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Marcus Kappler
Andreas Sachs *Editors*

Business Cycle Synchronisation and Economic Integration

New Evidence from the EU

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Series Editor
Prof. Dr. Dr. h.c. mult. Wolfgang Franz

Editors
Dr. Marcus Kappler
Centre for European Economic Research
Mannheim
Germany

Dipl.Oec. Andreas Sachs
Centre for European Economic Research
Mannheim
Germany

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Table of Contents

1 Introduction

This book establishes facts about business cycle synchronisation and convergence in the euro area and beyond as well as examines determinants of cyclical correlation. The identification of factors that are robustly linked to business cycle synchronisation and that are amenable to economic intervention may improve the formulation of policies that foster cyclical convergence. Synchronicity of business cycles is often regarded as an important prerequisite for a well-functioning common currency. In the absence of a certain degree of synchronicity, a common monetary policy may not satisfy the needs of all member countries and may even contribute to cyclical divergence. The extent of business cycle convergence in a monetary union is determined by a number of factors, including the degree of symmetry between macroeconomic shocks, transmission channels and institutional features – including fiscal policy – as well as the level of economic integration between member countries. All of these aspects play an important role in optimal currency area (OCA) theory, which seeks to determine the costs and benefits of a common currency and which received a great deal of attention in the discussion about the introduction of the euro. According to the seminal work by Mundell (1963) and the subsequent rich literature on OCA theory, the benefits of a currency union outweigh the cost of a foregone independent monetary policy if (i) the countries share similar business cycles, (ii) labour mobility across the region is high, (iii) the economies are open with capital mobility and price and wage flexibility across and region, and (iv) a risk-sharing system such as an automatic fiscal transfer mechanism is in place. The financial and economic crisis of 2008/09 has indicated that the traditional OCA indicators pay too little attention to financial markets. After the collapse of the US investment bank *Lehman Brothers* in September 2008, the inter-bank money market dried up completely as commercial banks lost confidence in the solvency of their counterparties. As a result, non-financial corporations had problems obtaining financing. These financial problems were a main reason for the drastic decline in world trade as well as the sharp recession that struck industrialised nations and many emerging markets almost simultaneously. In this way, tight financial market linkages and disruptions contributed significantly to a synchronous economic downturn. Thus, an analysis of financial markets is important for the investigation and understanding of business cycle synchronisation.

A common monetary policy may even contribute to a de-coupling of business cycles, as the experience of some countries at the periphery of the euro area (Greece, Spain, Portugal and also Ireland) has shown. Particularly the southern euro area countries experienced a significant drop in their interest rates after the

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founding of the euro area. At the same time, wage-induced inflation was high in these countries, leading to low or even negative real interest rates. These low interest rates contributed to rising domestic demand and further wage increases. As a consequence, the international competitiveness of these countries deteriorated markedly, resulting in rising current account deficits. On the other hand, core euro area countries with lower internal demand and wage pressures gained international competitiveness, and the current account of these countries improved considerably. Hence, the common monetary policy contributed to the build-up of external imbalances within the euro area, making a long-lasting and for some countries painful adjustment process necessary.

The second chapter of this book provides a summary of the latest findings in the *empirical literature* in order to address the key objectives of the study. Section 2 summarises the recent literature on business cycle synchronisation and convergence, which can be subdivided into several groups: studies that investigate these issues with a particular focus on the euro area and the New Member States (sub-section 2.1.1), studies that look at the cyclical conformity between the G7 and OECD countries (sub-section 2.1.2), and literature that compares the developments within the euro area with the global business cycle (sub-section 2.1.3). This is followed by a review of papers and reports that identify clusters of countries for which cyclical similarity is particularly pronounced (sub-section 2.1.4) as well as a summary of the findings for regional business cycle cohesion between US states and between Canadian provinces (sub-section 2.1.5). In sub-section 2.1.6, the role of idiosyncratic and common shocks as well as the role of shock propagation mechanisms are assessed by a review of the relevant literature. If there is risk sharing, i.e. if there are inter-state fiscal and market institutions that help smooth income between states and countries, a looser connection between individual countries' cycles may be less problematic since such equalisation mechanisms can partly substitute for the loss of an independent national monetary policy when it comes to stabilising asymmetric shocks and asymmetric business cycle fluctuations within a monetary union. Therefore, the latest findings regarding the degree of risk sharing between the Member States of the euro area and between US states are summarised in sub-section 2.1.7.

Section 2.2 reviews the literature dealing with the *determinants* of business cycle synchronisation and convergence. We first provide a detailed overview of recent studies and their main findings; the different approaches considered are then delineated. More specifically, sub-sections 2.2.1 to 2.2.6 examine determinants of business cycle synchronisation such as trade integration, membership in currency unions, monetary integration, fiscal policy, sectorial structure and financial market integration. This literature survey provides an overview of the existing evidence and serves as a guide for the empirical analysis that is conducted in chapter 1.

The remaining chapters of the book deal with empirical examinations. Chapter 1 starts off with addressing and discussing key methodological concepts for estimating business cycles, their similarity and convergence. The business cycle itself cannot be observed; assumptions therefore have to be made about its characteristics in order to estimate it. Section 3.1 presents and discusses several methods for disentangling the cycle and trend from observed data. In this section, we demon-

strate how one's view of the business cycle and its synchronicity depends on the methodology chosen (section 3.2). Furthermore, we discuss how convergence may be assessed by means of statistical measures and tests, allowing us to draw conclusions regarding the significance of the obtained findings (section 3.3). Then, a set of *stylised facts* concerning the characteristics of business cycles and synchronisation in the euro area and elsewhere are presented (sections 3.4 and 3.5). This part of the book also provides a descriptive overview on the question of whether *convergence or divergence* patterns between the euro area countries changed after the introduction of the euro. In addition, we take a look at the degree of business cycle synchronisation between other countries and the euro area average. The analysis is complemented by a frequency domain approach which allows us to characterise *coherence*, *dynamic correlation* and the *lead and lag relationship* between the business cycles of the euro area on the one hand and the US, UK and Japan on the other (section 3.6). In this part of the book, the main focus lies on convergence with respect to the cyclical component of output. However, both real and nominal convergence is needed for a common monetary policy to be efficient for all participants. For this purpose, section 3.7 looks beyond output gaps by also analysing convergence of *budget balances*, *inflation rates* and *real long-term interest rates*. Next, with the aid of a *cluster analysis,* groups of euro area and OECD countries sharing common business cycles are identified (section 3.8). In section 3.9, business cycle similarities between the US states are studied so as to facilitate a conclusive comparison between the euro area and the US, a mature currency union that is characterised by a larger amount of risk sharing through financial markets and federal fiscal instruments. Finally, in chapter 3.10 some conclusions are drawn.

The empirical work in chapter 4 is devoted to two aspects which have not received much attention in the literature so far: first, the significance of financial market integration and second, the influence of structural reforms and institutional determinants of business cycle synchronisation. The close financial links between European economies can be seen as a channel for the transmission of shocks between countries. Financial market integration thus functions as a catalyser for shocks. However, the integration of international financial markets also helps to insulate the domestic economy to a certain degree against idiosyncratic shocks and also facilitates specialisation. An analysis of the overall impact of these countervailing partial effects is the focus of section 4.1. Structural reforms may serve to increase flexibility and thereby improving resilience to macroeconomic shocks. In this way, as emphasised by the OCA literature, it can partly substitute for the loss of monetary and exchange rate adjustments in a monetary union. After presenting the key contents of the European reform agenda and their likely effects on the cyclical conformity of Member States, the effects of structural reforms on business cycle synchronisation, particularly in the field of labour markets, are analysed in section 4.2. In these sections, we employ panel data regressions that build on and extend the recent empirical literature on both factors in important ways.

Analyses of cyclical co-movement by correlation measures do not answer the question whether (a)symmetries in business cycles are caused by different responses to common shocks or by differences in idiosyncratic, country-specific

shocks. Such reactions to different sorts of macroeconomic disturbances are central to the understanding of co-movements in economic activity which is not revealed by basic correlation analyses. Chapter 5 provides analyses of shock propagation mechanisms and international business cycles based on structural vector autoregression (SVAR) models. Results from two different empirical models are presented. The first model (section 5.2) includes the G7 countries. The subjects of interest are the properties of output cycles and changes in inflation rates. In this regard, the role of common and structural (supply, demand and nominal) shocks is established. The second model (section 5.3) covers a shorter sample period and has less theoretical structure, but deals with more countries than the first model. It allows us to investigate whether differences in the aforementioned variables between the euro area average and its 12 Member States are mainly due to common or country-specific shocks.

The empirical analyses in this book cover a period ending in 2007, i.e. before the culmination of the financial and subsequent to the real economic crisis. It is conceivable that business cycle synchronicity has increased during the crisis since it hit nearly almost all industrialised countries and many emerging market economies more or less simultaneously. On the other hand, the cyclical upswing observed in 2009/10 was concentrated in emerging markets, particularly in Asia. Among the industrialised countries, Germany could benefit most from this recovery. While these stylised facts could be observed in the recent business cycle, it is too early to assess whether the long-run business cycle relationships have changed during the crisis and subsequent recovery. As this book focuses on these longer term patterns, it seemed appropriate to exclude the recent episode from our empirical investigations.

The last chapter of the book summarises the main findings and illuminates their policy implications.

This book is based on the research project "Study on economic integration and business cycle synchronisation", carried out by the Centre for European Economic Research (ZEW)in Mannheim and the Institute for Advanced Studies (HIS)in Vienna, commissioned and financed by the Bureau of European Policy Advisers (BEPA) of the European Commission in the context of "10 years EMU".

2 Literature Review

By Bas van Aarle, Marcus Kappler, Jonas Keil, Atilim Seymen, and Klaus Weyerstrass

2.1 Business Cycle Synchronisation and Convergence

A tabulated overview of the literature on business cycle convergence and its determinants is provided at the end of this section. In the following paragraphs, we will summarise the main findings of the many-faceted contributions to this strand of research.

2.1.1 Literature on the Euro Area and New Member States

In recent years a substantial literature has developed on business cycle synchronisation within the euro area and between the euro area and the countries that entered the EU in 2004 and 2007 (New Member States, NMS) in view of the pending euro area enlargement. The situation in Sweden, Denmark and the UK and their relation to the euro area have also been analysed in a number of studies. The literature on business cycle convergence between the euro area countries and other, non-EU countries is obviously much smaller.

Important contributions regarding the euro area have been made by Artis and Zhang (1999), who find that correlation has increased substantially over time in the euro area. They show that the European Exchange Rate Mechanism (ERM) period (1979-1993) influenced homogeneity positively and identify the clear emergence of a European business cycle during this time frame. A recent study by Gayer (2007) observes a significant harmonisation of output growth since the early 1990s, albeit with a short interruption in 2003/2004. The recovery in 2004 showed that the decline was probably just a transitory phenomenon due to increased uncertainty as a result of the war in Iraq, terrorism, etc. Interestingly, Gayer (2007) finds a recurrent pattern in the history of business cycle synchronisation in the euro area which implies that synchronisation typically decreases in the recovery phases of the cycle and that it rises again as the cycle continues. Using correlation-based measures of business cycle synchronisation, Gayer (2007) finds no evidence of higher correlation after the launch of the euro in 1999. Furthermore, by comparing the patterns of a "world cycle" and the euro area cycle, he observes continuous evidence for a distinct euro area business cycle. He concludes

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that the increased correlation in the euro area may not be regarded as a *"mere by-product of globalisation"*. However, de Haan et al. (2005) observe that we cannot speak of a *"monotone movement towards the emergence of a 'European' business cycle"*.

The literature is also conflicting with regard to the effects of European Monetary Union (EMU) on synchronisation in the euro area. While Afonso and Furceri (2007) find evidence that, since the introduction of the euro, the degree of synchronisation has increased remarkably for all countries except Germany – where it has remained similar – de Haan et al. (2002) are unable to provide a definite answer as to whether the currency union has a positive impact on synchronisation. Massmann and Mitchell (2004) find a long-run trend of rising correlations among euro area business cycles, a finding that stands in contrast to Mink et al. (2007), who conclude that synchronicity and co-movement in the euro area exhibit no clear upward tendency. In terms of country-specific patterns, Gayer (2007) shows that Greece in particular – but also Finland, Belgium and Ireland – has had business cycles that are uncoupled from the cycles shared in general by the larger European countries. The case of Greece can be mainly interpreted as a structural phenomenon, whereas Finland, for instance, had to deal with the breakup of the Soviet Union.

Business cycle synchronisation between the NMS and the euro area – as measured, say, by correlations between de-trended industrial output in NMS and the euro area – is generally found to be present, but at a lower average level than for individual euro area countries. A similar conclusion emerges concerning inflation. The literature on business cycle synchronisation is restricted by the relatively short sample of data for the NMS. Furthermore, the wide variety of business cycle methods and indicators used lead to considerable differences in the outcomes and conclusions reached in studies on this topic. Moreover, the results differ across countries as the NMS are quite heterogeneous, and general conclusions are hard to draw. Another drawback has been the frequent practice of using Germany as a reference country instead of using the euro area business cycle itself. Finally, many studies concentrate on industrial production since the corresponding data are often more reliable. On the other hand, a robustness check concerning results, using, say, GDP data, seems desirable since industrial production represents only a certain share of the total economy. Basing conclusions entirely on this variable is thus a precarious proposition.

Darvas and Szapary (2005) provide a relatively detailed analysis of business cycle synchronisation between the NMS and the euro area. Thanks to the use of a larger set of variables and more countries (similar to the countries in our analysis), more sub-periods and more measures of synchronisation than in most studies, more robust results on business cycle synchronisation between the NMS and euro area are achieved. The authors find that Hungary, Poland and Slovenia are the most synchronised of the NMS when compared to the countries in the euro area periphery (Portugal, Ireland and Finland). The other NMS are less synchronised with the euro area, raising doubts about the suitability of adopting the euro as soon as the countries with a higher degree of synchronisation. The authors also calculate impulse responses from a VAR model in order to analyse the impact of shocks

in the euro area on the NMS. Slovenia and Poland are found to be most sensitive to euro area shocks.

In a meta study, Fidrmuc and Korhonen (2006) provide a very good overview of the literature on business cycle synchronisation between the NMS and the euro area as well as of the literature on the degree of symmetry of macroeconomic shocks between the NMS and euro area. Thirty-five studies are analysed concerning (i) the NMS countries included, (ii) methodology used, (iii) frequency of the data and (iv) the reference country used. On average the highest average estimates of business cycle correlation with the euro area are found in the case of Hungary (0.36), followed by Slovenia (0.26) and Poland (0.25). In several studies, one or more of the NMS are found to have higher business cycle correlations with the euro area than one or more peripheral euro area economies (Greece, Portugal and Ireland).

Concerning euro area enlargement, the discussion has not only considered business cycle synchronisation of the NMS with the euro area but also OCA questions such as the following: For which countries is accession profitable in the sense that the likely benefits exceed the likely costs? In this complicated question, shocks play a particularly important role, in addition to the appropriateness of the current monetary and fiscal policy framework in the euro area and the current amount of business cycle convergence. Another aspect that has received attention is the role of the entry conditions (convergence criteria) laid down in the Maastricht Treaty and the choice of the concrete entry date and conversion rate. In general, it is suggested that due to a general catching up process and a larger amount of idiosyncrasies in macroeconomic shocks and macroeconomic structures, the NMS as a group are not as similar and homogenous as the current Member States. As a consequence, accession to the euro area is a process that should be carefully undertaken and supervised to avoid serious problems later on.

Empirical evidence on the degree of shock symmetry between the NMS and the euro area is provided by Fidrmuc et al. (2003), among others. Using a structural VAR model that is based on Blanchard and Quah (1989), demand and supply shocks are identified and their correlation with euro area demand and supply shocks is determined. Correlation of demand shocks with the euro area appears to be lower than the correlation of supply shocks for most NMS. The majority of NMS show a lower degree of macroeconomic shock correlation than the current euro area countries in relation to the euro area aggregate. This could reflect diverging macroeconomic conditions, different institutions and structures, and differences in macroeconomic policies (monetary policy, including exchange rate and fiscal policy). Clearly, a monetary union will leave most of these asymmetries unaffected; it will first and foremost reduce asymmetries resulting from independent monetary and exchange rate management. On the other hand, the introduction of a common monetary policy could lead to a new source of macroeconomic shocks and to uncertainty on the part of an acceding country, in the sense that it no longer has any influence on interest and exchange rates.

Babetskii (2005) finds that higher trade integration and lower exchange rate volatility induces a higher degree of demand shock symmetry in the NMS and that the effects on supply shocks vary from country to country. This partly confirms

the "endogenous OCA" hypothesis and the EU Commission's view on economic integration and the synchronisation of shocks. The results concerning supply shocks, on the other hand, do not rule out Krugman's hypothesis that due to increased specialisation, monetary unions can be subject to increased shock asymmetries. This possibility, when one also takes into account the greater structural and institutional heterogeneity of the NMS, could imply that euro accession of the NMS will aggravate the "core-periphery" dichotomy in the euro area, leading to potential risks for macroeconomic stability and convergence.

Taken altogether this literature leaves some doubt as to whether most of the NMS are natural candidates at present for the adoption of the euro. On the other hand, there is clearly a potential the prospect of euro area accession to induce a further and swift increase in synchronisation, in accordance with the logic of the endogenous OCA hypothesis. In particular, several studies have pointed to the importance of intra-industry trade in increasing business cycle synchronisation rather than bilateral trade integration per se.

2.1.2 Literature on the G7 and OECD Countries

Studies that focus on business cycles in the G7 countries typically find no evidence for an overall increase in synchronicity over the last decades. For instance, Stock and Watson (2005) find no signs of rising business cycle synchronisation in the G7 countries from 1960 to 2002, but observe an emergence of a European cycle and of one between English-speaking countries. They also find evidence for falling output volatility and explain this lower volatility with the absence of common shocks propagating through the G7. The synchronisation of the Japanese business cycle in particular with the rest of the G7 was low over the period under examination, as Japan had a very distinct cyclical development. Doyle and Faust (2002) find a slow though insignificant fall in the synchronisation of the G7 countries over the period from 1970 to 2002, a finding that stands in contrast to observed downtrend in the volatility of output fluctuations. This fall in the standard deviation of output volatility would imply a rise in business cycle correlation. The reason for this is that a decline in the prominence of idiosyncratic shocks in a country lowers the standard deviation of the country's economic growth. If, at the same time, common variation, measured by covariance, remains unchanged, then correlation rises. Moreover, Stock and Watson observe that co-movements are generally higher during recessions than in recovery phases. This is the same pattern that Gayer (2007) and others find for the euro area countries.

Kose et al. (2005) observe a notable increase in the synchronicity of business cycles among the G7 countries. They distinguish between three factors – common (G7), country-specific and idiosyncratic – that drive an economy and estimate their relative importance. First, they find that common and country-specific factors play different roles at different points in time in different countries. Second, the G7 factor is found to play a crucial role in explaining variations in GDP, implying that worldwide events are of sizable importance. Third, by dividing the full sample from 1960 to 2003 into three sub-periods – 1960-72 (Bretton Woods), 1973-86

(Common shocks) and 1987-2003 (Globalisation period) – the authors show that the common factor was most important in the second period and less important in the first. Finally, Kose et al. find that the G7 factor has less explanative power for variation in output among the G7 countries during the globalisation period. A study by Bordo and Helbling (2003), which builds on evidence from 16 countries, documents evidence of a rise in business cycle synchronisation over the past century. Furthermore, the authors find that global shocks are the dominant influence across different periods and that these shocks have gained increasing importance over time. This finding would appear to be a product of increasing globalisation, particularly the integration of goods and services through international trade and integration of financial markets. Taken together, the literature suggests that the synchronisation of business cycles among industrialised nations has undergone a change during the last three to four decades; however, mixed results are obtained regarding the question of whether country-specific or global impacts have gained in importance.

Additional insights from studies with broader country samples suggest, among other things, that English-speaking country pairs have a much higher correlation than other country pairs. Furthermore, a very low symmetry between New Zealand and Japan, which is attributable to several idiosyncratic shocks (Voss, 2000), can be identified. Akin (2007) observes that the co-movement of cycles is stronger among industrialised nations in comparison to emerging and developing countries. But while convergence tendencies can be observed in emerging economies, synchronisation has been rather stable in developed countries. Otto et al. (2001), who consider 17 OECD countries, show that the mean correlation of GDP growth has shrunk, although they do find evidence for greater cross-country economic integration. Akin (2007) analyses 47 countries from 1970 to 2003 and divides the full sample into three subsamples: the oil shock period, debt crisis period and globalisation period. He concludes that there is no significant change in the symmetry of business cycles, yet uncovers significant alternation in the various periods: for instance, increasing co-movement of output in Asian countries during the debt crisis period (1980-89) and an EU cycle in the globalisation period (1990-2003).

2.1.3 Literature on the Euro Area Versus Global Convergence

The last decades have seen a significant increase in trade and financial globalisation. Accordingly, cross-country output spillovers and financial linkages – e.g. regarding commodity and asset prices as well as volatility swings in the global financial system – are ever more important for the developed and developing countries. The recent experience with the collapse of the US subprime mortgage market and attendant impacts to the global financial system illustrate the new risks and vulnerabilities associated with financial globalisation.

In the euro area, business cycles are not only driven by domestic factors and euro area/EU wide adjustments, but also by global factors. The European Commission (2008) observes that while there have been no major further synchronisation gains since the single currency was introduced, the synchronisation between the

euro area and the rest of the world has increased in the last decade. This suggests that the euro area has been moving more in line with the global business cycle.

This implies that an analysis of euro area business cycles must include a country-specific part relating to country-specific developments and asymmetric shocks, an euro area-wide part reflecting euro area-wide adjustments – including the common monetary policy and symmetric euro area-wide shocks – and a global part that measures the impact of the global business cycle and global shocks. Kose et al. (2008) use such a decomposition of output into country-specific, group-specific, global and idiosyncratic factors to analyse business cycle convergence and decoupling for a panel of 106 countries over the period 1960-2005. Three groups are distinguished: 23 industrial countries, 24 emerging markets and 59 developing countries. For industrial countries, the global factor explains 27 per cent of output fluctuations, the group-specific factor 17 per cent, the country-specific factor 33 per cent and a residual factor 21 per cent. For Western Europe these factors are similar (23 per cent, 22 per cent, 34 per cent and 21 per cent, respectively). Over time, the group-specific factors tend to increase while the global and country-specific factors decrease as a result. This might be interpreted as the influence of phases of 'recoupling and decoupling' in the global economy where global and group/regional factors fluctuate in importance in explaining the business cycles of individual countries. In particular, a recent decoupling of emerging countries could explain why these countries have not been strongly affected by the slowdown in the US economy, which was caused mostly by developments specific to the US.

The increasing global integration is also manifested in two stylised facts that have been observed: (i) the volatility of the business cycle of the global economy and of the developed and developing countries has, on average, declined since the end of the 1970s, and (ii) the synchronisation of business cycles has increased globally. A number of explanations for the observed decline in volatility have been proposed: improved institutional quality contributing to political stability, improved quality of monetary and fiscal management, changes in structural features – such as financial deepening, improved inventory management, the information technology revolution and more flexible labour and product markets – lower terms-of-trade volatility and an overall decline of the size of supply shocks, particularly oil-supply disruptions (a so-called 'good-luck' factor). Explanations for the rise in business cycle co-movement are in particular linked to the observed increase in trade and financial linkages in the global economy and the increase in the symmetry of macroeconomic shocks across countries.

2.1.4 Literature on Country Clusters

Drawing on industrial production data, Camacho et al. (2005a) analyse business cycle co-movement as quantified by a combination of different synchronisation measures. Using data for the 27 EU countries (except Malta and Bulgaria), Canada, the US, Norway, Japan and Turkey, the authors identify three clusters. The first cluster includes the euro area countries (except Finland) plus Denmark, Swe-

den, Cyprus, Lithuania, Slovenia and Hungary. The second group consists of the US, Canada, the UK, Japan and Finland. The remaining countries, i.e. Latvia, Estonia, Slovakia, the Czech Republic, Romania, Turkey, Norway and Poland form the third group.

In a related study, the same authors (Camacho et al., 2005b) measure the similarity of business cycles by considering the duration, amplitude and so-called 'excess' of expansions and contractions. Excess is defined as the departure of the actual growth path from a hypothetical path that would have been witnessed if the transition between the two consecutive turning points in the series had been linear. The analysis is again based on industrial production data for the same sample of countries examined in the previously mentioned study. In this paper, the authors identify four clusters. The first cluster is composed of Cyprus, Estonia, Latvia, Lithuania, Romania and Turkey. The second group consists of Slovakia, the Czech Republic, Denmark, Spain, Sweden, Finland, Luxembourg, Austria, the US and Canada. In the third cluster, Slovenia, Japan, Norway, the UK, Portugal, the Netherlands, Italy, France, Greece, Germany and Belgium are grouped together. Finally, Poland, Hungary and Ireland form the fourth cluster, as they exhibit business cycle characteristics that are most distinct from the other countries.

Graff (2006) estimates the business cycle position on the basis of the deviation between the actual and trend capital coefficient over the period from 1970 to 2000. The sample comprises the 15 EU countries prior to the enlargements of 2004 and 2007 (EU15), plus Argentina, Australia, Chile, Hong Kong, Iceland, Israel, Japan, Canada, New Zealand, Norway, Switzerland, Singapore, Korea, Uruguay and the US. Based on a hierarchical cluster analysis, the author identifies two main business cycle clusters. The first one consists of Belgium, Germany, France, Greece, Ireland, Iceland, Israel, Italy, Japan, Luxembourg, Austria, Portugal, Switzerland and Spain. The second main group is made up of Denmark, Finland, Australia, New Zealand, the US, Canada, the UK, the Netherlands, Norway and Sweden. The remaining countries in the sample exhibit business cycle characteristics that are quite different from these two main country groups.

In an earlier study, Artis and Zhang (1997) measure the business cycle synchronisation of 18 countries, using Germany as a benchmark. The sample comprises the EU15 (except Luxembourg), the US, Japan, Switzerland, Norway and Canada. Three clusters are identified: the "US group", consisting of the US, Canada, Sweden and Finland; the "European group" with Italy, Ireland, the UK, Denmark, Portugal, Norway, Greece and Spain; and the "core group" with France, Austria, the Netherlands and Belgium. Switzerland and Japan do not belong to any of these groups.

2.1.5 Literature on Canada and the US: Lessons for the Euro Area

The literature on business cycle convergence and synchronisation between the provinces and states of Canada and the US as common-currency areas is summarised in table 2. Partridge and Rickman (2005) exclusively analyse the evolution of US state cycles and observe a decline in their co-movement over time despite a

high degree of overall synchronisation. They find the decline of overall US volatility to be the primary source of this result, and point to an important methodological problem regarding the assessment of optimal currency areas. According to the authors, a common monetary policy can still be beneficial despite an increase in asymmetry, provided the magnitude of nation and region-specific shocks declines sufficiently.

In Clark and van Wincoop (2001), de Haan et al. (2002) and Wynne and Koo (2000), the cycles of US states are used as a benchmark in order to evaluate the effects of European monetary integration on business cycle synchronisation. Clark and van Wincoop (2001) compare the degree of synchronisation across US census regions with that across European countries by defining a border dummy that describes the difference between cross-region and cross-country correlations of the considered business cycle variable. Although this border dummy is found to decline over time, a significantly lower degree of business cycle synchronisation across European countries compared to that of US regions is observed throughout. The lower level of trade between European countries seems to play the crucial role in this border effect. As the effect of a common monetary policy on business cycle synchronisation is found to be insignificant, Clark and van Wincoop (2001) do not predict business cycle convergence for the euro area after the adoption of a single currency. De Haan et al. (2002) fail to arrive at a clear answer as to whether the further integration of euro area countries would lead to business cycle convergence. Using pre-war data going back to 1929, they find that business cycles in the US have become less synchronised over time. Significant evidence for convergence is also not provided when the analysis is restricted to post-war data or uses a different number of subperiods. These results, together with the findings for Western Germany (as a second benchmark) and the OECD, do not allow precise conclusions about the potential impacts of the common European currency to be drawn. Wynne and Koo (2000) compare standard deviations and correlation coefficients of business cycle variables across, on the one hand, US Federal Reserve districts, and, on the other, EU countries. Although no clear statement can be made on whether high standard deviations result primarily from synchronous business cycles with different magnitudes or rather from a low degree of synchronisation, lower standard deviations in the cyclical components of employment and GDP can generally be observed in the US.

Imbs (2004) focuses on the determinants of synchronisation, also using US state level data. Estimating a system of simultaneous equations by applying a three-stage least squares (3SLS) approach, he tries to isolate the direct effects of inter-sectoral and intra-sectoral trade, financial integration and sectoral specialisation on the degree of business cycle synchronisation between 24 selected countries as well as between US states. Although the results for the latter are only discussed briefly and are part of a sensitivity analysis that is not reported in the published version of the paper, Imbs (2004) provides evidence that all of the posited determinants of business cycle synchronisation exert a significant effect.

Beine and Coulombe (2003) and Wakerly et al. (2006) focus on features of the business cycles in Canadian regions. In order to find out whether the adoption of the US dollar is preferable for Canadian regions, Beine and Coulombe (2003) in-

vestigate the evolution of business cycles in Canadian provinces relative to the US cycle. They find that correlations between the US cycle and that of the central provinces Ontario and Quebec tended to increase over time, whereas the correlations of the other provinces with the US decreased. Due to this strong heterogeneity between provinces, Canada does not seem to be an optimal currency area. Wakerly et al. (2006) obtain similar results and also report large asymmetries in regional output fluctuations, mainly due to similar levels of technology, as measured by total factor productivity, as well as due to similarity in preferences, as identified using the permanent income hypothesis.

The experience of the US in particular, as reported by Partridge and Rickman (2005), raises concerns about the usual practice of assessing OCAs in terms of cyclical correlation. In the US, close synchronisation can be observed for the period from 1971 to 1998. On the one hand, the analysis suggests that the US best fulfilled OCA criteria in the 1970s, a period in which US monetary policy is viewed as being particularly ineffectual. On the other hand, successful monetary policy during the 1990s was accompanied by a decline in synchronisation, and this business cycle de-coupling did not seem to affect the efficiency of monetary policy. Thus, standard OCA theory does not help to explain US monetary policy. A further lesson can be drawn from the US experience. Behavioural factors such as the political support for US monetary policy or structural factors which are linked to the effectiveness of monetary policy may play an important role for the success of a common monetary policy. The overall implication of this study for the euro area is "*that monetary unions can succeed in a wider range of settings than imagined, such as an inclusive euro area that expands to the UK and elsewhere*".

2.1.6 Literature on Identifying Business Cycle Shocks

2.1.6.1 Structural and Global VAR Models

The analysis of correlation between shocks in different countries could potentially provide information on the symmetry of these shocks. Fidrmuc and Korhonen (2003), who estimate bivariate structural VAR models using an approach suggested by Bayoumi and Eichengreen (1992) for the euro area and the individual countries, compare the estimated supply and demand shocks of every country with those of the euro area model. Their aim is to provide empirical evidence on the degree of structural shock symmetry between the New Member States (NMS) and the euro area. The correlation of demand shocks with the euro area appears to be lower than the correlation of supply shocks for most of the NMS. Moreover, most NMS exhibit lower scores than the current euro area countries when tested for macroeconomic shock correlation in relation to the euro area aggregate.

The Global VAR (GVAR) approach, introduced by Pesaran et al. (2004) for modelling interdependencies among many countries, provides a solution to the degrees-of-freedom problem by estimating country-specific VARs with exogenous variables (VARX). Foreign variables are modelled as exogenous. Those ex-