CESifo Working Papers
www.cesifo.org/wp

The Nature of Financial and Real Business Cycles: The Great Moderation and Banking Sector Pro-Cyclicality

Balázs Égert
Douglas Sutherland

CESIFO WORKING PAPER NO. 3824
CATEGORY 6: FISCAL POLICY, MACROECONOMICS AND GROWTH
MAY 2012

CESifo *Working Paper No. 3824*

The Nature of Financial and Real Business Cycles: The Great Moderation and Banking Sector Pro-Cyclicality

Abstract

This paper takes a fresh look at the nature of financial and real business cycles in OECD countries using annual data series and shorter quarterly and monthly economic indicators. It first analyses the main characteristics of the cycle, including the length, amplitude, asymmetry and changes of these parameters during expansions and contractions. It then studies the degree of economic and financial cycle synchronisation between OECD countries but also of economic and financial variables within a given country, and gauges the extent to which cycle synchronisation changed over time. Finally, the paper provides some new evidence on the drivers of the great moderation and analyses the banking sector's pro-cyclicality by using aggregate and bank-level data. The main findings show that the amplitude of the real business cycle was becoming smaller during the great moderation, but asset price cycles were becoming more volatile. In part this was linked to developments in the banking sector which tended to accentuate pro-cyclical behaviour.

JEL-Code: E320, E440.

Keywords: real business cycles, financial cycles, great moderation, banking system, financial markets.

Balázs Égert
OECD Economics Department
Paris / France
balazs.egert@oecd.org

Douglas Sutherland
OECD Economics Department
Paris / France
douglas.sutherland@oecd.org

The authors are members of the Economics Department of the OECD. The authors would like to thank Jørgen Elmeskov, Peter Hoeller, Jean-Luc Schneider and other members of the Economics Department for valuable comments and suggestions, and Mee-Lan Frank and Susan Gascard for excellent editorial support.

1. Introduction

The recent economic and financial crisis has challenged some presumptions about the forces shaping economic cycles and the effectiveness of policy that had developed during the great moderation era. This crisis *inter alia* casts doubt over the understanding of cyclical developments and also the impact of financial markets on the cycle and the cycle on financial markets. In reconsidering these issues, the paper examines the nature of the cycle and highlights how business and asset price cycles have been changing over time. The length, size and asymmetry of expansionary and contractionary periods are studied using a variant of the procedure developed by Bry and Boschan (1971) to determine peaks and troughs in time series. The degree of business cycle synchronization are established on the basis of so-called concordance indices aimed at quantifying the degree of overlap of different cycles once turning points are identified.

A well-developed financial sector can play a smoothing role in providing traction for monetary policy, but can also amplify shocks and at times be at the origin of economy-wide shocks. Indeed, capital, provisioning, liquidity and maturity mismatch in the banking sector can generate pro-cyclical behaviour in credit supply for a number of reasons including the regulatory setup, the nature of risk assessment and the prevailing incentives to take risks. At the same time, the banking sector can follow changes in the real economy and in the price of financial assets (housing and share prices). But the empirical evidence is far to be conclusive regarding the degree of the pro-cyclicality to real and financial cycles of the banking system of individual OECD countries. It is against this background that this paper takes a new look at the degree of synchronisation of a large number of banking sector variables (including capital, liquidity and provisioning indicators) with real and financial cycles by relying on dynamic panel regression analysis carried out for sector-specific and bank-level data.

The remainder of the paper is structured as follows. Section 2 reviews the factors that shaped the last cycle and summarises the drivers of banking sector pro-cyclicality. Section 3 provides the details of the methodologies and dataset used. Section 4 reports the empirical results. Section 5 concludes.

2. Economic and financial cycles

2.1. The last cycle and the great moderation

Existing evidence suggests that the amplitude of cyclical fluctuations have become smaller since the 1970s (Dalsgaard *et al*., 2002; Duval *et al*., 2007). Several factors can potentially explain a smaller cyclical amplitude. The literature provides a number of explanations for this episode, the so-called great moderation. In the United States, the standard deviation of output growth and inflation declined considerably with a break occurring around the middle of the 1980s (Blanchard and Simon, 2001; Dalsgaard *et al*., 2002; Davis and Kahn, 2008). Other OECD economies experienced similar declines in output and inflation volatility. On the other hand, not all countries enjoyed a great moderation, with output growth volatility even increasing in Iceland, while in some others (like France) output volatility was never pronounced. Three broad sets of explanations for the great moderation are advanced in the empirical literature: *i*) better macroeconomic policy, *ii*) good luck and *iii*) structural changes in the economy.

A number of findings suggest that better macroeconomic policy, particularly monetary policy, may have contributed to the great moderation. Output volatility is often correlated with the volatility of inflation, which is consistent with a story of better monetary policy (Blanchard and Simon, 2001). Dalsgaard *et al*. (2002) argue that monetary policy gained credibility because of institutional changes including greater central bank independence, the introduction of inflation targeting frameworks and a strong track record in fighting inflation. This led to a better anchoring of inflation expectations. Similarly, Clarida *et al*. (2000) identify a shift in monetary policy contributing to greater macroeconomic stability. The change may be related to the higher weight assigned to inflation in the monetary policymaker's objective function (Taylor, 1998). Even relatively small changes in policy rules and changes in the volatility of shocks can imply relatively large changes in the volatility of output and inflation (Canova, 2009). Cecchetti *et al.* (2006) argue that improved monetary policy played an important role in 21 OECD countries out of 25 in lowering the volatility of inflation, but was less instrumental in damping output volatility. However, improved monetary policy may have helped damp the impact of shocks.

A second explanation, not necessarily incompatible with better monetary policy, is good luck – in particular fewer large adverse shocks – contributing to reduced volatility.[2] Stock and Watson (2002) argue that the decline in volatility was too large to be explained by changes in monetary policy alone.

Third, a large number of other changes in the functioning of economies may have contributed to the great moderation. First, financial market deepening and innovation have allowed greater consumption and investment smoothing, by allowing better risk diversification and inter temporal smoothing (Blanchard and Simon, 2001; Catte *et al*., 2004; Dynan *et al*., 2006*a*; de Blas, 2009).[3] Cecchetti *et al.* (2006) show that higher proportions of credit granted to the private sector are correlated with lower volatility. Benk *et al*. (2009) argue that credit market liberalisation helped the absorption of shocks, which may otherwise have shown up in higher inflation and growth volatility. Nevertheless, these findings need re-examination in the wake of the crisis. Second, the impact of globalisation could either reduce or increase volatility. The rapid development of emerging economies has underpinned growth in the developed world. At the same time, cheap imported goods from China and other emerging economies have created a terms of trade gain for the advanced economies and thus a beneficial tailwind, which only turned into a headwind when rapid global growth led to sharp rise in oil and other commodity prices (Pain *et al*., 2006). On the other hand, greater trade and financial integration can make a country more exposed to external shocks. Third, better inventory management may have contributed to the decline in aggregate volatility (Dalsgaard *et al*., 2002). Kahn *et al*. (2002) show that in the United States, inventory levels declined in the mid-1980s and Cecchetti *et al.* (2006) show that the contribution of inventory changes to GDP growth declined for the major economies. However, this dynamic may only reflect smaller shocks hitting economies and other research finds that the great moderation has little to do with changes in inventory behaviour (Barrell and Gottschalk, 2004). Fourth, the shift in the composition of output from manufacturing to services may have affected volatility. This has been advanced by Black and Dowd (2009) using state level data for the United States. However, McConnell and Perez-Quiros (2000) and Stock and Watson (2003) demonstrate that the decline in volatility is common across sectors in the G7 countries. Finally, aggregation effects could have also played a role. Indeed, firm dynamics can exhibit distinct differences from aggregate developments. For example, Comin and Philippon (2005) show that firm-level output volatility increased, whereas aggregate volatility fell. This could be related to developments in financial markets allowing riskier firms access to external finance (Buch *et al*., 2009) and the consequences of regulatory reform and technical progress leading to idiosyncratic or sector-specific shocks becoming more important and less correlated across firms and sectors (Stiroh, 2009). In addition, Dynan *et al*. (2006*b*) find that individual households have faced increased economic uncertainty during the great moderation in the United States, but the covariance across households has decreased, leading to smoother aggregate income developments. They also find that the response of consumption to income shocks fell, which is consistent with changes in financial markets allowing greater consumption smoothing. Edmond and Veldkamp (2008) argue that changes in the United States' earnings distribution helped reduce GDP volatility, as income was concentrated among groups that were not credit constrained.

---

2. Empirically, it can be difficult to distinguish the two factors.

3. Evidence points to a decline in the "home bias" in OECD countries (Lane and Milesi-Ferreti, 2007; Sorenson *et al.*, 2007).

2.2. The interrelatedness of the financial sector and the real economy

The banking and financial sectors are strongly intertwined with the real economy. Bank credit and the access to capital markets can amplify movements in the real economy. At the same time, cycles in the real economy can introduce cyclicality in bank lending. Asea and Blomberg (1998) document that bank lending drives and amplifies the overall real cycle in the United States and that there is also a feedback from the real cycle to bank lending. The two main channels through which banks and capital markets can influence real activity are the bank lending channel and the broad lending channel (also called financial accelerator or balance sheet channel). The real sector may also influence bank lending. In fact, bank lending can react in a pro-cyclical way to cycles in the real economy. A pro-cyclical banking sector will in turn amplify the real cycle. Therefore, a policy design that reduces the banking sector's pro-cyclicality will help attenuate the real cycle. This section reviews the mechanisms through which the banking sector can become pro-cyclical, provides new empirical evidence on the extent of pro-cyclicality and finally discusses proposals for how to dampen the pro-cyclicality of the banking sector. In line with the literature, pro-cyclicality of banking sector indicators, such as capital or liquidity ratios are defined in terms of a negative relationship: an increase in bank capital in bad times and a decrease in good times is considered as pro-cyclical. Counter-cyclicality implies that bank capital increases in good times and decreases in bad times.

The demand for and the supply of bank loans and thus their cost fluctuate over the cycle because credit demand is related to production, business and residential investment (Ayuso *et al*., 2002) and because lending standards change over the cycle, being lax during expansions, but tight in downturns. Mortgage equity withdrawal to finance consumption can also boost borrowing by households. This can lead to over-lending in upswings and result in an accumulation of bad loans and credit rationing during downturns (Asea and Blomberg, 1998). Gorton and He (2008) suggest that cycles in lending standards and lending occur because banks do not only compete by compressing margins but also by relaxing lending standards during upswings.[4]

Financial liberalisation gave rise to more risk taking, especially during the great moderation period and resulted in higher leverage ratios.[5] Goodhart *et al*. (2004) suggest that this was because banks had to increase leverage if they wanted to maintain the return on equity unchanged while having riskier clients and facing lower profits due to more intense competition. Moreover, the move from relationship banking to arm's length banking and the commodification of financial transactions and securitisation increased the costs of monitoring and may have contributed to an underestimation of risks (Panetta *et al*., 2009).

Existing empirical work that analyses whether regulatory bank capital is pro- or counter-cyclical over the business cycle points to differences between the United States and Europe on the one hand and between the old and new EU member states on the other hand (Table 1). Yet, it fails to provide a consensus on how banks react to the cycle in a given country group. While multi-country panel studies suggest a weak counter-cyclical effect, country-specific studies for Spain, Germany, the United Kingdom and Norway come to opposite conclusions. This can be largely explained by the characteristics of the studies in terms of time span, data cleaning, country coverage, estimation method and the number of control variables.

A first group of studies investigates pro-cyclicality relying on panels covering several countries. Jokipii and Milne (2006) show the pro-cyclical behaviour of regulatory capital for old EU member states while they find that bank capital in the new EU members moves counter-cyclically. They also show that

4. Keys *et al*. (2010) show that lending standards became lax in the US subprime market as securitisation gained in importance.

5. The leverage of the banking sector may have become increasingly understated as the shadow banking sector evolved, given its links to banks via contingent credit lines, guarantees and reputational risk.

bank capital of commercial and savings banks and large banks is negatively (pro-cyclically) correlated with the cycle. The results by Bikker and Metzenmakers (2007) suggest that bank capital does not react to the cycle for a panel of OECD countries. But for subgroups of countries, they find that the old EU countries have counter-cyclical bank capital while US banks are pro-cyclical in this regard. At the same time, bank capital is negatively (pro-cyclically) related to bank-specific growth rates of customer loans. Kim and Lee (2006) include 30 OECD countries and 7 non-OECD Asian countries. The estimation results for the 37 countries do not provide a robust relationship between bank capital and the real cycle even though bank-level loan growth is negatively linked to capital. When they differentiate between different country groups, they find that bank capital is counter-cyclical in the OECD countries whereas it is pro-cyclical in non-OECD Asian countries. Finally, d'Avack and Levasseur (2007) use country level data as opposed to the other studies that are based on bank-level data. They found that the banking sectors of 11 Central and Eastern European countries are pro-cyclical in terms of regulatory capital.

A second group of papers focuses on bank-level data for a single country. Ayuso *et al*. (2002) found for Spain that the capital buffer (the part of capital above the minimum capital requirement) moved pro-cyclically with the business cycle from 1988 to 2000, though they qualify the degree of the pro-cyclicality as moderate. Similarly, Stolz and Wedow (2005) found that regulatory capital of German banks (including savings and co-operative banks) was linked to the cycle in a pro-cyclical fashion between 1995 and 2003. For a comparable time span (1990-2006), Francis and Osborne (2009) could establish only a weak statistical relationship between regulatory capital and the cycle for UK banks. Lindquist (2003) found either no statistically significant relationship or only weak pro-cyclicality for Norwegian commercial and savings banks' regulatory capital.

Table 1. **Literature overview on banking sector pro-cyclicality**

Study	Country coverage	Period	PRO/COUNTER cyclicality
Regulatory capital			
Ayuso *et al.* (2002)	Spain	1988-2000	PRO
Stolz and Wedow (2005)	Germany	1995-2003	PRO
Francis and Osborne (2009)	UK	1990:q1 to 2006:q4	Weak PRO
Lindquist (2003)	Norway	1995:q1 to 2001:q4	NO or weak PRO
Jokipii and Milne (2006)	European Union	1997-2004	EU-old: PRO EU-new: COUNTER
Bikker and Metzenmakers (2007)	29 OECD, EU, US	1992-2001	Loan growth: PRO Macro cycle: EU-old: COUNTER US: PRO
Kim and Lee (2006)	30 OECD, 7 Asian	1995-2004	OECD, US: COUNTER Asian countries: PRO
D'Avack and Levasseur (2007)	11 Central and Eastern European countries	1997-2005	PRO
Loan loss provisioning			
Bikker and Metzenmakers (2002)	OECD, EU, US, JPN, FRA, ITA	1991-2001	PRO ESP: NO UK: COUNTER
Profitability			
Beckmann (2007)	16 Western European countries	1979-2003	PRO

A few papers have investigated loan loss provisioning and bank profitability and show that these variables exhibit pro-cyclical patterns. Bikker and Metzenmakers (2002) show that provisioning is higher, if GDP growth is lower in OECD countries. They also show that Spain and the United Kingdom are exceptions. Results by Beckmann (2007) indicate that a higher return on assets is strongly correlated with higher GDP growth rates in Western Europe at the country level. He also shows that the results hold for both commercial and savings banks.

3. Measuring economic and financial cycles

3.1. Determining turning points

Cycles can be measured in three main ways (Harding and Pagan, 2005), and depending on data availability at a monthly, quarterly or annual frequency. These main measures are: *i*) classical (or business) cycles that are fluctuations in the level of an economic variable; *ii*) deviation cycles that are differences between the level and permanent component of an economic variable; and *iii*) growth rate cycles that are measured by the growth rates of level variables.

For empirical work, the cycle is often determined by applying a standardised procedure to identify expansions or contractions. To obtain data for deviation cycles, filtering techniques (such as the Hodrick-Prescott filter) can be used to identify the permanent component and thus the deviation in levels from this.

We use a variant of the procedure developed by Bry and Boschan (1971) to determine peaks and troughs in our series. We follow Avouyi-Dovi and Matheron (2005) and Everts (2007) by imposing the following rules:

- A search is carried out in the series to pin down local minima and maxima in a window of t+/-2 for quarterly series and t+/-5 for monthly series.
- No multiple consecutive peaks or troughs are allowed. In the occurrence of multiple peaks or troughs, the highest peak or lowest trough is selected and the rest eliminated.
- A minimum length is imposed for peak-to-trough and trough-to-peak phases and for full peak-to-peak and trough-to-trough cycles. For monthly (quarterly) series, each phase has to be at least 5 (2) months (quarters) long and the cycle cannot be shorter than 15 (5) months (quarters).

The above algorithm is applied to the raw series but also to series filtered in two different ways to eliminate outliers and volatility stemming from high frequency (monthly) data. First, a moving average of 15 months and 5 quarters are applied to the monthly and quarterly series. Second, the series are filtered using a 5-point and 15-point Spencer curve for quarterly and monthly series, respectively, which is indeed a moving average with a special weighting scheme as follows: $\tilde{x}_t = \sum_{i=-r}^{r} w_i x_{t+i}$ with $r = 2$ and $\overline{w} = 1/35[-3,12,17,12,-3]$ for quarterly data (Everts, 2007) and with $r = 7$ and $\overline{w} = 1/320[-3,-6,-5,3,21,46,67,74,67,46,21,3,-5,-6,-3]$ for monthly data (Avouyi-Dovi and Matheron, 2005).

3.2. Cycle synchronisation

A way to look at cycle synchronisation is to analyse the degree of overlap of different cycles once turning points are identified. The so-called concordance index (C_{xy}), given below, takes the value of 1 if the two cycles overlap perfectly and is 0 if for instance series x is always in expansion at a time series y is in contraction (Harding and Pagan, 2006; Avouyi-Dovi and Matheron, 2005).

$$C_{xy} = \frac{\sum_{t=1}^{T} [S_{x,t} S_{y,t} + (1 - S_{x,t})(1 - S_{y,t})]}{T}$$

Where $S_t = 1$ if X_t is in the phase of expansion and $S_t = 0$ if X_t is in the phase of contraction. To test the significance of the concordance index, Harding and Pagan (2006) suggest to estimate the following equation:

$$\frac{S_{y,t}}{\hat{\sigma}_x \hat{\sigma}_y} = \alpha + \beta \frac{S_{x,t}}{\hat{\sigma}_x \hat{\sigma}_y} + \varepsilon_t$$

Where β is the empirical correlation between S_x and S_y, and $\hat{\sigma}_t$ is the empirical standard deviation of S. Finally, Harding and Pagan (2006) show that if $\beta = 0$, the error term will suffer from serial correlation and therefore the equation needs to be estimated using a heteroscedasticity and autocorrelation consistent (HAC) estimator.

3.3. Measuring the pro-cyclicality of the banking sector

A number of variables can be used to capture the banking/real/financial cycle: *a*) the growth rate of customer loans, *b*) GDP growth and *c*) the growth rate of house and share prices.

Country-specific coefficient estimates of the cycle are obtained by inter-acting the cycle variable with country dummies.

Whether the banking sector behaves in a pro-cyclical manner can be analysed using bank-level data or sector-wide variables. For bank-level data, Bankscope contains annual income statements and balance sheet data for individual banks. The 20 biggest banks in terms of total assets in 2008 were selected for each OECD country. For the United States, the 100 largest banks were chosen. The vintage of Bankscope used for this analysis covers the period from 1994 to 2008. This sample provides theoretically 11 200 data points for 700 banks. Nevertheless, the actual sample size is smaller because some countries have less than 20 banks, observations are missing for many banks, and extreme values are eliminated for the indicators considered by cutting 1 percentile at both ends of the distribution. This leaves around 400 to 600 banks and 3 000 to 6 000 data points depending on the indicator considered. For sector-level data, The OECD's bank profitability database compiles annual data on the banking sector in 26 OECD countries using income statements and balance sheet data provided by national authorities. The data start in 1979 and stop in 2007. Data from 1994 onwards are used to render the estimates based on the various databases comparable in terms of time coverage. The leverage ratio (total financial assets over total equity) is computed using data from the OECD's national accounts database for the financial system including banks and non-banks. Data for the period 1994 to 2008 are used.

Different specifications and estimators can be used to analyse the pro-cyclicality of the banking sector by regressing various banking sector variables on a measure of the cycle.

- First, standard static fixed effect OLS panel estimations were carried out for the country-level (with country fixed effects) and bank-level data (with bank fixed effects and (country) clustered standard errors).

- Second, the lagged dependent variable is included on the right-hand side of the regressions. Because this may give rise to a bias in the OLS estimator, the difference and system GMM estimators were used (with orthogonal deviation transformation to preserve as many observations as possible) as they are particularly well suited for the bank-level dataset (large N, small T). Nevertheless, model specification tests indicated that GMM models are almost always mis-specified (while they usually pass the AR(2) test, they fail to pass the Sargan and Hansen J tests).

- For bank-level estimations, the size of banks (log level of total assets) was included as an additional control variable.

4. Empirical results

4.1. The nature of the cycle

Cycles can be measured in three main ways (Harding and Pagan, 2005), and depending on data availability at a monthly, quarterly or annual frequency. These main measures are:

- Classical (or business) cycles that are fluctuations in the level of an economic variable.

- Deviation cycles that are differences between the level and permanent component of an economic variable.

- Growth rate cycles that are measured by the growth rates of level variables.

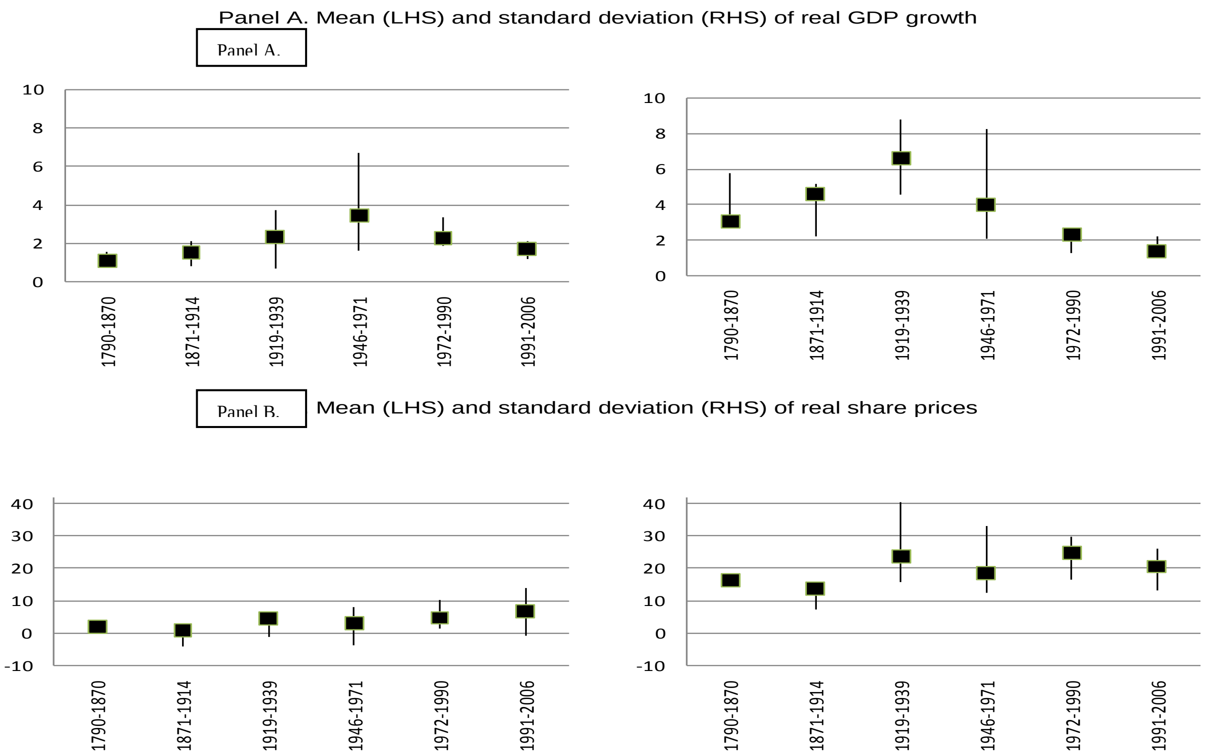
A convenient way of analysing changes in economic and financial cycles is to look at secular time series for economic variables. Annual data for 7 OECD countries (Canada, Germany, France, United Kingdom, United States, Japan and Sweden), for which both real GDP and real share prices are available for around 100 years, suggest that the average annual growth rate of real GDP was around 1% in the early 19th century, rising to almost 4% in the early 1970s and then moving to approximately 2% around the turn of the 21st century. The data indicate that not only has GDP growth volatility declined substantially from the 1930s onwards but also that today's low level of volatility is in line with limited volatility observed during the 19th century (Figure 1). For real share prices, a rise in growth rates appears to be accompanied by increased volatility.

The apparent cyclical features of an economy can vary depending on how the cycle is measured. The length and amplitude in growth and deviation cycles are broadly similar for both rising and falling phases. This is not surprising for deviation cycles as this arises by construction, while for growth cycles it implies that their regularity has not changed much. On the other hand, output (classical or level) cycles exhibit considerable length asymmetries between upswings and contractions (Table 2). GDP downturns often last only a handful of quarters, while expansions typically persist for 4 to 5 years. Furthermore, the amplitude of the expansion is typically much larger than the contraction.

Quarterly data for real output, real share prices, real house prices and real credit were used to calculate the length of the cycles and the asymmetries in the length and amplitude of the cycles for the period 1950 to 2008 or the longest available period for OECD countries. Information on the last cycle was estimated separately to examine whether cyclical developments were unusual in historical context. General results for the different types of cycles are somewhat diverging.

Changes in the nature of the cycle across countries may mask how different cycles are developing within a country. To give an example, in the US economy, since the beginning of the 1990s until 2006 the growth rate of real share and house prices was well above historical growth rates whereas at the same time economic growth was close to growth rates observed at the end of the 19th and mid-20th centuries (Table 3). The great moderation of volatility in economic growth appears unprecedented. Volatility in real share prices declined to levels observed in the 19th century, while volatility of real house prices increased well above levels seen in most of the 20th century. This analysis will be extended to other countries and variables.

Figure 1. **Changes in the cycle over the long-term across countries**



Source:

Table 2. **Output cycle asymmetries between expansions and downturns over the long run**

Annual data, unweighted average of OECD countries

	All cycles excluding last cycle		Last cycle only		Last expansion relative to previous expansions	
	Length asymmetry	Size asymmetry	Length asymmetry	Size asymmetry	Length comparison	Size comparison
1790-2009						
Level cycle	2.7	4.2	8.2	28.8	2.9	1.6
Deviation cycle	1.2	1.0	1.5	3.1	1.2	2.3
Growth cycle	0.9	1.0	1.4	0.9	1.4	0.3
1946-2009						
Level cycle	7.3	38.7	8.2	28.8	1.6	1.2
Deviation cycle	1.2	1.0	1.5	3.1	1.2	1.5
Growth cycle	1.0	0.9	1.4	0.9	1.3	0.5

Note: The sample excludes the Czech Republic, Hungary, Ireland, Luxembourg, Poland and Slovakia.

Length asymmetry = length of expansion / length of downturn; Size asymmetry = size of expansion/size of downturn; The last two columns compare the length and size of the last expansion relative to previous expansions.

Source: Calculations based on data obtained from Barro and Ursua (2008), "Macroeconomic Crises since 1870", BPEA, Online Appendix.

Table 3. **Changes in cycles in the United States over the long term**

	1871-1914	1919-1939	1946-1971	1972-1990	1991-2006
	Average growth rate				
Real GDP	1.63	1.09	1.61	2.27	1.82
Real share price	2.69	5.99	4.84	1.56	7.70
Real house price	1.06	0.64	0.94	0.71	3.17
Real gold price	0.41	3.80	-2.23	11.12	0.64
Real oil price	0.57	-0.13	0.32	15.05	6.29
	Standard deviation				
Real GDP	4.61	7.13	4.00	2.46	1.33
Real share price	15.70	26.46	16.17	16.64	15.18
Real house price	9.76	3.95	3.92	3.20	5.12
Real gold price	2.40	15.35	6.91	37.12	13.19
Real oil price	27.62	23.35	11.50	57.18	24.47

Source: OECD calculations.

First, the classical cycle (Figure 2) shows that the cycle for real share prices is typically shorter than the other types of cycles. For most countries and cycles the period from trough to peak and from peak to trough are more or less symmetric in length but the amplitude of the trough to peak is considerably larger for real ouput and real credit. The last cycle was longer, and its trough-to-peak phase was significantly longer than the peak-to-trough phase for real output, real credit and real house prices.

Second, Deviation and growth cycles tend to be shorter and more symmetric compared with the classical cycle (Figures 3 and 4). Measures of the deviation and growth rate cycles show that the last trough-to-trough cycle was longer than previous cycles and exhibited more variation in the lengths of the time and amplitude from peak to trough and trough to peak. Note that the last observed cycle does not include the recent recession because of the insufficient number of observations to detect the local minimum for the current recession.

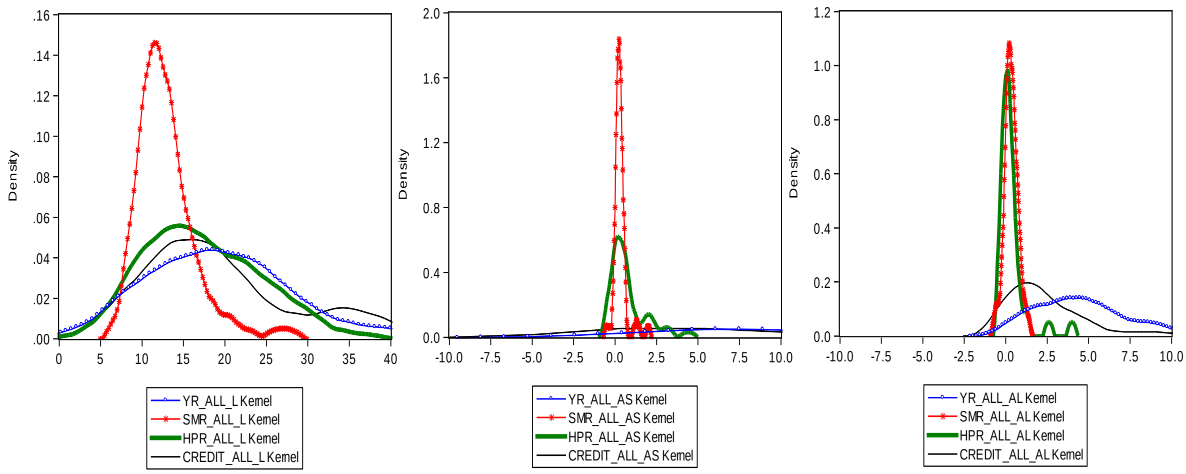
Figure 2. **The classical cycle**

Kernel density graphs of the distribution of country-specific results for real output, stock market returns, house prices and credit for OECD countries between 1950 and 2008

Panel A. All cycles bar the last cycle

YR=real output, SMR=real share prices, HPR=real house prices, CREDIT=real credit to the private sector

Full cycle length | Asymmetry in length | Asymmetry in amplitude

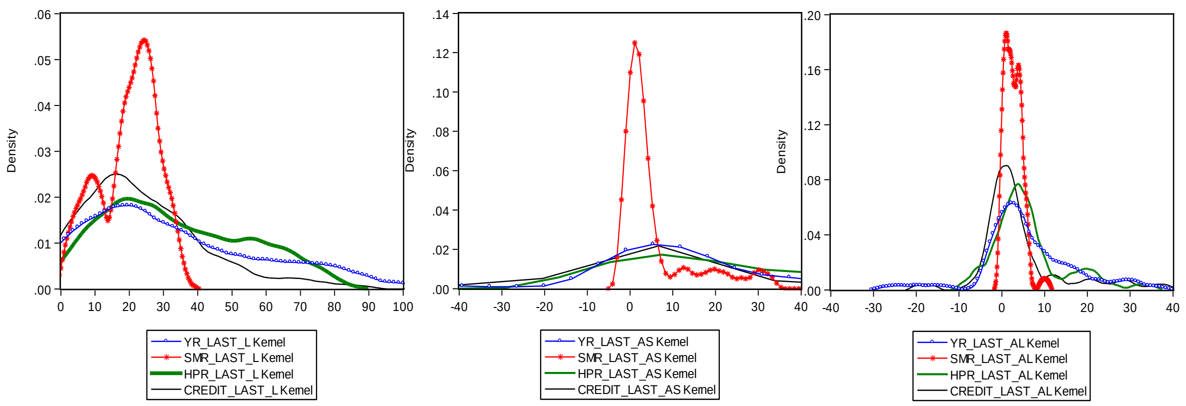


Panel B. The last cycle

(note scales differ from Panel A)

YR=real output, SMR=real share prices, HPR=real house prices, CREDIT=real credit to the private sector

Full cycle length | Asymmetry in length | Asymmetry in amplitude



Note: The The left hand graph in each panel gives the distribution of the lengths of the cycles, the middle graph in each panel presents the asymmetry of the cycles. A positive skew indicates that cycles are longer in the period between trough and peak; the right hand graph in each panel shows the amplitude of the cycle. A positive skew indicates that the amplitude of the cycle has been larger between the trough and the peak. These statistics are calculated for the longest available period for each country. The horizontal axis indicates the number of quarters for the length of the full cycle and the asymmetry indicator for the two measures of asymmetry that are computed as: IF(x>y,x/y-1,- 1*(x/y-1)) where x and y are the measures of length and amplitude in the phase of trough-to-peak and peak-to-trough, respectively.

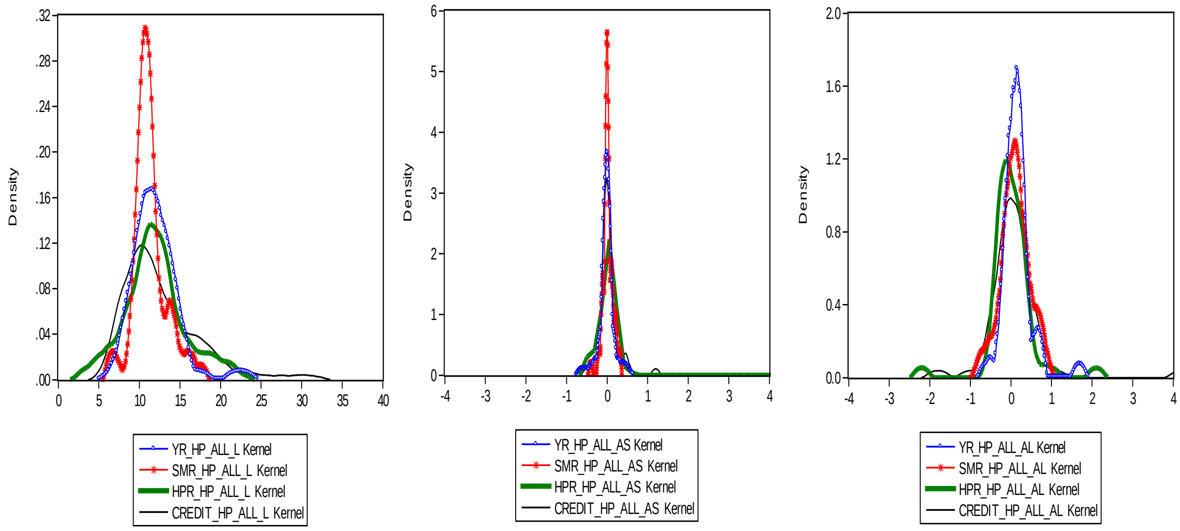
Figure 3. **The deviation cycle**

Kernel density graphs of the distribution of country-specific results for real output, stock market returns, house prices and credit for OECD countries between 1950 and 2008

Panel A. All cycles bar the last cycle

YR=real output, SMR=real share prices, HPR=real house prices, CREDIT=real credit to the private sector

Full cycle Length | Asymmetry in length | Asymmetry in amplitude

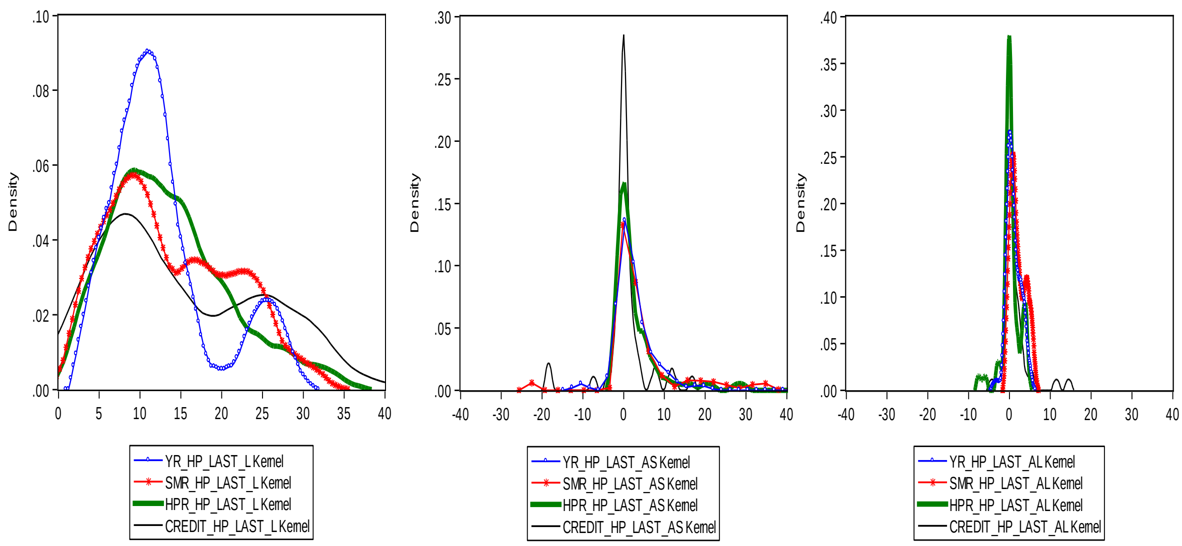


Panel B. The last cycle

(note scales differ from Panel A)

YR=real output, SMR=real share prices, HPR=real house prices, CREDIT=real credit to the private sector

Full cycle length | Asymmetry in length | Asymmetry in amplitude



Note: See Figure 2.

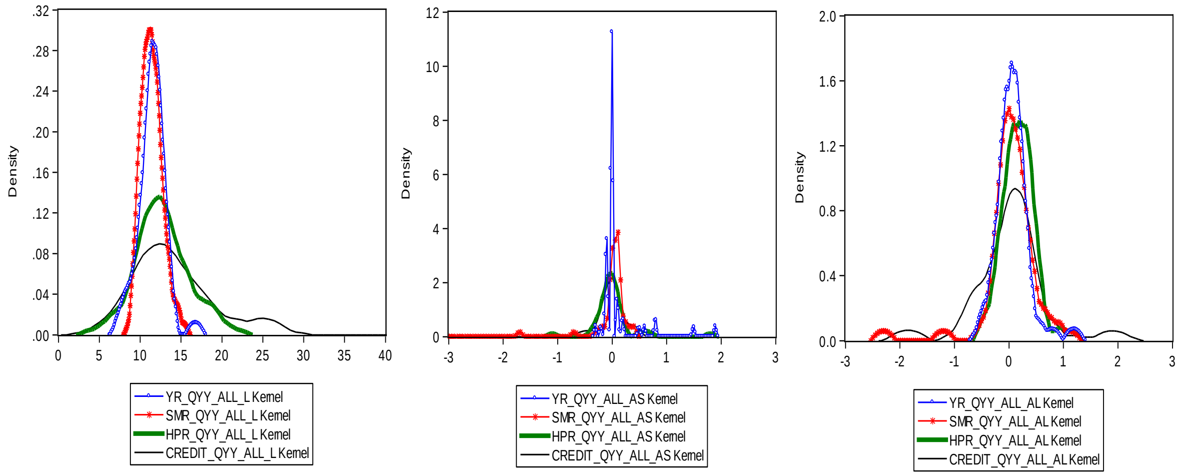
Figure 4. **The growth rate cycle**

Kernel density graphs of the distribution of country-specific results for real output, stock market returns, house prices and credit for OECD countries between 1950 and 2008

Panel A. All cycles bar the last cycle

YR=real output, SMR=real share prices, HPR=real house prices, CREDIT=real credit to the private sector

Full cycle length | Asymmetry in length | Asymmetry in amplitude

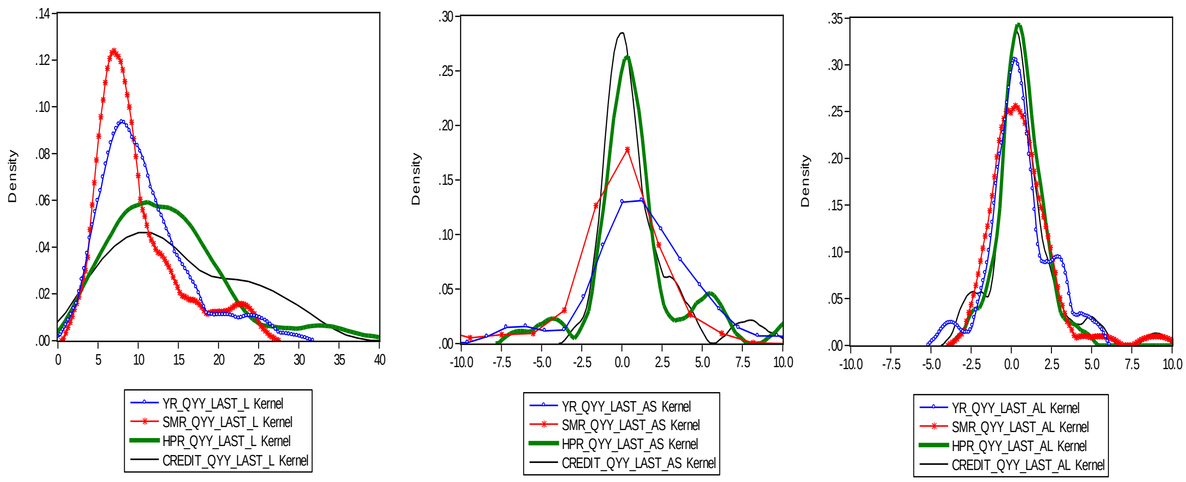


Panel B. The last cycle

(note scales differ from Panel A)

YR=real output, SMR=real share prices, HPR=real house prices, CREDIT=real credit to the private sector

Full cycle length | Asymmetry in length | Asymmetry in amplitude



Note: See Figure 2.

In comparison with GDP, expansions of consumption are longer and shorter for investment (Table 4). Also the size asymmetry is more pronounced for consumption and less pronounced for investment, indicating less trend increase for the latter and perhaps more volatility. Share and house price cycles over the long run tend to be more symmetric. Long and large expansions of GDP are often accompanied by long and large expansions of private consumption and real house prices.

Table 4. **Cycle asymmetries**

1950 where available to 2009, level cycle, quarterly data, unweighted average of OECD countries

	All cycles excluding last cycle		Last cycle only		Last expansion relative to previous expansions	
	Length asymmetry	Size asymmetry	Length asymmetry	Size asymmetry	Length comparison	Size comparison
Real GDP	6.3	14.1	11.5	32.5	2.5	3.2
Output gap	1.4	1.0	2.1	4.2	1.2	0.8
Private consumption	8.7	34.3	11.7	30.1	2.1	1.9
Investment	2.4	4.0	5.1	11.6	1.3	1.0
Long-term interest rate	0.9	1.0	1.6	1.5	1.5	0.7
Short-term interest rate	1.0	1.0	1.6	5.3	2.0	0.7
Real short-term interest rate	1.1	1.0	1.3	1.5	1.0	0.6
Government net lending	1.2	1.1	1.7	7.4	1.2	1.0
Unemployment rate	1.1	7.9	1.3	19.0	0.9	0.3
Stock market index	1.2	2.3	4.1	10.4	1.9	1.6
Real house prices	1.3	1.9	9.2	26.0	3.6	4.0

Note: Length asymmetry = length of expansion/length of downturn; Size asymmetry = size of expansion/size of downturn; The last two columns compare the length and size of the last expansion relative to previous expansions.

Source: OECD calculations based on the OECD Economic Outlook 86 database and Datastream.

The nature of the cycle has changed between 1950 and 2009, with the changes most pronounced for level cycles (Table 4). For most OECD countries, output cycles have tended to become longer and more asymmetric with expansionary phases lasting longer, while the length of slowdown or contraction phases has remained approximately the same. This is widespread among different variables, with larger and longer expansions occurring for consumption, investment (including stockbuilding), as well as share and house prices. In comparison with the average of previous expansions, the length of the latest expansion phase is about double for output, consumption and stock prices (10 years *versus* 5 years), while it nearly quadrupled for house prices (almost 10 years *versus* 2-3 years). The asymmetry of the size of the expansion in comparison with the contraction has also become more pronounced for level and deviation cycles but not for growth rate cycles. Another important feature for deviation and growth cycles has been the fall in the amplitude over time.

4.2. Cycle synchronisation within a country

Synchronisation, measured by the overlap of expansions and downturns of different variables with expansions and downturns of output within a country, shows marked differences across countries and sometimes there is only little synchronisation (Table 5). For instance, private consumption is highly synchronised with output in Canada, Japan, the United Kingdom and the United States, but not in France and Germany, while with the exception of Japan, the United Kingdom and the United States, house prices appear unsynchronised with GDP cycles. Rolling window correlations show that the synchronisation of GDP, real share and house prices became unprecedentedly strong during the last downturn compared with the previous 40 years (Figure 5).

Table 5. **Cycle concordance within countries**

Level cycle of real GDP, 1970 to 2008

	Canada		Germany		France		Japan		United Kingdom		United States	
Investment	0.82	**	0.69	**	0.71	**	0.65		0.77	**	0.81	**
Investment and stock building	0.76	**	0.70	**	0.65	**	0.60		0.64		0.80	**
Stock building	0.59	*	0.55	**	0.57	**	0.56		0.56	*	0.56	**
Private consumption	0.96	**	0.53		0.93		0.88	**	0.87	**	0.93	**
Government consumption	0.66		0.50		NA		0.41	*	0.49	*	0.74	
Unemployment rate	0.32	**	0.38		0.60		0.50		0.31	**	0.34	
Real short-term interest rate	0.57	*	0.64		0.51		0.45		0.39		0.53	
Real short-term interest rate	0.58	*	0.61	**	0.55		0.47		0.51		0.38	
Long-term interest rate	0.50		0.43		0.40		0.43		0.38		0.52	
Government net lending	0.76	**	0.59		0.60	**	0.63	**	0.43		0.70	**
Real stock prices	0.67		0.57		0.63		0.62	*	0.48		0.65	**
Real house prices	0.69		0.53		0.74		0.80	**	0.76	**	0.70	**
Real oil prices	0.53		0.51		0.52		0.53		0.49		0.53	

Note: The concordance index reported in this table takes the value of 1 if two cycles overlap perfectly and 0 if there is no overlap between the cycles.* and ** indicate statistical significance at the 10% and 5% levels.

Source: OECD calculations based on the OECD Economic Outlook 86 database and Datastream.

We can now look at monthly data to compute the concordance index and correlation for the following cycle pairs (which combine real/real cycles, real/financial cycles and financial/financial cycles):

- industrial production (ipi) – real and nominal interest rate (irs)
- industrial production – real credit (cre)
- industrial production – real share prices (smr)
- real and nominal interest rate – real credit
- real and nominal interest rate – real share prices
- real credit – real share prices

The mean of the concordance index seems to be higher than 0.5 for all cycle pairs, perhaps with the exception of real stock prices – interest rates. For instance, industrial production cycles overlap with cycles in real credit, interest rates and real stock prices to a great extent, in particular if classical cycles are considered.[6] This indicates that expansion in industrial production goes hand in hand with expansion in real credit and a rise in stock prices and short-term interest rates.

The distribution of the contemporaneous correlation coefficient suggests a positive relationship between industrial production and short-term interest rates (thus confirming the results of the concordance index) and between real credit and interest rates. This may indicate a generally countercyclical stance of monetary policy. Furthermore, real stock prices and interest rates are negatively correlated. Nevertheless, the distribution of the concordance indices and the correlation coefficients indicate large cross-country

[6] These results are based on nominal interest rate series. Future work will also use measures of real interest rates.

heterogeneities. The country-by-country examination of the results shows that various cycles are not very strongly correlated in a number of cases.

Figure 5a. **Distribution of the concordance index**

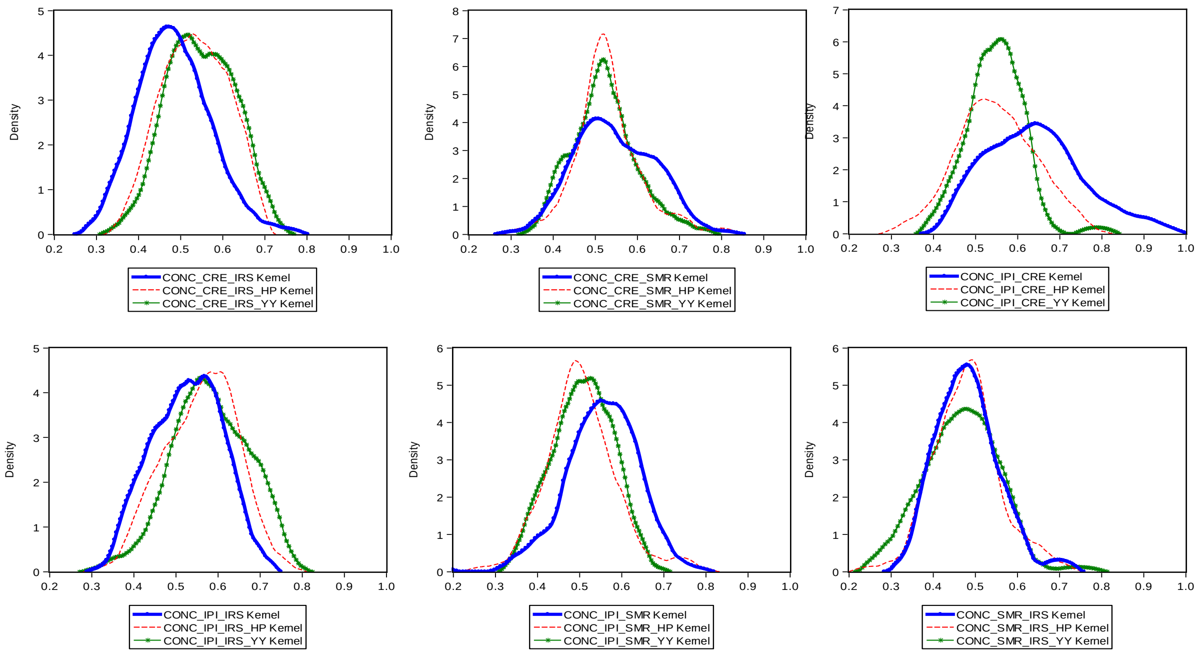
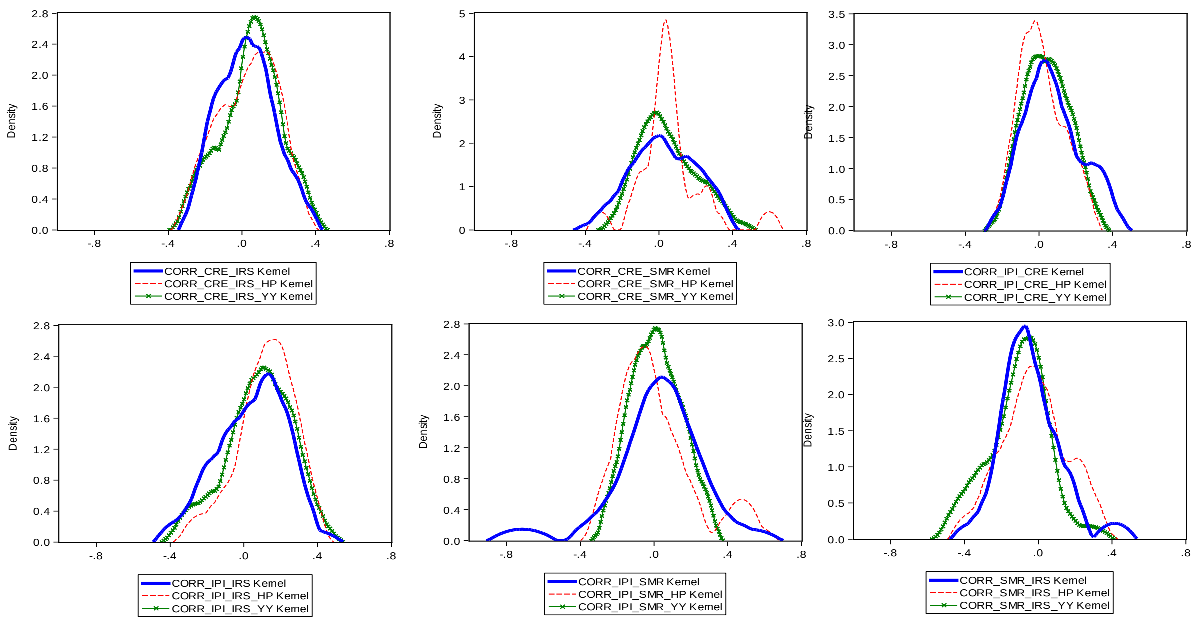


Figure 5b. **Distribution of the contemporaneous correlation coefficient**



4.3. Cycle synchronisation across countries

A number of factors can increase business cycle synchronisation. These factors diminish the risk of asymmetric shocks or allow an economy to cushion the effects of such a shock more effectively. For example, similar economic structures, trade openness and greater intra-industry trade and factor mobility can all play a role in increasing synchronisation. On the other hand, greater financial market integration provides better opportunities for countries to diversify idiosyncratic risks, which should weaken cross-country correlations of consumption and possibly also output. But strong financial linkages can also hasten the transmission of regional shocks, turning them into global shocks, as was the case with the economic and financial crisis. A high degree of synchronisation can imply both limits on policymakers' ability to undertake stabilisation at the domestic level and the need for more international policy co-ordination.

Examining cross-country synchronisation, output cycles have overlapped to a significant extent (Table 6). In particular, cycle synchronisation appears strong for some country groups (for instance, among Germany, Austria and the Netherlands or the United States, the United Kingdom and Canada). Furthermore, synchronisation has been higher in recent decades. The data also suggest that stock markets in OECD countries were highly synchronised over the last 40 years but that the cross-country correlation for real house prices was less pronounced and was limited to a subgroup of countries (United States, United Kingdom, Spain, France, the Netherlands, Norway and Sweden). Previous research – Duval *et al.* (2007), using a regression-based decomposition of output gap measures into common and idiosyncratic components – provide some evidence that synchronisation across OECD countries may not have been strong, with the possible exception of euro area countries.[7] Kose *et al.* (2008) on the other hand found for a large sample of developed and developing countries that business cycles became more synchronised within groups of countries, and that global factors – though not group factors – declined in importance since the early 1980s for developed countries.

Monthly data suggest significant synchronisation of real share prices and to a somewhat lesser degree of industrial production cycles across countries (Table 7 shows the concordance indices for industrial production, real credit and real stock price cycles for Germany, the United Kingdom and Japan with other countries). The data suggest that real credit cycles are less synchronised.

7. Artis *et al*. (2003), Böwer and Guillemineau (2006) and Giannone and Reichlin (2006) report similar findings for the euro area. Others report stronger idiosyncratic components (Nadal-De Simin, 2006; Camacho *et al*., 2006). With the formation of the euro area, the co-movement of consumption and output became stronger after the mid-1990s (Darvas and Szapáry, 2008).

Table 6. **Concordance of GDP cycles across countries**

Level cycle

	Annual data, 1870-2009				Quarterly data, 1970:q1-2008:q4			
	Germany		United States		Germany		United States	
Australia	0.85	**	0.74	**	0.70		0.79	**
Austria	0.86	**	0.79	**	0.82	**	0.88	
Belgium	0.80	**	0.72	**	0.83	**	0.78	
Canada	0.78	**	0.86	**	0.80	*	0.97	**
Denmark	0.75	**	0.74	**	0.76	**	0.74	
Finland	0.81	**	0.67	**	0.78	**	0.79	
France	0.81	**	0.72	**	0.87	**	0.91	**
Germany			0.76	**			0.84	**
Greece	0.76	**	0.58	**	0.65		0.63	
Iceland	0.74	**	0.69	**	0.73		0.75	
Ireland					0.81	**	0.91	**
Italy	0.77	**	0.73	**	0.82	**	0.81	
Japan	0.77	**	0.78	**	0.70		0.79	
Korea	0.77	**	0.78	**	0.72		0.82	
Luxembourg					0.83	**	0.89	*
Mexico	0.81	**	0.71	**	0.72		0.83	
Netherlands	0.81	**	0.71	**	0.86	**	0.90	*
New Zealand	0.66	**	0.67	**	0.71		0.81	
Norway	0.80	**	0.76	**	0.81	**	0.86	
Portugal	0.65	**	0.67	**	0.82	**	0.80	
Spain	0.78	**	0.79	**	0.84	**	0.86	
Sweden	0.71	**	0.72	**	0.77		0.83	
Switzerland	0.75	*	0.68	**	0.84	**	0.85	**
Turkey	0.78	**	0.76	**	0.64	**	0.76	
United Kingdom	0.79	**	0.86	**	0.82	**	0.90	**
United States	0.76	**			0.84	**		

Note: Data start in 1870 except for Korea (1912), Mexico (1895) and Turkey (1923). The concordance index reported in this table takes the value of 1 if two cycles overlap perfectly and 0 if there is no overlap between the cycles. * and ** indicate statistical significance at the 10% and 5% levels.

Source: Calculations based on data obtained from Barro and Ursua (2008), "Macroeconomic Crises since 1870", BPEA, Online Appendix and OECD Economic Outlook 86 database.

Table 7a. **Synchronization of industrial production cycles**

	Germany				United Kingdom				Japan			
	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)
AUT	0.43***	0.61***	0.58***	0.47***	0.11	0.37***	0.31***	0.31***	0.23***	0.13	0.2**	0.14*
BEL	0.53***	0.29***	0.57***	0.5***	0.34***	0.32***	0.41***	0.31***	0.25***	0.19**	0.39***	0.34***
CAN	0.13	0.12	0.31***	0.26***	0.26***	0.24***	0.42***	0.39***	0.06	0.12	0.31***	0.34***
CHI	0.04	0.05	0.32**	0.19	0	0	0.38***	0.08	0.09	0.01	0.27*	0.04
CZE	0.26*	0.01	0.44***	0.22*	0.24*	0.24**	0.47***	0.36***	0.21	0.03	0.04	0.01
DEU					0.35***	0.44***	0.36***	0.36***	0.28***	0.1	0.4***	0.19**
DNK	0.25**	0.3***	0.37***	0.36***	0.18*	0.2**	0.11	0.03	0.22**	0.17*	0.26**	0.21**
ESP	0.33***	0.18**	0.31***	0.32***	0.28***	0.19**	0.24***	0.16**	0.18**	0.04	0.13	0.1
EST	0.01	0.35**	0.5***	0.52***	0.38***	0.52***	0.19	0.4***	-0.11	0.12	0.26	0.32**
FIN	0.23**	0.3***	0.48***	0.32***	0.35***	0.28***	0.29***	0.14*	0.18**	0.08	0.23***	0.06
FRA	0.26***	0.26***	0.46***	0.32***	0.21**	0.3***	0.32***	0.25***	0.16*	0.07	0.26***	0.13*
GBR	0.35***	0.45***	0.36***	0.37***					0.19**	0.12	0.18**	0.18**
GRC	0.03	-0.01	0.44***	0.27***	0.26***	0.04	0.33***	0.19**	0.13	-0.08	0.29***	0.09
HUN	-0.01	0.09	0.19	0.25**	0.24**	0.1	0.46***	0.28***	0.04	0.15	0.18	0.33***
IRL	0.15	0.13	0.25**	0.18*	0.15	0.25**	0.26**	0.16	-0.01	-0.03	0.25**	0.15
ISR	0.09	-0.04	0.01	-0.07	0.21**	-0.12	0.16	0.05	0.02	0.09	0	0.05
ITA	0.24***	0.15*	0.2**	0.07	0.26***	0.22***	0.08	0.13	0.19**	0.12	0.17**	0.04
JPN	0.28***	0.1	0.4***	0.19**	0.19**	0.12	0.18**	0.18**				
KOR	0.03	-0.22*	0.15	0.05	-0.07	-0.19	0.39***	0.11	0.3***	0.42***	0.37***	0.39***
LUX	0.13	0.28***	0.45***	0.39***	0.06	0.3***	0.44***	0.39***	0.27***	0.09	0.24***	0.26***
NLD	-0.02	0.08	0.41***	0.21***	0.18**	0.04	0.25***	0.23***	-0.06	0.1	0.33***	0.15**
NOR	-0.08	-0.05	0.27***	-0.02	0.15*	0.06	0.21***	0	-0.03	0	0.1	-0.01
POL	-0.07	0.26**	0.19	0.26**	0.4***	0.26**	0.66***	0.39***	0.05	0.15	0.16	0.37***
PRT	0.14	-0.13	0.08	0.07	-0.02	0.04	-0.02	-0.25***	0.08	-0.03	-0.06	-0.11
RUS	0.09	-0.12	0.11	0.3**	-0.14	0.04	0.33**	0.35***	-0.07	0.24*	0.32*	0.37***
SVK	0.02	0.15	0.29**	0.32***	0.39***	0.21*	0.09	0.17	0.19	-0.14	0	0.11
SVN	0.37***	0.42***	0.67***	0.63***	0.03	0.3**	0.48***	0.24*	0.12	0.12	0.27*	0.19
SWE	0.46***	0.21***	0.47***	0.31***	0.25***	0.07	0.27***	0.19**	0.07	0.21***	0.18**	0.05
TUR	0.25**	-0.25**	0.17	0.13	0.37***	-0.02	0.16	0.11	0.03	-0.06	-0.04	0.27***
USA	0.14	0.28***	0.27***	0.17**	0.24***	0.14*	0.29***	0.27***	0.11	-0.03	0.23***	0.22***

Table 7b. **Synchronization of real share price cycles**

	Germany				UK				Japan			
	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)
AUT	0.19**	0.34***	0.35***	0.33***	0.11	0.21***	0.14*	0.09	0.34***	0.15*	0.19**	0.02
BEL	0.49***	0.36***	0.45***	0.29**	0.5***	0.33***	0.34***	0.41***	0.5***	0.08	0.21*	0.13
CAN	0.25***	0.24***	0.44***	0.55***	0.37***	0.28***	0.45***	0.38***	0.28***	0.27***	0.32***	0.16**
CHE	0.45***	0.4***	0.59***	0.49***	0.53***	0.44***	0.57***	0.6***	0.47***	0.25***	0.34***	0.19**
CHI	0.02	0.02	0.03	-0.09	0.15	0.02	0.25**	0.05	0.18*	-0.05	0.17*	-0.03
CZE	0.35***	0.43***	0.12	0.25*	0.18	0.34***	0.12	0.16	0.56***	0.51***	0.44***	0.53***
DEU					0.37***	0.31***	0.47***	0.49***	0.3***	0.3***	0.23***	0.16**
DNK	0.59***	0.5***	0.82***	0.49***	0.55***	0.58***	0.44***	0.3***	0.37***	0.21*	0.35***	0.08
ESP	0.64***	0.29**	0.78***	0.54***	0.55***	0.4***	0.66***	0.54***	0.61***	0.11	0.36***	0.28**
EST	0.52***	0.19	0.22	0.18	0.28**	0.33***	0.19	0.17	0.56***	0.25*	-0.04	0.34**
FIN	0.25***	0.13	0.32***	0.24***	0.06	0.2***	0.24***	0.31***	0.36***	0.27***	0.26***	0.32***
FRA	0.27***	0.23***	0.49***	0.52***	0.16*	0.3***	0.24***	0.36***	0.37***	0.19**	0.3***	0.15*
GBR	0.37***	0.31***	0.47***	0.48***					0.3***	0.31***	0.35***	0.26***
GRC	0.45***	0.18	0.41***	0.37***	0.36***	0.46***	0.41***	0.43***	0.47***	0.22**	0.18	0.32***
HUN	0.73***	0.31***	0.48***	0.36***	0.43***	0.31**	0.37***	0.21*	0.45***	0.44***	0.32**	0.27**
IRL	0.27***	0.3***	0.46***	0.27***	0.4***	0.26***	0.55***	0.46***	0.28***	0.14	0.37***	0.25***
ISR	0.37***	0.34***	0.26**	0.41***	0.27**	0.47***	0.57***	0.46***	0.07	0.35***	0.54***	0.45***
ISL	0.3**	0.2	0.28*	0.4***	0.05	0.22*	0.39**	0.15	0.35***	0.61***	0.53***	0.45***
ITA	0.32***	0.37***	0.27***	0.3***	0.26***	0.13	0.17**	0.33***	0.36***	0.27***	0.23***	0.29***
JPN	0.3***	0.3***	0.23***	0.16**	0.3***	0.31***	0.36***	0.26***				
KOR	0.11	0.08	-0.06	0.2*	0.12	0.24**	0.27**	0.27***	0.55***	0.46***	0.44***	0.3***
LUX	0.82***	0.49***	0.62***	0.53***	0.48***	0.46***	0.58***	0.77***	0.81***	0.52***	0.94***	0.36**
MEX	0.32***	0.12	0.3***	0.37***	0.25***	0.27***	0.37***	0.34***	0.34***	0.37***	0.51***	0.33***
NLD	0.47***	0.39***	0.6***	0.52***	0.48***	0.52***	0.53***	0.47***	0.55***	0.4***	0.43***	0.3***
NOR	0.65***	0.38***	0.64***	0.65***	0.34***	0.65***	0.57***	0.67***	0.38***	0.48***	0.35***	0.54***
POL	0.57***	0.49***	0.33**	0.51***	0.39***	0.42***	0.3*	0.38***	0.57***	0.53***	0.58***	0.66***
PRT	0.56***	0.41***	0.74***	0.56***	0.46***	0.41***	0.4***	0.39***	0.44***	0.26**	0.35**	0.26**
RUS	0.21	0.24*	0.38**	0.47***	0.31***	0.25*	0.36**	0.36***	0.27**	0.4***	0.52***	0.44***
SVK	-0.2	-0.32***	-0.28*	-0.12	0.01	-0.14	-0.34**	-0.24*	0.01	-0.46***	-0.41***	-0.06
SVN	-0.03	0.17	-0.04	0.05	0.07	0.08	-0.05	0	-0.05	0.36***	-0.23	-0.07
SWE	0.45***	0.38***	0.6***	0.45***	0.36***	0.4***	0.5***	0.43***	0.37***	0.29***	0.43***	0.28***
TUR	0.44***	0.17	0.54***	0.29***	0.37***	0.41***	0.46***	0.21**	0.34***	0.24**	0.15	0.4***
USA	0.34***	0.29***	0.45***	0.38***	0.51***	0.5***	0.62***	0.52***	0.25***	0.25***	0.34***	0.26***

Table 7c. **Synchronization of real credit cycles**

	Germany				United Kingdom				Japan			
	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)	Level cycle	Deviation cycle (hp filtered)	Deviation cycle (band-pass filtered)	Growth cycle (y-o-y)
AUT	0.03	-0.08	0.04	0.17**	-0.06**	-0.34***	0.14	0.13	0.17*	-0.05	-0.01	0.01
CAN	0	0.09	0	0.02	0.01	0.25**	0.03	0.21*	-0.05	0.11	0.05	0.17*
CHE	0.39***	0.03	0.32***	0.25***	0.3***	0.21*	0.19	0.27**	0.4***	0.14*	0.17*	0.05
CHI	-0.29***	-0.19*	-0.33***	-0.34***	-0.02	0.02	0.02	0.04	-0.38***	0.19**	0.07	0.03
CZE	-0.32	0.09	-0.15	0	0	0.18	0.2	0.06	-0.14	0.11	0.24	0.2
DEU					-0.18	-0.29***	-0.08	-0.2	0.53***	0.17**	0.07	0.11
DNK	-0.3***	0.14	0.3***	0.24***	0.54***	0	0.24*	0.41***	-0.29***	0.06	0.13	0.16*
ESP	-0.2***	-0.2**	-0.04	0.01	0.19	-0.17	-0.12	0	-0.18***	-0.1	0.09	0.18**
EST	-0.38***	0.02	-0.14	-0.08	0.36*	0.2	0.09	0.29**	-0.3**	-0.02	-0.08	0.08
FIN	-0.2***	0	-0.12	-0.1	0.31**	0.01	-0.13	-0.2*	-0.11	0.14*	0.13	0.16*
GBR	-0.25***	-0.24***	-0.08	-0.19					-0.37***	-0.1	0.26**	0.12
GRC	-0.22***	-0.23***	-0.02	-0.14*	0.62***	0.36***	0.39***	0.11	-0.23***	0.18**	0.16*	-0.12
IRL	-0.13	-0.13	-0.16	-0.06	1.07***	0.07	0.28**	0.27**	-0.28***	-0.12	0.18*	0.23**
ISR	0.07	-0.02	-0.06	-0.11	-0.11***	0.19	0.21	0.21*	0.11	0.08	0.01	0.08
ISL	-0.17	0.03	-0.08	-0.02	-0.03	-0.04	0.38***	0.13	0.08	0.12*	0.3***	0.17
ITA	-0.29***	-0.22**	0.22**	0.07	-0.02	0.08	-0.29**	-0.15	-0.38***	-0.08	-0.01	0.02
JPN	0.52***	0.17**	0.07	0.11	-0.25	-0.11	0.26**	0.12				
KOR	0.29*	0.01	0.12	0.03	-0.11	-0.27**	0.02	-0.01	0.02	-0.06	0.06	-0.12
NLD	-0.17***	0.1	0.14	0.15*	-0.06	0.36***	0.56***	0.24**	-0.28	-0.25***	0.15	0.07
NOR	-0.15***	0.12	-0.03	-0.05	0.24*	-0.06	0.32**	0.46***	-0.11	0.09	-0.09	-0.03
POL	0.35**	-0.25**	0.07	0.05	0.17	0.22*	0.06	0.04	0.1	-0.22*	0	-0.11
PRT	-0.21**	-0.29***	0.04	-0.09	-0.18**	0.14	0.05	-0.12	-0.35***	-0.17**	-0.08	-0.21**
RUS	-0.64**	-0.25**	-0.1	-0.35***	0**	0.16	0.38**	0.43***	-0.7***	0	0.04	0.1
SVK	-0.46**	0.15	-0.12	0.19	0***	0.23*	0.16	-0.16	-0.36**	-0.12	-0.26	0.05
SVN	-0.2**	-0.23*	0.59***	0.31**	-0.05***	0.08	0.11	0.01	0.07	0.14	0.41***	0.35**
SWE	-0.23**	0.07	0.07	0.21**	0.44**	-0.03	0.19	-0.05	-0.34***	0.01	0.29***	0.32***
TUR	-0.18**	0.09	-0.03	-0.05	0.02	0.01	0.38***	0.29**	-0.1	0.14*	0.11	0.01

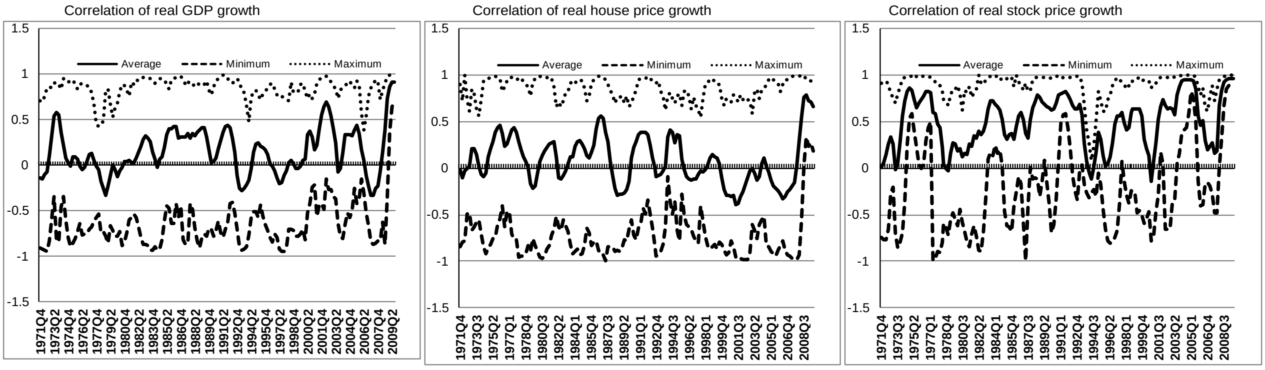
However, looking at time variations in cross-country co-movements based on rolling window correlations, GDP and real house price growth became extremely strongly correlated by historical standards during the recent crisis. A similarly very strong synchronisation of real share prices could be observed after the burst of the dot-com bubble (Figure 6). Also correlations between GDP growth, real house and share prices within countries were high in the run-up and during the crisis.[8]

The shocks originating from the United States in 2007 and 2008 were transmitted remarkably quickly to the rest of the world. Financial market integration and trade openness were key elements of the rapid and strong transmission, magnified by intra-industry trade within subgroups of countries. Small open economies, in particular, are vulnerable to such shocks, as their trade openness is often a multiple of that of the large countries, while their financial markets lack depth.

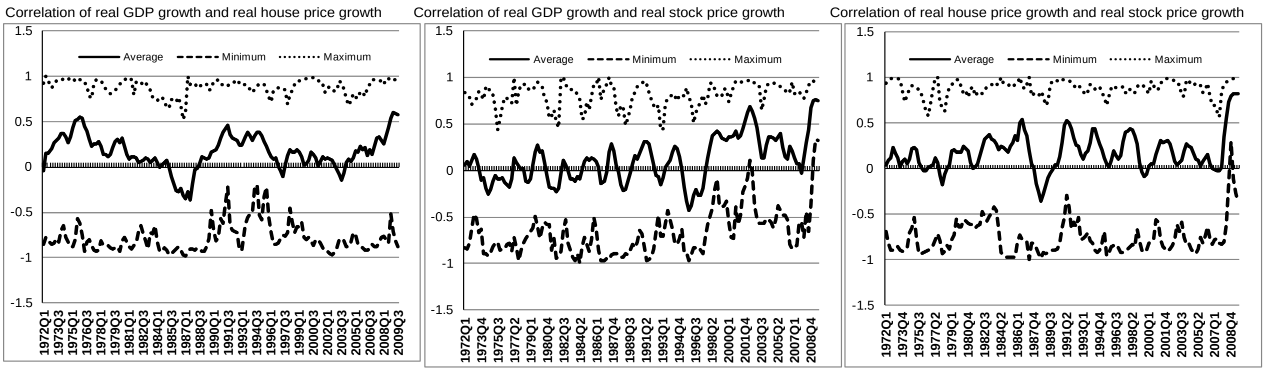
8. Previous studies argue that synchronisation is strong during recessions (Canova *et al.*, 2004) and during periods of above average growth (MacAdam, 2007).

Figure 6. **10-quarter rolling-window correlations of macroeconomic variables**

Panel A. 10-quarter rolling-window correlations against the United States



Panel B. 10-quarter rolling-window correlations of macroeconomic variable pairs within a country



Note: Average/minimum/maximum is the unweighted average/lowest/highest correlation of individual OECD countries' variables against the corresponding US variable (Panel A) or of the variable pairs for each OECD country (Panel B).

Source: OECD calculations based on the OECD Economic Outlook 86 database and Datastream.

Recent empirical studies show that trade and financial market integration (FDI and portfolio flows) fosters co-movements among OECD economies (Jansen and Stockman, 2004; Böwer and Guillemineau, 2006; Artis *et al*, 2008). Garcia-Herrero and Ruiz (2008) find for Spain and its trading partners that higher trade intensity and more similar economic structures have a positive effect on bilateral business cycle correlations, but that stronger financial integration results in lower business cycle correlations because of larger capital flows across countries. Labour market rigidities measured by the OECD's labour market regulations indicator tend to lead to less synchronised business cycles (Artis *et al*., 2008).

A high degree of intra-industry trade is important for business cycle synchronisation because a contraction or expansion in a sector will equally affect both countries (Frankel and Rose, 1998). Burstein *et al*. (2008) document that trade related to vertically integrated production chains increase business cycle co-movements between the United States, Canada and Mexico. More generally, intra-industry trade is found to increase synchronisation among OECD economies (Artis *et al*., 2008).

4.4. The great moderation

Many of these explanations are not mutually exclusive and their relative importance is unclear. In order to assess the possible influence of the competing factors panel regressions were estimated (Table 8).

Consumption volatility is found to be positively related with aggregate output volatility. As consumption volatility itself was generally declining, it contributed to the decline in aggregate volatility, though causality could run both ways. The results also imply that consistent with the better policy story the impact of inflation volatility on output volatility drops out, possibly a result of better anchored inflation expectations. Structural policies may also have begun to have an effect with unemployment volatility no longer appearing to exert a strong influence on overall volatility in the latter part of the sample. The volatility of the measure for openness also seems to have become less important in explaining overall volatility. On the other hand, the volatility of asset prices, notably stock returns and house prices, appear to have had an increasing influence on aggregate volatility during the great moderation period. Finally, stockbuilding was insignificant and the estimated coefficient suggests that the quantitative effect is trivial.

Table 8. **Factors contributing to the great moderation**

Multivariate regression coefficients

Regressors	1970-1989	1990-2009
Volatility of:		
Private consumption	0.435**	0.468**
Stock building	0.000	0.000
Investment	0.028*	0.029**
Unemployment	0.070**	0.007**
Working age population	-0.497	0.336**
Real stock prices	-0.016	0.012**
Real house prices	0.004	0.02**
Openness	0.039**	0.001
CPI inflation	0.006*	-0.004
Primary government balance	-0.022	-0.004
Level of:		
Primary government balance	-0.096	-0.017

Note: Dependent variable = volatility of real GDP growth.

Volatility is calculated as the standard deviation for 20-quarter overlapping windows. Countries with dubious quarterly data are not taken into account. The sample covers Australia, Canada, Switzerland, Germany, France, United Kingdom, Italy, Japan, Norway, Sweden and the United States. The estimations are obtained using fixed effect OLS. * and ** indicate statistical significance at the 10% and 5% levels.

Source: OECD calculations based on the OECD Economic Outlook 86 database.

4.5. Banking sector pro-cyclicality

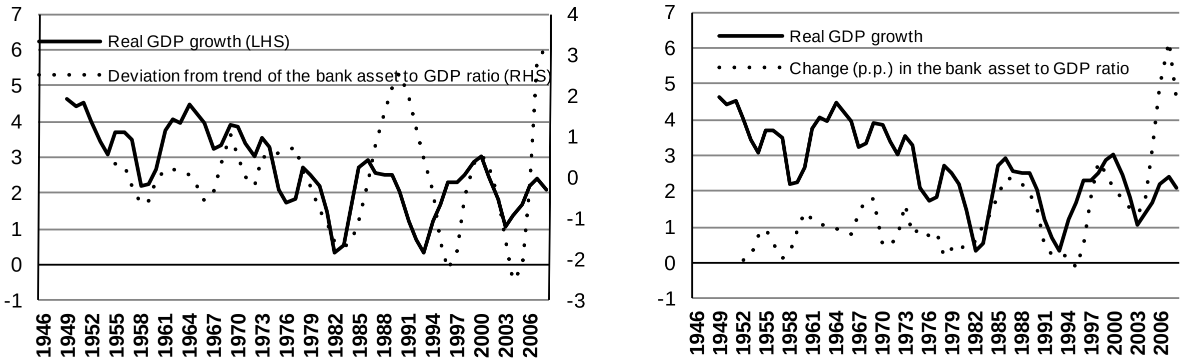
Fluctuations in bank assets relative to GDP have become more pronounced since the 1970s.[9] Figure 7 shows that the deviation of the bank asset-to-GDP ratio from its trend and its percentage point changes exhibit greater volatility since the 1970s. The pronounced co-movement of the banking sector was initially triggered by the move from credit controls of the post-war period to more liberalised banking and financial sectors during the 1970s, while financial innovations played an important role later on. Goodhart *et al*. (2004) show that financial liberalisation in OECD economies was followed by boom-bust cycles in bank lending, output and asset prices. They compare financial liberalisation to a permanent productivity shock in a credit-constrained economy à la Kiyotaki and Moore (1997) in which a positive

9. Real credit growth gives a biased picture about the importance of credit cycles. A growth rate of say 20% can be translated into very different figures relative to GDP at different stages of financial deepening: it would imply a 2 percentage point expansion relative to GDP for an initial credit to GDP ratio of 10% and a 16 percentage point increase to GDP for a credit stock of 80% of GDP.

productivity shock increases the value of collateral that in turn raises the capacity to borrow, which boosts lending, investment and output until the boom turns into a bust.

Figure 7. **Cycles in the real economy and the financial sector of OECD countries**

Unweighted average of OECD countries



Note: OECD staff calculations based on data provided by Alan M. Taylor (Schularick and Taylor, 2009). The series plotted are arithmetic averages of individual series of the following countries: Australia, Canada, Switzerland, Germany, Denmark, Spain, France, United Kingdom, Italy, the Netherlands, Norway, Sweden, United States. GDP growth is the rate of growth of real GDP, deviation from trend of the bank asset/GDP ratio is the deviation of the bank asset/GDP ratio from its trend (trend is computed using the HP filter). The series are 3-year moving averages. Banking assets are defined as total domestic currency assets of banks and banking institutions.

Source: Schularick and Taylor (2009) and OECD Economic Outlook 86 database.

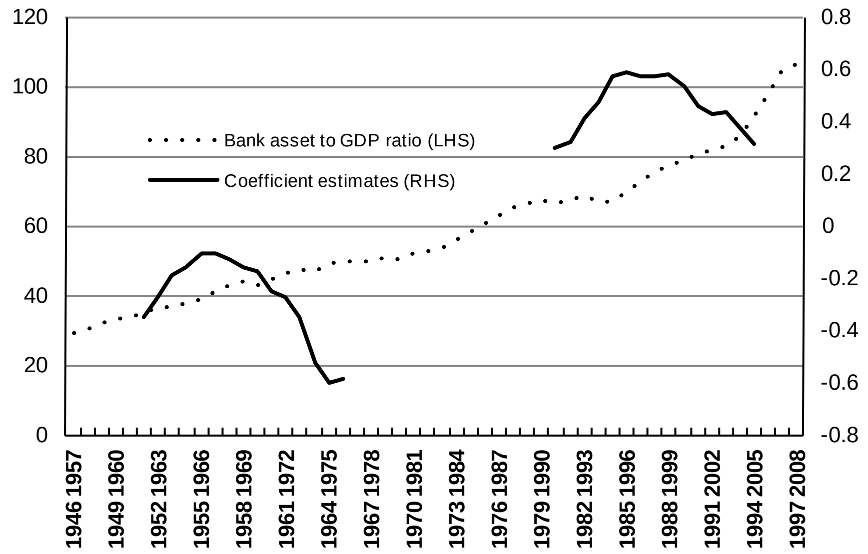
Examining changes in the relationship between the change of the bank asset-to-GDP ratio and the cycle over time (based on the data underlying Figure 7) shows that the banking system was not well synchronised with the real economy until the early 1970s and has become more synchronised only since the late 1970s (Figure 8). It may come as a surprise that the coefficient estimate is not statistically significant for the most recent 12 year period, but it is clear from Figure 8 that this is the period when leverage exploded. The rise in synchronisation correlates well with the number of banking crises for this country sample as reported by Reinhart and Rogoff (2008): No banking crisis occurred between 1945 and 1974, three countries experienced banking crises between 1974 and 1977 and 11 banking crises are identified between 1983 and 1995.

4.5.1. Pro-cyclicality of bank capital

The Basel Committee on Banking Supervision has aimed to establish a sufficient capital cushion for banks to absorb unexpected losses. The Basel Capital Accord I of 1988 raised the capital to risk-weighted asset ratio (capital adequacy ratio – CAR) to over 8%. Due to the risk-sensitivity of valuations and the pro-cyclical nature of risk ratings that affected requirements, a side effect of Basel I was the pro-cyclical impact of capital adequacy ratios. It proved to be pro-cyclical because shocks to banks' assets imply a pro-cyclical move in the capital ratio with a corresponding change in bank lending (Panetta *et al*., 2009). Its introduction is thought to have aggravated the 1991 recession in the United States as banks curtailed lending to meet the 8% CAR target (Goodhart *et al*., 2004). Moreover, Basel I provided for little bank capital back-up for trading book and off-balance-sheet activities.

Forward-looking banks would increase capital in good times to secure sufficient room for manoeuvre in bad times to comply with the 8% minimum target. However, short-sighted or backward looking banks would not increase capital during expansions and as a result would be constrained by the 8% limit in slowdowns, a behaviour that is reinforced by competitive pressures and possibly the market for corporate control. A similar cyclical pattern would apply if banks were to hold capital buffers above the limit of 8% and if they wanted to maintain a comfortable capital buffer over the cycle (Ayuso *et al*., 2002).

Figure 8. **Pro-cyclicality of the banking sector: rolling window estimations**



Note: Coefficient estimates are displayed only if they are statistically significant. The estimations are performed using difference GMM. The percentage point change in the bank asset/GDP ratio is the dependent variable and GDP growth and lagged changes in percentage points of the bank asset to GDP ratio are the independent variables. The data points for bank asset-to-GDP ratio refer to the end of the period. The bank asset-to-GDP ratio is calculated as the unweighted average of the ratio of 13 OECD countries.

Source: Schularick and Taylor (2009) and OECD Economic Outlook 86 database.

The Basel II accord was implemented in 2008 in most OECD countries and strengthens the link between risk exposure and capital. A major difference with Basel I is that the risk weights are no longer specified for broad asset classes and invariant over time, but tailored to individual assets. Capital requirements are computed either by a standardised approach (based on the ratings by rating agencies) or by an internal ratings approach, whereby the weights are computed by the bank itself.

The way risks are assessed can contribute to the cyclicality of bank capital. Internal credit risk models of banks are more pro-cyclical if default probabilities are estimated using the point-in-time approach. In this approach, risk is linked negatively to the business cycle because the probability of credit default risk increases in a downturn. A through-the-cycle approach smooths risk over the cycle. However, if the time horizon considered does not cover a full cycle, risks will remain negatively correlated with the cycle. The heavy reliance on credit rating agencies in Basel II does not help overcome this problem as credit rating agencies are also prone to pro-cyclical behaviour, as downgrades are more frequent in downturns and upgrades occur more often in upswings. It is not clear yet, whether Basel II will raise or reduce pro-cyclicality. While it strengthens the link between banks' regulatory capital and the risk of assets, it also contains safeguards against pro-cyclicality, for instance, by encouraging the through-the-cycle approach (Panetta *et al*., 2009).

There is no consensus in the literature whether actual bank capital is pro- or counter-cyclical. A panel of banking sector-level and individual bank-level data is used to re-assess the pro-cyclicality of bank capital (9). These estimates show how banking sector indicators have moved with the credit and output cycle, given the regulatory set-up. Results obtained using both aggregate and individual bank-level

Table 9. **Panel estimation results for bank capital**

Panel A. Country-level data (Bank profitability database)

	Loan growth	GDP growth	House price growth	Share price growth
Dependent variable	Level equation			
Tier 1 ratio	-0.043 **	-0.229 *	0.007	-0.004
Tier 2 ratio	-0.002	0.015	-0.001	-0.002
Leverage ratio (total capital/total assets)	-0.019 **	-0.011	-0.009	-0.004
Leverage ratio (SNA) (total assets/total capital)	0.030	-0.314 **	-0.035	-0.035 **
	First difference equation			
Tier 1 ratio	-0.023	-0.099	-0.003	0.002
Tier 2 ratio	0.000	0.040 **	0.005	-0.002 *
Leverage ratio (total capital/total assets)	-0.014 **	-0.028	0.001	-0.004
Leverage ratio (SNA) (total assets/total capital)	-0.029	-0.343 **	-0.019	-0.028 **

Panel B. Bank-level data (Bankscope database)

Independent variable	Loan growth	Loan growth	Loan growth	Loan growth
Dependent variable	Capital 1	Capital 2	Capital 3	Capital 4
Level equation	-0.002 *	-0.003 **	-0.009 **	-0.003
First difference equation	-0.004	-0.004 **	-0.004	-0.005 **

Panel C. Country-specific results

Independent variable	Loan growth	Loan growth	Loan growth	Loan growth
Dependent variable	Capital 1	Capital 2	Capital 3	Capital 4
Pro-cyclical (-)	BEL CAN CZE DEU DNK ESP FIN PRT SVK SWE	DEU DNK FRA HUN MEX NOR POL PRT SVK	CH CZE DEU DNK FRA HUN MEX NOR POL PRT SVK SWE	DEU DNK KOR SWE USA
Counter-cyclical (+)	CHE FRA ISL	–	NZL	NZL

Note: * and ** denote statistical significance at the 10% and 5% levels. The results are obtained using a dynamic specification where the dependent variable is regressed on its lagged value and the measure of the cycle (real loan growth, GDP growth, real share and real house price growth). In Panel C, these results are obtained by interacting the cycle variable with country dummies. Country names are not shown if the coefficient estimates are not significant. Capital 1, 2, 3 and 4 are defined as follows. Capital 1 = tier 1 capital over risk weighted assets, capital 2 = common shares over total assets, capital 3 = total equity over total assets, capital 4 = the sum of total capital and subordinated debt over total assets.

Source: OECD calculations based on the OECD Economic Outlook 86 database, OECD Bank Profitability Database and Bankscope.

datasets suggest that from 1994 to 2007/08, capital ratios, in particular the tier 1 ratio, the shareholder equity and the total equity/capital ratio have a negative association with loan growth. Country-specific estimations corroborate this result, though there are some exceptions. This relationship also tends to hold, if first differences of ratios are used. The co-movements are less pronounced for the leverage ratios calculated from national balance sheets and when GDP growth is used to capture cyclical fluctuations. Bank capital ratios do not correlate with real house prices, but there is a negative correlation of leverage ratios and a weak link with the tier 2 capital ratio with real share prices.

4.5.2. Pro-cyclicality of loan loss provisioning and funding

Regulators require banks to create provisions to cover expected credit losses. Provisions can be split into two categories: *i*) Specific (*ex post*) provisions relate to overdue loans where specific rules determine the size and timing of provisions and *ii*) general (*ex ante*) provisions should cover future loan losses that cannot be linked to specific loans. The general provisions are set by evaluating the risk of the loan portfolio. Another way of looking at provisions is to distinguish between *i*) a non-discretionary (rule-based) component that includes specific provisions and part of general provisions driven by the assessment of future credit default risk and *ii*) a discretionary (non rule-based) component.

The underestimation of credit default risks over the business cycle is a main source of pro-cyclicality in the non-discretionary rule-based component of loan loss provisioning. The following factors can explain why banks tend to underestimate credit risk during expansions (Bouvatier and Lepetit, 2008; Panetta *et al*., 2009):

- Risks are underestimated during expansions and overestimated during recessions if provisioning is based on a backward looking rule, for instance, if provisions are built when the risk materialises. There are only few problem loans in good times, but their share increases dramatically in bad times when the riskiness of loans granted at the peak of the cycle (on the basis of lax lending standards) becomes apparent.
- Skewed incentives in pay schemes can lead to herd behaviour and result in an underestimation of long-term risks. Incentive schemes for bank management that are skewed towards short-term horizons increase risk taking. Short-sightedness is being reinforced by performance remuneration linked to annual profits, stock options related to short-term stock market performance and remuneration packages that reward profits, but do not penalise losses.

As provisions have a direct impact on profits, bank capital and lending, their pro-cyclicality induces pro-cyclicality in bank profits, capital and lending as well. Nevertheless, the discretionary (non-rule based) part of provisioning can counteract the pro-cyclicality of the non-discretionary part if banks use discretionary provisioning for profit smoothing and if banks under-provision in bad times to secure regulatory capital (regulatory capital arbitrage) (Bouvatier and Lepetit, 2008; Lobo and Yang, 2001). This is particularly relevant in countries like the United States where provisions can be included in regulatory capital, whereas regulatory capital arbitrage will not occur, if provisions are not allowed to be part of regulatory capital as in Spain (Pérez *et al*., 2006).

Pro-cyclicality can be reinforced if the exposure of banks to negative shocks is substantial. For instance, banks with a large maturity mismatch (large holding of illiquid assets or short-term funding or both) or where wholesale funding instead of more stable funding by customer deposits is important will react more to changes in market conditions. Moreover, less conservative lending practices including high loan to value and high debt servicing to income ratios imply more exposure to asset price fluctuations and to the real cycle, and thus more pro-cyclicality of lending.[10]

10. Also accounting standards that focus on fair value accounting can accentuate the pro-cyclicality of bank balance sheets due to sharp swings in asset prices. There is little agreement in the literature on whether fair value accounting has exacerbated the severity of the financial crisis (Laux, 2009).

Estimations carried out with country-level and bank-level panel datasets concerning loan loss reserves, bad loan provisioning, the funding gap, various measures of bank profitability and bank liquidity all exhibit strong co-moving patterns. In addition, bank equity moves hand in hand with loan growth. This implies that deleveraging does not come about because loans drop while equity remains unchanged but because loans drop more than equity falls. Country-specific estimates broadly confirm the aggregate analysis (10).

Table 10. **Panel estimation results for other bank ratios**

Panel A. Country-level data (Bank profitability database)

	Loan growth		GDP growth		House price growth		Share price growth	
Levels								
Provisions	-0.011	**	-0.113	**	-0.011		-0.004	
Funding gap	-0.559	**	-1.562	**	-0.239	**	-0.028	
Roa 1	0.010	**	0.091	**	0.011	**	0.004	*
Roe 1	0.224	**	1.633	**	0.189	*	0.081	**
First differences								
Provisions	-0.008		-0.093	**	-0.004		0.001	
Funding gap	-0.369	**	-0.880	**	-0.110		-0.013	
Roa 1	0.009	*	0.088	**	0.012	*	0.000	
Roe 1	0.236	*	1.849	**	0.172		0.041	

Panel B. Bank-level data (Bankscope database)

	Level equation		First difference equation	
Provisions	-0.005	**	-0.010	**
Loan loss reserves	-0.006	**	-0.005	**
Return on assets	0.001		-0.001	
Return on equity	0.016	**	0.003	
Liquidity 1	-0.088	**	-0.048	**
Liquidity 2	-0.050	**	-0.022	**
Funding gap	-0.376	**	-0.137	**
Bank equity growth	0.356	**	0.295	**

Panel C. Country specific results

	Pro-cyclicality (-)	Counter-cyclicality (+)
Provisions	AUT, BEL, CZE, ESP, FIN, ITA, PRT, SVK, SWE	–
Loan loss reserves	AUT, CAN, CHE, CZE, DEU, ISL, JPN, POL, SWE, US	–
Liquidity 2	AUS, AUT, BEL, CAN, DNK, FIN, GBR, HUN, LUX, MEX, NLD, NZL, POL, PRT, SVK, SWE	–
Return on equity	ESP, FIN, FRA, GBR, POL, SVK	NOR, NZL, US, TUR
Bank equity growth	AUS, AUT, CHE, CZE, DEU, DNK, ESP, GRC, ISL, ITA, JPN, KOR, LUX, NLD, NZL, POL, SWE, US	TUR

Note: * and ** denote statistical significance at the 10% and 5% levels. The results are obtained using a dynamic specification where the dependent variable is regressed on its lagged value and measures of the cycle (real loan growth, real GDP growth, real share price and house price growth). The return on equity (Roe) and return on assets (Roa) are based on profits before tax. Liquidity 1 = liquid assets/(deposits+short-term funding), liquidity 2 = liquid assets/(all funding), the funding gap is the ratio of deposits over loans. Country names are not shown if the coefficient estimates are not significant. These results are obtained by interacting the cycle variable with country dummies.

Source: OECD calculations based on the OECD Economic Outlook 86 database, OECD Bank Profitability Database and Bankscope.

4.5.3 Results related to the type of banks

In addition to the results reported earlier, the synchronisation with loan growth of the capital and other ratios of different types of banks (commercial, investment, mortgage, savings and co-operative banks) were investigated (1). The capital ratios of commercial banks and mortgage banks show a stronger correlation with loan growth than that of other types of banks. The liquidity ratio co-moves with the credit cycle for all types of banks except for co-operative banks. The funding gap reacts strongly to the credit cycle in the case of commercial, investment and savings banks. Commercial and savings banks are also found to have loan loss reserves and provisioning strongly correlated with loan growth. Finally, profitability does not seem to be linked with any of the five categories (1).

Table 11. **Results related to bank types**

Results by bank type	Pro-cyclicality (-)	Counter-cyclicality (+)
Capital 1	Commercial banks, mortgage banks, co-operative banks	–
Capital 2	Commercial banks, mortgage banks	–
Capital 3	Commercial banks, mortgage banks	–
Capital 4	Mortgage banks	–
Provisions	Commercial banks, saving banks	–
Loan loss reserves	Commercial banks, saving banks	–
Return on assets	–	–
Returns on equity	–	–
Liquidity 1	Commercial banks, saving banks	–
Liquidity 2	Commercial banks, saving banks, Investment banks, mortgage banks	–
Funding gap	Commercial banks, saving banks, investment banks	–
Growth in bank equity	Commercial banks, saving banks, mortgage banks	–

Note: The results are obtained using a dynamic specification where the dependent variable is regressed on its lagged value and loan growth. Bank types are not shown if the coefficient estimates are not significant. These results are obtained by interacting the cycle variable with country/bank-type dummies. Capital 1, 2, 3 and 4 are defined as follows. Capital 1 = tier 1 capital over risk weighted assets, capital 2 = common shares over total assets, capital 3 = total equity over total assets, capital 4 = the sum of total capital and subordinated debt over total assets. Return on equity and assets are based on profits before tax. Liquidity 1 = liquid assets/(deposits+short-term funding), liquidity 2 = liquid assets/(all funding), funding gap is the ratio of deposits over loans.

Conclusions

Reassessing developments in the nature of the cycle leading up to the economic and financial crisis reveals a number of changes. While the amplitude of economic and financial cycles came down, output cycles tended to become longer and more asymmetric with expansionary phases lasting longer, while the length of slowdown or contraction phases remained approximately the same. There are many explanations for the great moderation era that preceded the economic and financial crisis. They focus on good luck, better policy and structural changes in the economy. Panel estimates suggest that better monetary and structural policies have reduced output volatility, though this effect was partly off-set by greater stock and house price volatility. Indeed, house price cycles and to a lesser extent stock market cycles became longer and larger in amplitude.

Though the evidence is not conclusive, the synchronisation of business cycles appears to have become stronger, especially among some country groupings. The degree of synchronisation of GDP, real share and house price growth during the economic and financial crisis is unprecedented both across countries and within countries.

With respect to financial markets, capital, provisioning, liquidity and maturity mismatch in the banking sector can generate pro-cyclical behavior in credit supply for a number of reasons including the regulatory setup, the nature of risk assessment and the prevailing incentives to take risks. In the available empirical work, there is little consensus on the degree of pro-cyclicality of the banking system. However, new estimation results based on aggregate and bank-level micro datasets show a pronounced synchronisation of the banking sector for most countries with real and financial cycles, even without taking into account the shadow banking system

Bibliography

Artis, M., M. Massimiliano and P. Tommaso (2003), "Dating the Euro Area Business Cycle", *CEPR Discussion Paper*, No. 3696.

Asea, P.K. and B. Blomberg (1998), "Lending Cycles", *Journal of Econometrics*, 83, pp. 89-128.

Avouyi-Dovi, S. and J. Matheron (2005), "Interactions between business cycles, financial cycles and monetary policy: stylised facts", *BIS papers* No. 22, pp. 273-298.

Ayuso, J., D. Pérez and J. Saurina (2002), "Are Capital Buffers Pro-cyclical? Evidence from Spanish Data", *Bank of Spain Working Paper*, No. 0224.

Barrell, R. and S. Gottschalk (2004), "The Volatility of the Output Gap in the G7", *National Institute Economic Review*, April.

Beckmann, R. (2007), "Profitability of Western European Banking Systems: Panel Evidence on Structural and Cyclical determinants", *Deutsche Bundesbank Banking and Financial Studies Discussion Paper*, No. 17/2007.

Benk, S., M. Gillman and M. Kejek (2009), "US Volatility of Output and Inflation, 1919-2004: A Money and Banking Approach to a Puzzle", *CEPR Discussion Paper,* No. 7150.

Bikker, J.A. and P.A.J. Metzenmakers (2002), "Bank Provisioning Behavior and Procyclicality", *De Nederlandsche Bank, Research Series Supervision,* No. 50.

Bikker, J.A. and P.A.J. Metzenmakers. (2007), "Is Bank Capital Procyclical? A Cross-country Analysis", De Nederlandsche Bank, mimeo.

Blanchard, O. and J. Simon (2001), "The Long and Large Decline in U.S. Output Volatility", *Brookings Papers on Economic Activity*, No. 1.

Blas, B. de (2009), "Can Financial Frictions Help Explain the Performance of the U.S. Fed?", *The B.E. Journal of Macroeconomics*, Vol. 9, No. 1.

Bouvatier, V. and L. Lepetit (2008), "Banks' Procyclical Behavior: Does Provisioning Matter?", *International Financial Markets, Institutions and Money*, 18.

Böwer, U. and C. Guillemineau (2006), "Determinants of Business Cycle Synchronization across Euro Area Countries", *ECB Working Paper,* No. 587.

Bry, G. and C. Boschan (1971), "Cyclical analysis of time series: selected procedures and computer programs", NBER.

Buch, C., J. Doepke and K. Stahn (2009), "Great Moderation at the Firm Level? Unconditional vs. Conditional Output Volatility", *The B.E. Journal of Economic Analysis & Policy*, Vol. 9 (1) (Contributions), Article 20.

Camacho, M., G. Perez-Quiros and L. Saiz (2008), "Do European Business Cycles Look Like One?", *Journal of Economic Dynamics and Control*, Vol. 32.

Canova, F. (2009), "What Explains the Great Moderation in the U.S.? A Structural Analysis", *Journal of the European Economic Association*, 7(4).

Catte, P., N. Girouard, R. Price and C. André (2004), "Housing Markets, Wealth and the Business Cycle", *OECD Economics Department Working Papers*, No. 394, OECD, Paris.

Cecchetti, S., A. Flores-Lagunes and S. Krause (2006), "Assessing the Sources of Changes in the Volatility of Real Growth", *NBER Working Paper*, No. 11946.

Clarida, R., J. Gali and M. Gertler (2000), "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory", *The Quarterly Journal of Economics*, January.

Comin, D. and T. Philippon (2005), "The Rise in Firm-level Volatility: Causes and Consequences", *NBER Macroeconomics Annual 2005*, Vol. 20.

D'Avack, F. and S. Levasseur (2007), "The Determinants of Capital buffers in CEECs", *OFCE Working Paper*, No. 2007-28.

Dalsgaard, T., J. Elmeskov and C. Park (2002), "Ongoing Changes in the Business Cycle: Evidence and Causes", *OECD Economics Department Working Papers*, No. 315, OECD, Paris.

Darvas, Z. and G. Szapáry (2008), "Business Cycle Synchronization in the Enlarged EU", *Open Economies Review*, 19 (1).

Davis, S.J. and J.A. Kahn (2008), "Interpreting the Great Moderation: Changes in the Volatility of Economic Activity at the Macro and Micro Levels", *NBER Working Paper*, No. 14048.

Duval, R., J. Elmeskov, and L. Vogel (2007), "Structural Policies and Economic Resilience to Shocks", *OECD Economic Department Working Papers*, No. 567, OECD, Paris.

Dynan, K., D. Elmendorf and D. Sichel (2006a), "Can Financial Innovation Help to Explain the Reduced Volatility of Economic Activity?", *Journal of Monetary Economics*, 53.

Dynan, K., D. Elmendorf and D. Sichel (2006b), "Financial Innovation and the Great Moderation: What Do Household Data Say?", mimeo.

Edmond, C. and L. Veldkamp (2008), "Income Dispersion and Counter-cyclical Markups", *NBER Working Paper*, No. 14452.

Everts, M. (2007), "Duration of business cycles", *MPRA Paper* No. 1219

Francis, W. and M. Osborne (2009), "On the behaviour and determinants of risk-based capital ratios: revisiting the evidence from UK banking institutions", Financial Services Authority, Occasional Paper Series, No. 31.

Giannone, D. and L. Reichlin (2006), "Trend and Cycles in the Euro Area: How Much Heterogeity and Should We Worry about it?", *ECB Working Paper*, No. 596

Goodhart, C., B. Hofmann and M. Segoviano (2004), "Bank Regulation and Macroeconomic Fluctuations", *Oxford Review of Economic Policy*, Vol. 20, No. 4.

Harding, D. and A. Pagan (2005), "A suggested framework for classifying the modes of cycle research", Journal of Applied Econometrics, 20, pp. 151-159.

Harding, D. and A. Pagan (2006), "Synchronisation of Cycles", *Journal of Econometrics*, Vol. 132.

Jokipii, T. and A. Milne (2006), "The Cyclical Behavior of European Bank Capital Buffers, *Bank of Finland Research Discussion Papers*, No. 17/2006.

Kahn, J., M. McConnell and G. Perez-Quiros (2002), "On the Causes of the Increased Stability of the US Economy", *Economic Policy Review*, Federal Reserve Bank of New York, 8 (1).

Keys, B.J., T. Mukherjee, A. Seru and V. Vig (2010), "Did Securization Lead to Lax Screening? Evidence from Subprime Loans", *Quarterly Journal of Economics*, Vol. 125, No. 1.

Kim, H-W. and H-Y. Lee (2006), "Procyclicality of Buffer Capital and its Implications for Basel II: a Cross-country Analysis", in Kim, H-W. and H-S. Shin (eds.), *Adopting the New Basel Accord: Impact and Policy Responses of Asia-Pacific Developing Countries*, International conference of the Korea Development Institute, Chapter 6.

Kiyotaki, N. and J. Moore (1997), "Credit Cycles", *Journal of Political Economy*, Vol. 105.

Lane, P., and G. Milesi-Ferretti (2007), "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970s-2004" *Journal of International Economics*, 73 (2), pp. 223-250.

Laux, C. (2009), "Did Fair-Value Accounting Contribute to the Financial Crisis?", *NBER Working Paper*, No. 15515.

Lindquist, K-G. (2003), "Banks' Buffer Capital: How Important is the Risk?", *Norges Bank Working Paper*, No. 2003/11.

Lobo, G.J. and D-H. Yang (2001), "Bank Managers' Heterogeneous Decisions on Discretionary Loan Loss Provisions", *Review of Quantitative Finance and Accounting*, No. 16.

MacAdam, P. (2007), "US, Japan and the Euro Area: Comparing Business-cycle Features", *International Review of Applied Economics*, Vol. 21 (1).

McConnell, M. and G. Perez-Quiros (2000), "Output Fluctuations in the United States: What Has Changed Since the Early 1980's?", *American Economic Review*, Vol. 90, No. 5.

Nadal-De Simone, F. (2002), "Common and Idiosyncratic Components in Real Output: Further International Evidence", *IMF Working Paper,* No. 229.

Panetta, F., P. Angelini, U. Albertazzi, F. Columba, W. Cornacchia, A. DiCesare, A. Pilati, C. Salleo and G. Santini (2009), "Financial Sector Pro-cyclicality: Lessons from the Crisis", *Banca d'Italia Occasional Papers*, No. 44.

Pérez, D., V. Salas and J. Saurina (2006), "Earnings and Capital Management in Alternative Loan Loss Provision Regulatory Regimes", *Bank of Spain Working Paper*, No. 0614.

Schularick, M. A.M. Taylor (2009),
"Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870-2008", *NBER Working Papers* 15512.

Sorensen, B., Y-T. Wu, O. Yosha and Y. Zhu (2005),
"Home Bias and International Risk Sharing: Twin Puzzles Separated at Birth",
CEPR Discussion Pape, No. 5113.

Stiroh, K. (2009), "Volatility Accounting: A Production Perspective on Increased Economic Stability", *Journal of the European Economic Association*, 7 (4).

Stock, J. and M. Watson (2002), "Has the Business Cycle Changed and Why?", *NBER Macroeconomics Annual*, NBER.

Stock, J. and M. Watson (2003), "Forecasting Output and Inflation: The Role of Asset Prices", *Journal of Economic Literature*, Vol. XLI.

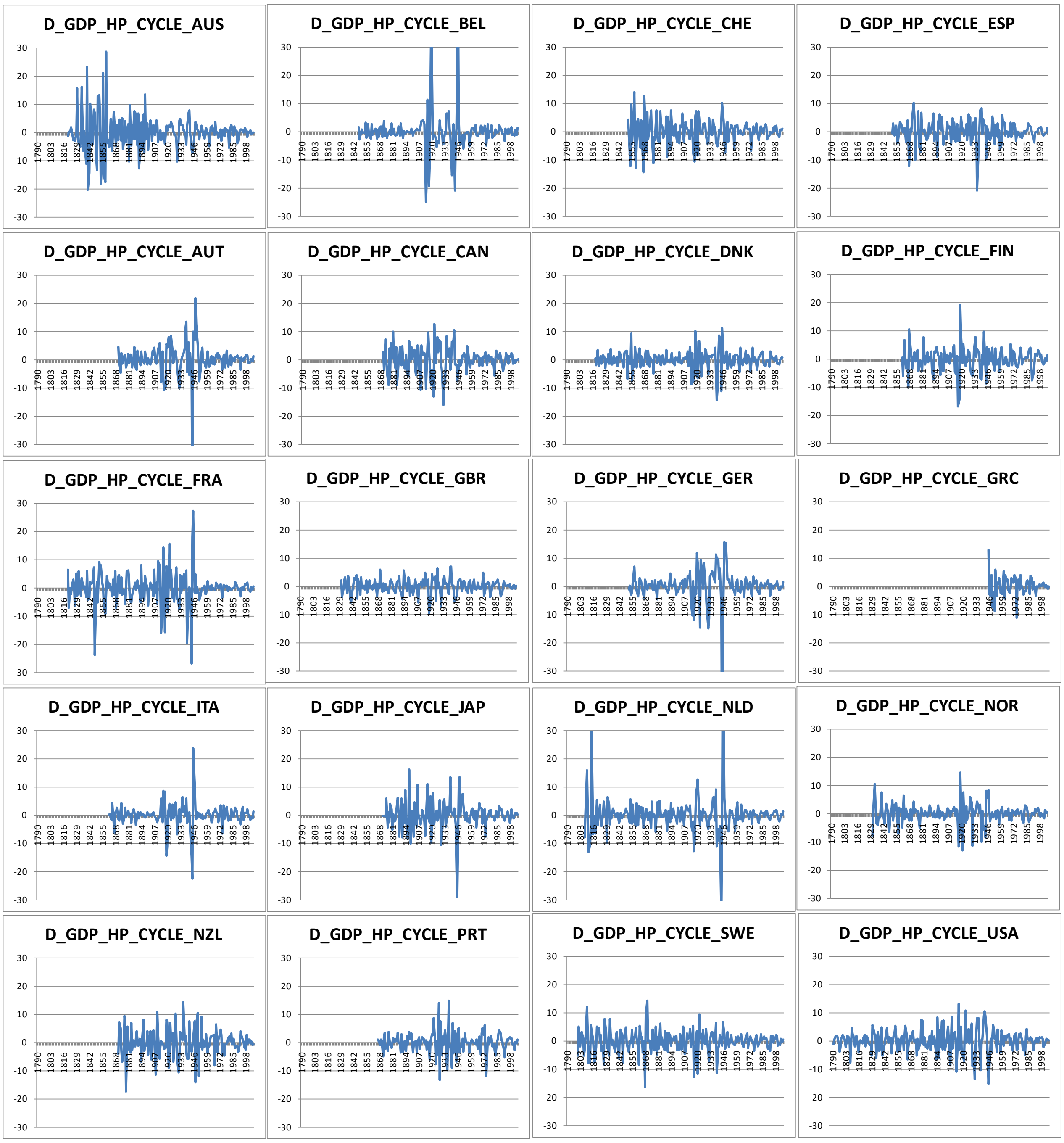
Stolz, S. and M. Wedow (2005), "Banks' Regulatory Capital Buffer and the Business Cycle: Evidence for German Savings and Cooperative Banks", *Deutsche Bundesbank Banking and Financial Studies Discussion Paper*, No. 07/2005.

Taylor, J. (1998), "An Historical Analysis of Monetary Policy Rules", *NBER Working Paper*, No. 6768.

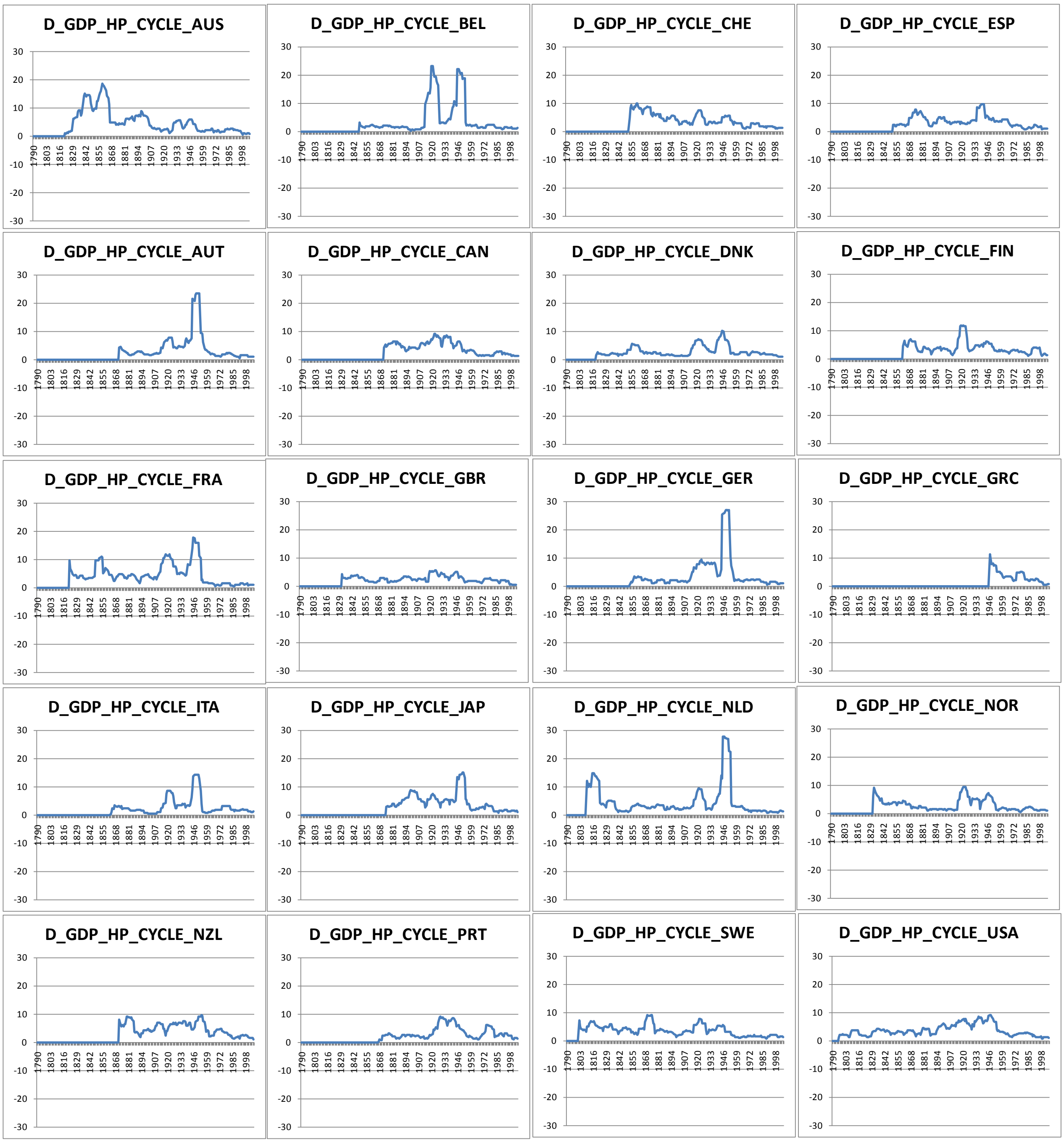
Annex A1

Deviation cycles

A. Secular real GDP series for deviation cycles for selected OECD countries, 1790-2006



B. Standard deviation of the deviation cycle (8-year window), 1790-2006



Annex A2

Cycles of industrial production

Table A2.1. **Cycles of industrial production, 1955-2008**

Country	Period	Classical cycle		Deviation cycle						Cycle of growth rates			
				HP filter		Bandpath filter				m-on-m		y-on-y	
						Baxter-King		Christ-Fitzg		Annualised			
		Nr	Length	Nr	Length	Nr	Length	Nr	Length	Nr	Length	Nr	Length
AUT	1955M01 - 2008M12	5	72.8	9	65.7	11	47.9	11	48.0	10	52.3	14	41.6
AUT_sp		4	53.3	13	46.2	10	48.0	10	48.1	8	55.9	15	38.9
AUT_ma		4	53.0	15	38.7	10	48.0	11	47.9	13	39.8	14	42.2
BEL	1955M01 - 2008M12	14	41.3	14	39.4	16	33.2	16	33.2	14	38.6	18	33.3
BEL_sp		10	56.6	15	39.3	16	33.2	16	33.2	10	49.1	19	29.1
BEL_ma		10	55.4	16	36.1	16	33.2	16	33.3	13	44.2	18	30.7
CAN	1961M01 - 2008M12	13	41.5	13	42.8	13	36.8	13	37.0	12	35.6	17	31.8
CAN_sp		11	44.5	14	35.9	12	38.6	12	38.7	14	35.8	16	32.4
CAN_ma		12	44.8	13	35.2	12	38.6	12	38.7	14	35.8	15	34.7
CHI	1990M12 - 2008M12	5	37.2	6	31.0	4	28.0	3	36.3	4	41.0	7	25.9
CHI_sp		2	44.0	5	31.4	3	29.3	3	36.3	5	35.0	6	23.7
CHI_ma		1	62.0	5	31.4	3	29.3	3	36.7	6	30.0	5	28.4
CZE	1990M01 - 2008M12	4	32.0	5	32.4	3	34.0	3	33.7	5	41.6	4	31.0
CZE_sp		3	43.0	5	39.4	3	34.0	3	33.7	2	81.0	5	34.4
CZE_ma		3	43.0	5	37.6	3	34.0	3	34.0	3	53.7	5	32.0
DEU	1958M01 - 2008M12	8	51.4	12	45.3	12	39.5	13	36.5	14	38.5	14	39.4
DEU_sp		11	41.7	12	46.3	12	38.7	12	39.6	8	69.6	16	35.3
DEU_ma		10	41.3	14	38.7	12	39.5	11	43.2	11	52.5	15	37.6
DNK	1974M01 - 2008M12	9	39.3	11	32.2	11	26.5	11	26.3	7	54.3	10	36.6
DNK_sp		9	35.8	9	40.6	11	26.5	10	28.9	9	42.2	11	33.1
DNK_ma		9	35.7	9	40.6	11	26.4	10	28.8	10	36.8	11	32.4
ESP	1961M01 - 2008M12	13	39.2	16	33.6	17	28.3	16	30.3	10	44.3	18	29.5
ESP_sp		15	35.6	17	32.1	16	28.6	15	30.6	13	35.9	18	28.2
ESP_ma		14	34.2	18	30.3	16	28.6	15	30.6	11	41.2	18	28.1
EST	1994M01 - 2008M12	1	115.0	3	38.7	2	31.0	1	32.0	2	59.0	4	30.8
EST_sp		1	114.0	3	47.0	2	31.0	1	32.0	2	56.5	3	27.0
EST_ma		1	114.0	4	35.0	2	31.5	1	31.0	2	51.0	3	30.7
FIN	1955M01 - 2008M12	10	49.6	8	63.6	12	42.8	12	42.9	5	124.6	12	49.0
FIN_sp		7	86.1	11	54.7	12	42.8	12	42.9	9	62.8	14	42.1
FIN_ma		8	76.8	12	51.1	12	42.8	12	42.9	8	61.6	15	39.3
FRA	1955M01 - 2008M12	10	56.7	14	43.9	15	35.3	15	35.3	14	38.3	17	35.0
FRA_sp		7	75.6	10	48.0	14	34.6	14	34.6	10	48.1	15	37.0
FRA_ma		8	61.4	11	44.0	14	34.6	14	34.6	13	45.4	16	34.8
GBR	1955M01 - 2008M12	12	49.7	16	37.3	12	44.1	12	44.1	14	43.1	17	36.6
GBR_sp		13	47.8	16	38.9	12	44.1	12	44.1	12	48.1	16	37.3
GBR_ma		13	47.8	16	38.9	12	44.0	12	44.1	15	40.1	15	39.9

Note: sp and ma indicate that the Spencer curve and a 15-month moving average were applied to the raw data. Nr. is the number of peak-to-peak cycles and length is the length of the cycle expressed in months.

Table A2.1. **Cycles of industrial production, 1955-2008** (*cont'd*)

Country	Period	Classical cycle		Deviation cycle						Cycle of growth rates			
				HP filter		Bandpath filter				m-on-m annualised		y-on-y	
						Baxter-King		Christ-Fitzg					
		Nr	Length	Nr	Length	Nr	Length	Nr	Length	Nr	Length	Nr	Length
GRC	1962M01 - 2008M12	8	67.4	9	59.9	15	30.1	14	32.3	9	56.7	10	45.3
GRC_sp		7	68.7	7	60.4	15	30.1	13	34.8	5	105.0	13	37.7
GRC_ma		8	60.1	8	55.6	14	32.2	13	34.8	9	57.8	14	37.1
HUN	1980M01 - 2008M12	3	102.0	7	43.9	6	39.8	6	39.7	5	37.0	5	47.0
HUN_sp		3	74.3	9	34.0	6	39.8	6	39.7	8	39.8	8	35.5
HUN_ma		1	156.0	9	34.0	5	47.8	6	39.8	8	39.5	9	31.6
IRL	1975M07 - 2008M12	4	68.3	8	35.3	9	32.4	8	36.5	9	42.2	11	33.2
IRL_sp		5	59.0	9	36.8	9	32.4	8	36.5	7	38.7	9	32.8
IRL_ma		5	66.2	8	40.0	8	36.5	8	36.5	10	35.5	9	32.9
ISR	1975M06 - 2008M12	7	52.3	11	34.7	10	30.7	9	34.1	9	39.2	9	37.1
ISR_sp		8	45.9	11	30.2	9	31.1	8	35.1	10	35.0	12	29.1
ISR_ma		6	48.5	11	30.1	8	35.0	8	35.1	12	29.2	11	31.6
ITA	1955M01 - 2008M12	11	47.5	8	56.9	15	34.9	14	37.4	8	68.4	16	34.9
ITA_sp		11	46.5	13	40.2	14	35.9	14	37.4	9	57.8	17	35.0
ITA_ma		11	54.1	12	43.6	14	35.9	14	37.4	11	43.3	17	35.1
JPN	1955M01 - 2008M12	14	42.9	19	31.6	15	34.2	17	31.3	17	36.5	19	32.6
JPN_sp		16	37.1	18	33.1	15	34.2	17	31.2	20	31.1	19	29.6
JPN_ma		16	37.1	19	31.3	15	34.3	17	31.2	16	34.4	19	29.6
KOR	1990M01 - 2008M12	2	48.0	4	38.8	4	25.5	3	34.0	2	44.0	5	30.2
KOR_sp		2	49.0	5	30.2	4	25.5	3	34.0	5	32.6	6	29.3
KOR_ma		2	49.0	5	30.2	4	25.5	3	34.0	4	43.3	5	33.8
LUX	1955M01 - 2008M12	13	43.9	12	43.8	14	34.2	13	36.8	9	65.9	14	42.4
LUX_sp		14	43.1	14	43.1	14	34.2	13	36.8	11	53.0	16	36.4
LUX_ma		13	40.9	12	50.3	12	39.9	13	36.9	12	42.7	15	36.4
NLD	1956M01 - 2008M12	14	43.1	12	50.3	15	35.2	15	35.2	11	44.2	14	39.9
NLD_sp		6	63.0	4	94.8	15	33.7	15	35.2	3	133.7	13	34.7
NLD_ma		6	69.0	4	94.5	14	37.7	15	35.2	8	51.5	11	41.0
NOR	1955M01 - 2008M12	8	74.5	15	42.1	17	30.2	17	30.3	15	37.9	14	34.3
NOR_sp		8	47.0	11	31.8	17	30.2	17	30.3	9	41.7	18	25.0
NOR_ma		8	57.5	10	35.0	16	32.1	17	30.7	8	42.8	19	30.1
POL	1985M01 - 2008M12	3	77.0	6	33.7	5	36.2	5	36.2	5	45.8	7	29.9
POL_sp		3	61.7	8	30.9	5	36.2	5	36.2	4	56.0	7	31.6
POL_ma		4	43.5	8	30.8	5	36.4	5	36.2	5	44.8	7	31.7
PRT	1955M01 - 2008M12	10	62.7	11	35.9	12	42.1	13	38.9	16	35.7	13	45.8
PRT_sp		9	57.3	9	50.7	12	42.1	13	38.8	6	68.0	14	39.1
PRT_ma		10	51.6	8	50.4	12	42.1	13	38.8	7	56.6	14	39.1
RUS	1993M01 - 2008M12	4	38.5	3	46.0	3	27.0	3	25.3	1	77.0	3	38.3
RUS_sp		2	22.5	4	31.0	3	27.3	3	25.3	3	41.3	4	33.3
RUS_ma		2	33.0	3	41.0	3	26.7	3	25.3	3	48.7	4	36.3
SVK	1989M01 - 2008M12	4	53.0	5	40.2	4	30.0	4	29.5	4	37.8	7	28.4
SVK_sp		3	33.3	6	33.7	4	30.0	4	29.8	5	35.0	6	28.5
SVK_ma		2	50.0	6	33.7	4	30.0	4	29.8	5	33.0	6	28.7
SVN	1992M01 - 2008M12	3	50.7	3	36.0	3	31.7	3	31.7	4	41.0	4	38.3
SVN_sp		2	75.0	5	30.0	3	31.7	3	31.7	5	27.8	4	38.5
SVN_ma		2	75.5	5	30.0	3	31.7	3	31.7	4	37.5	4	38.5
SWE	1955M01 - 2008M12	8	66.9	10	48.7	12	43.5	12	43.9	8	58.0	10	47.6
SWE_sp		8	57.5	9	47.1	11	42.9	12	44.1	11	47.3	14	41.9
SWE_ma		8	59.4	13	45.9	10	47.1	11	48.0	10	46.0	14	41.9
TUR	1985M01 - 2008M12	3	49.7	7	30.0	7	24.1	7	24.3	5	31.2	6	38.3
TUR_sp		7	36.9	5	44.2	7	24.1	7	24.1	3	45.7	8	28.9
TUR_ma		7	37.0	4	55.3	7	24.1	7	24.0	3	30.0	8	28.9
USA	1955M01 - 2008M12	12	50.6	16	37.9	15	34.6	14	37.1	19	32.6	17	33.9
USA_sp		12	50.6	15	40.5	15	34.6	13	39.9	16	37.9	17	32.5
USA_ma		11	55.3	16	37.9	15	34.6	13	39.9	18	33.6	17	32.5

Note: sp and ma indicate that the Spencer curve and a 15-month moving average were applied to the raw data. Nr. is the number of peak-to-peak cycles and length is the length of the cycle expressed in months.