in other industries.

3.2. Financial deregulation and liberalisation

Along with structural changes and technological advances, another potent factor affecting the nature of the business cycle is deregulation and liberalisation of financial markets. As for the "New Economy", these changes are likely to have transitory as well as permanent effects on the business cycle. For many OECD countries, which undertook financial deregulation and opened their markets in the 1980s and the early 1990s, the initial impact turned out to be a painful experience as deregulation triggered an overly strong cycle in savings and investment. In retrospect, a number of factors may have contributed to these adverse developments. The sequencing of reform was in some cases mismanaged as financial liberalisation preceded the establishment of adequate regulatory frameworks, including strengthened supervision and capital adequacy rules, as well as the correction of strong incentives to borrow embedded in tax systems. Adding to this, the internal risk management among financial institutions turned out to be deficient in many cases, which, sometimes in combination with moral hazard incentives created by implicit or explicit government bailout guarantees, led to instances of excessive risk taking in the early phases following liberalisation. Finally, the timing of deregulation was not always well chosen given the cyclical positions of the economies involved and the overall macro-policy stance.

Looking ahead, the more interesting question is how financial deregulation might permanently affect the nature of the business cycle. On the one hand, easier and cheaper access to credit implies that income and liquidity constraints are loosened, likely exerting a stabilising influence on private consumption and investment. On the other hand, deregulation may also lead to greater instability insofar as it amplifies the role of the financial accelerator (Box 2) and the risk of excessive asset-price and credit cycles. In line with the mechanisms driving the financial accelerator, developments in credit and asset prices are typically procyclical (Figure 12) and often mutually reinforcing (BIS, 2001). However, evidence that asset prices have become more procyclical following deregulation is scarce, although there seem to be plenty of anecdotes pointing in this direction.

Figure 12. Cyclicality of credit and asset prices



Sources : BIS; OECD.

Box 2. *The financial accelerator*

The financial accelerator describes the process whereby improved earning prospects of both firms and households during a cyclical upturn triggers both increased asset prices and easier availability of credit. Increased asset prices improve the value of collateral, which in turn stimulates further credit expansion. Faster growth and additional borrowing can then feed back into higher asset prices. Hence, there is a tendency for asset prices and credit to spiral up during an upswing (and *vice versa* during a downturn).

The financial accelerator is associated with information asymmetries between lenders and borrowers. Since borrowers tend to have more information on their project than lenders, it can be difficult to finance a profitable project when economic situations are unfavourable and collateral values are low. When the cycle reverses, better economic conditions and the related improvement of collateral values will enable such projects to find access to external financing sources.

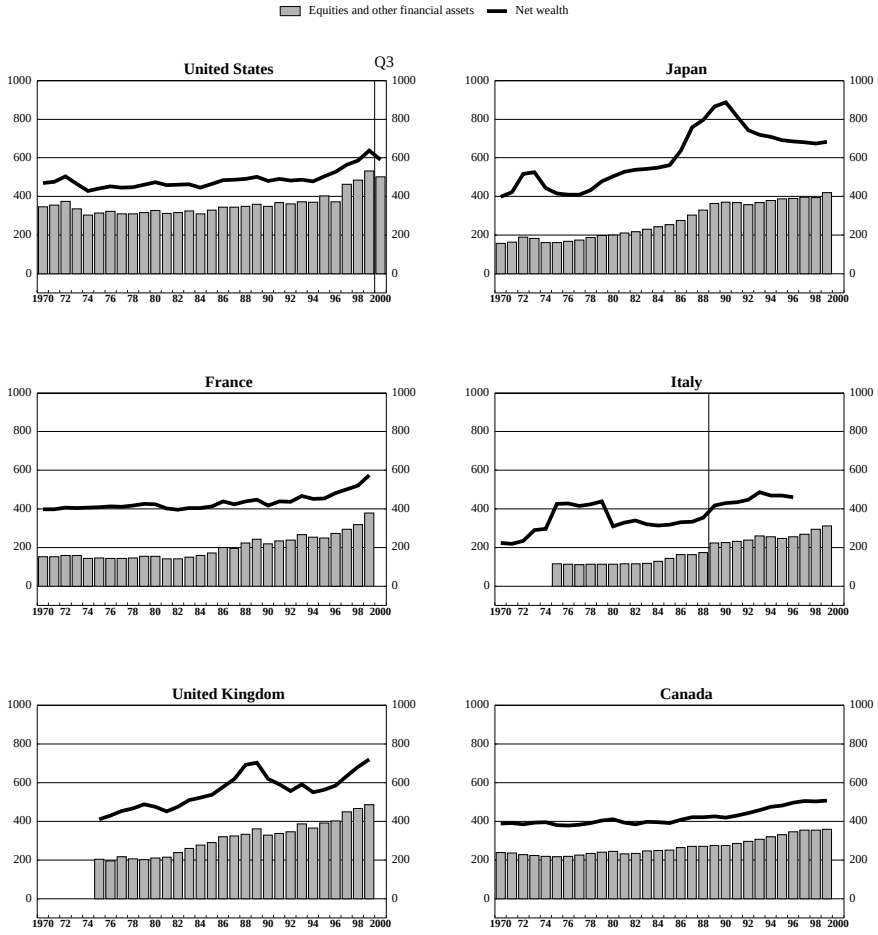
Another factor influencing the strength of the financial accelerator is the potential additional cyclicality of credit caused by cyclical biases in risk assessment. This leads to risks being underestimated in booms and overestimated in slumps, hence exacerbating the business cycle. An indication of the risk assessment bias is that high-yield bond spreads over AAA-rated corporate bonds tend to rise sharply during recessions, reflecting increased risk premia and tightened credit conditions for external financing and *vice versa* during upswings (Borio *et al.,* 2001).

In any case, there are other valid reasons to believe that the financial accelerator may now play a larger role in shaping the cycle. First, saving imbalances in the private sector can potentially be financed on a larger scale and sustained over a longer period compared to when markets were regulated. A second (and related) factor is that domestic imbalances may now more easily be financed through substantial cross-border capital flows. Third, and perhaps most important, financial liberalisation has spurred a significant financial deepening of private sector balance sheets, including a marked increase in corporate debt levels and larger household holdings of market-linked financial assets (Figure 13). The larger financial exposure of households has increased the sensitivity of domestic demand to changes in asset prices – since wealth effects are now much larger as a share of income, and because financial wealth is more firmly linked to asset prices. Likewise, enterprise balance sheets, and thereby their capacity to borrow, has become more dependent on asset prices.

Figure 13. Financial deepening in the private sector

Panel A. Household financial assets

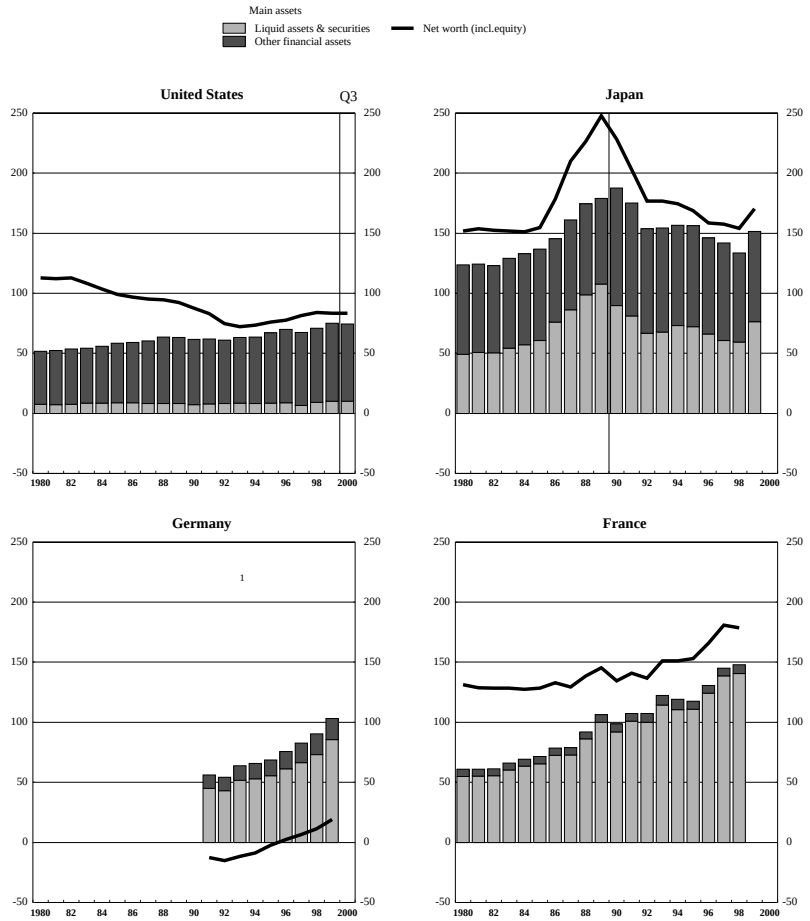
(in per cent of household disposable income)



Sources: see Table 57, OECD Economic Outlook, June 2001.

Panel B. Corporate sector financial assets

(in per cent of GDP)



1. Comprises only enterprises in former West Germany.
Sources shown at the end of document.

The impact of financial deregulation on the business cycle may also depend on the financial structure – *i.e.* whether the financial system is based primarily on credit institutions or securities markets. This may be particularly the case insofar as differences exist between the two systems in the effectiveness of monetary and supervisory policies to contain the financial accelerator. For instance, it could be argued that monetary policy is more effective in containing credit expansion in a system dominated by bank lending and where capital market imperfections prevent some firms from finding

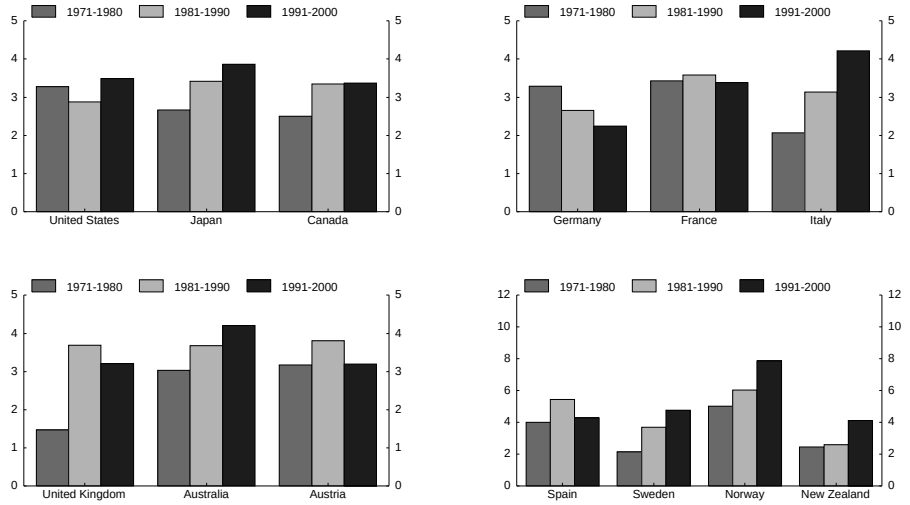
alternative sources of financing. The reason is that monetary authorities in such systems have direct control over the liquidity supplied to banks, whereas credit demand and supply in capital markets can only be influenced indirectly via the interest rate channel (Cecchetti and Krause, 2001).[25]

The real economy impact of deregulated financial markets is most directly felt on private investment and consumption. While private investment has become more volatile relative to output over the past 10-20 years in many OECD countries (Figure 14, Panel A), this does not necessarily point to financial deregulation as having had a destabilising influence; the increased volatility relative to output might just as well be rooted elsewhere, such as adjustment to new technologies, and increased stability of other components of demand. Another finding is that the contemporaneous correlation between the private sector investment gap and the output gap has decreased slightly in the 1990s in many countries (Figure 15, Panel A). It is too soon, however, to judge whether this is a permanent phenomenon and to what extent it is related to financial deregulation – *i.e.* if a more lasting decoupling of current earnings and investment projects has occurred due to better access to credit and long-term financing. Unlike investment, private consumption has generally not become more volatile relative to output, the volatility of both having declined in line (Figure 14, Panel B) and there is not much evidence of any systematic tendency for less correlation between consumption gaps and output gaps in most recent years (Figure 15, Panel B).

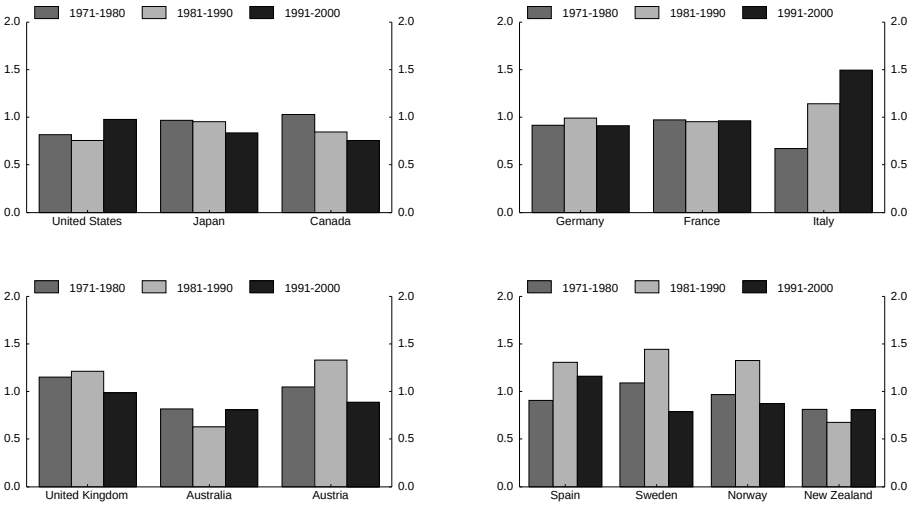
[25] It may also be added that financial deregulation by itself could have an impact on the financial structure.

Figure 14. Increasing relative volatility of private investment

Panel A. Standard deviation of private investment gaps relative to output gaps



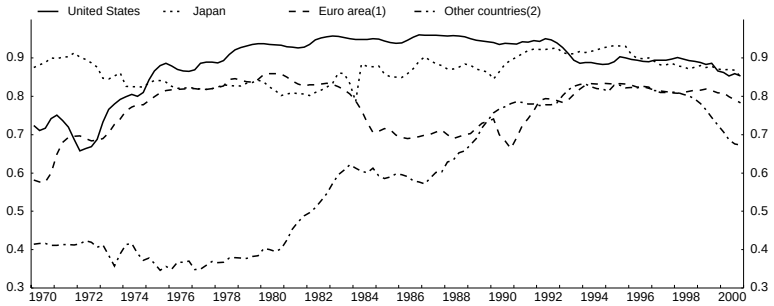
Panel B. Standard deviation of private consumption gaps relative to output gaps



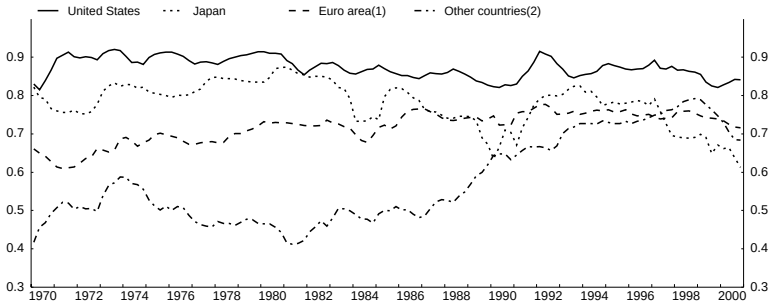
Note: Gap calculated using HP1600 filter.

Figure 15. Correlation of private investment and consumption gaps with the output gap

Panel A. Correlation between private investment gaps and output gaps



Panel B. Correlation between private consumption gaps and output gaps



Note: Contemporaneous correlation coefficients between gaps, mowing 10-year windows. Gaps are calculated using an HP1600 filter.
1. Simple average of Germany, France, Italy, Austria and Spain.
2. Simple average of the United Kingdon, Canada, Australia and Sweden.

3.3. Macroeconomic policy

The shift towards an economic environment of low and stable inflation, once it was accomplished, has almost certainly contributed to damping business cycles. Insofar as private sector inflation expectations have become more detached from cyclical developments, there is a reduced risk of having excessive price and wage increases triggering an abrupt slowdown following a cyclical peak.[26] At the same time, there is a concern that an environment

[26] The downturn may be caused by a mix of factors such as monetary or fiscal tightening, increased risk premia on long-term interest rates or loss of competitiveness for countries following a fixed exchange rate policy.

combining low current inflation with strong central bank credibility may contribute to over-optimism in financial markets during a cyclical upswing, thus fuelling credit booms and unsustainable increases in asset prices, leading to prolonged misalignments of private sector balances.[27] On balance, however, the low inflation environment is likely to have contributed to smaller cycles.[28]

It is difficult to measure accurately the change in inflation expectations, but in the context of this exercise, an indication may be had from the variability of inflation relative to that of the output gap. A reduction in this ratio is consistent with a firmer anchoring of inflation expectations.[29] Indeed, such a development seems to have taken place in most OECD countries over the past 20 years, except for Germany and the United States, where the ratio has been relatively constant, and Italy and Norway, where it has increased (Figure 16).[30]

As regards fiscal policy, a distinction must be made between automatic stabilisation and discretionary fiscal changes. Automatic stabilisers, by definition, exert a damping effect on the cycle, and countries with large stabilisers will experience smaller fluctuations, *ceteris paribus*.[31] Simulations using the OECD Secretariat's INTERLINK model suggest that over the 1990s, automatic fiscal stabilisers have worked to dampen cyclical fluctuations in the average OECD country by about 25 per cent, covering, however, a considerable cross-country variation (Van den Noord, 2000). Since taxes and government transfers have increased significantly as a share

[27] Such factors may for instance have played a non-negligible role in the United States during the late 1990s as, in the absence of inflation build-ups, the economy was able to sustain high investment and growth rates over a long period without credit and financial conditions becoming unstable.

[28] It has been argued that central banks have succeeded not only in stabilising inflation (and hence, indirectly, output), but have managed to become more effective in stabilising both inflation and output at the same time due, not least, to a combination of more central bank independence and changes in the monetary transmission mechanism as government ownership of banks has diminished and deposit insurance schemes have become more widespread (Cecchetti and Krause, 2001).

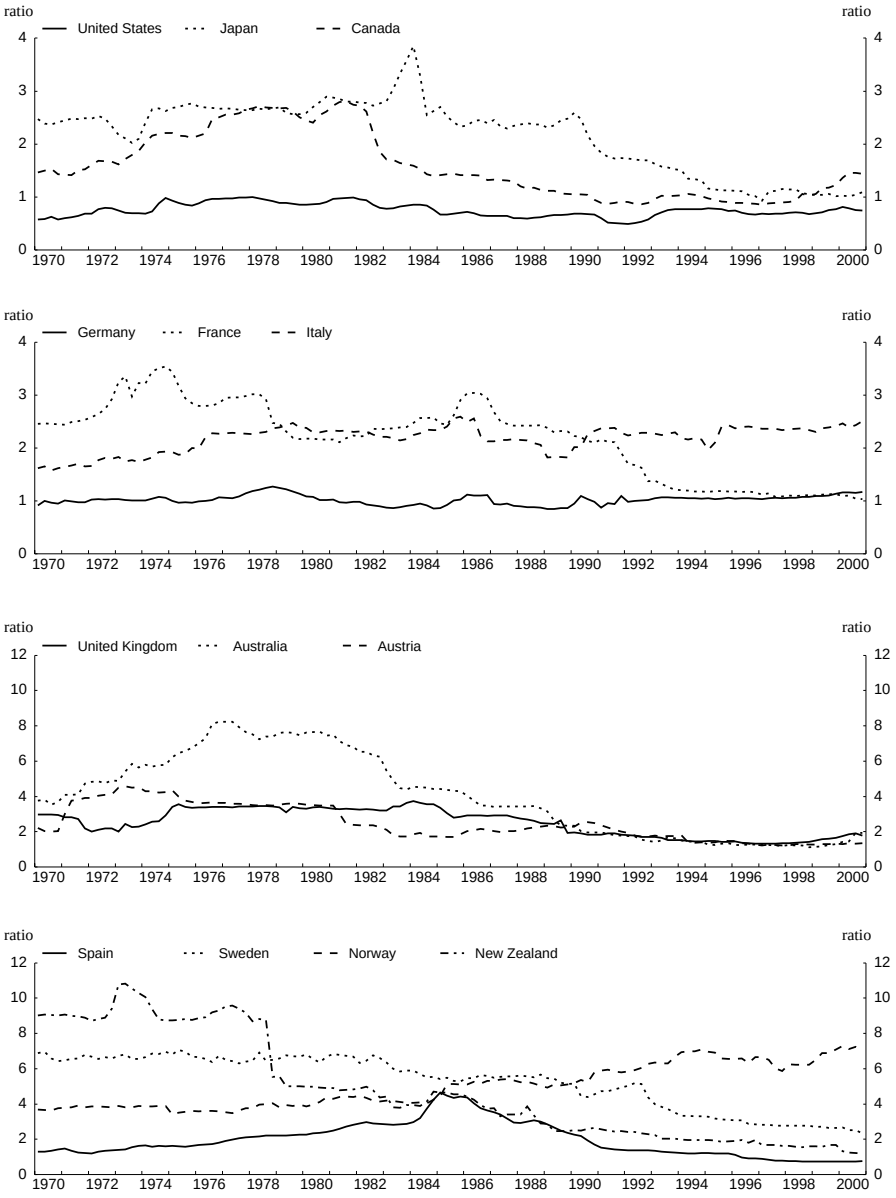
[29] This can be seen relatively easily, *cf.* the Annex.

[30] It should be noted, however, that the absolute variability of inflation has decreased significantly in all countries in the sample, except for Norway. In the case of Italy, the decline in trend inflation was particularly pronounced over the 1990s and tended to boost the standard deviation of inflation.

[31] Of course, this may be achieved at the cost of efficiency losses to the extent large stabilisers reflect highly distortive taxes and/or government expenditure.

Figure 16. Inflation expectations have become better anchored

(Relative standard deviations of inflation and output gaps)



Note: The figure shows the standard deviation of inflation relative to the standard deviation of the output gap (moving 10-year windows). Gaps are calculated using an HP1600 filter.

of total income in most OECD countries over the past 40 years, the dampening effect from fiscal stabilisers is likely to have become stronger.[32] Unfortunately, there is no evidence readily available about changes over time in the magnitude of automatic fiscal stabilisation.

For well-known reasons, discretionary fiscal stabilisation is prone to the risk of aggravating rather than counteracting an initial disturbance. Moreover, the political economy aspects involved in discretionary fiscal policy changes may imply that these are inefficient in terms of stabilisation. The outcome may be a sub-optimal policy mix insofar as monetary policy has to react to correct adverse cyclical implications of fiscal policy actions. However, the overall fiscal prudence prevailing in most OECD countries over the past decade or two has contributed not only to a substantial improvement in the macro-policy mix but also seems to have reduced the occurrence of macro-policy failures caused by badly timed fiscal policy changes. Based on correlations between fiscal stance and the output gap, there are indications – although very rough – that from a cyclical point of view, the timing of discretionary fiscal policy changes in the OECD area has slightly improved over the 1990s (Table 2).[33]

In conclusion, the combined effects from automatic stabilisation and discretionary fiscal policy seem increasingly to have contributed to dampen the cycle in most OECD countries. This is partly because automatic stabilisers have become stronger, partly because of better timing of discretionary fiscal policy changes in many countries throughout the 1990s. While the former effect may be permanent, insofar as the policies that increased fiscal stabilisers remain in place, the future of the latter effect remains more uncertain.

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[32] Taxes in per cent of GDP have increased by almost 12 percentage points for the average OECD country since 1965 (from around 25 per cent to 37–38 per cent). Government transfers have on average doubled over the same period (from around 8 per cent of GDP in the mid-1960s to around 16 per cent today). However, there is not necessarily a simple, linear relationship between the size of taxes and government transfers and the size of fiscal stabilisation. The stabilisation effect depends, among other things, on the degree of progressivity in the tax and transfer system as well as the composition of taxes on income-, consumption- and property taxes.

[33] Van den Noord (2000) likewise finds that a number of countries – including Australia, Japan, New Zealand, the United Kingdom, the United States and several smaller EU countries – succeeded in pursuing counter-cyclical discretionary fiscal policy during the 1990s.

Table 2. Correlation of fiscal stance with output gaps

	1976-1990	1991-2000
Australia	0.33	0.49
Austria	0.04	-0.06
Belgium	-0.42	-0.62
Canada	0.49	0.18
Finland	0.17	0.22
France	-0.08	-0.59
Germany	-0.48	-0.31
Italy	-0.10	0.41
Japan	-0.21	0.17
Netherlands	-0.59	0.05
Norway	-0.20	0.30
Portugal	-0.11	0.23
Sweden	0.04	-0.03
United States	0.49	0.41
Number of countries applying counter-cyclical discretionary fiscal policy	6	9
Number of countries applying procyclical discretionary fiscal policy	8	5

Note: The 14 countries included in the table are those OECD countries for which cyclically adjusted primary balances are available back to 1975. Counter-cyclical policies are identified where the contemporaneous correlation between output gaps and the fiscal stance is positive over the sub-period in question. Procyclical policies are identified where the correlation between output gaps and the fiscal stance is negative over the sub-period in question. Coefficients in bold are significant at the 10 per cent level of the 2-sided t-statistic. The fiscal stance measures the yearly change in the cyclically adjusted primary balance in per cent of potential output. The derivation of the cyclically adjusted primary balance is outlined in Van den Noord (2000). The fiscal stance is only indicative for discretionary fiscal policy changes as it is also affected by changes in potential output and other effects on the budget not related to fiscal policies (changes in revenues from natural resources, etc.). The results should hence be interpreted with caution.

4. Factors explaining reduced international divergencies

The tendency for reduced cross-country divergence of output gaps among OECD countries, as noted in Section 2, seems mainly to reflect the reduced size of the cycle observed for individual countries rather than business cycles having become more synchronised across countries. Against that background, this section discusses the role of different demand components in generating international divergencies. It then goes on to consider various channels for transmitting cyclical impulses from one country to another which in the future may increase cross-country synchronisation.

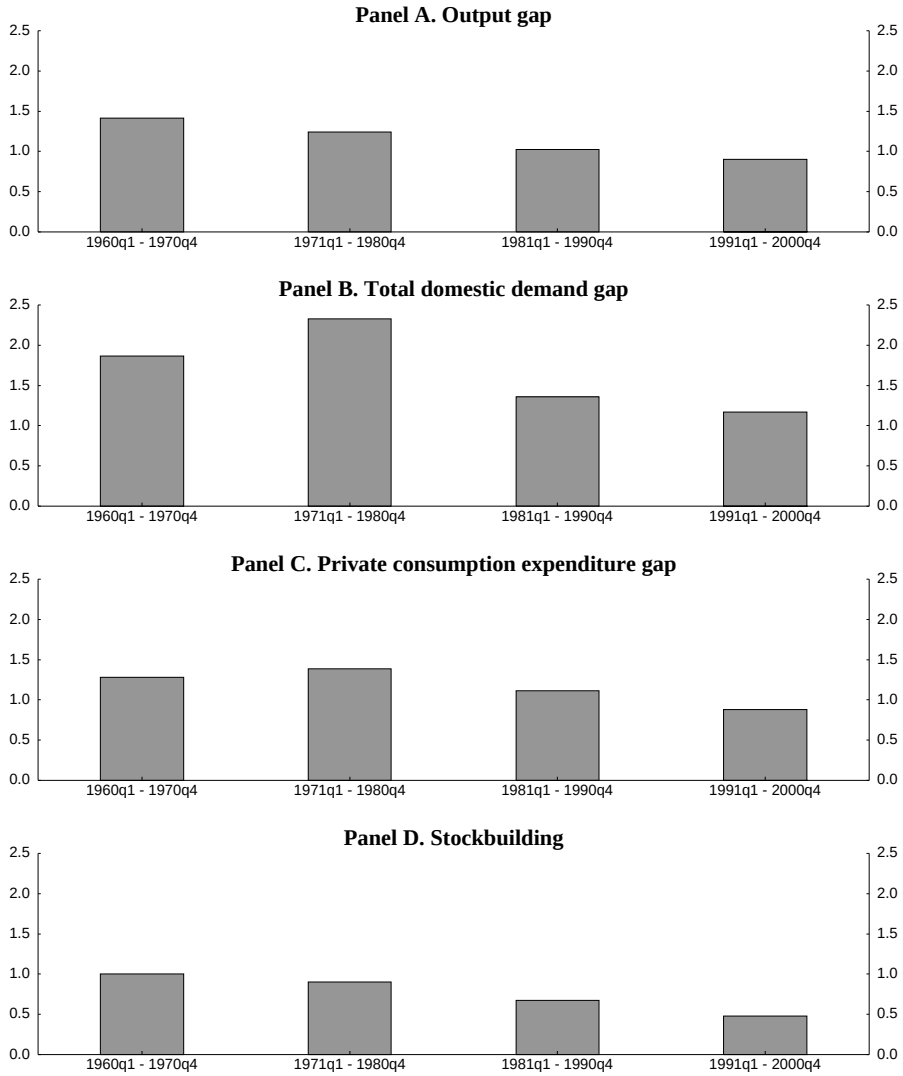
To identify the sources of reduced cross-country divergencies in output gaps, it may be worth considering the divergencies of different demand components (Figure 17). Like for GDP, the movements over time are somewhat irregular and period averages are therefore considered. Not surprisingly, the degree of divergence is higher for domestic demand than for GDP as reflected in a higher level of the standard deviation. Trade clearly acts as a cushion. The change in divergencies over time is virtually identical between GDP and domestic demand. That is, the contribution from trade to bring countries' positions closer together has not risen over time, despite increases in openness as measured by trade shares in GDP.[34] This could reflect that reduced divergence of domestic demand has tended to reduce the divergence of imports.

The two main factors accounting for the reduced divergencies in domestic demand are stockbuilding and private consumption. In contrast to total domestic demand, the level of divergencies of final domestic demand is about equal to that of GDP. Stockbuilding hence contributes to increased cross-country divergence of GDP. However, this effect has diminished substantially since the 1970s and has become very moderate in recent years. This trend is hardly surprising given the diminished role of stockbuilding in driving cycles within countries, as discussed in Section 3. The factors behind the diminished role of the stockbuilding cycle have therefore also made for reduced

[34] Trade shares have increased in both the United States and European Union countries while Japan is a notable exception (OECD, 1999a). It should also be noted that even though trade has not contributed to reduced divergencies over time, there is no clear-cut answer to whether it has become more or less important in cushioning the cycle across OECD countries. As noted in Section 3, changes over time in the impact from trade differ substantially from country to country.

Figure 17. Domestic demand reducing cross-country divergencies

(Average standard deviation of gaps across countries)



international divergence. The greater cyclical stability of private consumption over time, noted in Section 2, is also likely to be a factor behind declining international divergencies. It is noticeable that many of the same trends seem to be present and perhaps even a bit stronger in Europe (Box 3).

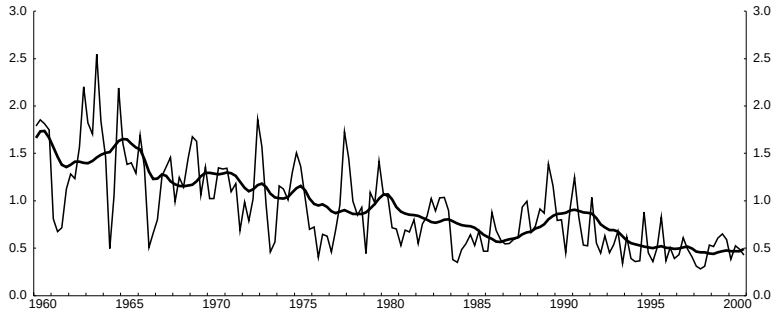
Box 3. *The particular case of the euro area*

In the context of Economic and Monetary Union in Europe, a crucial question has been how to deal with asymmetric developments in Member countries. As well, it has been discussed whether the removal of barriers that create market segmentation would stimulate synchronisation through greater market integration or reduce it through greater specialisation. Evidence presented in OECD (1999*b*) suggests that, on balance, the integration effect is the strongest.

Long time-series are available only for five euro-area countries (Austria, France, Germany, Italy and Spain) but at least for these countries Figure 18 shows a clear tendency for reduced divergencies of output over time. Indeed, the trend looks somewhat stronger and less noisy than for the full country sample considered in the main text and there are also indications that the reduced desynchronisation is linked to the euro economies moving increasingly in phase, something that could not be found for the full sample. The tendency for reduced divergence is driven principally by stockbuilding and private consumption. In contrast to the full sample, the tendency for investment to become less divergent is also more clear for the euro area.

Figure 18. Reduced divergencies among euro area countries

(Standard deviation of output gaps across countries)



Note: The degree of synchronisation is measured by the standard deviation of the output gap at each point in time across 5 euro countries (Germany, France, Italy, Spain and Austria). The thick line shows the 12 quarter moving average. The gap is calculated using an HP1600 filter.

While little evidence has been found that countries are increasingly in-phase, this could have changed recently or might do so in the future. Indeed, a number of factors can be identified that contribute directly to aligning the business cycle across countries. Some of these factors are reviewed in what follows, with the main focus on the role played by asset prices and their tendency for co-movement across countries.

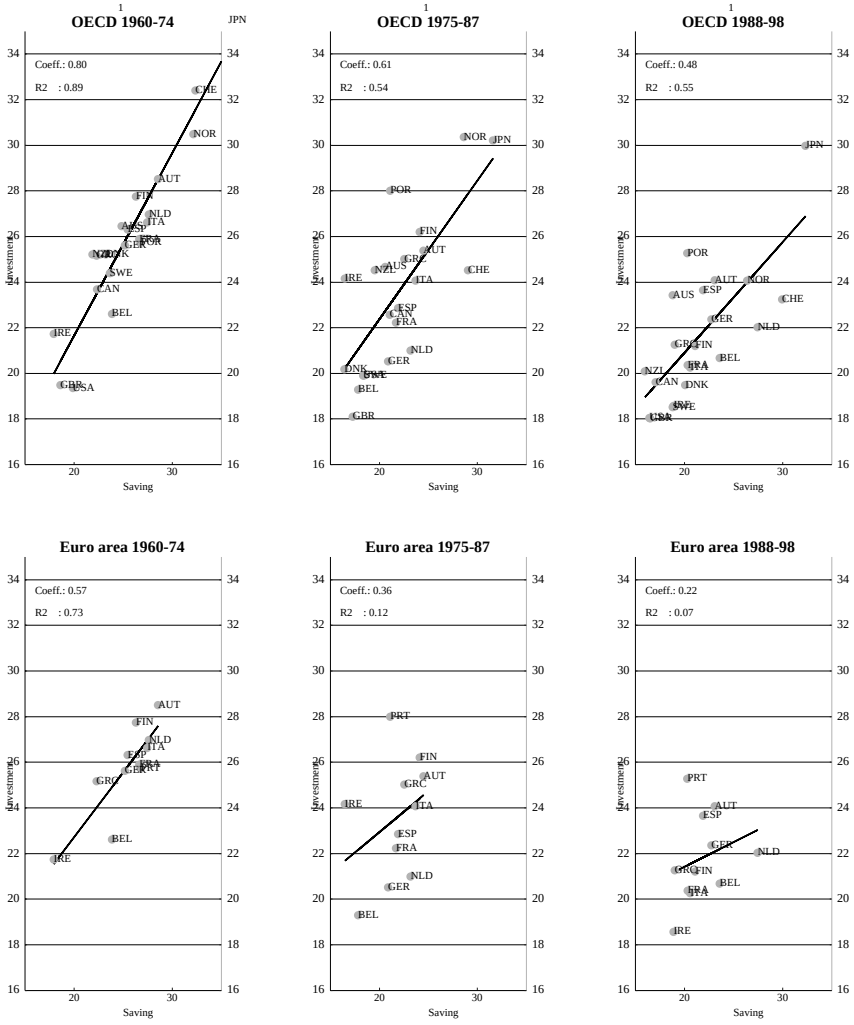
As discussed in Section 3, balance sheets in the corporate and, particularly, the household sector have tended to expand, with household net wealth also rising over the past three decades. Furthermore, this process has been associated with a greater weight for assets with market-determined prices. As a result, net wealth positions have tended to become more sensitive to movements in asset prices. For any given degree of cross-country correlation in asset prices, this – by itself – has tended to increase synchronisation. The evidence that wealth effects in private consumption have become stronger over time is suggestive of a further increase in the influence of common international movements in asset prices (but evidently also of national, idiosyncratic asset price movements). Expanding corporate sector balance sheets also imply that collateral and, hence, the availability of external funding resources has become more sensitive to international movements in asset prices.[35]

Perhaps more interesting are the signs that increased financial market integration is leading to greater co-variation in asset prices across countries and hence may be responsible for more synchronised domestic demand. One indication that capital is now more mobile and financial markets hence more integrated is the decreasing correlation of saving and investment across countries, *i.e.* the tendency for the Feldstein-Horioka puzzle to fade (Figure 19). This tendency seems to be particularly marked among EU countries where there has been very little correlation between saving and investment over the past decade. Increased capital mobility should be associated with more internationally diversified portfolios, which again should increase covariation of returns. However, higher asset price correlations could also be the result (rather than just the cause) of increasing synchronisation of real economic developments across countries. For example, the move towards fiscal consolidation and a regime of stable low inflation has taken place across virtually all countries and is likely to have boosted bond yield correlation. In practice, thus, causality is presumably bi-directional.

[35] There seems to have been no generalised tendency for bank balance sheets to expand (relative to GDP) and it is therefore not clear that international asset price movements have gained greater influence through stronger bank balance-sheet effects (OECD, 2000).

Figure 19 . Declining correlation between saving and investment

(In per cent of GDP)

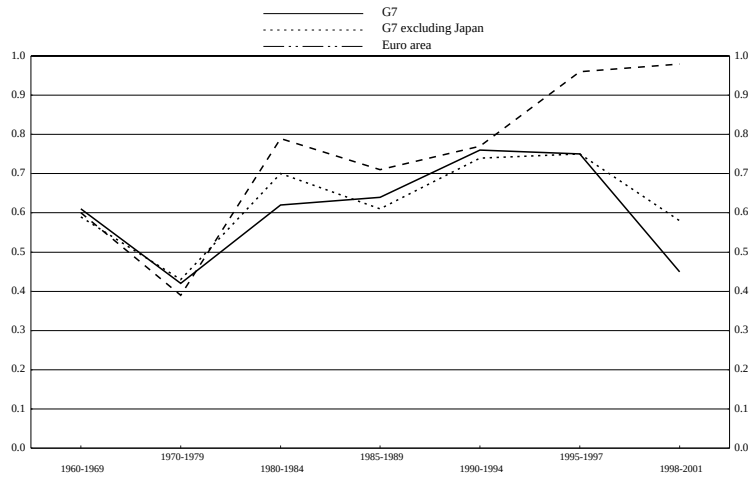


1. The sample consists of 21 OECD countries: United States, Japan, Germany, France, Italy, United Kingdom, Canada, Australia, Austria, Belgium, Denmark, Finland, Greece, Ireland, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden and Switzerland.

Government bond prices have been correlated across countries for some time, but correlations have tended to rise in general and have become near-perfect among euro-area countries (Figure 20). Furthermore, considering corporate bond prices the evidence points to a high correlation in risk premia in recent

years, though insufficient data prevent an examination of whether this is the result of an increase over time. The bottom-line is that bond yields have become very highly correlated across countries, likely contributing to greater synchronisation.[36]

Figure 20. Ten-year government bond yields have become more correlated



Note: Average correlation coefficients are calculated as simple averages of bivariate correlation coefficients between G7 countries (i.e. United States, Japan, Germany, France, Italy, United Kingdom, and Canada). Bivariate correlations are calculated for each pair of G7 countries from 1973 to 2001:5 over 7 different time periods.

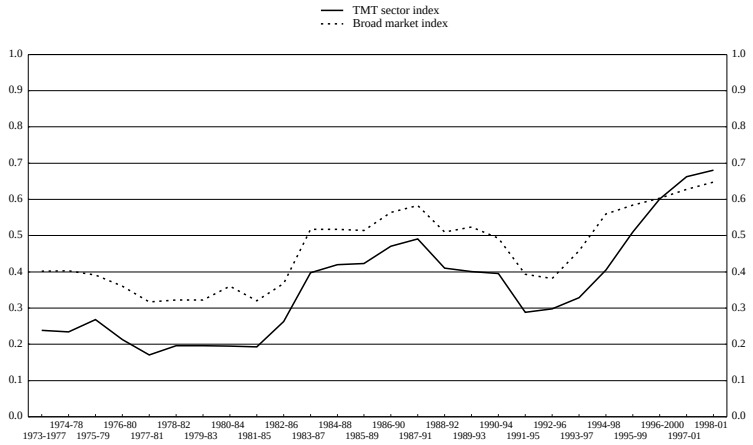
Sources: Datastream, OECD.

Equity prices have also tended to become more correlated. Figure 21 shows that, on average across pairs of G7 countries, bilateral correlation coefficients between one-month returns on broad market indices have risen over the period since the early 1970s.[37] Indeed, cutting the period in half, every bilateral correlation coefficient has increased. In terms of factors driving this development, it is noticeable that the increase in average correlation has been much more pronounced for the TMT (technology, media and telecom) sector than for the broader indices. This is, in all likelihood, a case of common technology shocks driving the co-movements of equity markets (Box 4).

[36] It might have been thought that an increased correlation of bond prices would have been associated also with increased correlation of real house prices. However, the available evidence does not point to any such increase.

[37] The same picture emerges when, for a shorter period, considering a wider set of EU countries.

Figure 21. Stock market returns have become more correlated



Note: Monthly stock returns are calculated as log differences between end-of-month prices for the broad market and TMT sector indices of the G7 countries; i.e. United States, Japan, Germany, France, Italy, United Kingdom, and Canada. Bivariate correlation coefficients are then calculated for each pair of the G7 countries' stock returns from 1973 to 2001:5 in 5-year moving windows. Average correlation coefficients are constructed as arithmetic averages of the estimated bivariate correlation coefficients.

Sources: Datastream, OECD.

Box 4. *Common technology shocks driving share prices?*

There may be a number of causes behind increased share price correlations across countries. Financial integration and reduced divergencies in macroeconomic policies are examples with repercussions throughout the economies. Others relate to global developments in individual sectors driving correlations. An example could be technological change. In this case, increased cross-country correlations would be driven by the sectors where such common technological change took place. Thus, the news driving share price co-movements would tend to be industry-specific and increased aggregate correlation across countries would be the result of increasingly correlated news in some industries. In the alternative case of economy-wide developments driving share price correlations, the news driving increased correlation should be spread over all industries.

Conditional variances of share price returns may be considered a proxy indicator of risk, which again is affected by the arrival of new information. Thus, if conditional variances have become more highly correlated in some sectors but not in others, this may suggest that the news driving share prices in the former sectors have had a more global character, possibly as a result of common technological developments. To shed light on this, time-varying conditional variances of equity returns have been estimated for the G7 countries using a GARCH technique. Bilateral correlations of conditional variances have subsequently been calculated for country pairs and the averages taken

over all such country pairs. This has been done for two sub-periods since 1973 and for a number of sectors (Table 3).
The results indicate an increased correlation of total market volatility (or risk) driven, in particular, by the IT sector and more generally TMT shares (note that non-cyclical services include the Telecom industry) as well as the financial sector. Given that major technological breakthroughs, product developments and internationalisation have taken place in the TMT and financial sectors (where considerable deregulation and liberalisation has taken place since early and mid 1980s) it is perhaps not surprising that the shocks affecting these industries transmit more globally. Also, in light of the "new economy", the results seem to be consistent with the hypothesis that common technology shocks, spurred by rapid expansion of information and communication technology, may have been the main driving force in concurrent asset price developments across borders.

Table 3. Average correlation coefficients of conditional variances

	1973-1987[1]	1988-2001
Resources	0.21	0.10
Basic industries	0.29	0.41
General industries	0.27	0.45
Cyclical consumer goods	0.21	0.21
Non-cyclical consumer goods	0.41	0.26
Cyclical services	0.38	0.41
Non-cyclical services	0.23	0.45
Utilities[2]	0.11	0.02
Financials	0.11	0.35
Information technology	-0.02	0.57
Total market	0.34	0.46
Of which: TMT sectors	*0.07*	*0.61*

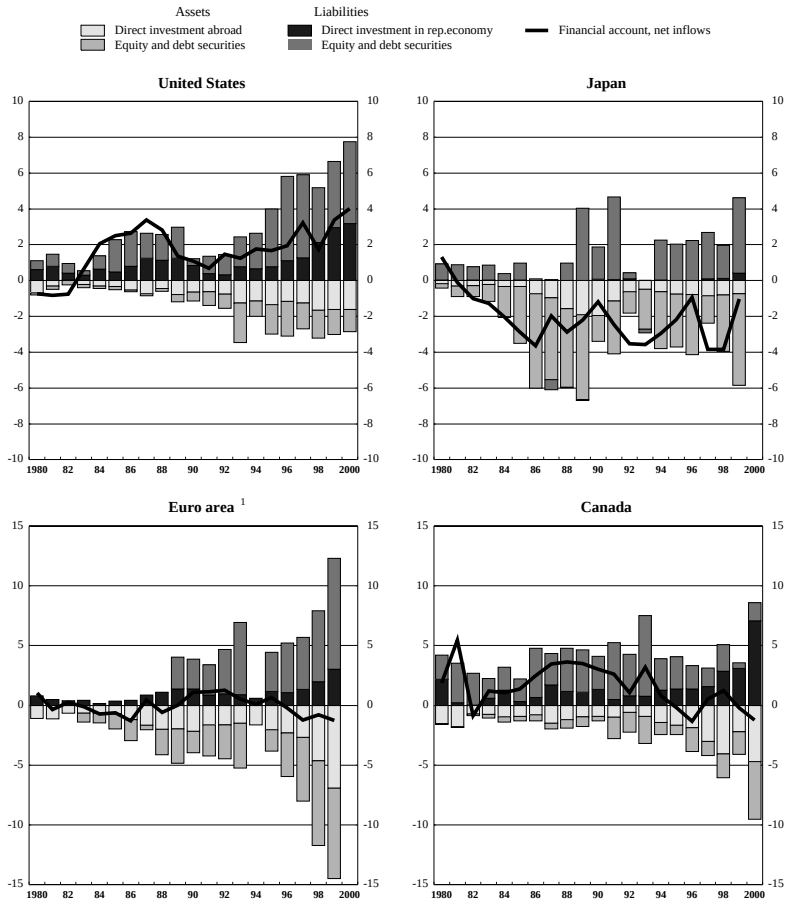
1. For Resources, Cyclical and Non-cyclical consumer goods, Utilities and Information technology, average figures are only for the countries for which the number of observations is more than at least half of the full observation number during the sample period. However, two sub-periods (1988-2001 and 1995-2001), where most countries in the sample have the full time series, show trends similar to those over the two periods reported.
2. For Utilities, France is not included, as data is only available from July 2000.

A further, much more speculative, channel for greater synchronisation is the internationalisation of enterprises – over and above the effect it may have on synchronisation of share prices as discussed in Box 4. For example, to the extent enterprises are multinational, the need to retrench because of

developments in one market may cause cut-backs in activities in other countries, and *vice versa* in case of buoyant conditions.[38] It is difficult to get a picture of the potential importance of such effects. However, foreign direct investment flows have expanded strongly in recent years pointing to a potentially rising influence of this channel (Figure 22).

Figure 22. International investment has become more important

(in per cent of gross domestic product)



1. Germany, France, Italy and United Kingdom
Source: IMF, International Financial Statistics.

[38] Conceivably, this may be the case even where no cross-border trade is concerned. By contrast, where a downturn in one market affects activities elsewhere through trade linkages it should not matter for the international propagation whether these trade linkages occur within a firm or between different firms.

The transmission of cyclical fluctuations over time may conceivably also be affected by "soft" factors such as confidence. Even if more tangible influences such as linkages *via* trade and asset prices may determine the overall magnitude of international transmission, its timing could well be influenced by confidence. Indeed, over the decade of the 1990s there has been a very high correlation between indicators of business confidence and share prices in many countries, notably the United States. Although causality remains uncertain, this may conceivably have speeded up the impact of share price developments by directly affecting the "animal spirits" of investors. Nevertheless, despite closer correlation of equity returns over the last two decades, it is not obvious that cross-country correlations of confidence indicators have increased in any systematic manner.

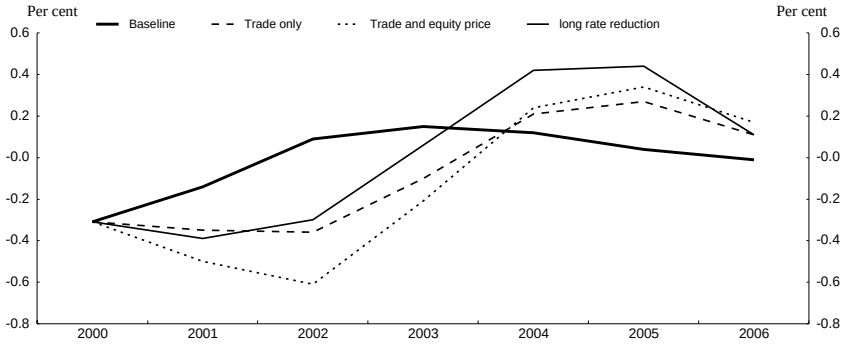
5. Implications for policy of the changed cycle

As argued above, the tendency for the amplitude of national business cycles to decline over time may be partly related to the greater emphasis on medium-term oriented monetary and fiscal policies. The success of these policies in achieving this outcome is a good reason for maintaining the overall macroeconomic policy stance. However, within this overall orientation some new challenges, principally to monetary policy, can be discerned. First, monetary policy needs to be alert to tendencies for greater international synchronisation of business cycles and the rising importance of non-trade channels of international spillover. Second, the increased role for asset prices in driving domestic economies makes it important to avoid misalignments of these prices which subsequently may be painful to unwind. This points to the role that prudential regulation and supervision has to play, in particular since private savings imbalances can now accumulate on a larger scale than was possible before. Third, the factors working to change the shape of the business cycle and to strengthen international spillovers are also likely to influence the monetary transmission mechanism. In what follows, the first theme will be further developed by means of simulations with the Secretariat's INTERLINK model.

The simulation refers to an episode of economic downturn in the United States (Figure 23). Concretely, it is assumed that the recovery projected in the *OECD Economic Outlook 69* from the second half of 2001 is delayed by two semesters due to a further weakening of private consumption and investment. At the same time it is assumed that doubts about the sustainability of the new economy will lead to a drop in US share prices by 20 per cent. The Fed responds to this weakness by cutting short-term interest by 200 basis points, which is sufficient to bring inflation and output back towards baseline over the medium term. Long-term US interest rates are assumed to be reduced by half the cut in short rates. Three variants of the simulation are considered to gauge the effect of the US slowdown on the euro area, where in all three cases the ECB is assumed to ease interest rates sufficiently to bring inflation back towards baseline over the medium term. In the first simulation, activity is affected only through trade links, while European share prices remain unchanged and bond yields respond only partly to the easing in ECB interest rates. In the second simulation, European share prices move down to the same extent as in the United States. The third simulation combines this with the assumption that European bond yields are affected by their US counterparts.

With limited knowledge of exchange rate determination, nominal exchange rates have been assumed unchanged.

Figure 23. Effect of a US downturn on the euro area output gap transmitted through different channels



Note: The Figure shows the adjustment of real GDP in the euro area to a US demand shock under three different assumptions about the transmission mechanisms, cf. the main text. INTERLINK simulation.

The assumptions adopted for these simulations are obviously rough-and-ready but they nevertheless illustrate the potential importance of non-trade linkages. With only the trade channel in operation, the required short-term interest rate reduction in the euro-area peak at 125 basis points. As is the case for the United States, long rates are assumed to be reduced by half this amount. Output drops by a little more than $^1/_2$ per cent before returning to its baseline in 2004. Despite equity prices having smaller impacts on consumption and investment in Europe than in the United States, the next simulation shows that more monetary easing is needed when lower equity prices spill over. Concretely, short rates are cut by 175 basis points in the euro area (and the pass-through to long rates maintained at $^1/_2$), but despite the additional monetary easing, the peak reduction in output is now around $^3/_4$ per cent. The final simulation illustrates the importance of reactions in the long rates: euro-area short rates are cut by 150 basis points, but since European long rates now reacts to euro-area short rates as well US long rates, the ensuing reduction in the euro-area long rates turns out to be similar to the reduction in the short rates, *i.e.* 150 basis points. In this case, the output loss is contained at around 0.6 per cent, *i.e.* an intermediate position compared with the two former simulations.

The upshot of these model simulations is that non-trade spillovers are potentially powerful. Thus, monetary policy may need to react more forcefully than in a situation where trade is the only cross-country transmission channel. At the same time, however, asset prices – including not only shares and bonds but also fixed property[39] – have become more important for the monetary transmission mechanism through wealth and balance-sheet effects. This might be an argument for a more gradual approach to monetary policy given that the links between interest rates and asset prices may be tenuous and unstable (as may the links between asset prices and activity) (OECD, 2000). Being forceful and gradual at the same time is hard. Arguably, though, the recent episode of monetary policy easing in the United States may be seen as an example that involved moving interest rates a lot but doing so in relatively small steps.

[39] Not to speak of exchange rates, whose effects are even more important, but whose determination is unclear and therefore have been disregarded in this paper.

6. Conclusion

There is strong evidence that business cycles have become smaller in most OECD countries over the past two decades, mainly reflecting a reduced role of stockbuilding and more stable private consumption. Trade acts to cushion fluctuations in output, but despite the increased openness of OECD economies, this effect has not generally become larger over time. The persistence of the cycle is unchanged in the major regions but has increased elsewhere. Divergencies of output gaps across OECD countries have diminished since 1960 with a particularly strong tendency since the early 1990s. This mainly reflects the decreasing size of domestic gaps as opposed to closer international alignment of cycles. However, synchronisation may increase in the future, not least due to increased financial integration among OECD countries.

Macroeconomic policies have exerted a stabilising influence over the past two decades, pointing to the necessity of continuing – and potentially strengthening – current frameworks. A main challenge for policy makers is related to how to cope with increasing financial deepening in the private sector and the ensuing vulnerability to changes in asset prices. This challenge is reinforced by the increasing covariance of asset prices across countries.

Annex

1. The Hodrick-Prescott filter

The HP filter extracts a stochastic trend (y_t^{HP}), which for a given value of λ moves smoothly over time and is uncorrelated with the cycle (Kydland and Prescott, 1990). The trend is defined as the solution to the problem:

$$\min_{(y_t^{HP})} \sum_{t=1}^{T} (y_t - y_t^{HP})^2 + \lambda \sum_{t=2}^{T-1} [(y_{t+1}^{HP} - y_t^{HP}) - (y_t^{HP} - y_{t-1}^{HP})]^2$$

λ is a smoothing parameter which penalises variation in the growth rate of the trend. When λ approaches infinity, the trend is perfectly log linear. When λ approaches zero, the trend collapses into the actual series. As noted by Cogley and Nason (1995), the optimal value for lambda can be approximated by $(\sigma_{yHP} / \sigma_c)^2$, where σ_{yHP} is the standard deviation of the innovations to the trend and σ_c is the standard deviation of the innovations to the cycle. However, no formal criteria have been developed to pick the optimal λ and most studies use the value originally chosen by Kydland and Prescott, *i.e.* λ=1600 for quarterly data. As pointed out by Canova (1998), this value of λ leaves in cycles of an average duration of four to six years, corresponding roughly to the length of an average US cycle as defined by the NBER. However, while this value may be sensible from the point of view of a business cycle researcher, the assumed magnitude has been challenged by several studies. Nelson and Plosser (1982), for instance, estimated λ to be close to 1 for most of the series they examined, implying that much of the variability that the HP1600 filter attributes to the cyclical component is, in fact, part of the trend. In other words, by choosing low values of λ, only high frequency cycles are identified – cycles are perceived almost as white noise – while cycles of longer duration will be perceived as part of the trend. On the other hand, choosing a λ much higher than 1600 implies that cycles are assumed to be "very long". It follows that by applying various values of λ, the HP filter is capable of mimicking quite closely the outcomes a range of other detrending methods, among them the band-pass filter (frequency domain) and first order differentiating. Interestingly, some studies find little or no difference between the output-gap outcomes of applying different filtering techniques (Christodoulakis *et al.*, 1995). Others however, including Bjørnland (2000) and Canova (1998), find more substantial differences,

though it appears that these are mainly related to detrending of real wages, working hours and productivity.

The HP filter has several attractions from a practical viewpoint, because it optimally extracts the trend (Canova, 1998) and because it is additive. The latter feature implies that it is easy to decompose contributions to movements in detrended series by the variations in its (uncorrelated) components. However, a number of studies, including Boone *et al.* (2001), also emphasise some critical features about the HP filter:

- The HP filter suffers from the well-known end-point problem: as the filter is symmetric it has a strong tendency to move the trend towards the actual data towards the end of the sample.

- Determining the smoothing parameter (λ) in extracting the trend, *i.e.* the "penalty" for deviations of trend from actual values, is based more on subjective judgement than on formal criteria.

- The HP filter implicitly assumes that the gap is white noise and that the underlying series can be approximated by an I(2) process. This is inconsistent with historical time series data as well as standard models of the business cycle, which posit a high degree of first order autocorrelation in the gap (a high degree of persistence). However, these inconsistencies may not be as bad as they sound in practice – they are mostly related to the end-point problem and for generating forecast for the underlying series beyond the historical data.

- The HP filter, like other univariate filtering methods, ignores other information than what is embodied in the specific time series being filtered. This may result in biased estimates.

- The mechanical application of the HP filter to series which are either integrated or driven by deterministic trends may induce spurious results (Cogley and Nason, 1995). Hence, the HP method is essentially subject to the critique by Nelson and Kang (1981), who showed that if data are actually generated by a random walk, detrending will lead to the identification of spurious cycles.

It is difficult to gauge the importance of these problems. The end-point problem can be substantially mitigated in various ways, *e.g.* by extending the sample with forecasts or artificial data. Moreover, by applying HP filters with

various λ's, it is possible to mimic a broader range of other filtering techniques. In conclusion, the choice of a specific filtering method potentially has a substantial impact on the resulting detrended levels of the time series data and hence on the levels of the output gaps and their standard deviations. However, when comparing business cycle behaviour over time and across countries, as is the case in this study, this is not too large a concern since the focus is on the change in the variability of gaps as well as the relative variability across countries. In other words, assuming that the bias implied by a certain filter does not change too much over time or across countries, the outcomes are likely to be fairly robust to the choice of filtering approach.

2. A brief survey of the business cycle literature

Box A1 below summarises methodologies and main findings of a number of recent business cycle and detrending studies.

3. Measuring inflation expectations from relative variances of inflation and the output gap

It is difficult to accurately measure the change in inflation expectations, but in the context of this exercise, an indication can be given by the variability of inflation relative to that of the output gap. A reduction in this ratio may imply that inflation expectations have become more firmly anchored (*cf.* Figure 16 of the main text). This can be seen relatively easily from cases *a)* and *b)* below:

Case *a)* Assume that private sector inflation expectations are anchored around a constant, B:

$\pi(t) = B + a*gap(t)$, where π is inflation and gap is the output gap. Then we have that:

$$var(\pi(t)) = a^2 * var(gap(t))$$

$$\Rightarrow var(\pi(t)) / var(gap(t)) = a^2 \qquad [1]$$

Case *b)* Assume instead that private sector inflation expectations are backward-looking:

$\pi(t) = \pi(t-1) + a*gap(t)$. Then we have that:

$$\text{var}(\pi(t)) = a^2*[\text{var}(\text{gap}(t))+\text{var}(\text{gap}(t-1))+.....+\text{var}(\text{gap}(t-n))] +$$
$$+ n*\text{cov}[\text{gap}(t), \text{gap}(t-1)...\text{gap}(t-n)]$$

$$\Rightarrow \text{var}(\pi(t))/\text{var}(\text{gap}(t)) = a^2*[1+\text{var}(\text{gap}(t-1))/\text{var}(\text{gap}(t))+$$
$$+ .....\text{var}(\text{gap}(t-n))/ \text{var}(\text{gap}(t))]$$

$$+n*\text{cov}[\text{gap}(t), \text{gap}(t-1)...\text{gap}(t-n)]/\text{var}(\text{gap}(t))$$

$$\Rightarrow \text{var}(\pi(t))/\text{var}(\text{gap}(t)) > a^2 \qquad [2]$$

Note that (2) only holds if the covariance between lagged gaps is not negative and numerically large (which is rather unlikely).

Table A1. Contributions to the variance of output gaps

Country and period	Total output gap variance	Contribution from total domestic demand	Contribution from trade	Residual	*Memorandum item:* gross contribution from trade	*Memorandum item:* gross contribution from covariance
	(1)=(2)+(3)+(4)	(2)	(3)	(4)	(5)	(6)
Austria						
1961-1970	2.2	3.0	-0.8	-0.1	0.8	-1.5
1971-1980	3.5	6.0	-2.4	-0.1	2.7	-5.1
1981-1990	0.8	1.2	-0.3	-0.1	2.4	-2.7
1991-2000	0.9	0.7	0.5	-0.3	2.9	-2.4
Canada						
1961-1970	1.3	1.4	-0.7	0.6	0.4	-1.1
1971-1980	1.4	1.3	-0.3	0.3	1.2	-1.5
1981-1990	4.3	6.0	-2.7	1.0	2.7	-5.4
1991-2000	1.5	1.8	-0.3	-0.0	1.7	-1.9
France						
1961-1970	1.4	3.7	-0.5	-1.9	0.4	-0.8
1971-1980	1.3	2.1	-0.6	-0.0	0.6	-1.4
1981-1990	0.9	1.4	-0.5	-0.1	0.4	-0.9
1991-2000	0.7	1.2	-0.4	-0.0	1.0	-1.3
Germany						
1961-1970	2.6	2.3	-0.8	1.1	0.6	-1.4
1971-1980	2.9	4.6	-1.5	-0.1	0.9	-2.4
1981-1990	0.9	0.9	0.0	0.0	1.1	-1.1
1991-2000	1.5	1.4	0.0	0.1	2.1	-2.1
Italy						
1961-1970	2.6	4.4	-2.0	0.1	0.6	-2.6
1971-1980	4.4	7.2	-2.7	-0.1	1.3	-4.0
1981-1990	0.8	1.2	-0.4	0.0	0.8	-1.2
1991-2000	0.7	3.1	-2.5	0.1	2.0	-4.5
Japan						
1961-1970	2.9	2.7	-0.4	0.5	0.1	-0.5
1971-1980	3.3	5.2	-1.8	-0.1	0.3	-2.1
1981-1990	1.1	1.5	-0.3	-0.0	0.2	-0.6
1991-2000	1.8	2.2	-0.4	-0.0	0.3	-0.7
Spain						
1961-1970	1.5	2.0	-0.5	0.1	0.2	-0.8
1971-1980	1.7	2.8	-1.1	0.1	0.5	-1.6
1981-1990	1.0	2.9	-1.8	-0.1	0.5	-2.3
1991-2000	1.3	3.6	-2.6	0.2	1.1	-3.7
Sweden						
1961-1970	3.0	4.0	-0.8	-0.1	1.1	-1.9
1971-1980	2.4	5.3	-2.6	-0.2	3.5	-6.1
1981-1990	1.5	3.3	-2.0	0.2	1.7	-3.7
1991-2000	2.5	3.2	-0.9	0.2	3.6	-4.5
United Kingdom						
1961-1970	1.4	2.0	-0.7	0.0	0.4	-1.1
1971-1980	4.5	5.2	-1.1	0.4	1.6	-2.7
1981-1990	2.5	4.9	-2.3	-0.1	1.2	-3.5
1991-2000	1.1	1.5	-0.4	0.0	0.8	-1.2
United States						
1961-1970	1.8	2.1	-0.2	-0.0	0.1	-0.3
1971-1980	4.6	6.7	-1.6	-0.5	0.3	-1.9
1981-1990	3.1	4.2	-1.0	-0.1	0.3	-1.3
1991-2000	0.7	1.3	-0.6	0.0	0.2	-0.8

Note: The variance of the output gaps is a proxy for the average size of the gap (since it measures the squared average distance from the gap mean, which is close to zero). The contributions to total output gap variance from the total domestic demand gap and the trade gap are calculated as a weighted average of their individual variances and their covariance. The residual is the discrepancy between the total output variance and the sum of its components, which is due to statistical discrepancies, averaging effects as well as the non-additivity of real expenditure components for countries using chain-weighted accounts. The gross contribution from trade denotes the isolated impact on output gap variance from the variance of export- and import gaps. The covariance effect is mainly related to the strong positive covariance between the total domestic demand gap and the import gap, but includes also the covariance between the total domestic demand gap and the export gap as well as between the export gap and the import gap. Australia, Norway and New Zealand are not included due to lack of adequate data.

Box A1. *Business cycles – overview of the literature*

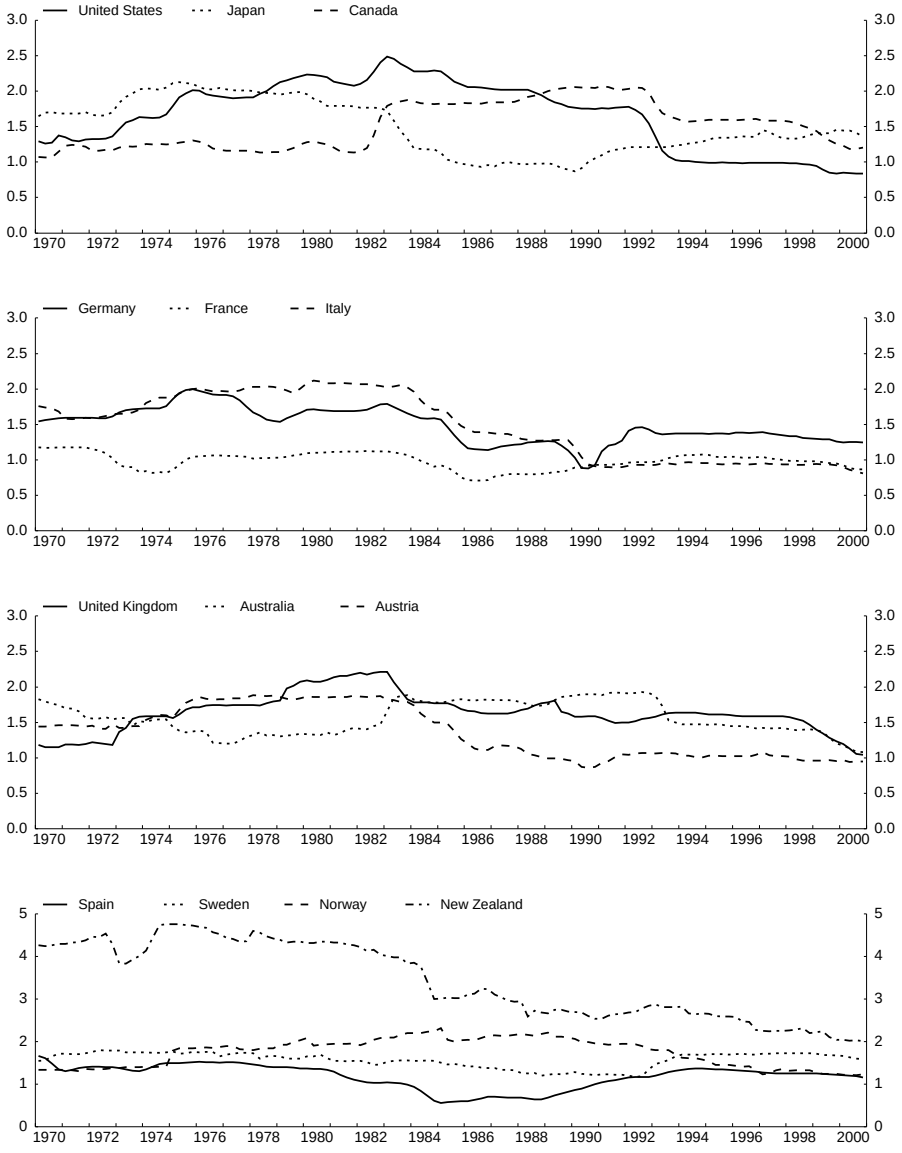
Author	Method; frequency; period	Countries	Main findings
Backus and Kehoe (1992) "International evidence of the historical properties of business cycles"	i) Gaps based on logs using an HP100 filter ii) Annual data iii) Pre- 1900-1990	Australia, Canada, Denmark, Germany, Italy, Japan, Norway, Sweden, United Kingdom, United States	Output fluctuations are smaller post-WWII than inter-war (pre-war not evident). Private consumption is procyclical with same standard deviation as GDP. Investment is also uniformly procyclical with standard deviation 2-4 times that of GDP. Government consumption is more volatile than output, but is counter-cyclical as often as procyclical. Net exports have mostly been counter-cyclical. Cross-country correlations of output gaps are typically positive and more pronounced in the post-war period than in the pre-war period (but data reliability is a particular problem here). There is a sharp increase in inflation persistence post-war. Price level gap/output gap correlations are mostly negative post-war (while positive pre and inter-war).
Wynne and Koo (2000) "Business cycles under monetary union: a comparison of the EU and the US"	i) Band pass filter (results are quite similar to using an HP1600 filter on a quarterly basis) ii) Annual data iii) 1950-95	EU15 countries plus 12 federal districts in the US	Compares the size of pair-wise output gap correlations across countries and whether these vary over time (by gradually extending the period). Result: greater synchronisation among EU6 (original EU members), but less than in USA12. Less synchronisation among later EU joiners, although significant co-movements among close trading partners. Significant positive correlation of price level gaps across EU countries. Price level volatility lowest in Germany. Less correlation of inflation gaps across EU countries. Significant negative correlation between output and price gaps. Negative, but insignificant, correlation between output gap and the inflation gap (Italy is an exception). Generally, the US has a much more significant positive correlation across the 12 Fed districts that what is seen across 15 EU countries for output gaps, employment gaps and price level gaps.

Zarnowitz (1998) "Has the business cycle been abolished?"	No empirical work	United States plus others	The insistence on a single source of recessions (such as oil prices, interest rates) is erroneous. Have to look at movements in growth of demand, money and credit, profits and investment. At high capacity utilisation levels, corporate earnings decline because slowing of sales and rising costs of production and financing. It is the relative price effect (sales prices increase by less than costs) that triggers the investment drop, not the effect of the expansion itself on the general price level of goods and services. The potential effects on business cycles of downsizing and globalisation are still difficult to assess. They are probably mixed and may differ on the demand and supply side.
Den Haan (1996) "The comovements between real activity and prices at different business cycle frequencies"	i) * VAR model * Band pass filter ii) Annual data iii) 1875-1993	United States	In the post-war period, the comovement between output and prices is positive in the short run and negative in the long run, consistent with a model where demand shocks dominate in the short run and supply shocks dominate in the long run. The sign and strength of correlations between output and prices (or wages) are very sensitive to the methods used to calculate them. It is shown (both by the VAR model and the band pass filter) that correlation between price and output is positive in the short term and negative in the long term.
Bjørnland (2000) "Detrending methods and stylized facts of business cycles in Norway – an international comparison"	i) Analyse detrended data in time and frequency domains using different methods: Benveridge-Nelson; HP-filter; Band Pass/frequency domain; method of unobserved component ii) Quarterly data iii) 1967q1-1994q4	Denmark, Finland, Germany, Norway, Sweden, United Kingdom, United States	The evidence suggest that whereas some variables (*e.g.* consumption and investment) behave consistently procyclically with GDP, for other variables (*e.g.* real wages and prices), the business cycle properties vary considerably with the detrending methods used. There is little evidence to support a (supply driven) real business cycle.
Diebold and Rudebusch (1992) "Have Postwar economic fluctuations been stabilized"	i) WILCOXON, rank sum test ii) Annual data iii) 1854-1990	United States	Apply the question of stabilisation in terms of duration of the business cycle rather than its volatility. Find strong evidence of a post-war shift toward longer expansions and shorter contractions.

Canova (1998) "Detrending and business cycle facts"	i) Analyse detrended data in time and frequency domains using different methods. Univariate filter: Beveridge-Nelson, HP-filter, first order differencing, unobserved component, Band Pass/frequency domain. Multivariate methods: cointegration, common linear, multivariate frequency domain. ii) Quarterly data iii) 1955q3-1986q3	United States	Show that second-order properties (variance) of the estimated cyclical components of the analysed series vary widely across detrending procedures and that even among filters that produce similar duration features, significant qualitative differences emerge. Higher moments only show small differences across filters. The HP1600 filter resembles band pass (freq1). HP1600, the band pass and UCM displays cycles with average duration of 4-6 years and turning points for expansions and contractions which approximately reproduce the NBER dating of cycles. However, there are instances where selecting cycles with this particular duration may inappropriately characterise a phenomenon (*e.g.* labour hoarding), neglect a large portion of the variability of a series (*e.g.* productivity) or induce extreme second-order properties in detrended data.
Christodoulakis, Dimelis and Kollintzas (1995) "Comparisons of business cycles in the EC: idiosyncracies and regularities"	i) HP filter (results checked and confirmed using two alternatives: quadratic detrending of logs as well as first order differencing). ii) Quarterly as well as annual data iii) 1960-1990	EU12 countries	Extension of Backus and Kehoe (1992). Focus on volatility, measured by the standard deviation and persistence, measured by the first-order auto-correlation. Find that the behaviour (volatility and persistence) of GDP, private consumption, investment, prices (and to a smaller degree net exports/GDP) is quite similar across EU12 but that government consumption, terms of trade and money supply vary considerably. Private consumption, investment and stockbuilding are all procyclical and more volatile than GDP. This is less clear for government consumption. Deflators for GDP and private consumption are counter-cyclical. Confirming B&K it is found that private consumption is less correlated across countries than output. Prices are strongly correlated. Results are fairly robust across detrending procedures, except for government consumption and money supply.
Cogley and Nason (1995) "Effects of the Hodrick-Prescott filter on trend and difference stationary time series: implications for business cycle research"	HP	–	This paper extends earlier work on the HP filter by analysing its effects on trend- and difference- stationary series. The paper's main result is that the HP filter is subject to the Nelson-Kang critique. When applied to integrated processes, the HP filter can generate business cycle periodicity and comovement even if none are present in the original data.

Figure A1. Amplitude of output gaps, country specific details

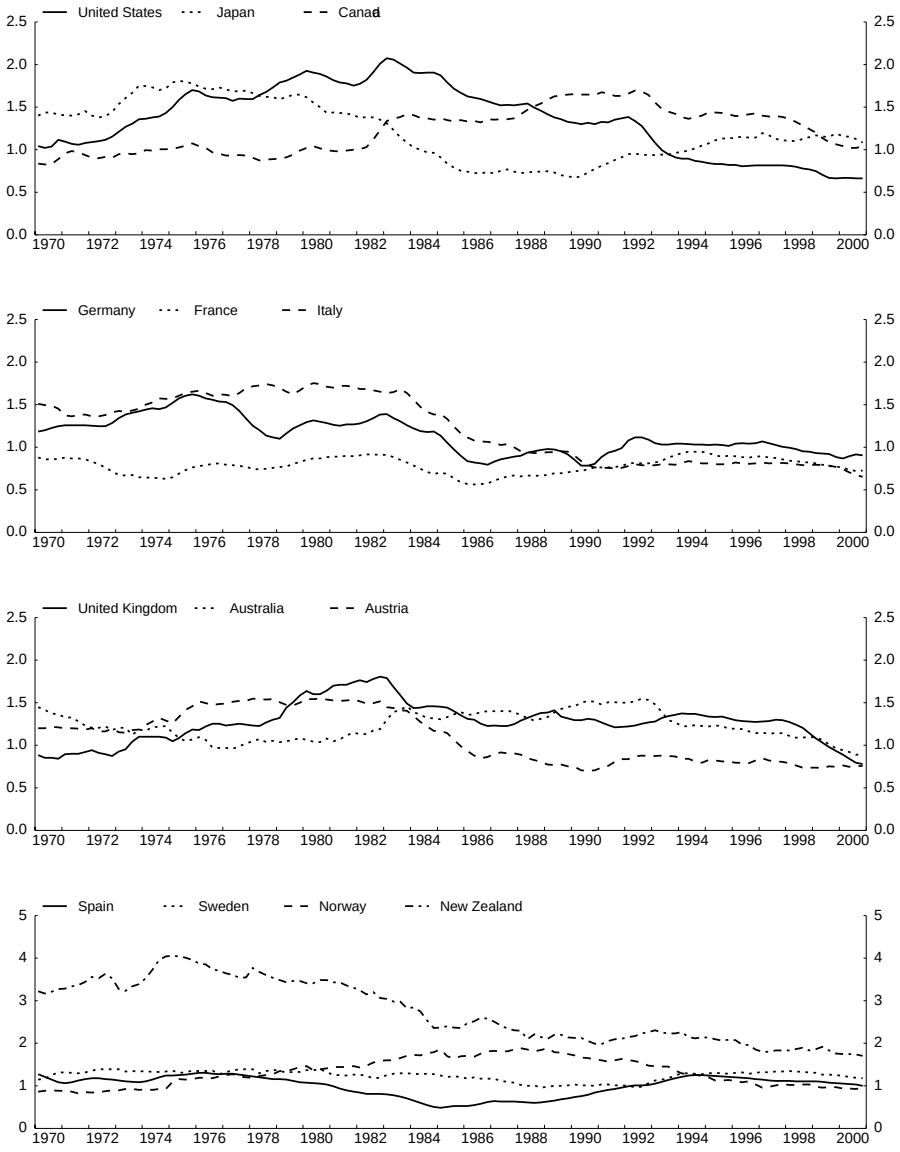
Panel A. Standard deviation of output gaps



Note: Moving 10-year windows. The gap is calculated using an HP1600 filter.

Figure A1 (cont.). Amplitude of output gaps, country specific details

Panel B. Average absolute size of output gaps



Note: Moving 10-year windows. The gap is calculated using an HP1600 filter.

Figure A2. Standard deviation of gaps

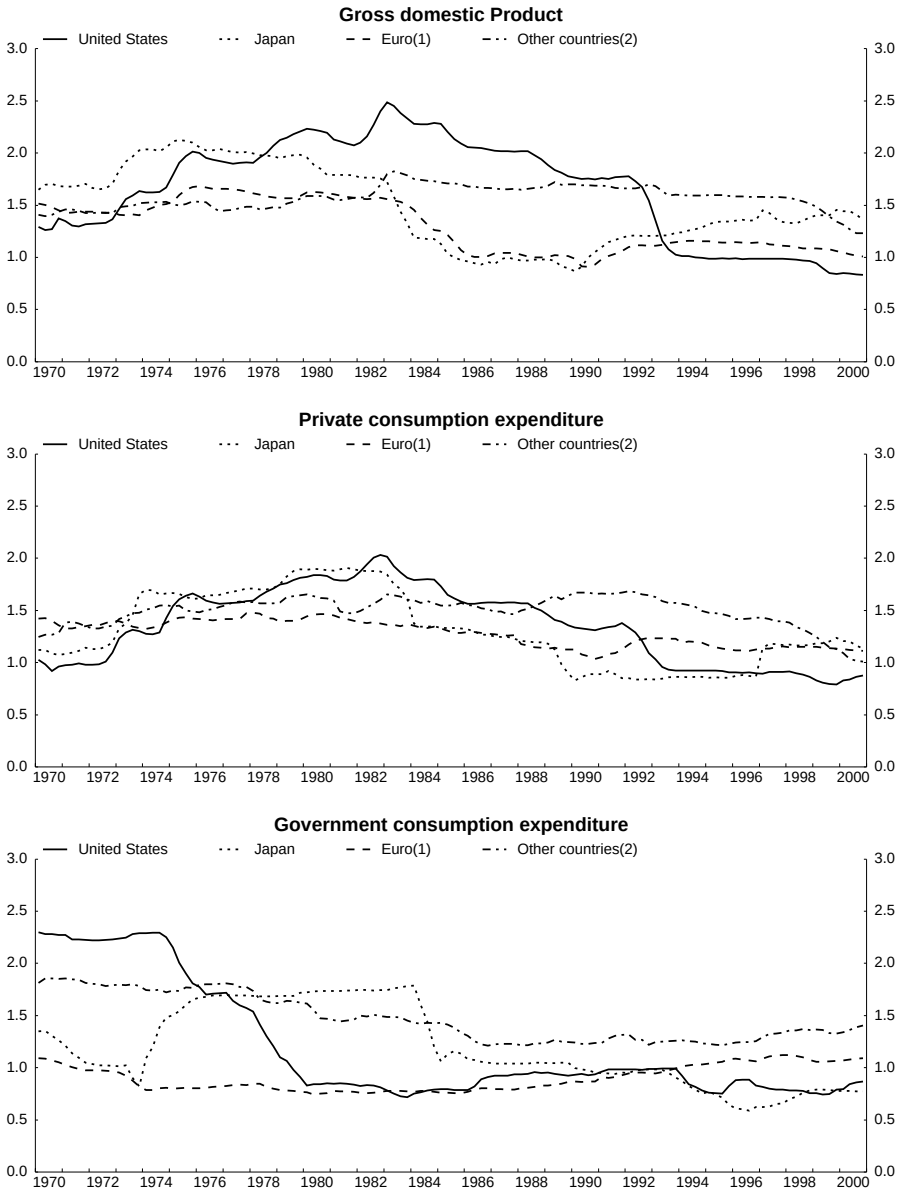


Figure A2 (cont.). Standard deviation of gaps

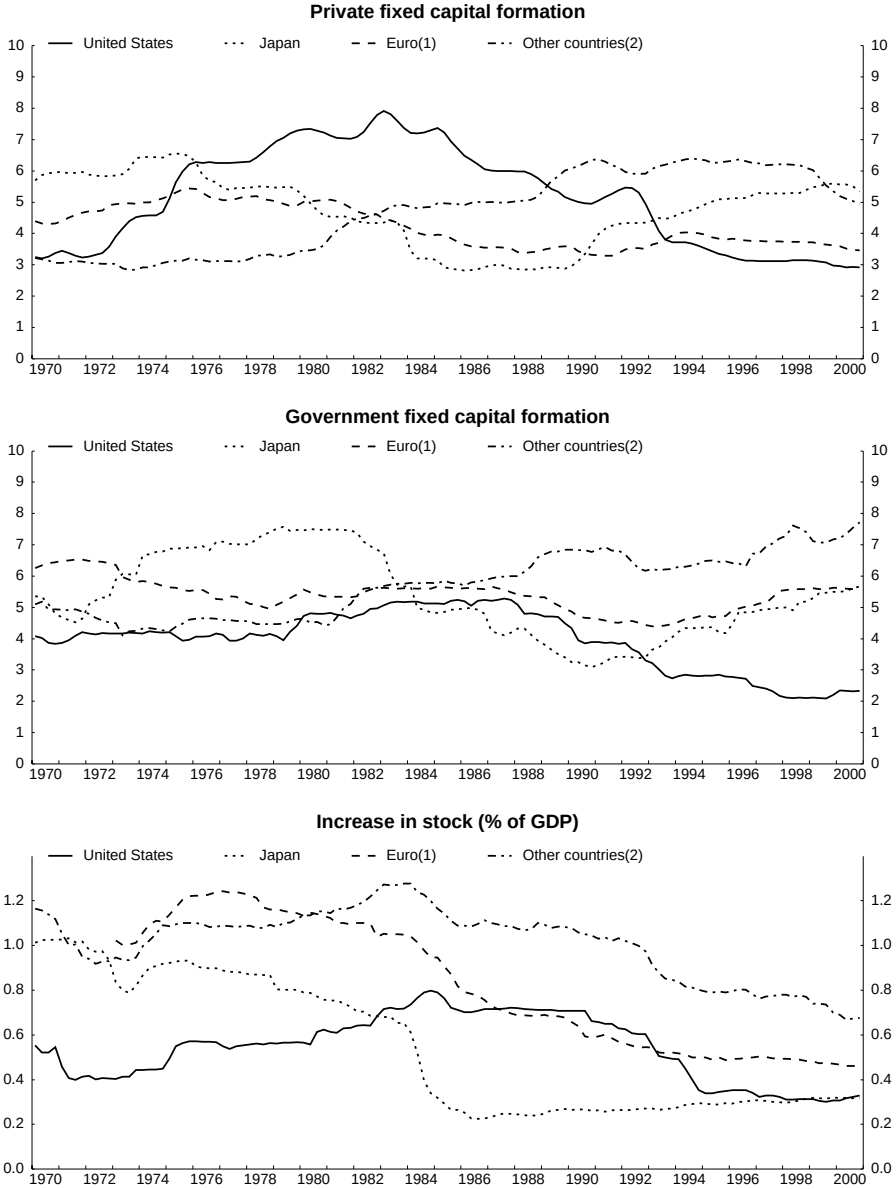


Figure A2 (cont.). Standard deviation of gaps

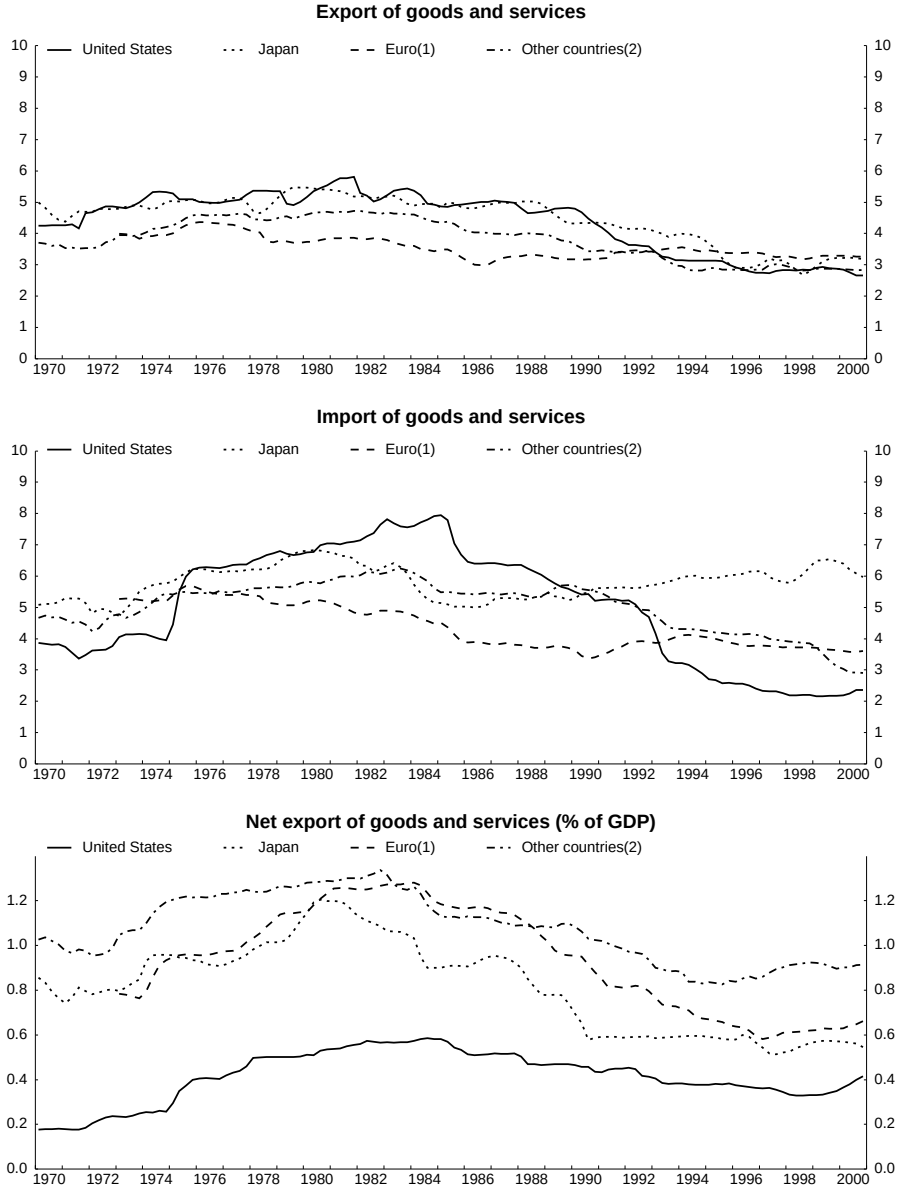
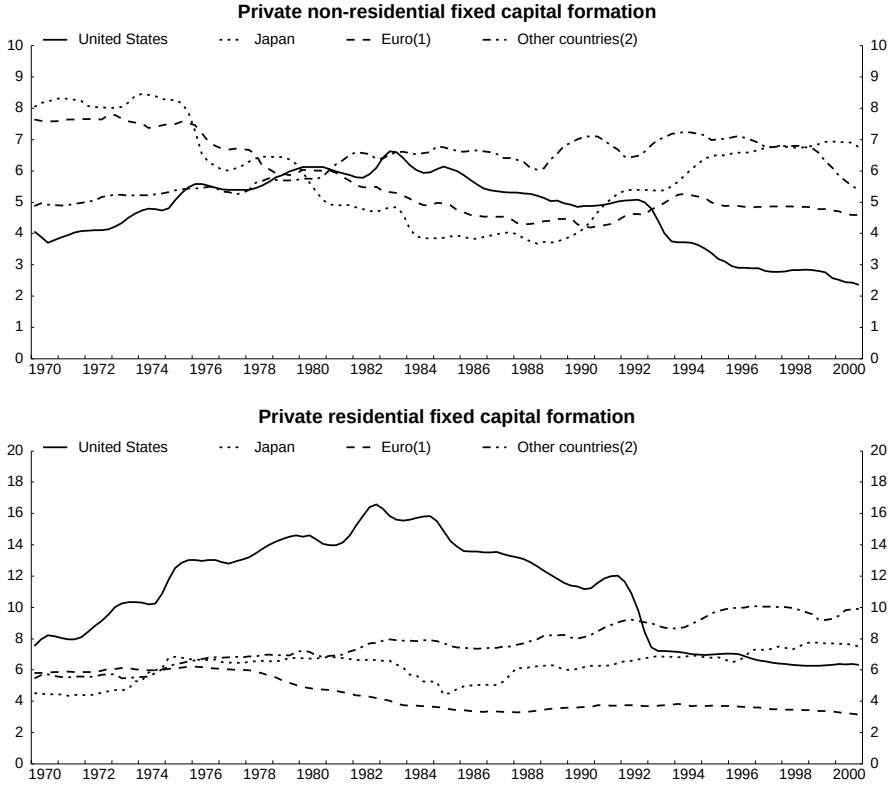
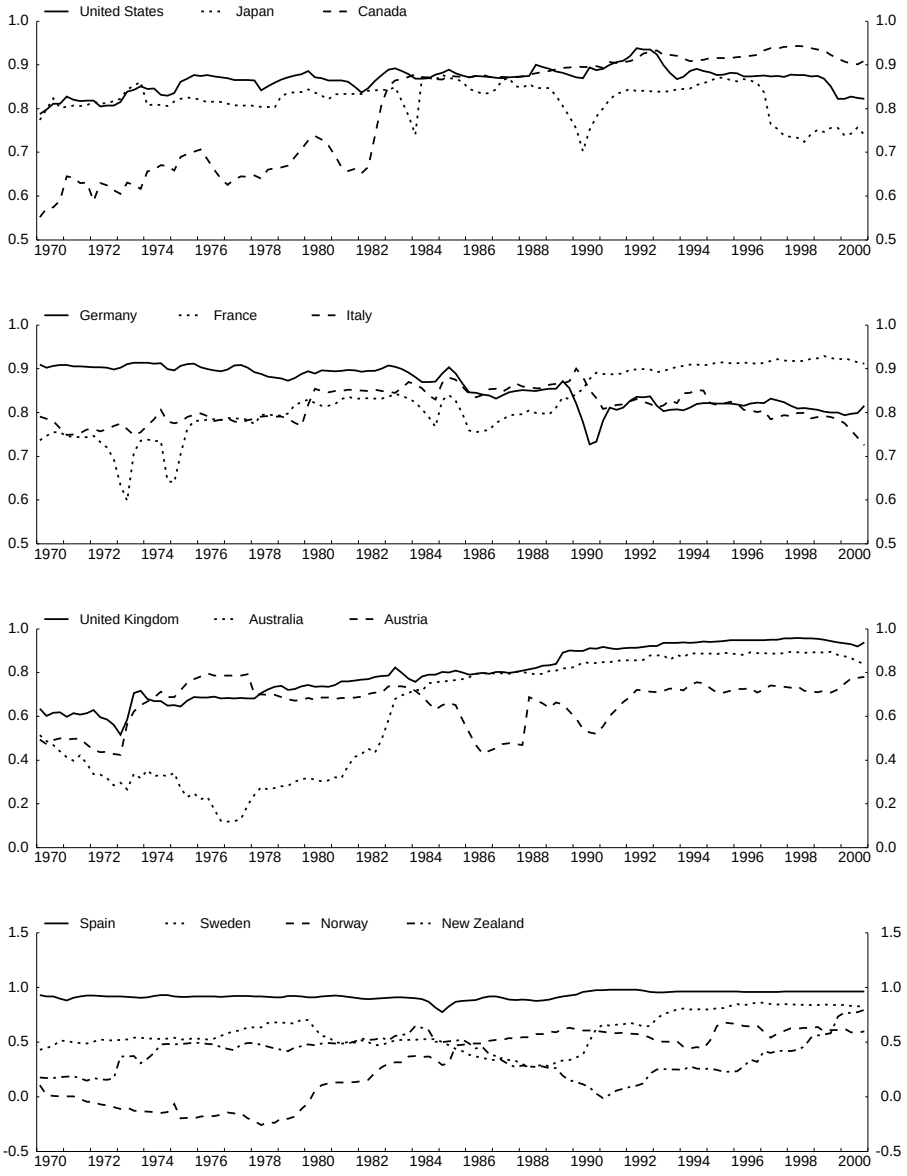


Figure A2 (cont.). Standard deviation of gaps



Note: Moving 10-year windows. The gap is calculated using an HP1600 filter.

Figure A3. Persistence of output gaps



Note: Moving 10-year windows. The gap is calculated using an HP1600 filter.

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