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Globalisation: the End of National Economic Policy?
New Forms of International Business Cycle Linkages

Edited by
Joachim Scheide, Thomas Straubhaar and Rainer Winkelmann

Duncker & Humblot · Berlin

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Editorial

This supplement to *Applied Economics Quarterly* reports on the 66th Annual Meeting of the Association of German Economics Research Institutes (ARGE), which took place in Berlin on May 15, 2003. The topic was

**"Globalisation: the End of National Economic Policy?
New Forms of International Business Cycle Linkages"**

Annette Kuhn (IfW Kiel) and Roland Doehrn (RWI Essen) were responsible for the conceptual preparation of the conference. The opening address was given by Willi Koll (BMWA – Federal Ministry of Economics). Subsequent sessions were organized in the form of presentations, each followed by a discussant's statement. The following authors contributed to the conference: Volker Clausen (Essen); Christian Dreger (Halle / Saale); Horst Entorf (Darmstadt); Ferdinand Fichtner (Cologne); Gerhard Flaig, Jan-Egbert Sturm and Ulrich Woitek (Munich); Gustav-Adolf Horn (Berlin); Andre Jungmittag (Wuppertal); Willi Koll (Berlin); Annette Kuhn (Kiel); Bernd Lucke (Hamburg); Torge Middendorf and Nils A. Radmacher-Nottelmann (Essen); Manfred J. M. Neumann (Bonn); Michael Schroeder (Mannheim).

Next year's Research Meeting is scheduled for April 22 / 23, 2004 in Berlin and will deal with

**"*Reformstau:* a Logjam of Reform in Europe
and the Economics of Reform".**

The next meeting will be organized in association with non-German European research institutes.

June 2003

Joachim Scheide
Thomas Straubhaar
Rainer Winkelmann

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Economic Policy in the Light of New Forms of International Business-Cycle Convergence

By Willi Koll*

Since the massive and synchronous world-wide economic slump of 2000/2001, the topic of "business-cycle convergence" has been the object of intensive discussion by academics and policymakers. But there are significant differences between many of the perspectives taken and conclusions drawn. We must therefore be clear about what we mean by the term "business-cycle convergence" and about the economic processes and phenomena it involves; for it is of central importance for economic-policy conclusions and recommendations for action.

1. Business-Cycle Convergence from the Perspective of Economic Policy

The synchronous trend of growth rates is not a reliable yardstick for determining the degree of integration of the global economy and for identifying the genuine influence of global economic impulses on domestic economic trends.

The following is a good illustration of this point: a simple correlation of growth rates indicates a decrease rather than an increase of convergence of business cycles among Germany, the United States, and the world economy since the seventies (in the nineties there was even a counter-trend!). Some recent studies (which are making use of more refined methodologies) also arrive at a conclusion of diminished business-cycle convergence (Fig. 1 see page 10).

But great care should be taken for policymakers not to look at the diminished convergence and draw any premature or false conclusions about the actual significance of global economic inter-action and the resulting need for political action. From the economic policy perspective, it is important clearly to distinguish three different dimensions or levels of business-cycle convergence, and to ask:

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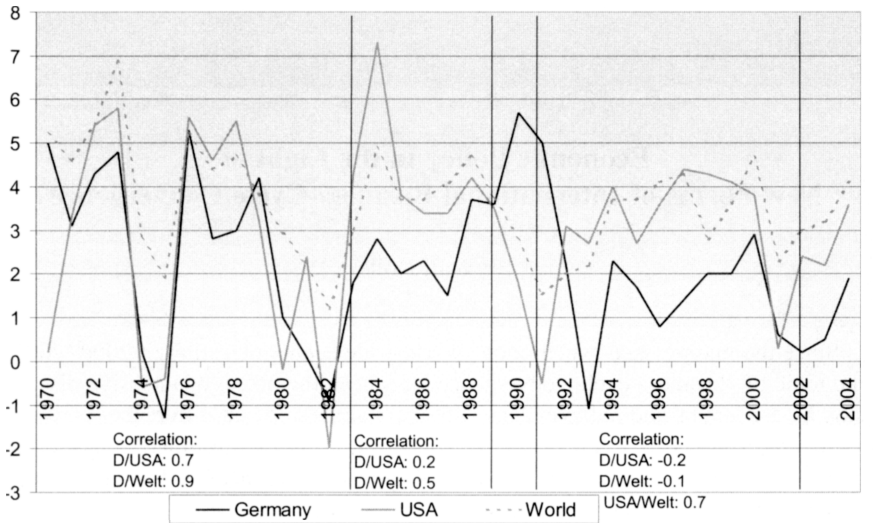
* This paper is based on a publication by the Federal Ministry of Economics and Technology (2002): Germany's Integration in Global Economic Processes – The Increasing Significance of "New" Transmission Mechanisms.

Author's address: Federal Ministry of Economics and Labour, Berlin



Source: IMF, World Economic Outlook, April 2003.

Figure 1: Germany, USA, World: Real Growth – % change from previous year

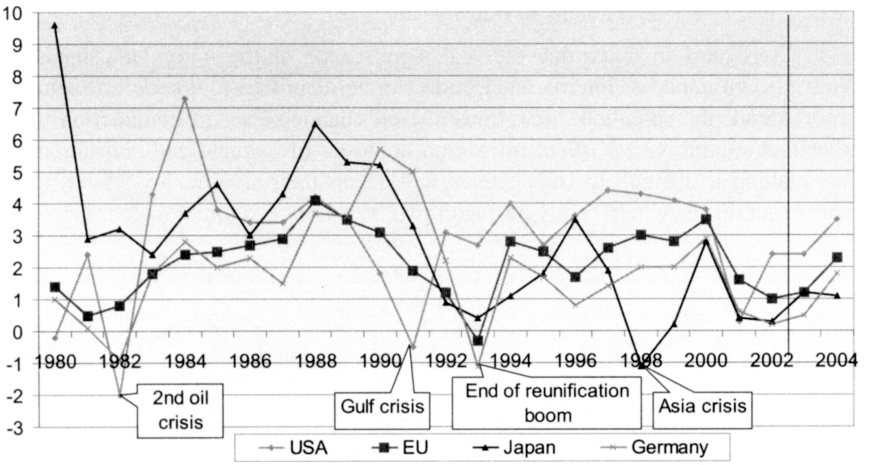
➢ First: **What impulses or "shocks" – global or country-specific – trigger the economic fluctuations?**

The seventies and eighties were largely characterized by shocks, such as the two oil crises, that impacted all economies worldwide both similarly and above all simultaneously, and for this very reason produced synchronous developments. By contrast, important impulses to economic activity in the nineties – German reunification and the Asia crisis are examples – in the initial phase affected only individual regions and, in terms of their timing of positive and negative events (such as the Gulf War / reunification at the beginning of the nineties), had an internationally contrary impact, and thus an offsetting effect. These offsetting, country-specific "shocks" of the nineties have masked over the increasing significance of business-cycle transmission and thus resulted in an underestimation of global economic interaction with the consequence of contributing to serious mistakes in growth forecasting in recent years (Fig. 2 see page 11).

➢ Second: **What are the actual transmission mechanisms?**

There is far-reaching agreement (including IMF, OECD, EU Commission, German Council of Economic Experts) that global economic integration has appreciably increased, in particular as the result of the "new transmission mechanisms," which I will return to in greater detail in the next chapter. Global changes have a

far stronger and faster impact on domestic economic dynamics than even only a few years ago.



Source: IMF, World Economic Outlook, April 2003; Arbeitsgemeinschaft deutscher wirtschaftswissenschaftlicher Forschungsinstitute, April 11, 2003.

Figure 2: USA, Japan, Europe and Germany: Real Growth – % change from previous year. 2003 and 2004 projections in research institutes' spring report

➢ Third: **How are global economic changes handled by the domestic economy?**

The ability to adapt, flexibility on the part of the domestic economy, and the possibilities of policy response ultimately determine – as key links in business-cycle convergence – the extent to which global economic changes translate into growth losses or growth impulses. The strengthening of resilience to global economic shocks is therefore a central challenge to be confronted by national economic policy. Above all, this aspect should not be overlooked with regard to the question of the impacts of international business-cycle influences.

"Business-cycle convergence" thus appears as the result of the interaction of the three elements "shock," "transmission," and "resilience."

2. New Transmission Mechanisms

Developments of the past several years show that global economic impacts on the German economy – regardless of whether they impede or stimulate – may be explained less and less only in terms of the so-called "classic mechanisms of transmission" (i.e. exchange-rate / interest-rate convergence, foreign trade). Increasing

direct investment by globally operating companies, international financial markets that are becoming more and more interrelated, and the expectations of investors and consumers that are influenced by international developments have helped create new and effective channels of transmission.

But it is hard to determine the real significance of the individual channels. While the influence of international trade can be identified *indirectly* through the export trend, the so-called "new transmission channels" act in conjunction with other factors and have a *direct* impact on domestic investment and consumption, thus making it difficult to isolate them and assess their significance. Arriving at more exact results would surely be a worthwhile task for economic science (Fig. 3).

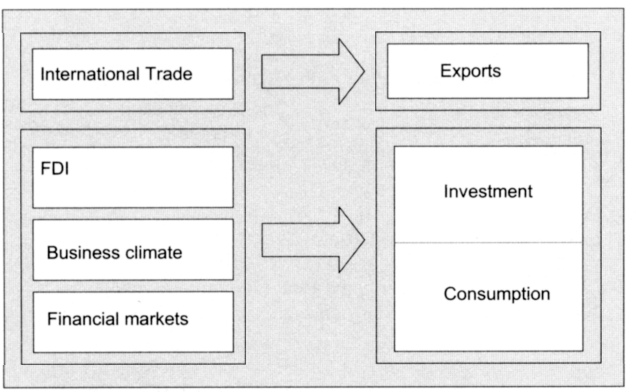
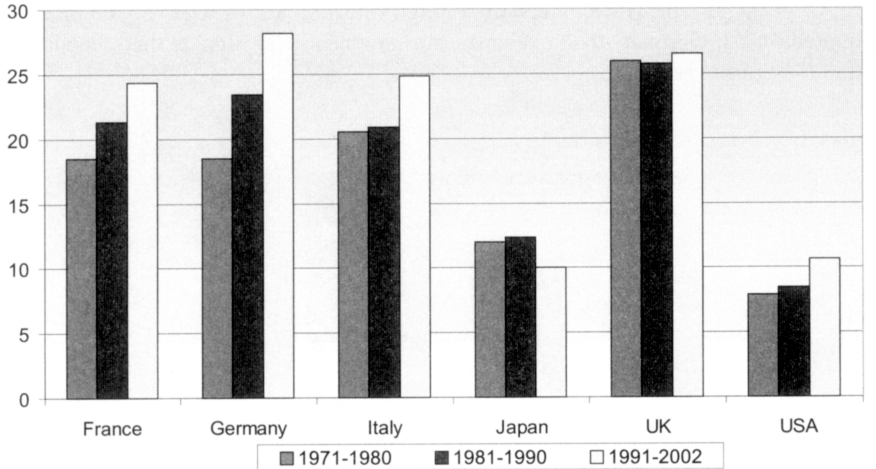


Figure 3: International Linkages:
New Transmission Channels gaining in Importance

2.1 Foreign Trade: a Factor of Continued Importance

As the world's vice-champion in exports, Germany is particularly dependent on the development of world trade: the long-term average trend of export ratios in the G7 countries shows a continuous increase in Germany's export-openness. By contrast, only a very slight change has been noted for Japan, the UK, and the United States (Fig. 4 see page 13).

Third-country effects via world trade are more important than bilateral trade flows: Studies (among others, by the INSEE, France's National Institute for Statistics and Economic Studies) show that, for example, the negative influence of slower growth in the United Sates on economic growth in Germany is approximately three-times stronger via world trade (i.e. including third-country effects) than alone through bilateral trade between Germany and the United States.

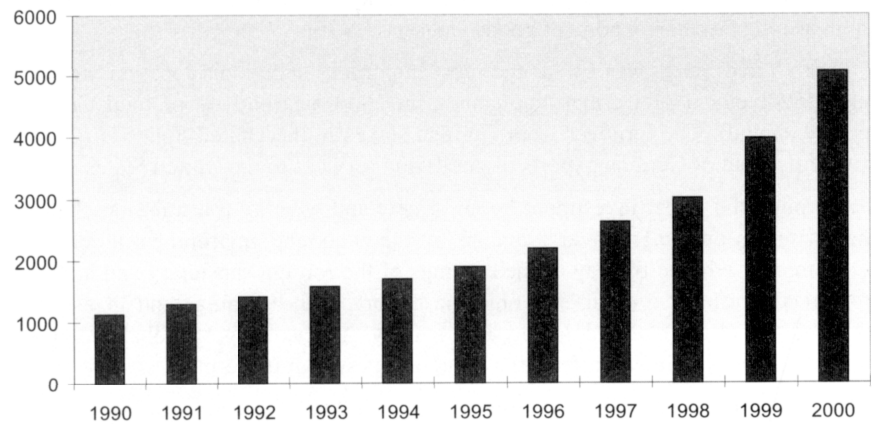


Source: OECD.

Figure 4: G7: Exports' Share of GDP[1] – in %

2.2 International Direct Investment and Corporate Integration have Gained Considerable Importance in Recent Years

The total amount of German direct investment abroad has more than quadrupled in the ten years from 1990 to 2000 (Fig. 5).

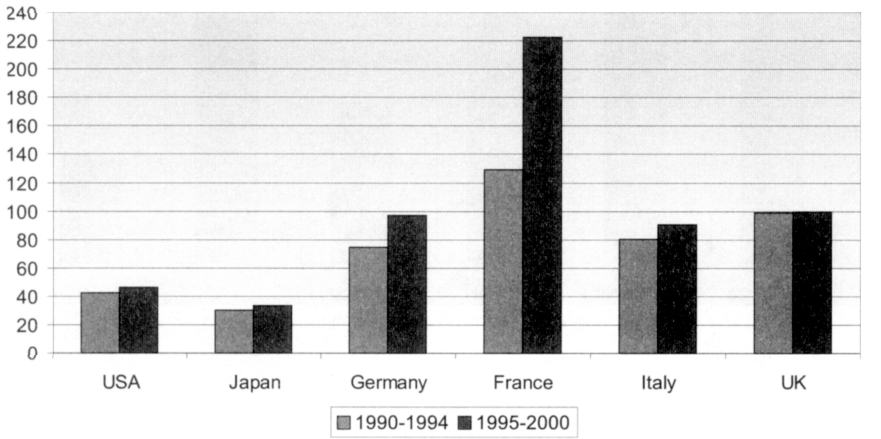


Source: Deutsche Bundesbank.

Figure 5: Stock of German Direct Investments Abroad – in Euro (billions)

[1] Nominal, exports of goods and services.

According to the IMF, sales by foreign subsidiaries of German companies quoted on the German stock exchange are now nearly as high as the companies' domestic turnover (Fig. 6).



Source: IMF 2001.

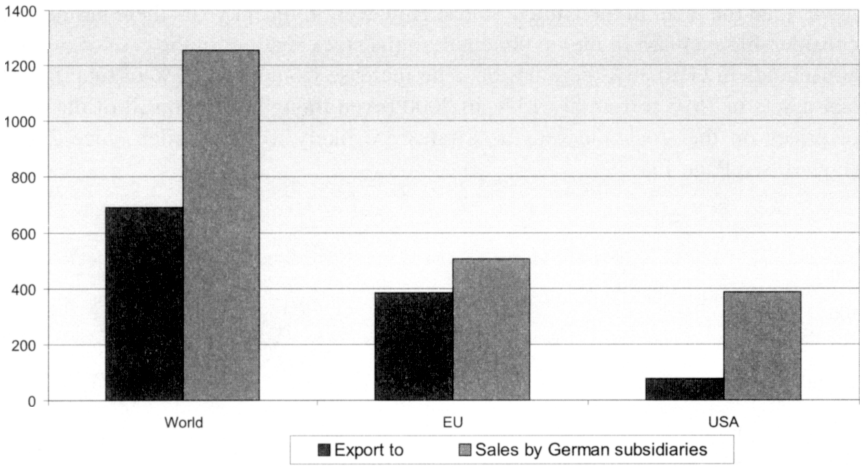
Figure 6: Sales of Foreign Subsidiaries in % of Domestic Sales by Companies Quoted on Stock Markets
1990 – 1994 by comparison with 1995 – 2000

In 2000, the global turnover of German subsidiaries abroad was nearly twice as high as total German exports of goods and services (Fig. 7 see page 15).

The United States was by far the most important "individual location" for foreign involvement of German companies (in 2000, nearly 30% of total German equity capital). The turnover from German stakes in the United States is roughly five times that of German exports of goods and services to the United States.

Through the direct investment boom, a new and weighty transmission channel has arisen in only a few years: changes in the economic environment abroad are felt directly at home by way of the earnings of the foreign subsidiary and are able to directly influence – thus not only via exports – the earnings and investment possibilities of the parent company in Germany. A weakening of global economic activity therefore directly affects the trend of investment in Germany.

But trade flows are also increasingly directly linked with corporate involvement abroad: initial estimates by Germany's Federal Statistical Office suggest that some one-third of German exports and imports of goods now take place among affiliated companies (intra-company trade).



Source: Deutsche Bundesbank.

Figure 7: Germany's Exports and Sales by German Subsidiaries Abroad – 2000 in Euro (billions)

2.3 Changes in the Mood of Consumers and Investors are Directly Transmitted

Recent studies (IMF, DIW) show that the mood in European business and industry reacts far more strongly to changes in the business climate in the United States than parallel economic trends would be able to explain. "Climate transmission" above all from the United States has clearly become more significant in recent years.

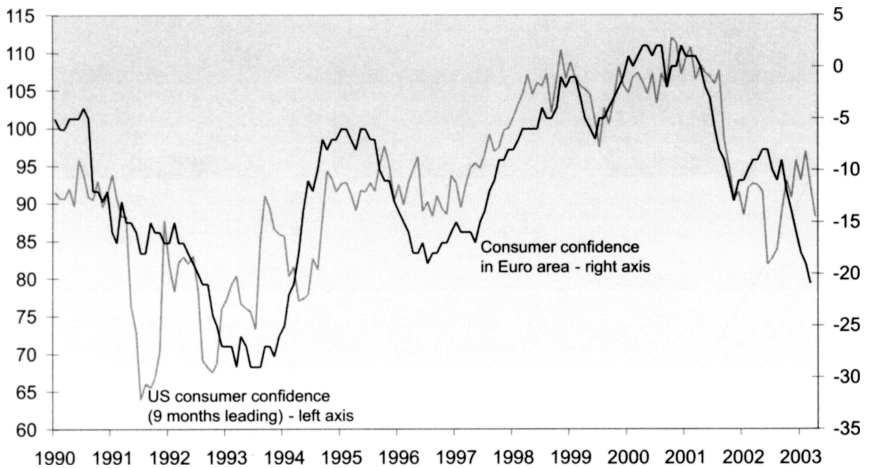
Also consumers' confidence in the future would increasingly appear to react to fluctuations in the global economic climate. In recent studies, the EU Commission has identified an every closer link between the trend of consumer confidence in the United States and Europe (Fig. 8 see page 16).

2.4 The Growing Together of Financial Markets Synchronizes Economic Trends

The trends on financial markets in the United States and Europe are increasingly moving on parallel tracks. Worldwide "branch-related business-cycles" (IT stocks) are increasingly replacing regionally limited "location-related business cycles." Refinancing possibilities, above all for growth companies quoted on the stock exchanges, thus move in a more and more synchronous manner (Fig. 9 see page 16).

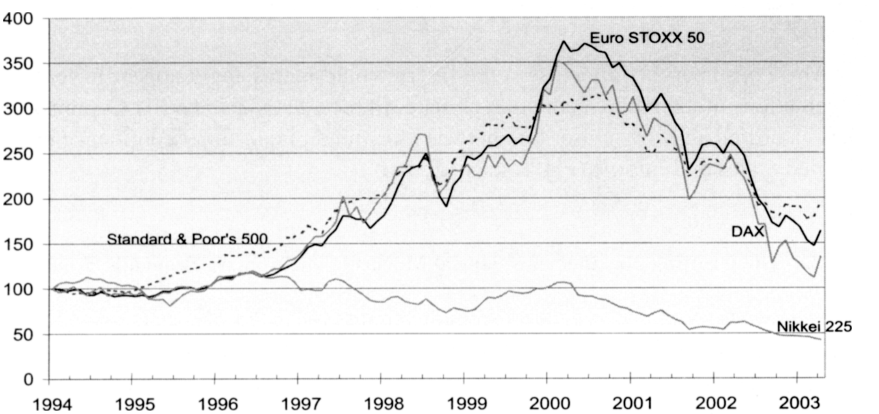
In Europe, the share of private households' financial assets accounted for by stock and investment certificates quoted on the stock markets is still significantly

lower than the level in the United States. However, in recent years there has been a considerable increase in the involvement in the stock market: in the case of private households in Germany, there has been an increase from some 10 % of total financial assets in 1995 to roughly 17 % in 2000 (even though as the result of the drop in prices on the stock market, these rates are likely to have fallen since 2000) (Fig. 10 see Page 17).



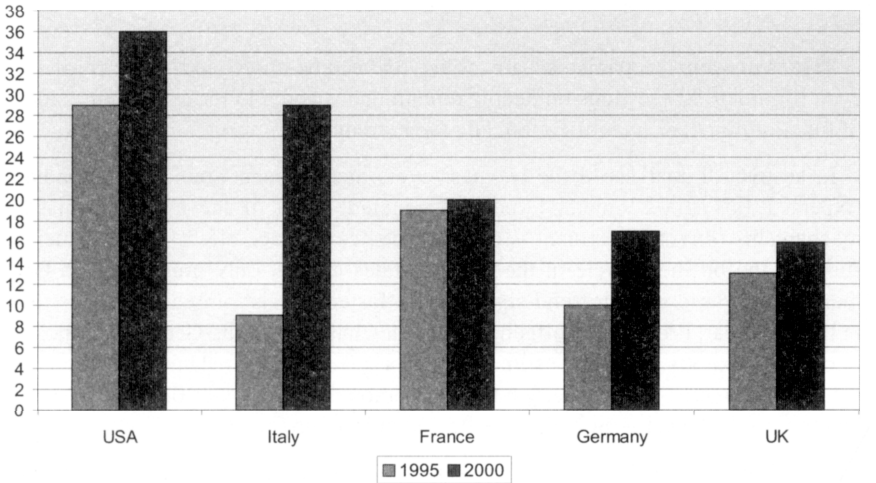
Source: University of Michigan, European Commission.

Figure 8: Consumer Confidence in Euro Area and in USA



Source: ECB.

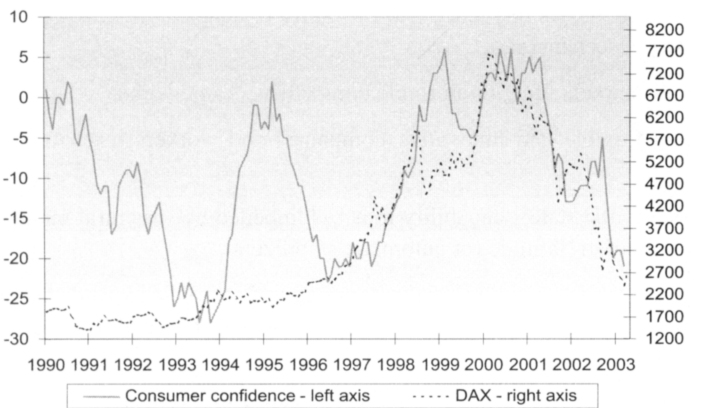
Figure 9: Trend of Stock Market Prices EU / USA / Japan / Germany
(January 1994 = 100)



Source: Deutsche Bank 2001.

Figure 10: Share of Households' Financial Assets accounted for by Issues and Investment Certificates Quoted on Stock Markets

Even if, according to most studies, direct wealth effects on private consumption are likely to have had little significance in Germany thus far, the link between consumer confidence and the trend on the stock market has become increasingly pronounced in recent years, just as in the United States. It should be added, however, that parallel movement of expectations for the future will also likely play a role as a common factor (Fig. 11).



Source: ECB, European Commission.

Figure 11: Consumer Confidence and Stock Price Trend in Germany

Conclusions

"Transmission mechanisms" are going to become more and more important even if numerous questions on details remain unanswered in terms of their manner of functioning, their quantification, and their strength of impact.

In an overall analysis of the business-cycle, the German Council of Economic Experts (2001 / 2002 Annual Expertise) concludes that, if the new transmission mechanisms (direct investment, stock markets, confidence effect) are considered, shifts in the business cycle in the United States are not only transmitted to Germany's economic growth trend significantly faster but also, three times as strong in the first year. Professor Wolfgang Wiegard, Chairman of the German Council of Economic Experts, recently estimated that a 1 % decline in United States GDP results in an increase of capacity under-utilisation in Germany of 0.3 to 0.4 percentage points for a year – more than in the rest of the Euro zone.

The IMF also confirms (October 2002 country report on Germany) a link between growth declines in the United States and diminishing vitality in Germany that is more pronounced than in the rest of Europe.

3. Political Conclusions

3.1 National Economic Policy: Increasing the German Economy's Resilience in the Face of "external Shocks"

"External shocks" (e.g. geopolitical conflicts, terrorism, oil-price trend, financial market instability) cannot be ruled out in the future.

An open economy's resilience and its ability to adapt in the face of global economic disturbances increase

- the better markets function in stable competitive frameworks;
- the more flexible and innovative companies and workers react to new conditions;
- the less that the state's capability to act is impeded by structural budget deficits and debt burden (latitude for automatic stabilizers).

Reforms that take account of these principles not only expand the long-term growth and employment potential of the economy but additionally make the growth process more robust.

➢ **Structural reforms of the past several years** in Germany contribute importantly in this context (e.g. tax reform 2000, comprehensive market liberalization in telecommunications / energy / post / transport, strengthening of research and development activities, modernization of education and training).

➢ **Agenda 2010:** The comprehensive reform measures packaged together in the Federal Chancellor's reform agenda should thus not only be understood as national steps toward more growth and employment. Structural reforms on the labour market, in social insurance systems, and for the promotion of entrepreneurship and private initiative serve as important contributions to increasing indigenous vitality and thus the structural resilience of the German economy in the face of "external shocks."

3.2 Thinking and Acting European

Recent experience has shown that European integration cannot provide insulation from global economic influences or freedom from national responsibility. But by way of the internal market and single currency it offers the opportunity for more competition, greater efficiency and innovation, and thus for more indigenous vitality from a stable, common, inner base.

But to ensure that this is the case, European policy must be conducted in each country. Such a policy must be based on a cross-border perspective; it must allow a single and open market to develop; and it must utilise European competition as an innovative force (also in policymaking by using benchmarking and best-practice comparisons). Synergies in knowledge acquisition and use must be encouraged.

A solid framework of fiscal policy as provided by the stability and growth pact, and a wage trend conducive to stability and employment are needed as prerequisites which allow monetary policy to support growth and employment without jeopardising price stability.

Despite the numerous deficits in enactment that undoubtedly still exist, we are making gradual progress on this path to an integrated Europe (inter alia common stability culture in fiscal and monetary policy; market liberalisation in the electricity, gas, postal, and railway sectors; common competitive policy and supervision of the granting of aids; closer financial market integration through the Euro; mobility in the education and science sectors and among companies and workers).

3.3 Intensifying International Co-operation

➢ Closer global economic integration is important for all of the industrial countries and means for them an expanded responsibility for global economic events.

➢ There is basically an institutional framework for the necessary international dialogue; necessary is the willingness of *all,* even for difficult national topics (such as WTO / agriculture) to think, act, and co-operate at the multilateral level more with an eye to the global economic implications.

➢ Global governance in multilateral co-operation is becoming a task of central importance for the future.

Examples of central fields where action is needed are:

➢ **International Monetary Fund:** Of increasing importance for the stability of the overall world economy is the need to safeguard the stability of the international financial system as a global public-good. Against this background, we see greater IMF activity in the following areas as especially important:

- *Crisis prevention* (including transparency and early action, greater IMF surveillance of the Member Countries; a strengthening of individual responsibility and ownership in the context of IMF loan programs);
- *Monitoring of the international capital markets* as developments occur (regular IMF capital market reports and co-operation with private market players have proved to be valuable measures);
- *Private sector involvement* to help overcome crises (*inter alia* clearly restricted access to IMF funding for Member Countries, avoidance of unjustified bail-outs and moral hazard);
- New mechanisms for avoiding *crises of over-indebtedness* (we support IMF efforts to find new ways for timely debt restructuring for emerging and less developed countries. Since a comprehensive sovereign debt restructuring mechanism (SDRM) is not now feasible at the international level, work on collective action clauses and on a voluntary code of conduct must be intensified.

➢ **WTO:** Of decisive importance as a signal for functioning international co-operation is a successful conclusion of the Doha Round. There is concern that progress has thus far been made on only a small part of the Doha agenda for negotiations. Above all in the critical negotiating areas (agriculture, issues involving developing countries such as access to medication), decisive progress must be achieved before the opening of the Cancún ministerial if success is to be ensured.

➢ **G7 / G8 process:** The annual summit of heads of state and government presents the opportunity for dealing with global economic topics of central importance at the highest level and drafting joint efforts. In view of the close linkage of the G7 / G8 process with the economic policy administration of the G7 countries, the world economic summit – as an ongoing discussion process – has proven to be a powerful flywheel for international co-ordination, harmonisation, and joint actions.

Above all these co-ordinating processes are of enormous importance in our present difficult situation, for they act to strengthen confidence in the ability of governments to act at the international level.

International Synchronization of National Business Cycles?

By Gebhard Flaig*, Jan-Egbert Sturm*, ** and Ulrich Woitek**

Abstract

This paper explores the extent to which co-movement in business cycles in the G-7 countries has changed over the last fifty years. Several complementary methods are applied to check the robustness of the findings. The most important result is that the correlation between the national business cycles was remarkably high during the fifties and early sixties of the last century, declined in the late sixties to in some cases even negative values and recovered after the first oil price shock. Over the last two decades we observe a rather stable and high co-movement of the national business cycles.

Keywords: business cycles, economic integration

JEL classification: C20, E32, F02

1. Introduction

In an open economy, business cycle developments not only depend upon internal supply and demand factors, but also from shocks originating in other countries. The increasing international integration of goods, capital and factor markets suggests that economic dynamism in one country is more responsive to external influences as used to be the case. This suggests increasing business cycle affiliations. On the other hand, however, economic and financial integration allows countries to exploit comparative advantage through specialization, which leads to increased macroeconomic asymmetry (Krugman, 1991). This paper explores the extent to which co-movement in business cycles in the G-7 countries has changed over the last fifty years. Several complementary methods will be applied to check the robustness of our findings.

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The degree of synchronization depends upon the correlation of the external shocks between countries and the intensity to which single markets are internationally integrated. For instance, changes in oil prices affect countries simultaneously, but to a different extent. It is also possible that shocks that originate in one particular country expand across border and affect other countries as well. Following the European Commission (2001, p. 7), the transmission channels can be grouped into four: international trade, the corporate channel, confidence effects and financial linkages. Ideally, one needs a structural model to be able to differentiate between these channels and to test whether at least one of these channels has changed over time. There is a general feeling that all four channels have indeed become more important in recent history. Removal of trade barriers has boosted international trade, especially between European countries. Recent years have witnessed exponentially increasing flows of foreign direct investment. Confidence indicators throughout the world have moved in tandem in recent years. As confidence influences business cycles, the increased international co-movement of confidence indicators could suggest a larger transmission of shocks. Finally, linkages through financial markets have become stronger as investors have increased the international diversification of their portfolio.

The often mentioned intensification of international business cycle co-movement has clear implication for economic policy. For instance, many economists argue that divergence among the EMU member countries still is so high and the flexibility of labor markets so low, that the euro-zone common currency area is not optimal from an economic point of view (De Grauwe, 2000; Eijffinger and De Haan, 2000). Various studies have, in that respect, pointed out that business cycles in the euro-zone countries diverged considerably in the past (see, e.g. Christodoulakis, Dimelis and Kollintzas, 1995). However, in assessing the economic case for EMU the crucial question is how likely it is that business cycles will diverge in the future.[1]

This paper explores to which extent co-movement of business cycles actually has increased over time and should therefore be seen as an – in our view – first and necessary step in a larger project on business cycle synchronization. We concentrate on the seven largest OECD countries, i.e. the G-7. The next section will discuss the data and present some descriptive statistics. Section 3 uses rolling correlation coefficients for the cyclical component generated by an Unobserved Components Model, whereas Section 4 applies spectral analysis to the problem at hand. We end with some conclusions.

[1] Arthis and Zhang (1999) found evidence that business cycles are becoming more synchronous across Europe. This view is challenged by Inklaar and De Haan (2001).

2. Data

In order to analyze business cycles across countries and over time, we need to observe the evolution of a measure of production both comparable across countries and over time. The latter implies focusing on a measure like real GDP. Cross-country comparison forces us to convert real GDP into one unit of measure. As we do not want the data to be influenced by the relatively volatile movements of exchange rates, we turn to Purchasing Power Parities (PPPs). We use GDP measures based on constant PPPs. This approach to generate time series of PPPs is to fix a 'base' year and to extrapolate PPPs for other years. Extrapolation is done by applying the relative rates of inflation observed in different countries to the base year PPPs. GDP series in national currency and at current prices can now be converted with these PPPs to yield volume measures that are comparable across countries. The resulting measures of GDP comparisons are volume indices at constant prices and PPPs.[2]

These time series have a very convenient property: they replicate exactly the relative movements of volume GDP growth of each country, which facilitates the use and interpretation of PPPs over time. Another advantage is that the resulting series is unaffected by methodological changes relating to the calculation of PPPs.[3] For these reasons, the OECD recommends indices based on constant PPPs for the analysis of relative business cycle performance between countries and over time.[4]

The GDP data comes from the GGDC Total Economy Database at the University of Groningen and The Conference Board.[5] This database is strongly rooted in the work of Angus Maddison. For most countries trends in GDP before 1990 are derived from Maddison (2001) as well as some of Maddison's other publications. GDP series since 1990 are constructed by researchers of the Groningen Growth and Development Centre and The Conference Board. In some cases the long-run series were revised when new estimates came available. We use the tables for OECD countries expressed in 1999 US dollars, for which 'EKS' purchasing power parities (as published by the OECD, 2002) have been used. For all G-7 countries, data covers the period 1950 until 2002.[6] Figure 1 shows the GDP growth rates for (the sum of) these countries.

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[2] The same result would have been achieved by applying volume growth rates of GDP to the comparative GDP levels of the base year.

[3] A drawback of this approach is that it is assumed that price structures do not change over time. Economic reality has it, however, that relative prices do change over time and it is well known that ignoring these shifts over longer periods can generate a biased picture of economic developments. Another consequence of fixing price structures at a base year is the dependence of results on the choice of the base year.

[4] For the latest 'snapshot' comparisons of GDPs and therefore business cycles across countries, the OECD recommends the use of indices based on current (benchmark) PPPs.

[5] http://www.eco.rug.nl/ggdc

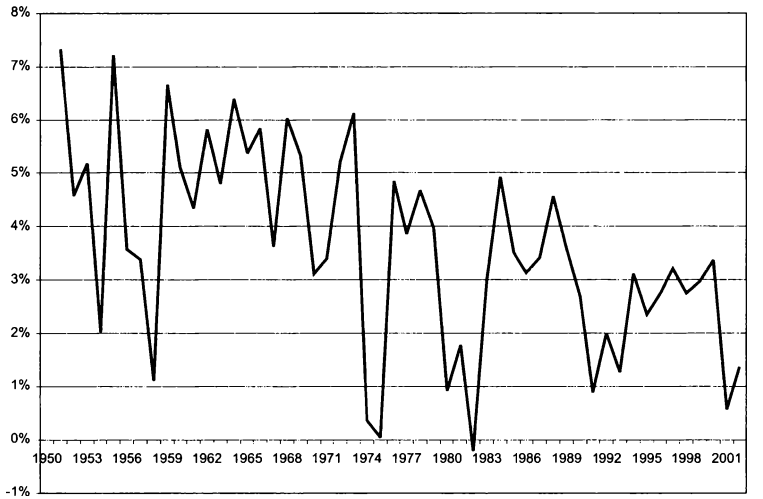

Figure 1: Growth rates for G-7 GDP

To analyze the issue of business cycle synchronization, it is necessary to determine the cyclical component of output. The problem we face here is that the widely used filtering methods cause artificial cyclical structure when applied to a series based on a data generating process different from the assumptions underlying the chosen filter.[7] Following Canova (1998), we chose the pragmatic way of comparing the results for different filters, e.g., the difference filter, the Hodrick-Prescott filter (HP, Hodrick and Prescott, 1997), the Baxter-King filter (Baxter and King, 1999) with a modification by Woitek (1998) and the filter generated by an Unobserved Components Model.[8]

2.1 Correlation Coefficients

Arguably the most commonly used measure of co-movement is correlation analysis.[9] Correlation analysis is used to summarize the extent to which the cyclical components exhibit co-movements across countries. A high coefficient of correla-

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6 The G-7 countries include Canada, France, (West-) Germany, Italy, Japan, the United Kingdom and the United States.

7 See the discussion in Cogley and Nason (1995), King and Rebelo (1993) and Harvey and Jaeger (1993).

8 Note that, Arthis and Zhang (1997, 1999) and De Haan et al. (2002) report that their results are not dependent on the choice of the detrending method.

9 Recently, Harding and Pagan (2002) proposed a new 'concordance' measure as new indicator for economic convergence. We will not focus on this new measure.

tion indicates that countries tend to be in similar states of cyclical movement. The degree of synchronization itself is determined on the basis of contemporaneous cross-correlation, while the overall linkage between cyclical movements is measured by the maximum coefficient, which emerges from cross-correlation at different lags and leads. This allows for a fairly comprehensive analysis. Developments in synchronization over time are examined on the basis of the contemporaneous cross-correlation coefficients for rolling 10-year periods.[10]

While evidence of increasing or decreasing synchronization may emerge, there is uncertainty as to whether this is due to generally higher or lower linkages in cyclical developments or simply to a phase shift of the cycles, effectively reducing the number of lag and lead periods during which the maximum correlation occurs. Evidence of increased synchronization may thus be considered most convincing if the contemporaneous correlation is increasing over time and tends to be equal to the maximum correlation at a zero lag or lead (ECB, 1999).

There are drawbacks when using 'moving windows'. For instance, the results might be quite dependent on the size of the window. For example, if the moving window covers a common shock (such as the oil price shock in the 1970s), correlation is very high, and immediately drops once this common shock is no longer covered.

In this section we restrict our attention to a correlation analysis for the period 1950 until 2002. In a first step we explore the association between the growth rate of GDP of each country and the growth rate of GDP of the rest of the G-7 countries.

The left-hand side of Table 1 shows the highest cross-correlation coefficients between the growth rates of single countries versus the growth rate of the rest of the G-7 countries. As the first column indicates, the contemporaneous correlation coefficient is the highest among all lead / lag-relationships.

Using the cyclical component extracted by using the Hodrick-Prescott-filter the picture is somewhat changed. The right-hand side of Table 1 shows that in this case the US leads the other G-7 countries by one year; France, Germany, Italy and Japan on the other hand lag the other G-7 countries by one year. The differences in correlation coefficients are substantial. Whereas Canada, France, Italy and the United Kingdom all report correlation coefficients of around 0.7, for Germany and Japan its magnitude drops to 0.38 and 0.37, respectively.

[10] For our purpose, to determine the evolution of co-movement over time subsamples need to be examined. This makes the measure sensible to the length of the samples.

Table 1

Maximum cross-correlations for single countries versus G-7 countries

	Growth rates		HP filtered series	
	lead / lag	corr.	lead / lag	corr.
Canada	0	0.71	0	0.70
France	0	0.63	-1	0.71
Germany	0	0.57	-1	0.38
Italy	0	0.60	-1	0.70
Japan	0	0.56	-1	0.37
United Kingdom	0	0.50	0	0.70
United States	0	0.47	1	0.54

3. Synchronization of Business Cycles in the Time Domain

3.1 The Econometric Model

In this section we employ an Unobserved Components Model in order to extract the cyclical component from the yearly GDP series for single countries and the rest of the G-7 countries, respectively. In a second step, we use rolling correlation coefficients to analyze the changing pattern of synchronization between the national and international business cycles.

The basic assumption underlying Unobserved Components Models is that an observed time series y_t can be decomposed into several interpretable components (for a general discussion see Harvey, 1989; Maravall, 1995). In the following, we decompose the logarithm of the yearly GDP series into the unobserved components trend T, cycle C, and the irregular I:

$$y_t = T_t + C_t + I_t \ . \tag{1}$$

The trend component represents the long-run development of GDP and is specified as a random walk with a possibly time-varying drift rate μ_t:

$$T_t = T_{t-1} + \mu_{t-1} + \varepsilon_t \ . \tag{2}$$

The level impulse ε_t is a white noise variable with mean zero and variance σ_ε^2. The drift rate μ_t is allowed to vary over time and is also defined as a random walk:

$$\mu_t = \mu_{t-1} + \xi_t \ . \tag{3}$$

The drift impulse ξ_t is a white noise variable with variance σ_ξ^2.

The model specified in equations (2) and (3) implies that the trend component follows an IMA(2,1)-process. Special cases emerge when we set the variance of the shocks to zero. If both are zero, we get a deterministic linear trend. If σ_ξ^2 is zero and σ_ε^2 is strictly positive, the model collapses to a random walk with a constant drift rate. The opposite case with a strictly positive σ_ξ^2 and σ_ε^2 equal to zero gives an integrated random walk with a usually smooth trend component.

The *cycle* C_t captures the business cycle fluctuations around the trend component and is modeled as the sum of M subcycles with different frequencies:

$$C_t = \sum_{i=1}^{M} C_{t,i} \ . \tag{4}$$

The specification of the total cycle as the superposition of subcycles with different frequencies is able to represent some ideas of classical business cycle theory (e.g., the existence of Kitchin or Juglar cycles) and to capture several forms of business cycle asymmetries (for some alternative specifications see Harvey, 2002, and Harvey and Trimbur, 2001).

Each subcycle is specified as a vector AR(1) process:

$$\begin{pmatrix} C_{t,i} \\ C_{t,i}^* \end{pmatrix} = \rho_i \begin{pmatrix} \cos\lambda_i^C & \sin\lambda_i^C \\ -\sin\lambda_i^C & \cos\lambda_i^C \end{pmatrix} \begin{pmatrix} C_{t-1,i} \\ C_{t-1,i}^* \end{pmatrix} + \begin{pmatrix} \kappa_{t,i} \\ \kappa_{t,i}^* \end{pmatrix} . \tag{5}$$

C^*appears only by the construction of the recursion and has no intrinsic interpretation.

The period of subcycle $i$is $2\pi/\lambda_i^C$ with λ_i^C the frequency in radians. The damping factor $\rho_i$with $0 < \rho_i \leq 1$ ensures that $C_{t,i}$ is a stationary ARMA(2,1) process with complex roots in the AR-part (see Harvey, 1989). This guarantees a quasi-cyclical behavior of $C_{t,i}$. The shocks $\kappa_{t,i}$ and $\kappa_{t,i}^*$ are assumed to be uncorrelated white noise variables with common variance $\sigma_{\kappa_i}^2$. They induce a stochastically varying phase and amplitude of the wave-like process. The total cycle C_t is an ARMA($2M$,$2M$-1) process with restricted MA-parameters.

The *irregular component* is specified as a pure white noise process:

$$I_t = u_t \ . \tag{6}$$

It is assumed that all disturbances are normally distributed and are independent of each other. This is the usual assumption to assure the identification of the parameters (see, e.g., Watson, 1986).

Estimation of the model parameters is carried out by maximum likelihood in the time domain. The initial values for the stationary cycle components are given by

the unconditional distribution and for the nonstationary trend and drift components by a diffuse prior. The filtered and smoothed values of the unobserved components are generated by the Kalman filter (for details see Harvey, 1989).

3.2 Empirical Results

After an intensive specification search we choose a model with two subcycles. This model passes all specification tests and delivers plausible estimates for the trend and cycle components. The short subcycle varies between 3.5 and 5 years, the long subcycle between 9 and 12 years.

Figures 2 to 8 show the results for the G-7 countries. The upper part of each figure contains the estimated cyclical component for the individual country (thick line) and for the rest of the G-7 countries (thin line).

In the lower part of each figure the rolling contemporaneous correlation coefficients between the two cycle components are depicted (thick line). Each value of the correlation coefficient is calculated over a window of the past 10 years. In order to capture some phase shifts between the cycles of different countries we calculate in addition a centered three year moving average of each cycle component. The thin line shows the rolling correlation coefficients for the moving average.

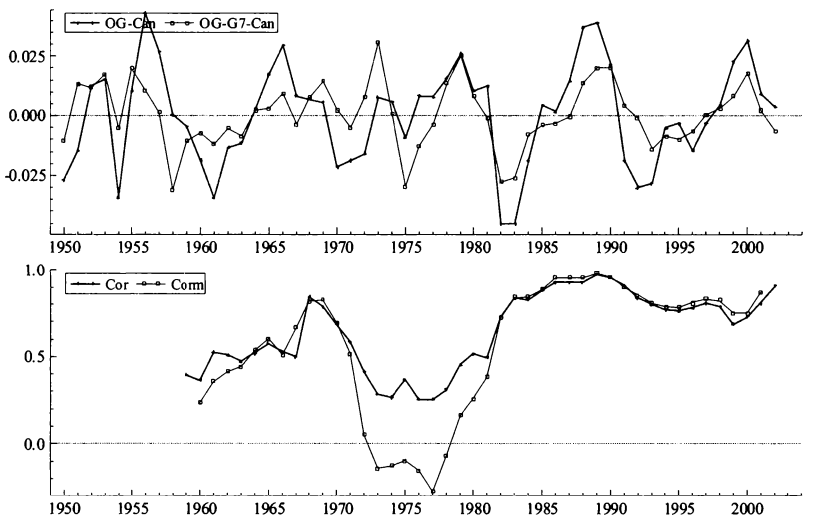

Figure 2: Canada

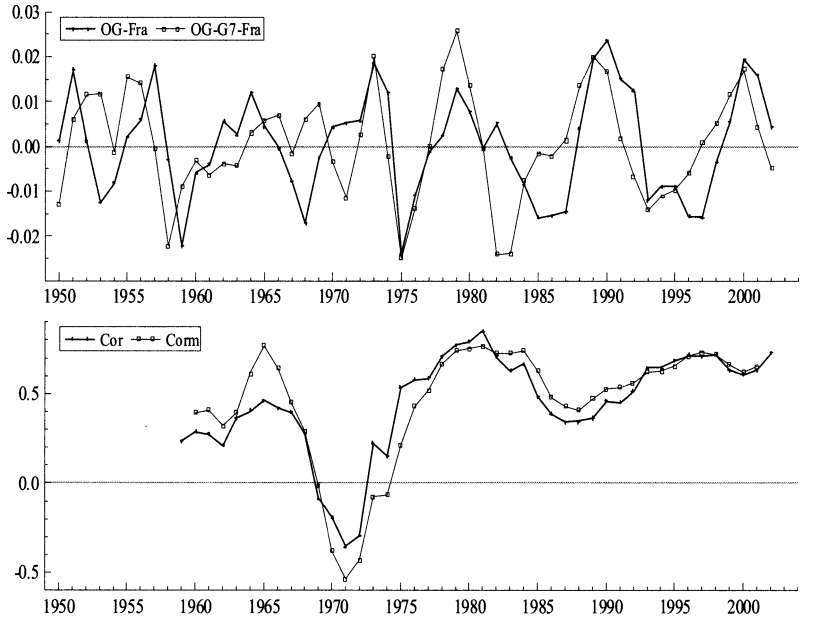

Figure 3: France

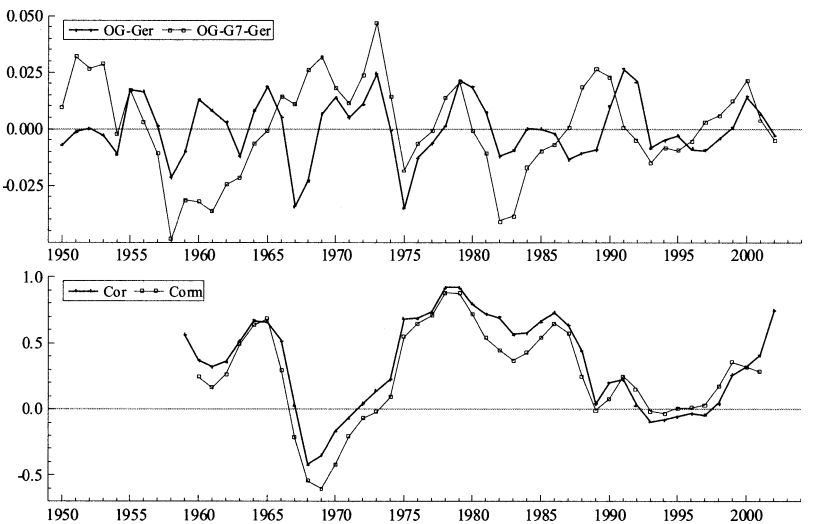

Figure 4: Germany

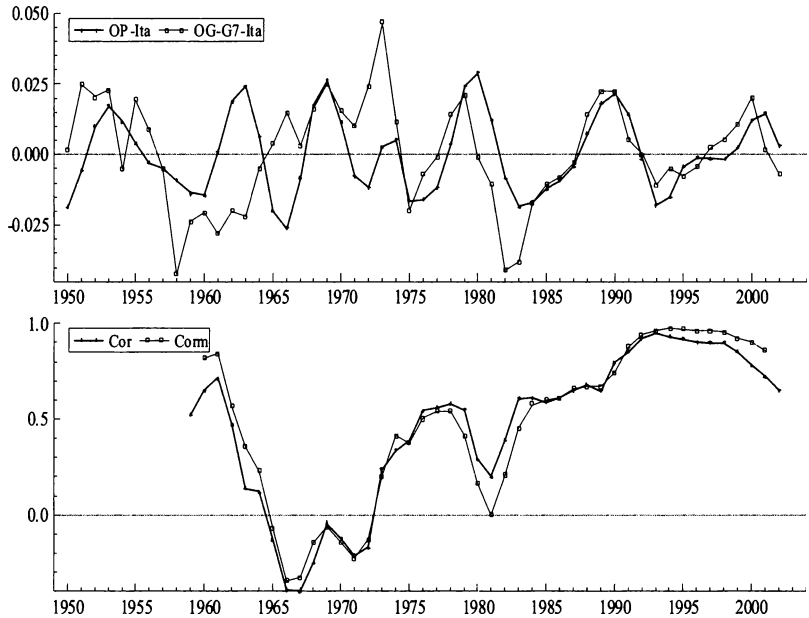

Figure 5: Italy

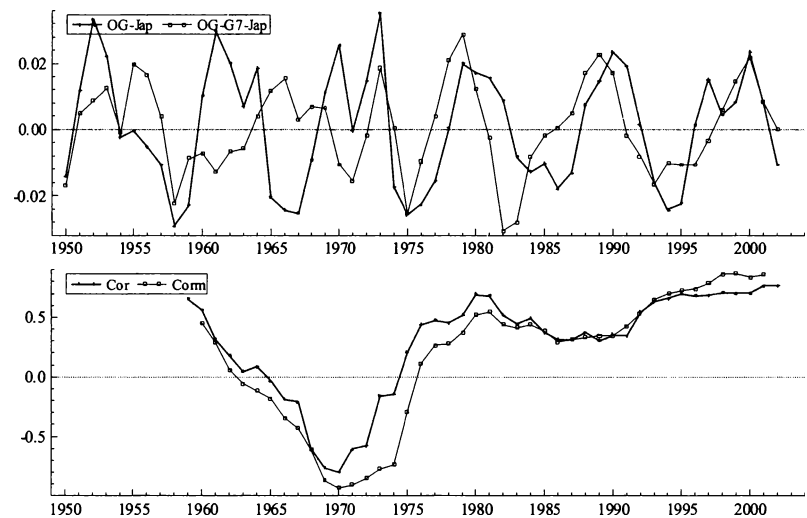

Figure 6: Japan

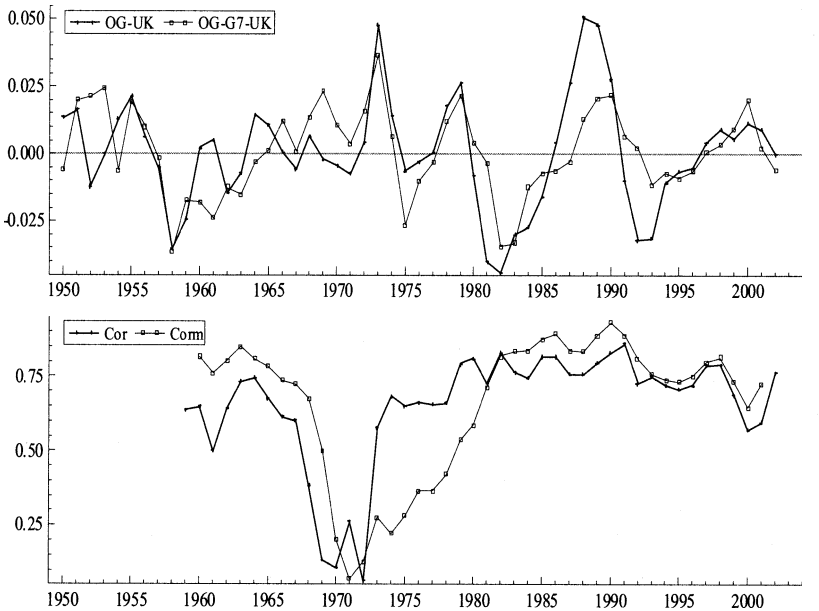

Figure 7: United Kingdom

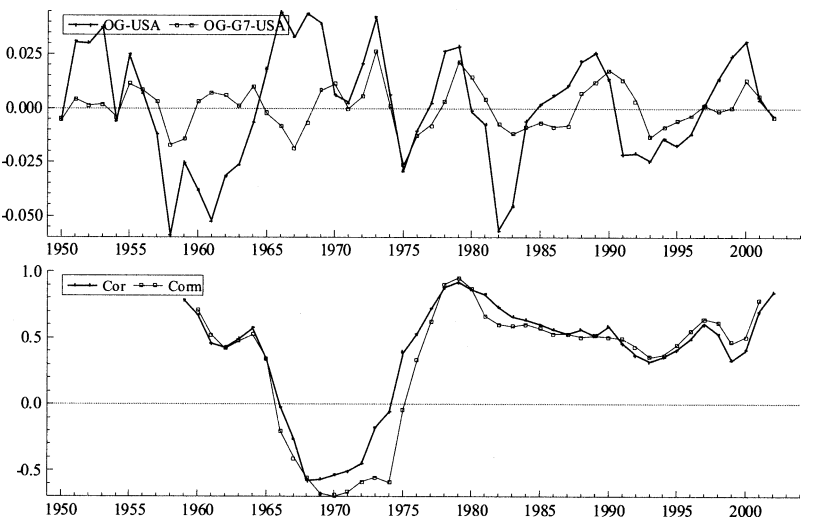

Figure 8: United States

Due to lack of space, we do not comment in detail the results for each individual country. Since the time pattern of the correlation coefficients is very similar in most countries (with the exception of Germany), it is possible to summarize the results as follows. The correlation between the national business cycles was remarkably high during the fifties and early sixties. For almost all countries we observe a sharp decline in the business cycle synchronization during the late sixties, leading to even negative correlations. The reason for this result is that the US experienced a pronounced upswing between 1965 and 1969, whereas many other countries had a recession around 1967. The first oil price shock induced a high synchronization between the national business cycles. Consequently, the correlation coefficients show a sharp increase from the mid-seventies to the early eighties and remain then fairly stable on a high level. There is no evidence that the strength of the co-movement of national business cycles has further increased during the nineties of the last century. The only exception to this general rule is Germany: After the mid-eighties, the correlation of the German with the international business cycle drops to zero where it remains for almost ten years. This is due to the sluggish behavior of the German economy between 1982 and 1987, when other countries experienced a more or less strong recovery from the 1981/82 recession and to the idiosyncratic unification boom in Germany in the years 1990/91.

The last few years exhibit a tendency to a stronger co-movement of the German and the international business cycle. So we have a convergence to a situation which is 'normal' for most other countries over the last two or three decades. 'Normal' means that we observe a correlation coefficient in the range of 0.5 to 0.8 between the national and the international business cycle, respectively. There is a significant association among the cycle in different countries, but the co-movement is far from a perfect synchronization.

4. Synchronization of Business Cycles in Frequency Domain

To go a step further and check the results in time domain for robustness, we employ spectral analysis techniques. This method has the advantage that it allows to derive a measure for synchronization frequency by frequency, which enables us to focus on the relevant business cycle frequency intervals.[11] The measures are based on those developed in A'Hearn and Woitek (2001). We focus on three cycle ranges: the 7–10 years range (Juglar cycle), the 5–7 years range, and the 3–5

[11] An example for potential weaknesses of the correlation coefficient in time domain as a measure of synchronization is the result in Backus and Kehoe (1992), who report a very low correlation coefficient (0.01) between the US and the UK cycle before World War I. Based on this result, one would have to conclude that the 'Atlantic Economy' did not exist. Both the state space approach (Solomou, 1998) and spectral analysis (A'Hearn and Woitek, 2001), however, reveal that there is a strong relationship between cycles with periods in the range 7–10 years.

years range (Kitchin cycle). The dominant cycle band is identified by calculating the share of total variance attributable to cycles in these intervals. To address the issue of synchronization, we decompose the variance for each frequency band into an explained and an unexplained part. In addition, we adopt the dynamic correlation measure suggested by Croux, Forni and Reichlin (2001) to distinguish between in-phase and out-of-phase movements.

To derive these measures, consider two stationary time series, $X_t$and Y_t. The spectrum is defined as the Fourier transform of the covariance function $\Gamma_{xy}(\tau)$, $\tau = 0, \pm 1, \pm 2, \ldots$:[12]

$$F_{xy}(\omega) = \frac{1}{2\pi} \sum_{\tau=-\infty}^{\infty} \Gamma_{xy}(\tau) e^{-i\omega\tau}, \omega \in [-\pi, \pi] \; . \tag{7}$$

The diagonal elements of the spectral density matrix $F_{xy}(\omega)$ are called autospectra. Integrating the autospectra over the frequency band $[-\pi, \pi]$, we obtain the variance of the respective series. After dividing the autospectrum by the variance, we can calculate the contribution of cyclical components in a frequency band $[\omega_1, \omega_2]$. The off-diagonal elements or cross-spectra are complex numbers and given by

$$f_{xy}(\omega) = c_{xy}(\omega) - iq_{xy}(\omega), \omega \in [-\pi, \pi] \; , \tag{8}$$

where $c_{xy}(\omega)$ is the cospectrum and $q_{xy}(\omega)$ is the quadrature spectrum. The cospectrum measures the covariance between the 'in-phase' components of X_t and Y_t, whereas the quadrature spectrum measures the covariance between the 'out-of-phase' components. Together with the autospectra, the cross spectrum can be used to calculate a measure similar to R^2 in linear regression analysis. This measure is the squared coherency $sc(\omega)$:

$$sc(\omega) = \frac{|f_{xy}(\omega)|^2}{f_x(\omega) f_y(\omega)}, 0 \leq sc(\omega) \leq 1 \; . \tag{9}$$

This measure assesses the degree of linear relationship between two series, frequency by frequency. If we are interested in the extent to which the variance of cyclical components of the series X_t in the frequency band $[\omega_1, \omega_2]$ can be attributed to corresponding cyclical components in series Y_t, we can use $sc(\omega)$ to decompose the fraction of overall variance in this interval into an explained and an unexplained part:

$$\int_{\omega_1}^{\omega_2} f_x(\omega) d\omega = \underbrace{\int_{\omega_1}^{\omega_2} sc(\omega) f_x(\omega) d\omega}_{\text{explained variance}} + \underbrace{\int_{\omega_1}^{\omega_2} f_u(\omega) d\omega}_{\text{unexplained}} \; . \tag{10}$$

[12] See e.g. Harvey (1993, 175 – 179), Granger and Newbold (1986, 48 – 53), Brockwell and Davis (1991, 434 – 443), Priestley (1981) and Koopmans (1974, 119 – 164).

We will use this decomposition to compare the degree of linear relationship between cycles in the aggregate of the G-7 countries and each of the member countries in the three business cycle frequency intervals mentioned above.

As pointed out by Croux, Forni and Reichlin (2001), a measure like the squared coherency presented above is not suited for analyzing the co-movement of time series, because it does not contain information about possible phase shift between cycles in the series X_t and Y_t. In this sense, the correlation coefficient in time domain used in the previous sections is more informative, since it is calculated lag by lag, providing both information on the lead-lag structure and the degree of linear relationship between the two series. Croux, Forni and Reichlin (2001) propose an alternative measure, the so-called dynamic correlation $\rho(\omega)$, which measures the correlation between the 'in-phase' components of the two series at a frequency ω:

$$\rho(\omega) = \frac{c_{xy}(\omega)}{f_x(\omega) f_y(\omega)}\,, \quad -1 \leq \rho(\omega) \leq 1\,. \tag{11}$$

Using

$$sc(\omega) = \frac{\left|f_{xy}(\omega)\right|^2}{f_x(\omega) f_y(\omega)} = \frac{c_{xy}(\omega)^2 + q_{xy}(\omega)^2}{f_x(\omega) f_y(\omega)}\,, \tag{12}$$

we can use this idea to further decompose explained variance:

$$\begin{aligned}
\int_{\omega_1}^{\omega_s} f_x(\omega)d\omega &= \underbrace{\int_{\omega_1}^{\omega_s} sc(\omega) f_x(\omega)d\omega}_{\text{explained variance}} + \underbrace{\int_{\omega_1}^{\omega_s} f_u(\omega)d\omega}_{\text{unexplained variance}} \\
&= \int_{\omega_1}^{\omega_s} c_{xy}(\omega)^2 + q_{xy}(\omega)^2 f_y(\omega)d\omega + \int_{\omega_1}^{\omega_s} f_u(\omega)d\omega \\
&= \underbrace{\int_{\omega_1}^{\omega_s} c_{xy}(\omega)^2 f_y(\omega)d\omega}_{\text{explained variance (in-phase)}} + \underbrace{\int_{\omega_1}^{\omega_s} q_{xy}(\omega)^2 f_y(\omega)d\omega}_{\text{explained variance (out-of-phase)}} + \underbrace{\int_{\omega_1}^{\omega_s} f_u(\omega)d\omega}_{\text{unexplained variance}}
\end{aligned} \tag{13}$$

Thus, it is possible to decompose explained variance into the 'in-phase' component and the 'out-of-phase' component, adding some information on the importance of the phase shift in a frequency interval to the R^2 interpretation of the decomposition in equation (10) above.

To estimate the spectra, we fit VAR models in time domain, and calculate the spectra of the estimated models.[13] With a VAR model of order p, the spectral density matrix is given by

$$F(\omega) = 12\pi A(\omega)^{-1}\Sigma A(\omega)^{-*}, \omega \in [-\pi, \pi] \; . \tag{14}$$

The error variance-covariance matrix is denoted by Σ, and $A(\omega)$ is the Fourier transform of the matrix lag polynomial $A(L) = I - A_1 L - A_2 L^2 - \ldots - A_P L^P$.[14] But before we can actually estimate the spectrum, we have to solve the problem that the series under consideration are not stationary. As already noted, the widely used filtering methods cause artificial cyclical structure when applied to a series based on a data generating process different from the assumptions underlying the filter.[15] Bearing this problem in mind, we chose the pragmatic way of presenting the results for the Hodrick-Prescott (1997) filter,[16] and checking it against the outcome for a modified version of the Baxter-King filter (Baxter and King, 1999),[17] and the difference filter.

'Synchronization' describes a process; hence, we need the measure in equation (13) to be time-varying. Since the estimator for the spectrum is parametric, it is straightforward to obtain a time dependent measure: we re-cast the VAR-model into state-space form, treating the parameters as unobservables. The starting point is a VAR of order p

$$\begin{aligned} x_t &= c + \sum_{j=1}^{p} A_j x_{t-j} + u_t \\ &= \underbrace{\left(cA_1 \ldots A_p\right)}_{A} \underbrace{\begin{pmatrix} 1 \\ x_{t-1} \\ \\ x_{t-p} \end{pmatrix}}_{Z_{t-1}} + u_t \\ &= AZ_{t-1} + u_t \; , \end{aligned} \tag{15}$$

where u_t is $iid(0,H)$. Vectorizing the above equation and treating the parameters of the VAR as state variables, results in

$$x_t = \left(Z_t' \otimes I\right)\text{vec } A_t + u_t = \left(Z_t' \otimes I\right)\alpha_{t-1} + u_t \; , \tag{16}$$

---

[13] This method is based on the seminal work by Burg (1967), who shows that the resulting spectrum is formally identical to a spectrum derived on the Maximum Entropy Principle. This is seen to be a more reasonable approach then the normally used periodogram estimator. The periodogram employs the assumption that all the covariances outside the sample period are zero. Given that economic time series are notoriously short, this seems to be a problematic assumption (see the discussion in Priestley, 1981, 432 and 604 – 607).

[14] L is the backshift operator, and the superscript '*' denotes the complex conjugate transpose.

[15] See the discussion in Cogley and Nason (1995), King and Rebelo (1993) and Harvey and Jaeger (1993).

[16] Smoothing weight 100. Note that the results do not change if we use instead the smoothing weight 6.25 as suggested by Ravn and Uhlig (2002).

[17] Cut-off frequency: 0.067. This filters cycles with a length greater than 15 years out of the series. See A'Hearn and Woitek (2001) for a discussion of the modification.

which is the measurement equation in the state-space version of equation (15).[18] The transition equation describes the time path of the VAR parameters and is given by

$$\alpha_t = T\alpha_{t-1} + \eta_t \,, \tag{17}$$

where η_t is $iid(0,Q)$. We assume the matrix T to be a diagonal matrix with elements $\rho = 0.9$ on the diagonal, forcing the time path of the parameters to be a damped AR(1) process. The elements in the covariance matrices H and Q are treated as hyperparameters, and the likelihood function based on the cumulated prediction errors of the Kalman filter applied to equations (16) and (17) is maximized with respect to these parameters. The solution implies a time path for α_t, thus allowing the measures in equation (13) to be time dependent.

The time path for the in-phase proportion of explained variance for the G-7 countries is displayed in Figure 9 (data in logs).[19] Explained variance is calculated as variance of a G-7 member explained by the variance of the rest in the business cycle intervals (7 – 10 years, 5 – 7 years, and 3 – 5 years). The share of total variance in the 3 cycle ranges is more or less constant over time for all three filters (averages: Hodrick-Prescott: 0.56; Baxter-King: 0.64, difference filter: 0.51). When interpreting the results, one has to bear in mind that with the Hodrick-Prescott filter, the most important interval is the 7 – 10 years range, while with the Baxter-King and the difference filter, the intervals with the shorter cycles are more important. Overall, the difference filter produces the lowest share of total variance in the business cycle frequencies.

All in all, the results in Figure 9 are similar to the outcome discussed in the previous section. An obvious finding is that there are changes in co-movement over time. The broad trend of these changes is strikingly robust across all three filters: if we focus on the 7 – 10 years range, we see an increase in the in-phase proportion of explained variance until about 1970. In the period 1970 – 1980, the in-phase proportion stays at a relatively high level (around 80 – 90 per cent). One might speculate whether the two oil price shocks helped to increase the synchronization of cycles in this period. The 1980s are characterized by a decrease (the turning point is earlier for the Hodrick-Prescott and Baxter-King results than for the difference filter), and this decrease is continued until the beginning of the 1990s. From about 1990 on, the 7 – 10 year cycles begin to synchronize again. For the other frequency bands, the results are similar, although less than for the 7 – 10 years range.

Ahmed, Levin, and Wilson (2002) interpret synchronization in the high frequency ranges as due to converging business practices like improved inventory management, while synchronization in the lower frequency range is caused by

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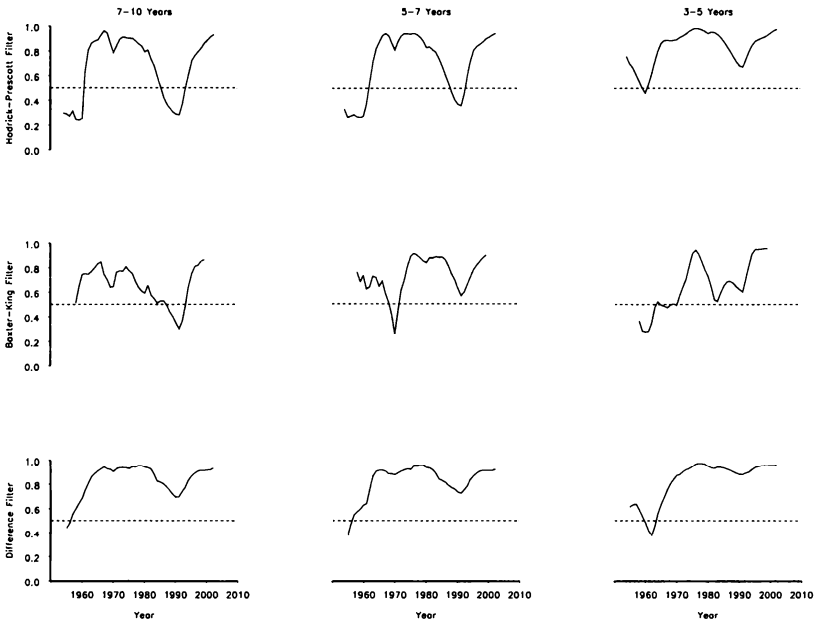
[18] For the following, see Harvey (1989).

[19] Weighted average, with $GDP_{j,t} / GDP_{\text{G-7},t}$ as weight for country j at time t.



Notes: Weighted averages of in-phase proportions of explained variance (weights:

$$GDP_{j,t} \Big/ \sum_{i=1}^{7} GDP_{i,t} \ .$$

Smoothing weight for the Hodrick-Prescott filter: 100; cut-off frequency for the Baxter-King filter: 0.067. Note that with the Baxter-King filter and annual data, we lose 3 observations at the beginning and the end of the series.

Figure 9: Synchronization of G-7 Business Cycles

fiscal and monetary policies aimed at smoothing out the business cycle. Reducing the variance of innovations would affect all frequencies. Since our results do not favor a particular range, and are also not entirely the same over all three ranges, there seems to be a mixture of causes responsible for the synchronization process of the G-7 cycles.

Turning to specific countries, the results for France seem worth reporting. France exhibits a very low in-phase proportion (10 per cent on average over all filters and all frequency ranges). This does not mean that France is not affected by the G-7 cycle: the average explained variance (average over all filters and all frequency ranges) is over 50 per cent. It just means that the French cycle is not in phase with the G-7 cycle for the most part of the observation period. As Sicsic and Wyplosz (1996) point out, France has of course been subjected to similar output shocks as the other G-7 countries, and hence, we would expect a closer co-movement with the aggregate cycle. However, Sicsic and Wyplosz (1996) argue that counter-cyclical economic policy has been more active and successful than in the

other countries. This might help to explain why the link between the French and the G-7 cycle is so weak over the entire observation period.

5. Concluding Remarks

This paper presents an exploratory study concerning the strength of business cycle co-movement of the G-7 countries from 1950 to 2002. Special emphasis is given to the question of whether the correlation between the national business cycles has changed over time. We find that the association between the national and the international business cycle was remarkably high during the fifties and early sixties. Since the mid-sixties we see a dramatic decrease in the strength of co-movement with even negative correlation coefficients. The first oil price shock induced a closer co-movement of the national cycles. Since then we observe over more than 25 years a high and stable correlation (with the exception of Germany with its idiosyncratic development in the late eighties / early nineties). There is no sign that the co-movement strengthened further in the nineties. These findings are generally corroborated by an analysis in the frequency domain. Looking at co-movement in three different frequency bands (7 – 10 years, 5 – 7 years, 3 – 5 years) reveals additional insight. It turns out that France can be seen as an outlier with respect to synchronization with the aggregate business cycle. For the most part of the observation period, the French cycle is not in phase with the G-7 cycle.

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International Synchronization of National Business Cycles? A comment

By Manfred J. M. Neumann*

Flaig, Sturm and Woitek (FSW) study the co-movement of business cycles among the G7 countries with annual data on gross domestic product covering the period 1950 – 2002.[1] They are interested to learn whether the correlation of national cycles has increased over the last decades due to the global move towards an opening-up of economies. FSW acknowledge that different approaches to measuring business cycles may yield different results and, therefore, trace alternative avenues, the estimation of an unobserved components model and spectral analysis. The main result of the paper is that the business cycles of G7 countries were highly correlated during the 1950s and again since the mid-1970s. In between, during the 1960s, the correlation fell towards zero.

The main finding that during the 1960s the co-movement of national business cycles was rather weak comes as a surprise, at first glance, given that those years marked the high time of the fixed exchange rates system of Bretton Woods and a period of unusually high real growth for total G7. But in fact, this was also the longest period during which the economies of the two dominant countries, the United States and Germany, developed in cyclic disconcert. It would be interesting to investigate the economic and political factors that were responsible for that. FSW do not take up such issues. They confine themselves to estimating suitable indicators of cycles and in measuring bilaterally the degree of correlation between the cycle of each country and the joint cycle of the other G7 countries. Thus, the motivation is reliable description rather than hypothesis test or explanation.

As a first approach at estimating the cyclical component in the growth of gross domestic product FSW apply closely a trend-plus-stochastic-cycle model of Harvey and Jaeger (1993). They estimate the model for each G7 country and then compute the bilateral correlation between the cycle of each country and the joint cycle of the rest of G7. Unfortunately, the estimates of the Harvey-Jaeger model

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[1] The comment is based on the version of the FSW study presented at the conference because the discussant did not receive a revised version.

are not presented; the only information provided is that the empirical models chosen allow for two cycles, a short one of 3.5 to 5 and a long one of 9 to 12 years. Thus the reader has to be content with a graphical presentation of the strength of correlation between the cycles of each country and rest G7.

It is instructive to compare the cycles estimated by FSW with those one derives by applying the Hodrick-Prescott filter (with the penalty parameter set at 100 for annual observations) or the simple difference filter. This is done in charts 1 and 2 for the United Kingdom (UK) and for France, respectively. These two countries are chosen because according to Figure 11 of FSW the UK's business cycle is highly synchronized with rest G7 since the mid-1960s while the French performance is just the opposite. As one can read from Chart 1, the estimate by FSW for

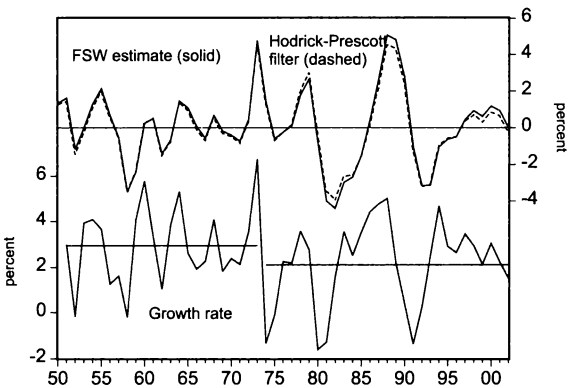


Chart 1: Three Indicators of Cycles: United Kingdom

the UK closely replicates the conventional Hodrick-Prescott filter. Also, it is noteworthy that the difference filter provides roughly the same cycles. As regards the poorly synchronized France, we observe that FSW's model yields the same cycles as the conventional Hodrick-Prescott filter but displays a smaller variance; see Chart 2. The simple difference filter, in contrast, exhibits larger differences. The examples of the UK and France suggest that not much is gained by employing the authors' estimates of the Harvey-Jaeger model instead of simply applying the standard Hodrick-Prescott filter. In any case, it would be useful if FSW compare and discuss this for all countries of G7.

FSW provide for each country a graph where the country's cycles, the cycles of rest G7, and rolling correlations between these cycles are plotted. The correlations are based on a 10 years window. The rolling correlations are very useful as they indicate the changes over time in the degree of cyclical synchronization. It seems that a little experimenting with the size of the window permits to squeeze out even more information. Consider again the cycles in the UK and France but add now

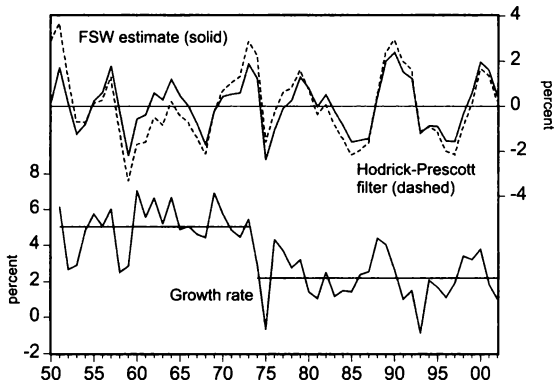


Chart 2: Three Indicators of Cycles: France

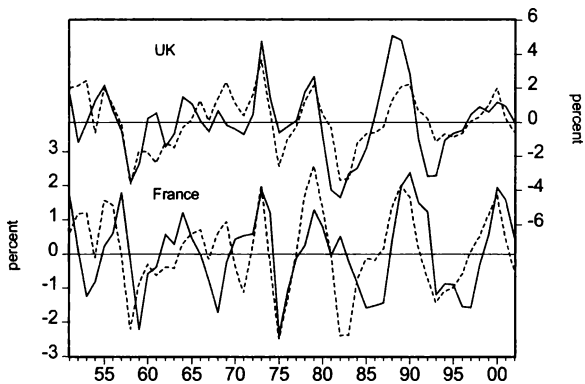
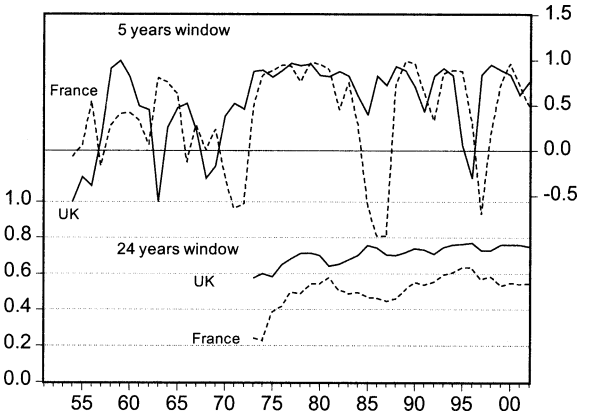


Chart 3: Cycles in the UK and France and Rest G7
Estimate of FSW

the cycles in the rest G7 confronting the UK and France, respectively; this is done in Chart 3. For the UK one finds that its business cycle has moved in step with the aggregate cycle of rest G7, except for the early 1950s and the period 1958 – 68. The same cannot be said about France. Its cycle for most of the time lags the cycle of rest G7 by about a year, and on top of that has occasionally been disturbed by uncoordinated macroeconomic policies. The differences between both countries as regards the development of cycles can also be read from the rolling correlations plotted in Chart 4. In order to highlight the short-run versus the long-run aspect, the authors' ten years window has been replaced by a five and a twenty-four years window. The five years window reflects the short-run cycle. For both economies we observe that they switch between full and zero synchronization, but in France



Period	Correlations	
	UK	France
1950 - 73	0.58	0.24
1962 - 85	0.75	0.63
1979 - 02	0.75	0.54

Chart 4: Correlations of Cycles vis-a-vis Rest G7
Based on the estimates of FSW

the sub-periods of full synchronization are much shorter, while periods of weak synchronization or even disconcert are longer and more pronounced. This also shows up in the correlations based on a 24 years window. The respective coefficients for France are considerably lower than for the UK. For example, over the most recent 24 years the correlation for France was 0.54 but 0.75 for the UK.

In sum, inspecting the cycles that FSW derive from estimates of the Harvey-Jaeger model we find that the British cycles are highly synchronized with those of rest G7 while the French ones leave a lot to be desired in this respect. The result is qualitatively in line with the respective results from spectral estimates for the two countries shown in Figure 11 of FSW. There, following the proposal by Croux, Forni and Reichlin (2001) the authors present dynamic correlation coefficients that measure the correlation between the "in-phase" components for each country and the respective rest G7. Again it is to be noted that FSW provide no statistical information that would permit the reader to gain insight into the properties of the estimated vector auto regressions that underlie the computed dynamic correlations. The graphical information presented for each G7 country in Figure 11 is rather diverse and bilateral in nature. As a result, it is difficult to draw a general conclusion as regards the evolution of business cycle synchronization.

Instead of examining bilateral measures, it would be useful if FSW compute a multilateral indicator of the cohesion of the national business cycles. This could be

done for the static as well as the dynamic correlation coefficients. All it needs is to introduce a weighting schema. For example, Croux, Forni and Reichlin (2001) have proposed to measure cohesion by computing a weighted average of a bilateral indicator where the shares of the countries in total G7 output could be used as weights.

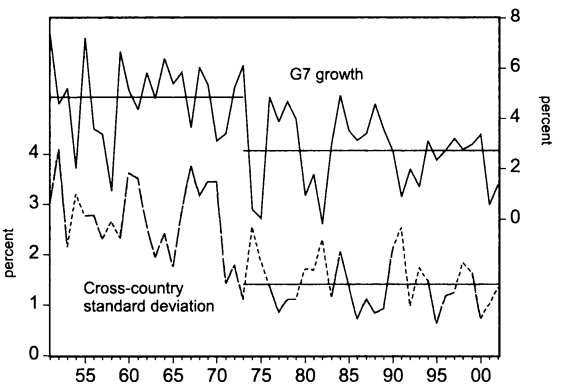


Chart 5: G7 Growth and Cross Country Variation

As an alternative to weighted averages of the static and the dynamic correlation coefficients one might examine cross-country standard deviations of cycles. For example, in Chart 5 the cross-country standard deviation of output growth is plotted together with the growth rate of joint G7 output. Though the simple difference filter should be inferior to estimated models, Chart 5 drives home the following observation. During the early period of high growth world-wide, 1951 – 73, the cross-country standard deviation of output growth was high but falling; an exception was the second half of the 1960s. Since the first oil-price shock in late 1973 the cross-country standard deviation of output growth appears to have settled at a comparatively low level.

The investigation of the cohesion of the business cycles of major economies can be a fascinating topic of macroeconomic research. FSW have made a first exploratory step that complements the literature. It seems we do need to compare several alternative avenues of measurement and to take recourse to a theory-driven interpretation of the economic history of these economies in order to understand the changes signalled by the statistical constructs.

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Germany and the European Business Cycle – An Analysis of Causal Relations in an International Real Business Cycle Model

By Ferdinand Fichtner*

Abstract

This paper studies the role of the German economy for the existence of the so called European business cycle, a term referring to the regularly observed synchronization of the national business cycles in Europe. Using a three-country general equilibrium model, we are able to simulate impulse response functions mimicking the important features observed in the data. Focusing on the importance of shocks affecting the German GDP we show that trade-related transmission from Germany to the other European economies is only of minor importance for the synchronization of national business cycles. On the contrary, our findings suggest that the influence of common shocks and of technology spillovers accounts for most of the parallels in economic performance.

Keywords: European business cycle; Transmission; Open economy macroeconomics; Real business cycles

JEL classification: E32; F41

1. Introduction

The constitution of the European Monetary Union has brought back to light an issue, that has been discussed in a global context for a long time – the existence of common elements in national business cycles.[1] As, among others, Bayoumi and Eichengreen (1993) and Tavlas (1993) have noted, monetary integration in case of insufficient similarities between the participating countries may lead to high costs of the integration process due to improper coordination between national economic fluctuations and supranational monetary policy. Whether there exists what might

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[1] See e. g. Mitchell (1927, 424 f.) for an early study. For recent empirical documentation of parallels among international business cycles see, for example, Backus and Kehoe (1992) or Gregory et al. (1997).

be called a "European business cycle" therefore plays a crucial role for success or failure of the union.

While there appears to be a consensus in the literature that the European economies indeed share some common elements in their aggregate cyclical behavior (see Artis et al., 1998, or Lumsdaine and Prasad, 2003), opinions diverge concerning the question whether or not this common component gained importance for the national economies. Most econometric studies however suggest increasing similarities between the national business cycles with on-going European integration.[2] Reasons for this phenomenon still remain unrevealed though.

Two major sources of economic synchronization tendencies have been discussed in a global context: common shocks and the transmission of country specific shocks. Several authors, including Dellas (1986) and Canova and Marrinan (1998), have shown that in order to simulate realistic output fluctuations in an international business cycle model, transmission alone is not sufficient. Instead, the presence of a common exogenous shock appears to be necessary to quantitatively match the data gathered in empirical studies. Other authors (see, among others, Anderson et al., 1999, or Laxton and Prasad, 2000) however point out the importance of trade linkages for the synchronization of international business cycles.

Given the extraordinary economic and political integration of the European economies one might expect transmission effects to be of predominant importance for synchronizing the European business cycles. From this point of view, the German economy might well have an exposed position in Europe due to its economic weight and its intense inner-European trade linkages. The presumption, that Germany might have a similar role in Europe as the often cited "locomotive" USA in the world economy, seems quite plausible; German economic fluctuations thus were comparatively independent and influenced (in a boom as well as a recession) the other European economies' business cycles.

Following the work of Canova and Marrinan (1998), this paper presents a multi-country general equilibrium model, essentially due to Zimmermann (1997), allowing to quantify the importance of trade interdependencies for transmitting shocks across countries. Using this model as a tool to simulate output time series of an artificial world economy, we contribute to the growing literature dealing with the European business cycle some insights about sources and mechanisms of this phenomenon.

Our findings can be summarized like this: Focusing on the importance of shocks affecting the German GDP we show that trade-related transmission from Germany to the other European economies is only of minor importance for the observed

[2] See e. g. Artis and Zhang (1997, 1999), or Dueker and Wesche (2001); sceptical: Inklaar and de Haan (2000).

synchronization of national business cycles. On the contrary, our findings suggest that the influence of common shocks and of technology spillovers between the countries accounts for most of the parallels in economic performance.

The paper is structured as follows. In order to provide a benchmark for the model and to offer some first insights into the driving forces of synchronization tendencies, section 2 derives some empirical regularities of the European business cycle. Section 3 explains the model economy. Section 4 presents the derivation of steady state equilibria. The methods used to calibrate the model are described in section 5. Section 6 gives an overview of the computational procedures used to calculate the simulated time series. In section 7 we present the results of our simulations and compare them with the empirical findings. Section 8 offers some further interpretation and discusses our results. Section 9 concludes. An appendix presents the sources of the data.

2. Empirical Regularities of the European Business Cycle

In the following, the influence of Germany's economic fluctuations on the business cycles of its European neighbors shall be analyzed by estimating a multi-country vector autoregressive model and retrieving impulse response functions for a shock affecting the German economy.[3] Such an analysis obviously requires an operationalization of the term "business cycle". Following the definition by Lucas (1977) of the business cycle as "co-movements among different aggregative time series" and specifically as "movements about trend in gross national product," the business cycle will here be represented by fluctuations of output series (GDP) around their trend. The trend is identified using the HP (1600) filter, thus considering the long-run growth component to be a smooth but non-deterministic process.[4]

The study is based on quarterly data taken from the IMF's International Financial Statistics covering the sample from 1970:1 to 2001:4. We estimate a VAR on the log of detrended real GDP of Austria, Germany[5], France, Italy, Japan, UK and the US. Additionally included are a (highly significant) dummy for the boom phase in Germany induced by the reunification (1991:1 until 1992:4) and the oil price growth rate as exogenous variable. According to the usual information criteria the lag length has been set to 1.

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[3] A similar analysis is carried out by Canova and Marrinan (1998) for interdependencies between Germany, Japan and the US.

[4] Application of the HP filter has been discussed controversially, as it is subject to the Nelson-Kang (1981) critique to create spurious periodicity in the data. Additionally, there is no upper bound for the frequencies passing the filter, thus short time variations in the data are left as part of the cyclical component. See Baxter and King (1999) for a detailed discussion.

[5] To avoid a jump in the data an artificial series has been created by writing back all-German values with West German growth rates from 1992:1 backwards.

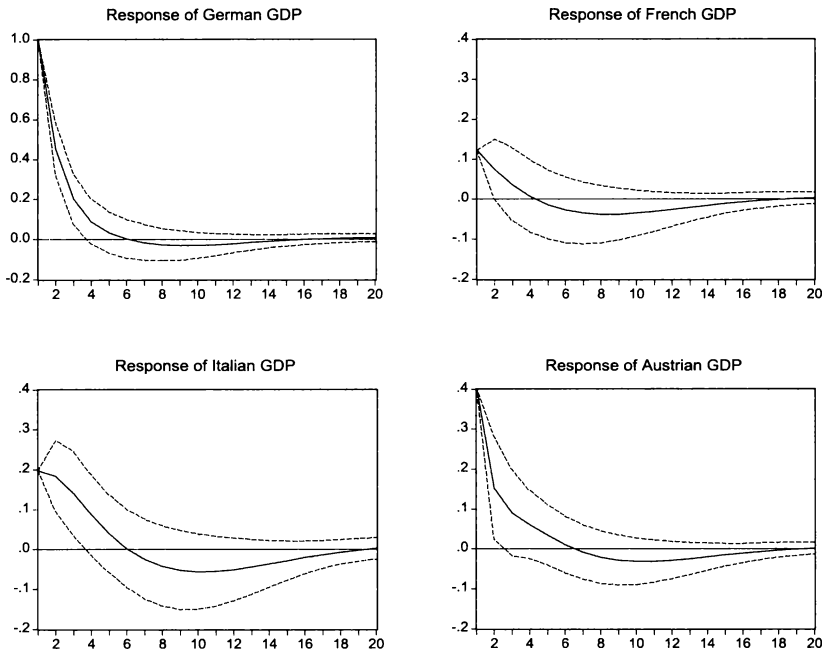

Figure 1: Impulse response functions of a 1% shock on German GDP with 95% confidence bands

The impulse response functions have been simulated using the following Cholesky ordering: US, Germany, UK, France, Italy, Austria and Japan. With the exception of Japan this ordering follows the economic weight as indicated by the GDP in 1985 and can – given that bigger countries tend to influence smaller countries and not vice versa – be regarded as economically quite plausible. The exception of Japan seems justified in view of its less important economic linkages with the European countries.

Fig. 1 plots the mean estimate of the impulse response functions to a 1% shock on German GDP with 95% confidence bands.[6] Obviously, German output shocks have significantly large and positive contemporaneous effects on the European economies, with the reaction in Austria clearly being higher than in the other countries. As a whole, a positive interdependence between German business cycles and those of the included European economies can be assumed.

[6] Economic dependencies between Germany and Europe shall here be analyzed focusing on France, Italy and Austria, as their economic relationship to Germany has been relatively stable over the examined period and data is readily available for these countries.

To get an impression of changes in the relationship leading to unreliabilities in the presented results, in a next step VARs will be estimated for different subsamples. The first subsample ("70ies") covers the period 1970:1 – 1979:4, the second subsample ("80ies") the period 1980:1 –1991:4,[7] and the third subsample ("90ies") the period 1992:1 – 2001:4.

The impulse response functions for the subsamples (see fig. 2) reveal some interesting features of the European economic system. While in the 1970ies and 1990ies positive shocks on the German GDP have positive contemporary impacts on the other European economies, business cycle interdependencies between Germany and France as well as Italy appear to be negative and relatively weak during the 1980ies.[8]

This pattern of German influence on the French and the Italian business cycle seems rather unusual for an economic integration process that one would expect to lead to an increase in correlation. Having in mind that economic synchronization might be the outcome of transmission as well as common exogenous shocks, interpretation is straightforward though: In the 1970ies, economic fluctuations were influenced by oil price shocks leading to a synchronization of business cycles worldwide. By contrast, in the 1980ies such symmetric shocks were absent. Instead, business cycle fluctuations were rather weak and marked by different economic policies: while, e. g., the French socialist government reacted to the emerging recession in the early 1980ies with expansive fiscal policy, a consolidation policy was implemented in Germany. Already in the early 1990ies, but still as part of the 80ies subsample, Germany experienced an upswing after its reunification, that coincided with a recession in the rest of Europe.[9] During the 1990ies European economic integration finally led to a reenforcement of economic interdependencies and thus synchronicity.

In contrast, the influence of Germany on the Austrian business cycle has remained qualitatively unchanged over time. For all subsamples we observe a positive contemporary reaction of the Austrian GDP in response to a shock leading to a deviation of the German GDP from its trend. While the French and Italian GDP's peak response in the 1970ies and 1990ies subsample lag for 1 quarter behind the German shock (a feature not observed in the full sample analysis), Austria's peak response in the 80ies and 90ies arises without delay. While this might be interpreted as a sign of the influence of common exogenous shocks on both the German and the Austrian economy, we by no means can rule out the existence of economic

[7] This upper bound is chosen in order to match the break in the data due to the German reunification.

[8] This has been previously noted. See e. g. Seifert (1999) for an analysis of correlation coefficients in different periods.

[9] Application of the HP filter induces additional negative correlation. As a result of the strong expansion process after the German unification, the cyclical component of German GDP in the late 1980ies, even though following an upswing, is assessed rather low, while the other European economies experienced a boom period.

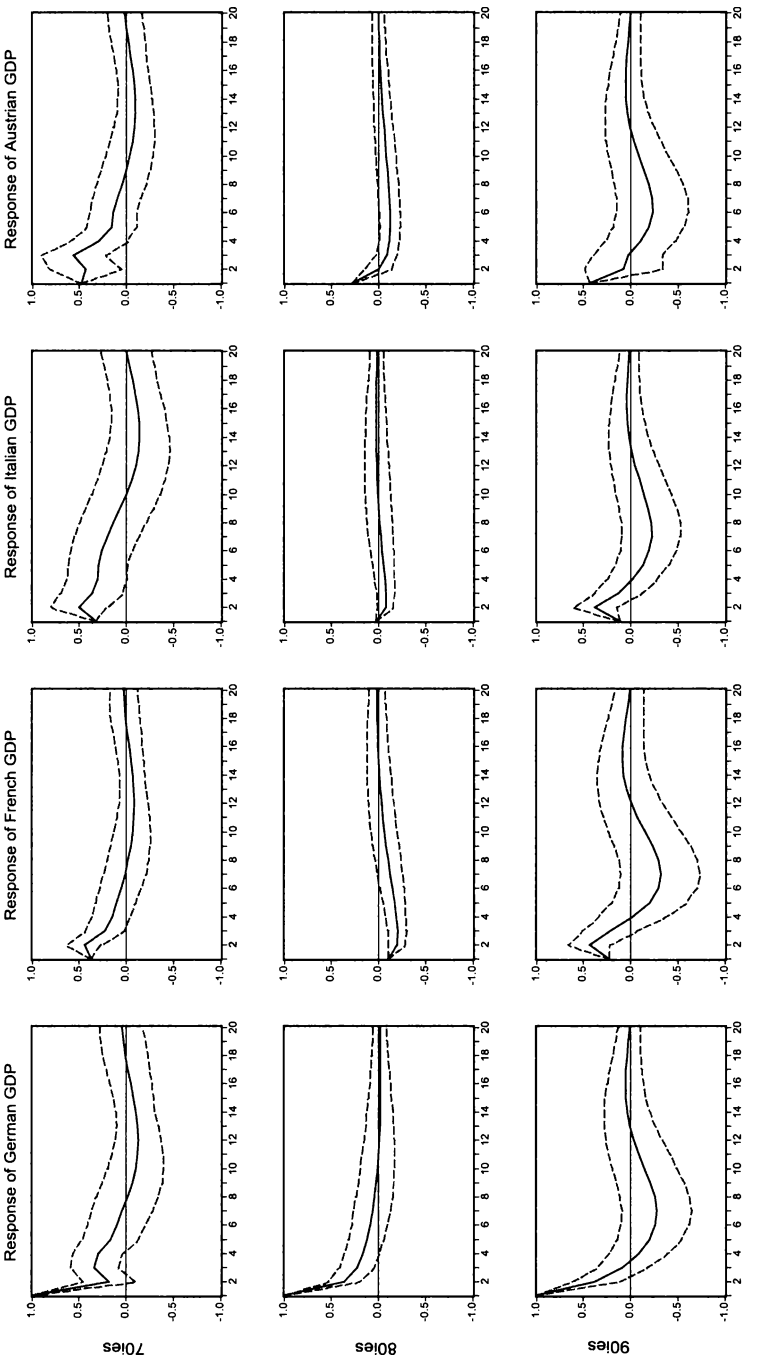

Figure 2: Impulse response functions of a 1% shock on German GDP with 95% confidence bands

linkages transmitting Germany's economic fluctuations to Austria.[10] Assuming that the transmission between highly integrated economies might be rather fast (having in mind e. g. the capital markets as a transmission channel), the use of quarterly data could be too coarse to allow a clear distinction between the influence of common shocks and transmitted asymmetric shocks. On the other hand, the observed lag between Germany's and the French and Italian peak response can not necessarily be interpreted as an indication for the absence of common exogenous shocks and for high importance of transmissive effects. As Mills and Holmes (1999, 560) note, even if countries experience a common shock, their response might well be temporarily spread due to differing economic structures or different ways of dealing with the shock, thus leading to an impulse response function similar to the one obtained in the case of a transmitted idiosyncratic shock.

Therefore, the possibilities to further investigate the influence of Germany's economic fluctuations on the European business cycle on basis of the empirical findings presented above are quite limited, as a clear distinction between the importance of transmissive effects and common shocks for the synchronization of the national cycles is not feasible. Our analysis confirms the previously observed strong correlation between the output fluctuations in Germany and the other economies especially in the 1970ies and 1990ies. Evidence of reasons for this close connection remains unreliable though. There might be some weak indication of an increase in transmission between Germany and France as well as Italy in the 1990ies compared to the 1970ies, as the contemporaneous correlation decreased (thus indicating a diminished influence of common shocks), while the lagged reaction of either country's GDP increased. A confirmation of the hypothesis that German economic fluctuations influence the business cycle of the other European countries by means of transmission has yet to be given, though.

In the following sections we present an international real business cycle model, that is capable to simulate the observed regularities of the European business cycle. By modifying the model's mechanisms and using the empirical findings presented above as a benchmark, we are able to assess the importance of different driving forces of the national cycles.

3. The Model

The model employed here to further investigate the influence of German business cycles on the economic fluctuations of its European neighbors, corresponds in its characteristic features to the basic real business cycle models presented in the seminal papers by Kydland and Prescott (1982) and Long and Plosser (1983). Apart from rational expectations and cleared markets due to an efficient price me-

[10] While it seems plausible to expect the main influence to be directed from Germany to Austria, an influence from Austria on Germany shall clearly not be precluded.

chanism, this is in particular the assumption of a pure supply sided stochastic shock (technology shock) as impulse for economic fluctuations. There is no monetary sector and no governmental influence on the economy. The fundamental extension of this model compared to the baseline models is the opening of the economy to international goods markets.[11] In contrast to the international models decisively developed by Backus et al. (1992) and Baxter and Crucini (1993), heterogeneities among the countries are taken into account by Zimmermann (1997). The following exposition is chiefly based on his work.

The model's world economy consists of three countries differing in size and trade related variables. The countries are populated by a constant[12] number of representative agents maximizing their lifetime utility by consuming or investing goods and varying their labor supply over time. While goods are freely traded internationally, labor is internationally immobile.

The representative agent in country $i = 1 \ldots 3$ maximizes his expected lifetime utility $\mathrm{E}\{U_i\}$, which is assumed to be representable by

$$U_i = \sum_{t=0}^{\infty} \frac{\beta^t}{\gamma} \left({c_{i,t}}^{\mu} \cdot (1 - n_{i,t})^{1-\mu} \right)^{\gamma}, \qquad 0 < \beta < 1, 0 < \mu < 1, \gamma < 1, \tag{1}$$

where $c_{i,t}$ is the agent's consumption at time t, $n_{i,t}$ his working time and thus $1 - n_{i,t}$ his leisure, β the discount factor, and γ the coefficient of relative risk aversion.

Each country produces one good $y_{i,t}$ according to a Cobb-Douglas production function using capital $k_{i,t}$ and labor $n_{i,t}$.[13] Production is influenced by a stochastic technology parameter $z_{i,t}$:

$$y_{i,t} = z_{i,t} \cdot {k_{i,t}}^{\theta} {n_{i,t}}^{1-\theta}, \qquad 0 < \theta < 1 . \tag{2}$$

The technology parameter $z_{i,t}$ follows a first order vector autoregressive process:

$$z_{t+1} = \left[z_{1,t+1} \; z_{2,t+1} \; z_{3,t+1} \right]^T = Z + A z_t + \varepsilon_{t+1} , \tag{3}$$

where $\varepsilon_{t+1} = \left[\varepsilon_{1,t+1} \; \varepsilon_{2,t+1} \; \varepsilon_{3,t+1} \right]^T \sim N(0, V)$ is a vector of normally distributed serially independent technology shocks with mean 0 and variance-covariance matrix V.[14]

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[11] International capital markets are not explicitly modeled here. See e. g. Baxter and Crucini (1995) or Cantor and Mark (1988).

[12] As the model is used to simulate business cycles rather than growth tendencies we refrain from growth in population.

[13] All variables are in per capita terms of the respective country.

[14] Contemporary correlation of the technology shock in the respective countries is thus taken into account by the matrix V and lagged correlation (e. g. due to technological spillovers) by the matrix A.

Capital is accumulated according to

$$k_{i,t+1} = (1-\delta)k_{i,t} + x_{i,t} \ , \qquad 0 < \delta < 1 \ , \tag{4}$$

where $x_{i,t}$ is gross investment and δ the depreciation rate.

Total production of country i, $y_{i,t}$, is used domestically and abroad. Exports from country i to country j per capita of country j are symbolized by $y_{i,j,t}$. Thus, if the population of country i is given as α_i:

$$\alpha_i y_{i,t} = \alpha_i y_{i,i,t} + \alpha_j y_{i,j,t} + \alpha_k y_{i,k,t} \ , \qquad i \neq j \neq k \ . \tag{5}$$

Goods are used for consumption $c_{i,t}$ and investment $x_{i,t}$, where a limited substitutability between goods of different origin is handled by introducing an Armington (1969) aggregator $G(\cdot)$ into the household's problem. This function attaches different weights ω_{ij} to goods of different origin and aggregates them to a single homogeneous good being consumed or invested:

$$\begin{aligned} c_{i,t} + x_{i,t} &= G(y_{i,i,t}, y_{j,i,t}, y_{k,i,t}) = (\omega_{i,i} {y_{i,i,t}}^{-\rho} + \omega_{j,i} {y_{j,i,t}}^{-\rho} + \omega_{k,i} {y_{k,i,t}}^{-\rho})^{-\frac{1}{\rho}} \ , \\ &\text{with } \omega_{i,i}, \omega_{j,i}, \omega_{k,i} \geq 0, \rho \geq 1 \ . \end{aligned} \tag{6}$$

4. The Steady State

In the steady state the trade balances and all markets are in equilibrium. The influence of technology shocks is set to zero ($\varepsilon_{i,t} = 0$). The technology parameter's equilibrium value $\bar{z}$ is then $\bar{z} = (I - A)^{-1} Z$.

The producer's maximization problem is

$$\max_{\{k_i, n_i\}} z_i {k_i}^{\theta} {n_i}^{1-\theta} - w_i n_i - (r+\delta)k_i \ , \tag{7}$$

where r is the interest rate and w_i the wage. The first order conditions are then

$$\bar{y}_i = \bar{z}_i^{\frac{1}{1-\theta}} \left(\frac{\theta}{r+\delta} \right)^{\frac{\theta}{1-\theta}} \bar{n}_i \ , \quad \bar{k}_i = \theta \frac{\bar{y}_i}{r+\delta} \ , \quad \bar{w}_i = (1-\theta)\frac{\bar{y}_i}{\bar{n}_i} \ , \quad \bar{x}_i = \frac{\delta\theta\bar{y}_i}{r+\delta} \ . \tag{8a–d}$$

Households maximize their utility subject to their budget constraint:

$$\max_{\{c_i, n_i\}} \frac{1}{\gamma} ({c_i}^{\mu}(1-n_i)^{1-\mu})^{\gamma}, \qquad \text{s. t. } w_i n_i + (r+\delta)k_i = c_i + x_i \ . \tag{9}$$

This leads to

$$\bar{n}_i = \frac{(1-\theta)\frac{\mu}{1-\mu}}{1 + (1-\theta)\frac{\mu}{1-\mu} - \frac{\delta\theta}{(r+\delta)}} \quad \text{and} \quad \bar{c}_i = \frac{\mu}{1-\mu}(1-\theta)\frac{\bar{y}_i}{\bar{n}_i}(1-\bar{n}_i) \ . \tag{10a,b}$$

If $p_{i,j}$ or $p_{i,k}$ is the respective price of the foreign good valued in units of the domestic good (price ratio, bilateral terms of trade), the household's maximization over the three goods $y_{i,i}$, $y_{j,i}$ and $y_{k,i}$ according to the Armington aggregator, complete markets assumed, leads to

$$p_{i,j} = \frac{\partial G/\partial y_{j,i}}{\partial G/\partial y_{i,i}} = \frac{\omega_{j,i}}{\omega_{i,i}} \left(\frac{y_{i,i}}{y_{j,i}}\right)^{1+\rho}, \tag{11a}$$

$$\text{and } p_{i,k} = \frac{\partial G/\partial y_{k,i}}{\partial G/\partial y_{i,i}} = \frac{\omega_{k,i}}{\omega_{i,i}} \left(\frac{y_{i,i}}{y_{k,i}}\right)^{1+\rho} \tag{11b}$$

The trade balance is defined as value of exports less value of imports (expressed in prices of country i's goods). Per capita of country i, it is

$$tb_i = \frac{\alpha_j}{\alpha_i} y_{i,j} + \frac{\alpha_k}{\alpha_i} y_{i,k} - p_{i,j} y_{j,i} - p_{i,k} y_{k,i} \,. \tag{12}$$

In the steady state, the trade balance is in equilibrium ($tb_i = 0$) and the terms of trade are equal to one. For the trade flows, this leads to

$$\bar{y}_{i,i} = \frac{\bar{y}_i}{1 + \left(\frac{\omega_{j,i}}{\omega_{i,i}}\right)^{\frac{1}{\rho+1}} + \left(\frac{\omega_{k,i}}{\omega_{i,i}}\right)^{\frac{1}{\rho+1}}}, \tag{13a}$$

$$\bar{y}_{j,i} = \frac{\bar{y}_i}{\left(\frac{\omega_{i,i}}{\omega_{j,i}}\right)^{\frac{1}{\rho+1}} + 1 + \left(\frac{\omega_{k,i}}{\omega_{j,i}}\right)^{\frac{1}{\rho+1}}}, \tag{13b}$$

$$\bar{y}_{k,i} = \frac{\bar{y}_i}{\left(\frac{\omega_{i,i}}{\omega_{k,i}}\right)^{\frac{1}{\rho+1}} + \left(\frac{\omega_{j,i}}{\omega_{k,i}}\right)^{\frac{1}{\rho+1}} + 1} \,. \tag{13c}$$

This completes the description of the model's steady state.

5. Calibration

As common in RBC theory, the model's parameters are determined by calibration (see e. g. Kydland and Prescott, 1996). Following Zimmermann (1997) and most of the literature the (quarterly) interest rate in all countries is set to $r = 1\%$. This yields $\beta = \frac{1}{r+1} \approx 0.99$. The quarterly discount rate is fixed at $\delta = 0.025$, the capital income share θ is set to 0.35.[15] Rearranging (10a) and setting $\bar{n}_i = 0.3$ as well as $\frac{\bar{c}_i}{\bar{y}_i} = 0.75$, leads to $\mu = \frac{1}{1+\frac{\bar{y}_i}{\bar{c}_i}(1-\theta)\frac{1-\bar{n}_i}{\bar{n}_i}} \approx 0.33$. For the measure of risk aversion $\gamma = -1$ is assumed.

The $\omega_{i,j}$ are determined by setting $\frac{\bar{y}_{i,i}}{\bar{y}_i}$ according to the average domestic production share of the respective country's GDP as recorded in the IMF's International

[15] Assuming that factors are paid according to their marginal product, it follows from the production function that the households' income share from capital equals θ.

Financial Statistics.[16] Additionally $\frac{\bar{y}_{j,i}}{\bar{y}_i}$ and $\frac{\bar{y}_{k,i}}{\bar{y}_i}$ are set such that the countries import ratios from the two other countries match the average import proportions as reported in the IMF's Direction of Trade Statistics. Taking into account, that in the long run $\bar{c}_i + \bar{x}_i = \bar{y}_i$ and the terms of trade in the steady state are equal to one, one can derive the weights in the Armington aggregator as $\omega_{j,i} = \left(\frac{\bar{y}_{j,i}}{\bar{y}_i}\right)^{1+\rho}$.

The calibration of the technology parameter is based on the estimation of Solow (1957) residuals. Using time series of employment, real output and capital formation for the respective countries, we derive a time series for the Solow residual of each country.[17] As assumed in the model, z_t evolves according to a VAR(1) process. We thus use the series of the Solow residuals to estimate the parameters of this VAR process (coefficient matrix A and variance-covariance matrix V) by ordinary least squares.

6. Synopsis of the Computational Procedure

As most RBC models, the model discussed in this paper can not be solved analytically due to the functional forms of preferences and production.[18] It will therefore be evaluated numerically using a dynamic programming technique explained by Hansen and Prescott (1995) and Díaz-Giménez (1999). This technique requires the optimization problem underlying the consumers and producers behavior to be written in terms of a social planning problem.[19] This allows us to exploit the recursive structure of the dynamic optimization problem, as the social planner's problem is structurally the same in each period: given a fixed capital stock k_t and technology parameter z_t, he decides about labor, consumption, investment and imports such that the expected value of the agents' discounted life time utility is maximized. This will be the case if the social planner maximizes a weighted sum of the representative agents' utility, where the weights are given by the country size α_i.

The social planner's optimization problem is thus given by

$$\max \sum_{i=1}^{3} \alpha_i \sum_{t=0}^{\infty} \frac{\beta^t}{\gamma} \left(c_{i,t}^{\mu}(1 - n_{i,t})^{1-\mu}\right)^{\gamma} \tag{14}$$

$$\text{s.t. } c_{i,t} = G(y_{i,i,t}, y_{j,i,t}, y_{k,i,t}) - x_{i,t} \tag{15a}$$

$$\alpha_i y_{i,i,t} = \alpha_i y_{i,t} - \alpha_j y_{i,j,t} - \alpha_k y_{i,k,t} \tag{15b}$$

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16 Averages cover the period from 1970 to 2000. See the appendix for details.

17 See the appendix for sources and details of the aggregation procedure.

18 Analytical solutions can be found for models with very strict assumptions, e. g. a depreciation rate of 100% and logarithmic utility as in Long and Plosser (1983).

19 According to the Second Welfare Theorem, the decentral maximization problem of consumers and producers can equivalently be analyzed in terms of a social planning problem, if there are no externalities such as distorting taxes in the considered model.

$$y_{i,t} = z_{i,t} k_{i,t}^{\theta} n_{i,t}^{1-\theta} \tag{15c}$$

$$z_{t+1} = (z_{i,t}, z_{j,t}, z_{k,t})^T = Z + Az_t + \varepsilon_t \tag{15d}$$

$$k_{i,t+1} = (1-\delta)k_{i,t} + x_{i,t} \tag{15e}$$

for all $i \neq j \neq k$ and $i, j, k \in \{1, 2, 3\}$. Substituting (15a) – (15c) in (14) leads to the global utility function, which serves as the social planner's objective function in the dynamic programming problem:

$$\max_{\{n_{i,t}, x_{i,t}, y_{i,j,t}\}} \sum_{i=1}^{3} \alpha_i \sum_{t=0}^{\infty} \frac{\beta^t}{\gamma} \left(\left[G\left(z_{i,t} k_{i,t}^{\theta} n_{i,t}^{1-\theta} - \frac{\alpha_j}{\alpha_i} y_{i,j,t} - \frac{\alpha_k}{\alpha_i} y_{i,k,t}, y_{j,i,t}, y_{k,i,t} \right) - x_{i,t} \right]^{\mu} (1 - n_{i,t})^{1-\mu} \right)^{\gamma} \tag{16}$$

$$\text{s.t. } z_{t+1} = Z + Az_t + \varepsilon_t \ , \tag{17a}$$

$$k_{i,t+1} = (1-\delta)k_{i,t} + x_{i,t} \ . \tag{17b}$$

In order to simplify the computations, the global utility function (16) is approximated by a second order Taylor series around the steady state. Dynamic programming techniques are then used to derive decision rules from this quadratic function under the linear constraints given in (17a) and (17b). Using these decision rules we are able to simulate the model economy's reaction in response to a numerically defined or a stochastic shock affecting the technology parameter z_t.

7. Simulation of Impulse Response Functions

In a next step the model will be used to simulate output series. In analogy to the empirical analysis carried out in section 2 of this paper these series are detrended using the HP filter.[20] Subsequently, a VAR is estimated on the detrended series and impulse response functions are determined. The simulated series are thereby chosen to have a length of 5000 periods, thus reducing the influence of singular observations.

The model is simulated under two different scenarios concerning the calibration of the country-specific parameters ("Model A" and "Model B", respectively). Country 1 in both scenarios shall be Germany, as the main objective of this work is to isolate transmissive effects from Germany to the rest of Europe. Country 2 in model A is calibrated to mimic the main features of the French economy, in model B country 2 corresponds to the Austrian economy. Country 3 ("Rest of the World", RoW) is parameterized according to an aggregate consisting of the remaining countries used in section 2.[21]

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20 Detrending the simulated series might seem redundant, as due to the model's construction the series by definition don't have a growth trend. In order to maintain comparability with our empirical results, filtering the series is indispensable anyway, because the filtering process removes longer-term fluctuations as trend, even though they are not to be regarded as trend in the model's context. Zimmermann (1997) applies the same procedure in order to allow direct comparison of data and simulated histories.

As has been noted in section 5, the country specific calibration of the model's parameters is limited to features concerning the respective country's integration and dependencies in an international context. Specifically, these parameters are the weights in the Armington aggregator (determined, as described above, by the respective import share $\frac{y_{j,i}}{y_i}$ of the country) and the matrices affecting the level and motion of the technology parameter. Table1 and 2 report these parameters' values for the two model specifications based on data from 1970:1 to 2000:4.[22]

Table 1

Calibration of the country specific parameters in model A

Table 1.a: Import shares.

From: \ To:	Germany	France	RoW A
Germany	$\frac{y_{1,1}}{y_1} = 0.793$	$\frac{y_{1,2}}{y_2} = 0.065$	$\frac{y_{1,3}}{y_3} = 0.070$
France	$\frac{y_{2,1}}{y_1} = 0.048$	$\frac{y_{2,2}}{y_2} = 0.818$	$\frac{y_{2,3}}{y_3} = 0.035$
RoW A	$\frac{y_{3,1}}{y_1} = 0.159$	$\frac{y_{3,2}}{y_2} = 0.117$	$\frac{y_{3,3}}{y_3} = 0.895$
	$\sum_1 : 1.000$	$\sum_2 : 1.000$	$\sum_3 : 1.000$

Table 1.b: The technology parameter.

$$A = \begin{bmatrix} 0.881620 & -0.041001 & 0.104630 \\ (0.03467) & (0.04505) & (0.06693) \\ -0.039868 & 0.943340 & 0.082678 \\ (0.01930) & (0.02507) & (0.03725) \\ -0.009231 & -0.057053 & 0.917830 \\ (0.02195) & (0.02852) & (0.04237) \end{bmatrix} \qquad V = \begin{bmatrix} 2.5431\text{E-}05 & 5.8401\text{E-}06 & 1.6281\text{E-}06 \\ 5.8401\text{E-}06 & 7.8998\text{E-}06 & 1.8278\text{E-}06 \\ 1.6281\text{E-}06 & 1.8278\text{E-}06 & 1.0199\text{E-}05 \end{bmatrix}$$

Numbers in parentheses are standard errors.

The parameters are broadly in line with other estimates in the literature. Some remarkable features arise, though: First, the coefficients describing the spillover effects (matrix A), are generally rather low compared with the estimates presented in the literature. This is especially surprising for the model B scenario, where one would expect Austria's technology level to be more dependant on German technology shocks. The second remark concerns the negative coefficients in the spillover matrix. Though not significant at the 10 % level, this point calls for attention. Following Zimmermann (1997, 330 f.), it might be interpreted as the outcome of a competitive advantage emerging from a positive technology shock in one country, inducing a negative effect on output and productivity in the other country. Although this interpretation appears reasonable, we want to point out, that these estimates are rather unusual compared to similar studies dealing with other countries' business cycles. We leave to future research an assessment of the stability of these results in a European context.

21 RoW A = {AT,IT,JP,UK,US}; RoW B = {FR,IT,JP,UK,US}.

22 See the appendix for a detailed description of sources and methods.

Table 2

Calibration of the country specific parameters in model B

Table 2.a: Import shares.

From: \ To:	Germany	Austria	RoW B
Germany	$\frac{y_{1,1}}{y_1} = 0.793$	$\frac{y_{1,2}}{y_2} = 0.187$	$\frac{y_{1,3}}{y_3} = 0.084$
Austria	$\frac{y_{2,1}}{y_1} = 0.047$	$\frac{y_{2,2}}{y_2} = 0.710$	$\frac{y_{2,3}}{y_3} = 0.026$
RoW B	$\frac{y_{3,1}}{y_1} = 0.160$	$\frac{y_{3,2}}{y_2} = 0.103$	$\frac{y_{3,3}}{y_3} = 0.890$
	$\sum_1 : 1.000$	$\sum_2 : 1.000$	$\sum_3 : 1.000$

Table 2.b: The technology parameter.

$$A = \begin{bmatrix} 0.856396 & -0.000865 & 0.096106 \\ (0.04008) & (0.02561) & (0.06819) \\ 0.062181 & 0.872364 & 0.104022 \\ (0.05970) & (0.03814) & (0.10157) \\ 0.003042 & -0.028566 & 0.891018 \\ (0.02494) & (0.01593) & (0.04243) \end{bmatrix} \qquad V = \begin{bmatrix} 2.6572\text{E-}05 & 5.6809\text{E-}06 & 2.2685\text{E-}06 \\ 5.6809\text{E-}06 & 5.8956\text{E-}05 & 1.8182\text{E-}06 \\ 2.2685\text{E-}06 & 1.8182\text{E-}06 & 1.0288\text{E-}05 \end{bmatrix}$$

Numbers in parentheses are standard errors.

Basically, the model allows for two different reasons why technological disturbances in one country lead to fluctuations in the time series of the other countries. Following Canova and Marrinan (1998), we distinguish between production interdependencies on the one hand and consumption interdependencies on the other hand, with production interdependencies being characterized by contemporary and lagged correlation of the technology parameter, i. e. a direct transmission of the technology shock.[23]

In contrast, consumption interdependencies are generated by international trade: a technology shock in one country leads to a sharp rise in productivity and, due to increasing marginal products, a rise in labor, investment and output. Additionally, the households, now calculating with a higher permanent income, increase their consumption. Since the increase in consumption and investment is higher than the increase in output, imports will rise, which leads in the short run (given initially unchanged productivity and output) to a decrease in investment in the foreign country. This is followed by a reduction of the capital stock and a decline of output abroad. In the long run, the rise of output in the country experiencing the shock leads to a decline of the relative price of this country's production and an increase of exports, thus in turn resulting in a rise of investment and production in the foreign country.

23 Note, that in contrast to Canova and Marrinan (1998) the term "production interdependencies" shall here be extended such that it covers contemporary correlation and is not limited to lagged spillover effects as in Canova and Marrinan (1998).

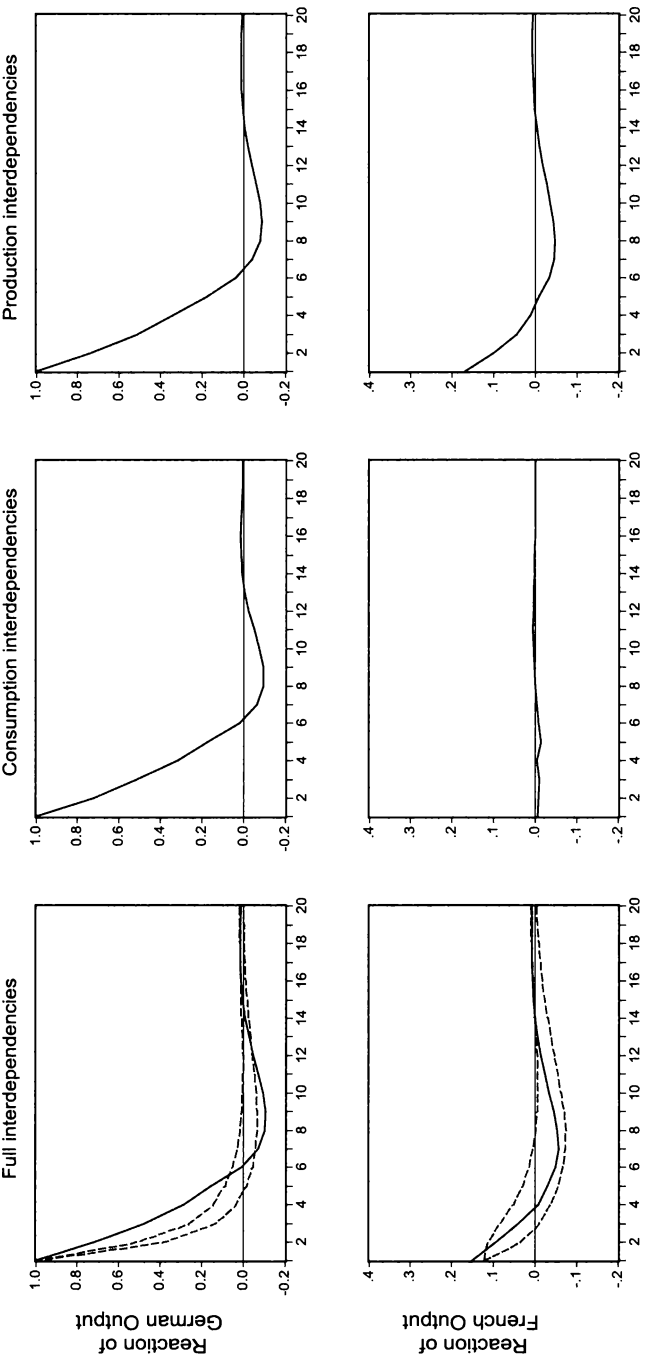

Figure 3: Simulated impulse response functions in model A: Output of the model's economies after a technology shock increasing German output by 1%. Depicted are the reactions with all transmission mechanisms in effect (additionally pictured are the 95% confidence bands of the empirical analysis), with pure consumption interdependencies and with pure production interdependencies.

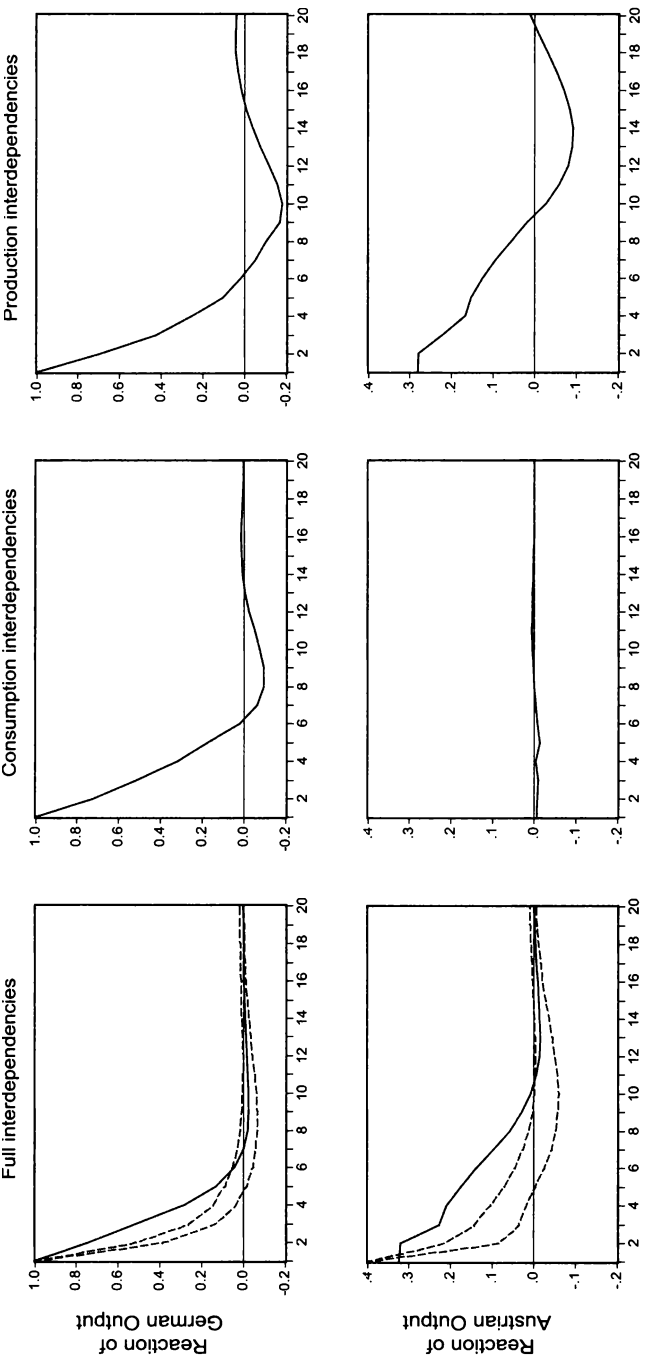

Figure 4: Simulated impulse response functions in model B: Output of the model's economies after a technology shock increasing German output by 1%. Depicted are the reactions with all transmission mechanisms in effect (additionally pictured are the 95% confidence bands of the empirical analysis), with pure consumption interdependencies and with pure production interdependencies.

In order to assess the relevance of these two kinds of interdependencies, for each specification of the model three time series are simulated. In a first run, the model is simulated as described above, i. e. with all transmission mechanisms in effect. In a second run the importance of trade for the international transmission of cycles shall be evaluated. Therefore, the off-diagonal elements of the matrices A and V are set to zero, thus eliminating the direct international effects of technology shocks and leaving consumption interdependencies as the only remaining transmission channel. In a third run, a model reduced by trade linkages (but with restored matrices A and V) is simulated, i. e. no import goods are demanded. The direct international effects of the technology shock are then the sole reason for international transmission.

Impulse response functions based on these simulated time series are depicted in figure 3 and 4. As is apparent when comparing the graphs with the additionally pictured 95 % confidence interval of the empirical analysis, the base model (with all transmission mechanisms in effect) resembles rather well the broad features of the European business cycle transmission as documented in section 2, figure 1. In Germany, the shock's influence fades out rather quickly and the economy reaches its long-run growth path after approximately 7 quarters, which is slightly more than the empirically estimated persistence of a 1% shock on the German GDP. For France, the model's result shows a persistence somewhat too small, with the model economy returning to its steady state within 4 quarters, while in the non-structural VAR model of section 2 it takes the French GDP about 5 quarters to reach its trend. In contrast, the model's prediction for the Austrian output is plainly too persistent in comparison to the empirical regularities documented above.

In contrast to the model's predictions concerning the persistency of a shock, the model's simulation of the contemporary reaction of the European countries' fits the empirical data impressively well. As a whole, the model is rather successful in mirroring the differences between the respective country's reaction on a shock: Austria experiences a fairly strong and long lasting reaction on a German technology shock, while the reaction in France is quite weak and dies out quickly.

The modifications of the model as described in the paragraph further above turn out to be interesting with regards to the question of the German economy's role for the European business cycle (see fig. 3 and 4). As becomes unambiguously clear, international trade plays only a minor role for the transmission of business cycles within the framework of the model. In scenario A as well as in scenario B production interdependencies are crucial for transmitting impulses across borders. Despite of strong trade linkages especially between Germany and Austria the trade channel does not appear to promote business cycles on a large scale.

The importance of production interdependencies suggests a deeper analysis. For this purpose we distinguish additionally between contemporary correlation accord-

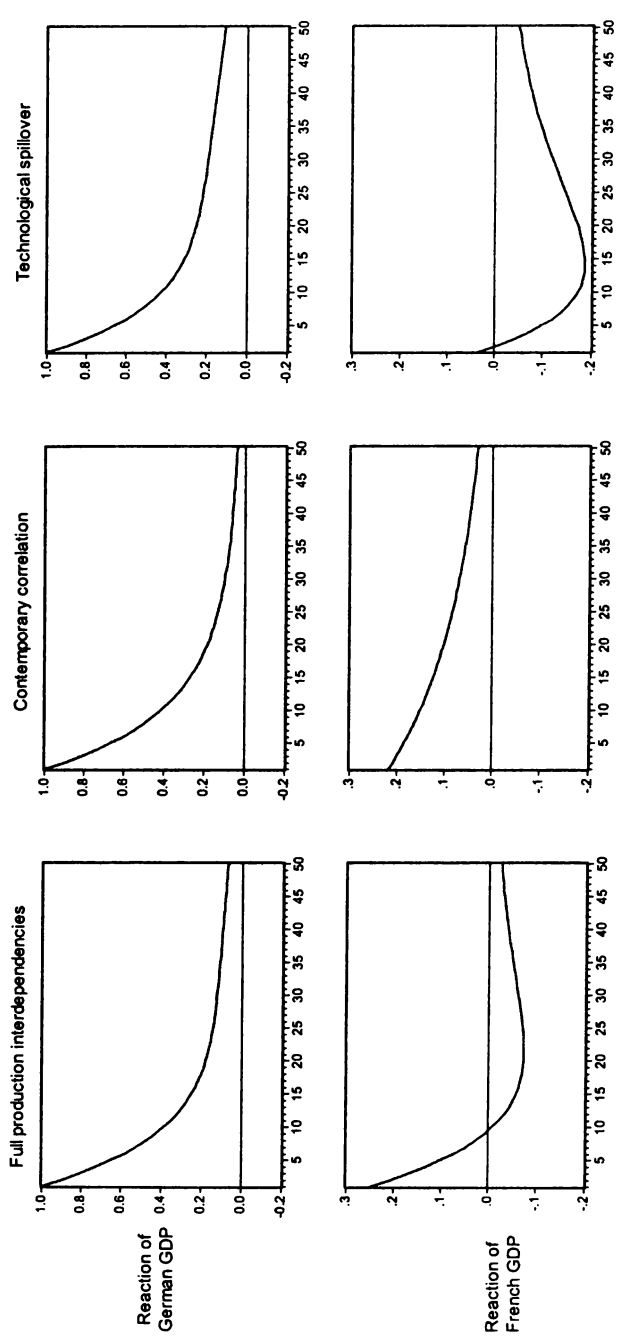

Figure 5: Detailed analysis of production interdependencies in model A: Output responses following a 1% shock on German GDP with full production interdependencies, with isolated contemporary correlation and lagged technological spillovers.

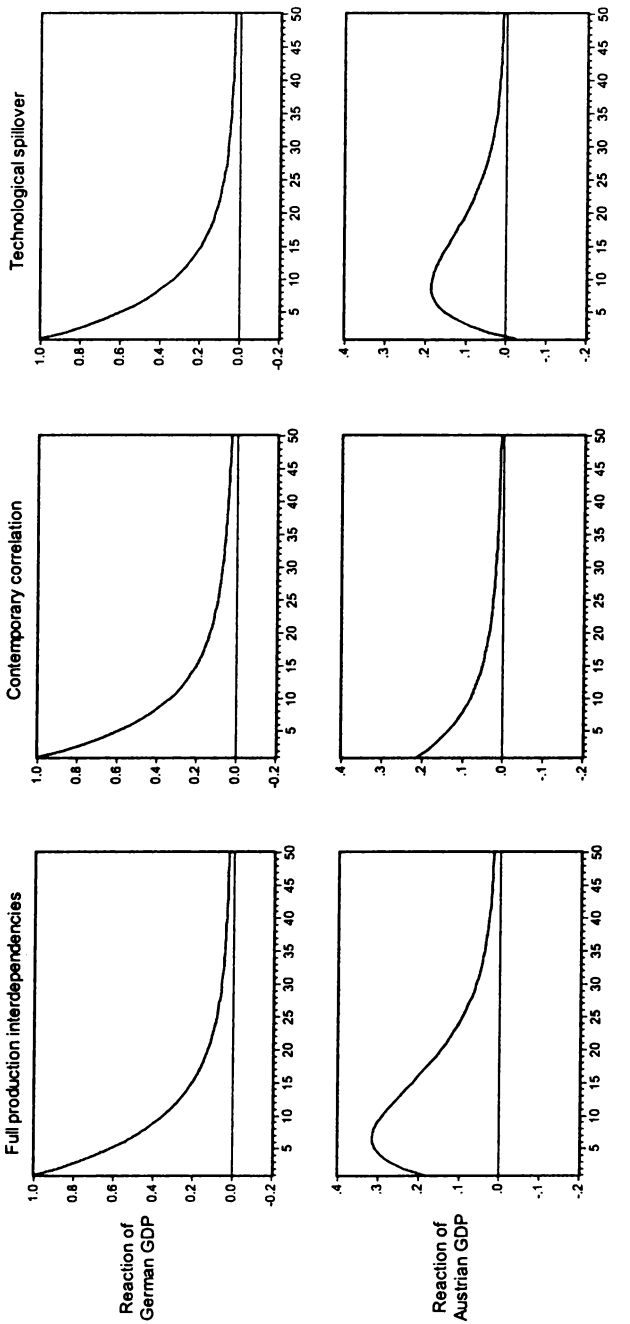

Figure 6: Detailed analysis of production interdependencies in model B: Output responses following a 1 % shock on German GDP with full production interdependencies, with isolated contemporary correlation and lagged technological spillovers.

ing to matrix V and lagged spillovers according to matrix A (see fig. 5 and 6).[24] Thus, the model is simulated first with A's off-diagonal elements and second with V's off-diagonal elements set to zero.

For both model specifications apparently neither lagged nor contemporary production interdependencies are the decisive mechanism to shape the impulse response function. On the contrary, in both cases contemporary as well as lagged correlation of the technology parameter is necessary to model the economies' behavior in order to match the empirical results.

8. Implications and Discussion of Results

The findings presented above allow us to give some concluding assessment of the influence of different synchronization mechanisms: In view of our theoretical analysis the importance of trade (consumption interdependencies) for the relations between European business cycles is to be assessed rather low. The role of technological interdependencies demands a more sophisticated examination. As we have shown in the preceding section, contemporary as well as lagged correlation of the technology parameter is required in order to simulate realistic impulse response functions.

We follow Canova and Marrinan (1998, 144) in interpreting contemporary correlation as a sign of common exogenous shocks influencing the national economies. Our results therefore imply, that exogenous shocks are highly relevant for the existence of synchronization tendencies among the European economies.

The interpretation of lagged correlation is not as forthright though. High off-diagonal elements of matrix A might well be interpreted as an indication for the transmission of technology, e. g. through the export of technically advanced intermediate goods, international knowledge transfers or imitation of foreign goods. In this sense, the model provides some indication for an influence of Germany's economic developments on the other European nations'. This is not to say that this influence necessarily points just in one direction. On the contrary, a comparison of the coefficients of matrix A does not confirm an unidirectional effect in the case of France, where the influence appears to be relatively balanced. The existence of a "German locomotive", that increases the foreign productivity by technological spillovers, might be affirmed in the case of Austria, though. Still, we can not deny the problem already discussed in section 2, that the impression of lagged correlation might simply be induced by different economic policies to deal with a common (exogenous) shock or by different structural conditions. This problem is as relevant for the estimation of the technology shock's parameters as it was relevant for the estimation of the VARs on GDPs in section 2.

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[24] Note that the graphs are plotted by directly simulating the model's reaction on the technology shock, not, as before, by estimating a VAR on HP-detrended simulated time series.

Concluding, we can state that from a theoretical point of view the European business cycle is mainly based on common exogenous shocks and mutual supply side dependencies. Given, that the model and the chosen parameter values are a correct description of reality, the importance of trade related transmission effects is rather low.

This result corresponds to the findings presented by Canova and Marrinan (1998) for the international component of business cycles in Germany, Japan and the US. We can not provide an indication for a diverging result due to the special economic situation in Europe. Neither can we confirm the thesis of Germany having a dominant and thus synchronizing influence on the European business cycles, nor does the deep integration of European national economies via trade appear to have a harmonizing effect.

However, the central role of production interdependencies in the model might at least in part be provoked by a common (and controversially discussed) characteristic of real business cycle models: the indefiniteness of the Solow residual. The interpretation of this "measure of our ignorance" (Abramovitz, 1956, 11) as an indicator for a country's technology level appears inappropriate. As notes Mankiw (1989), the observed high correlation between the Solow residual and GDP is not necessarily to be interpreted as an indicator for the important role of technological disturbances for business cycles, but might well have its reasons in an insufficient separation of technology shocks from other influences when estimating the Solow residual. King and Rebelo (1999) argue similarly, when they point out, that the unreasonable – but for the quantitative fit of standard RBC models necessary – large volatility of the Solow residual and its central role in business cycle theory is not reflected by a corresponding public perception of these shocks: "If these shocks are large and important why can't we read about them in the *Wall Street Journal*?" (King and Rebelo, 1999, 962). In this sense, the Solow residual, being additionally biased by measurement problems e. g. due to changes in capacity utilization, appears quite unsuitable to be a realistic indicator for technology shocks. According to King and Rebelo (1999), models relying on the Solow residual as driving process are therefore just with caution to be regarded as useful for actual business cycle analysis.

In the model presented here the dominance of the Solow residual leads almost inevitably to an overestimation of technological disturbances as a source of economic fluctuations. Trade-related transmission effects are thus pushed in the background. Our assessment of Germany's economic fluctuations being rather irrelevant for the synchronicity of the European economies' business cycles is therefore to be taken with caution.

9. Conclusion and Final Remarks

This paper investigates the sources of the so called European business cycle, a term referring to the regularly observed synchronization of the national business cycles in Europe. We concentrate on the role of Germany and examine, whether or not German economic fluctuations have an important influence on the synchronization of national cycles by causing transmissive effects leading to an adjustment of the other nations' cycles.

Using a calibrated multi-country general equilibrium model featuring three heterogenous countries connected by trade linkages, we are able to reproduce the important characteristics of empirically estimated impulse response functions. The model offers basically two mechanisms, why economic fluctuations in one country might lead to a similar development in another country: consumption interdependencies and production interdependencies. While consumption interdependencies, namely dependencies due to trade on international goods markets, are strikingly irrelevant for the synchronization of our model economies' output fluctuations, we show that the central mechanism to mimic the empirically derived impulse-response functions relies on lagged and contemporary correlation of technology disturbances.

By identifying contemporary correlation as the outcome of the influence of common shocks and interpreting lagged correlation as technological spillovers, we finally conclude that the European business cycle is mainly based on exogenous factors. Inner-European synchronization mechanisms are limited to technological interdependencies. The hypothesis, that Germany might influence the other European countries due to its large economic weight, has thus to be rejected. In contrast, we find that the European business cycle owes its existence to a large scale to outside influences. It shall be noted, that the relevant exogenous influences are not limited to obvious impulses as the oil price shocks in the 1970ies, but that e. g. the US' business cycle can be regarded as a major source of exogenous disturbance (Canova and Marrinan, 1998; SVR, 2001). From this point of view, an increase in synchronization has to be attributed mainly to an approximation of policies in response to shocks and a harmonization of structural conditions in Europe.

The model is subject to the regular criticism of real business cycle theory, though. Due to the restriction to technology shocks as source of economic fluctuations, we allow for a limitation shedding some doubt on our results. An integration of fiscal shocks in the model might improve its reality considerably. Additionally, the high degree of abstraction rules out the possibility to simulate governmental actions. Appropriate modifications of the model promise interesting implications in view of the further integration of the European economies.

Appendix

Sources of the Data

The data for the GDP series presented in section 2 were taken from the IMF's International Financial Statistics database. We used quarterly index data at constant prices from 1970:1 to 2001:4. If necessary, the data was seasonally adjusted using the US Census Bureau's X12 method. For the determination of oil price growth rates we also used the time series provided by the IMF.

The import shares $\left(\frac{y_{j,i}+y_{k,i}}{y_i}\right)$ were derived on the basis of annual IMF data from 1970 up to 2000.

We used data of real GDP and of Imports of goods and services, both in national currencies. To determine the import and GDP figures for RoW, values were converted in US dollar and summarized. We then removed internal trade according to the IMF's Directions of Trade Statistics. From this data, we calculated the import share and their mean value for the period [1970, 2000]. The domestic production share $\frac{y_{i,i}}{y_i}$ is then calculated by subtracting this value from 1.

To determine the relative import shares $\frac{y_{j,i}}{y_i}$, the import shares are split up according to IMF data. The Directions of Trade Statistics provide the necessary figures to calculate each country's sum of imports to be considered in our model economy in terms of US dollar. Relating the import value from one country j to the total sum of imports and multiplying the resulting quota with the import share derived above leads to the relative import share $\frac{y_{j,i}}{y_i}$. In the case of the aggregated country RoW we removed internal trade prior to the calculations.

The time series of the Solow residual were derived by using IMF quarterly data of real GDP from 1970:1 to 2000:4. We then multiplied each national series with a constant factor in order to match the real GDP in international prices compiled by Heston et al. (2002) in their Penn World Tables. We proceeded accordingly to derive the figures for the capital stock. To determine the employment time series, OECD data was used. If available, we used the civilian employment series provided in the Main Economic Indicators, otherwise we calculated approximate figures according to labor force and unemployment statistics. Data for the aggregated countries were added up. Each series has then been normalized to give it a sample mean of 1. According to $z_{i,t} = \frac{y_{i,t}}{k_{i,t}^{\theta} n_{i,t}^{1-\theta}}$ we calculated time series of the technology parameter. These series have been seasonally adjusted and linearly detrended (the model assumes a stationary technology parameter) and were then used to estimate the matrices A and V in a VAR(1) process.

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Germany and the European Business Cycle – An Analysis of Causal Relations in an International Real Business Cycle Model A Comment

By Bernd Lucke*

Fichtner considers the hypothesis of a European business cycle, which finds some support in empirical studies. His aim is an examination of the causes of the purported synchronization. He distinguishes two alternative explanatory patterns: Either the European economies may be exposed more or less simultaneously to similar supply shocks or the country-specific shocks may be transmitted through international trade. The second interpretation would imply that business cycle developments of countries which are not directly affected by a shock were in an essential way demand-determined.

The question boils down to the issue of whether business cycle fluctuations in European countries have almost exclusively exogenous causes, or if there are mechanisms of endogenous shock propagation which transmit business cycle phenomena of certain countries to the macroeconomic environment of other countries. Fichtner's choice of the analytical framework – an international RBC model – may predetermine his findings here since RBC models typically have very weak endogenous shock propagation mechanisms.

Fichtner sets off by estimating a VAR-Model of the HP-filtered GDP series. The impulse-responses of the model point to a certain synchronization among the fluctuations in Germany, France, Italy and Austria. In the analysis of subsamples, Fichtner rightly remarks that this synchronization does not seem to be constant over time: The impulse-responses for the 80s are qualitatively considerably different from those of the 70s and 90s. This is actually a disturbing finding for the economic model that Fichtner uses in the subsequent analysis since his model assumes that the investigated economies are relatively close to their steady-state positions and that all the structural parameters are constant.

To justify his usage of RBC modeling, Fichtner correctly points out that mere data analysis with descriptive statistics cannot say anything about the causal relationships of the business cycles. A causal economic interpretation requires model-

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based theoretical underpinnings. To this end, Fichtner decides to use the international RBC model due to Zimmermann (1997).

But would identification and interpretation of the shocks not also have been possible in a more general model? VAR analysis would suggest using structural VAR models (SVAR), in which certain identifying restrictions could be imposed to allow variance-decompositions. These decompositions would show the importance of different shocks along the time dimension and in the cross-section. In general, the identifying assumptions are less restrictive a priori than those employed in the specification of an RBC model. Thus the analysis would be less exposed to the critique that the choice of the model might already predetermine its results. However, for a SVAR-analysis it is advisable to use the original series instead of the HP-filtered ones so that the restrictions about the long-run relationships can be exploited.

Fichtner's handling of the three-country RBC model is thoughtful and competent. The model formalizes international trade integration using an Armington-approach and thus allows for temporary international borrowing and lending. However, deviating from many other open RBC models no adjustment costs are speficied in the capital accumulation equations. Hence the marginal products of capital are identical for all countries. This assumption is certainly debatable, but one would not expect the results of the investigation to differ much with moderate adjustment costs.

Fichtner's solution method (approximation of the model dynamics around the steady-state) is indispensable in the RBC literature. For the sake of consistency it is also necessary to impose the assumption of zero steady state trade balances. It should be noted, however, that Germany seems to be far off the steady-state using this measure: Neither in the short-run nor in the long-run would we find Germany's trade balance to be at least approximately zero. By looking at a single country it is difficult to understand why a country that grows with a constant rate cannot have net foreign assets also grow at a constant rate.

The calibration of structural parameters follows the usual standards in the literature. Presumably the order of magnitude of the calibrated parameters is less important than the empirical determination of the technology shocks which result from the growth decomposition that is based on an aggregate Cobb-Douglas production function. Although this is also a standard procedure, it should be noted that the production elasticities which are used for growth decompositions (especially for labor) can in general not be confirmed econometrically.

Fichtner uses the constructed Solow residuals to describe technology shock dynamics of the model as VAR(1) processes. Clearly, estimation results for the VAR(1) models are especially important for the interpretation of Fichtner's results. First of all, the covariance Matrix V leads to apparently minor contemporary correlations (approximately between 0.1 and 0.4). This implies that the supposed technology shocks are rather country-specific, which is not precisely what one would

expect for technology. The hypothesis of joint shocks examined by Fichtner should display high contemporaneous correlations or at least positive off-diagonal-elements in the coefficient-matrix *A*. But Fichtner rightly emphasizes that the latter is not the case. Some of the off-diagonal-elements are even negative.

So what then is the correct interpretation of the supply shocks? A technological interpretation is not convincing and Fichtner does not hesitate to point out that the Solow-residuals are just a *measure of our ignorance*. However, it is well known that Solow-residuals are often highly correlated with trend deviations of GDP and thus correlated with the business cycle. Fichtner briefly mentions the possibility that the Solow-residual contains remaining endogenous components, e. g. because of variable capacity utilization.

The standard critique of RBC models asserts that the Solow-residual (whatever it really measures) feeds just the business cycle as supposedly exogenous shocks into the model. Due to the weak endogenous propagation mechanisms, these shocks undergo little changes and basically constitute the model results. The remarkable message of Fichtner's study is that his model seems to be comparatively well equipped against this criticism. This is so because the exogenous impulse (in the form of a VAR(1) process with a dominant diagonal in the *A* matrix) would make us expect monotonically decreasing impulse-response functions. Instead, Fichtner convincingly shows that the impulse-responses generated by the model are clearly not monotonous. In many cases the predominantly positive effect at short horizons reverses into a negative effect in the medium-term. For production dependencies this is valid also across borders, whereas for consumption dependencies this is confined to the country suffering the shock. Thus, international trade integration seems to generate considerable shock propagation in a way not typically encountered in the RBC literature.

There is hence no reason to suspect that the choice of the model unjustly influences the model outcome. While it is still possible that true propagation mechanisms are stronger than specified in the model, model propagation mechanisms are too strong to be judged negligible. This is why Fichtner's analysis provides interesting and informative insights: On the one hand, the model offers an explanation of synchronized business cycle fluctuations through common shocks, on the other hand it suggests that shock propagation across borders is almost totally due to supply side effects.

Further research should try to robustify these results. It could especially pay off to embed intermediate consumption in the model. In the current version of the model traded investment goods are the sole channel for cross-borders shock propagation. But in reality intermediate inputs are exported and imported in large amounts. Thus the consideration of intermediate input trade would have the potential of intensifying the effects of international trade integration.

Fichtner's work constitutes an interesting, carefully handled and competently interpreted study of the European business cycle. While sometimes perhaps too

much emphasis may have been put on the "engine-function" of the German economy, Fichtner's paper enhances our understanding of European business cycle phenomena. Direct economic policy implications, however, cannot be derived from this work. For instance, implications for the ECB (e. g. accomodating monetary policy) cannot be derived from a purely real model. However, the integration of a monetary sector into the model could be a promising subsequent research project.

US Outlook and German Confidence

Does the Confidence Channel Work?

By Gustav Adolf Horn*

Abstract

One channel of business cycle shock transmission which gained attraction only recently is the confidence channel. The aim of the paper is to find out whether the confidence channel is actually working between the US and Germany. This is analysed using times series methods. In contrast to other studies the direct informational content of leading US indicators for German producer confidence and the significance of asymmetric reactions is tested. The results show that there is a relationship between the respective variables, which has become closer during the nineties. However the hypothesis of asymmetries had to be rejected.

Keywords: Confidence Channel, Business Cycle, Leading Indicators

JEL classification: E37

1. Introduction

In 2001 almost all professional forecasters were surprised by the extent of global economic deterioration. Although there was the general expectation of a weaker business activity, outright recessions in all major global economies were a surprise not welcomed. There were a lot of hints that US growth would slow down in 2001 and it was assumed that this shock would have its world wide implications. Moreover it was clear that the oil price shock would hamper global economic growth on top of a restrictive course of monetary policy in all major industrial countries during the year 2000. All these traditional channels of global shock transmissions were considered when forecasts were made. Nevertheless the expected outcome was not the wide spread recession which took place. Obviously some important features driving a downturn on a global scale had been overlooked.

One channel which gained attraction only recently is the confidence channel.[1] Confidence on future economic activity will deteriorate in one country when the outlook for another major economy clouds. If e.g. forecasts for the US signal a

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[1] Cf. IMF (2001).

weaker growth than previously expected confidence in other economies e.g. Germany accordingly will decline too. Reasons for this transmission are global trade and capital links. Two different implications with respect to economic activity can be derived from the existence of this channel. Firstly one can assume that transmission of shocks is speeded up by a confidence channel. Since people know that due to a decline in the US there will be a decline in exports in due time, they react immediately. In particular investment will then be reduced not just after a decline in exports occurs but already ahead of it. That is exactly what was observed in 2001 in Germany. The question is whether the confidence channel just leads to a speeding up of transmission or whether a stronger impact is implied. This second conclusion must be distinguished from the first one. It can only hold if either people do not have rational expectations and overshoot in their reaction to news. Or other links like foreign capital assets even lead to an enhancement of shocks. In this case investors reduce their domestic investments when the value of their foreign assets declines. In any case the existence of a confidence channel would change the pattern of the business cycle. Then expectations of US developments may lead to deviations from patterns shaped by the usual fundamental variables. In particular the rapid downturn 2001 in the Euro area may be explained in this way.

The aim of the paper is to find out whether the confidence channel is actually working between the US and Germany. This is done by using information on leading indicators in the US and looking how they influence confidence in Germany. The focus is on producer confidence since firms are significantly earlier and – due to global assets – more affected than private households. Questions to be addressed are: Does such a relationship exist? Has its importance increased during recent years? Are there asymmetries in the sense that negative shocks show a higher impact on economic growth than positive ones?

These questions are analysed using times series methods. In this paper the direct informational content of US indicators for German confidence and the significance of asymmetric reactions is tested. It is measured by using a composite leading indicator for the and the ifo expectation index for Germany. The results show that there is a relationship between the respective variables, which has become closer during the nineties. However the hypothesis of asymmetry had to be rejected. These results derived differ to some extent from those of other studies which do not test the impact on expectations directly.[2] They rather focus on the impacts of shocks on the real economy while not testing the implications for expectations. Therefore in these approaches the transmission of shocks is based mainly on fundamentals like exports, technological change or foreign direct investment. Some approaches outline that the transmission is caused by stock market movements.[3] In any case the impact on expectations is never directly measured. Thus the reaction

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2 Cf Baxter/Crucini (1995),Baxter (1995),Backus7Kehoe/Kydland (1992)and Canova/Marrinan(1998).

3 CF SVR (2001), Ziffer 470.

of fundamentals which may be due to clouded expectations is not considered. In this paper as a first step in this direction is attempted.

2. Data

To measure the transmission of confidence between the US and Germany several steps of econometric analysis are taken. As a first step, times series properties of both variables are tested. Both indicators follow different principles. The ifo expectation indicator (ifo Indikator der Geschäftserwartungen) is a balance between shares of positive and negative expectations whilst the US composite leading indicator contains a growth component. Therefore, an assessment of degree of integration is required. The outcome will determine the transformation with which the respective indicator will enter the consecutive analysis. In a second step an unrestricted VAR will be designed to find out whether there is interdependence between both variables or what is – given the size of the respective economy – more likely that the impact runs from the US to Germany. The next step consists in an application of a Granger test which should provide some further insight into the structure of leads and lags. Especially one should find out whether the US economy is leading or lagging behind expectations in the German economy. A lead is expected. This analysis serves at the same time as a mean to detect informational content of the US variable for Germany. After that, stability over the sample period will be checked. Then an estimation equation is developed. Finally, the symmetry of transmission in upswing and downswing phases will be tested.

The construction principle of the ifo business expectation indicator (IFO) is fairly simple. It is the balance between the shares of positive and negative answers with respect to the nature of economic perspectives.[4] As the graph below shows, recessions in 1982 and 1992/93 are expressed by significant negative values. However, the intensity of the ups and downs is not really reflected in the indicator. Whereas the up-turns 1999 and 2000 show high positive values. The mild recession of 2001 shows almost the same negative values for the indicator as the much deeper slumps in 1982 and 1992. The same applies to the upturns: The recovery in 1994 showed much lower growth rates than those in 1987 or 1999. Nevertheless, the indicator showed even higher values for 1994.

One would assume that this construction leads to a stationary series. Indeed the results of the ADF test[5] do not request a rejection of the I(0) hypothesis.(Cf Table 1) Hence the ifo indicator will enter without any further transformation.

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[4] In this analysis the original values of the ifo expectation indicator have been seasonally adjusted by the BV4 method.

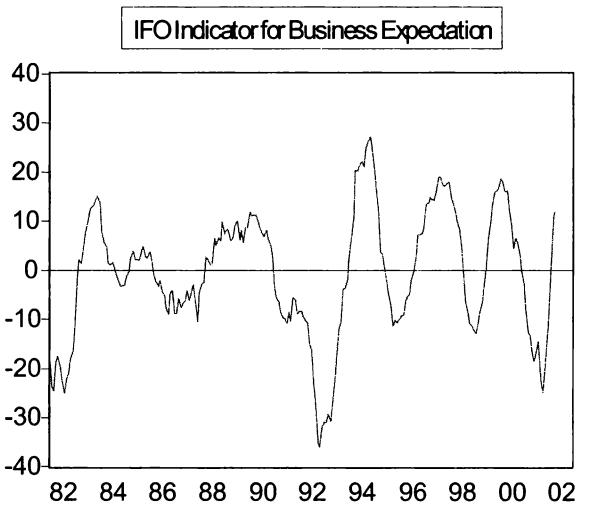
[5] The equation has been derived by omitting all insignificant lagged values starting from 12 lags downwards.

Table 1

Augmented Dickey-Fuller-Test

Sample: 1982.01 2002.04

Variable	Specification	Lags	t-value	Critical values		Order of integration
				5 %	1 %	
IFO	No Trend No Constant	1,2,3,4,5,6,7	-6,43	-1,94	-2,57	0
USIND	Constant Trend	1,3,5	-2,27	-2,87	-3,46	-
Δ USIND	Constant	1,2,3	-6,10***	-2,87	-3,46	1

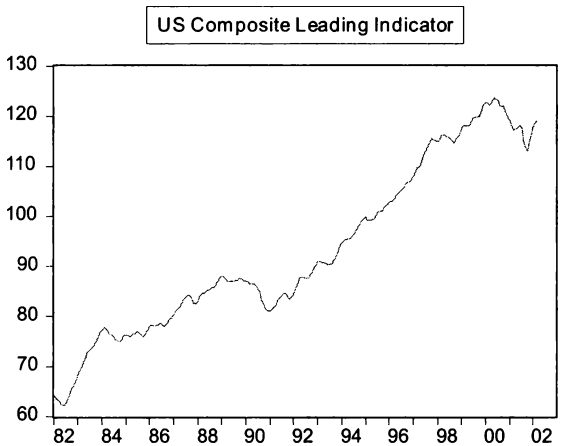


The series for the US is the composite leading indicator (USIND) containing several components which include information for the near future of economic development.

Looking at the times series properties of USIND[6], it is obvious that the series is not stationary, not even trend stationary. But a decline in the outlook of the US economy clearly shows up in a decline of the indicator. This is the case during the recessions at the beginning of the eighties and the nineties and to a very dramatic extent during last year[7].

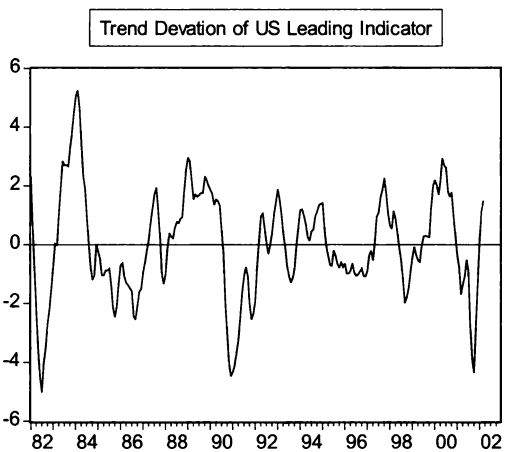
6 The equation has been derived as in footnote 5.

7 This is partly because of the attacks on September 11,2001.



The results of the ADF Test in table 1 show that the I(1) hypothesis is not rejected at the 1% significance level. Therefore the variable USIND will enter the following analysis as first difference. That means it is rather the change of the leading indicator or the outlook on business cycle activity which plays a major role in the following. As an alternative also the stationary annual change of this variable was used. But the results proved to be very similar to those of the monthly change, hence they are omitted.

One could also argue that not the actual leading indicator should be used but rather its deviation from a trend in order to have a comparable measure to the ifo indicator which makes its interpretation more intuitively.[8] In order to do so the



[8] This analysis is based on a comment by Reinhard Pohl.

USIND series was filtered by the Hodrick-Prescott (HP) procedure and the deviation between the actual USIND and its HP filtered trend was used as the relevant deviation (USINDDEV). This time series is stationary by construction.

Again the impact of recessions can clearly be detected. Astonishingly the most recent decline is as strong as during the much harder recessions at the beginning eighties. But this can be due to the construction of this measure since previous acceleration of growth has shifted the trend upwards a lot.

The ifo index was published until the end of 2001 at the 20th of each month covering the previous month. About the same time the USIND is released for the same period. This implies that until recently both indicators were simultaneously available. Since the beginning of this year the IFO indicator is published around the end of the month it covers. Therefore since then the US indicator is not available when ifo is published. That should in principle lead to a more delayed influence of USIND. But that remains to be tested, since expectations may also play a role.

3. Granger Tests

The inclusion of the US outlook into an equation for German Business expectations is only a sensible concept if the US outlook in fact leads these expectations. To assess whether this is the case an unrestricted VAR is constructed just including the ifo index, the absolute change of USIND and a constant.

$$IFO_t = \sum_{i=1}^{k} \alpha_{1i} IFO(t-i) + \sum_{i=1}^{k} \beta_{1i} \Delta USIND(t-i) \tag{1}$$

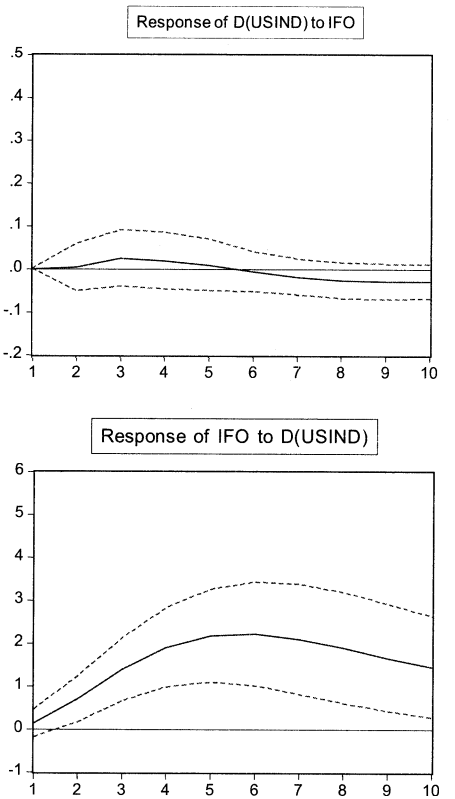
$$\Delta USIND = \sum_{i=1}^{k} \alpha_{2i} IFO(t-i) + \sum_{i=1}^{k} \beta_{2i} \Delta USIND(t-i) \tag{2}$$

The lag length was determined using AIC and SIC information criteria. The optimal lag length turned out to be three. A simple Cholesky decomposition shows the expected result.

Given the leading role of the US economy it is not surprising that ifo index does not show any significant influence on the US indicator whereas the US indicator has some impact on the ifo index. The result holds for any transformation of the US indicator. Since USIND Granger causes IFO, IFO is the dependent variable.

In the following a parsimonious Granger test is applied to measure the lead of the US indicator. This is done by an univariate estimation of ifo first as a benchmark equation. Then increasing lags of USIND are added as long as they improve the explanatory power of the equation as measured by information criteria. The results should provide information whether the inclusion of USIND can beat the

Response to Cholesky One S.D. Innovations ± 2 S.E.



benchmark equation and thus contribute significantly to the explanation of IFO. The result for the period from 1982.01 to 2002.04 are presented in table 2.

As far as the benchmark equation is concerned it explains already a great deal of the variance. A constant proved to be insignificant in this estimation. When adding the US indicator it turns out that there is some influence. Both information criteria used indicate an improvement over the benchmark estimation in three out of the four cases by adding US indicators. In case of using the trend deviation to explain IFO, equation (3), progress is minor, the SIC does not even show an improvement.

Given the huge changes on global capital markets and the ever tighter trade and equity relations among economies, one should not be surprised to find structural breaks in above equations. Tests on structural stability (CUSUM, CUSUMQ and Chow) showed indeed that this may be the case. Equation (2) in Table 2 is a marginal case. While the CUSUM test did not reject the hypothesis of stability, CUSUM of squares only marginally rejects and the Chow test even indicates a

structural break. The CUSUM test also does reject instability for the trend deviation equations (3). However CUSUM of squares and Chow tests do not. In order to overcome these problems the sample period was shortened for each equation until test results confirm a stable relationship. For equation of type (2) this was the case from 1994.01 onwards. CUSUM and Chow tests signalled stability for the whole rest of the sample while the CUSUM of squares indicated instability for 1999.01. But since the Chow test did not corroborate that result, stability was assumed. For equation (3) it turned out that a stable equation could only be derived for the rather short period from 1999.01 until 2002.04. Hence this period was selected for estimation. The results of the respective estimations are presented in Table 3.

Table 2

Granger Causality Test

US Outlook on German Confidence
– Dependent Variable: IFO Expectation Index – (1982.01 – 2002.04)

Variable	(1) Benchmark	(2) Δ USIND	(3) USINDDEV
IFO (-1)	1.08***	1.09***	1.09***
	(40.02)	(39.4)	(39.0)
IFO (-5)	-0.23***	-0.23***	-0.24***
	(2.98)	(3.06)	(3.10)
IFO (-6)	0.14*	0.11	0.12
	(1.71)	(1.41)	(1.46)
IFO (-9)	-0.10***	-0.07*	-0.07*
	(3.0)	(1.89)	(1.92)
Δ USIND		-0.01	
		(0.03)	
Δ USIND (-1)		1.02***	
		(2.82)	
USINDDEV			0.03
			(0.07)
USINDDEV (-1)			1.10
			(1.62)
USINDDEV (-2)			-1.12***
			(2.81)
R^2	0.96	0.96	0.96
DW	1.78	1.82	1.82
AIC	4.69	4.64	4.65
SIC	4.75	4.73	4.76
SE	2.51	2.44	2.44
Observations	235	234	234

Δ absolute change operator; USINDDEV deviation from HP filtered trend of USIND; t values in brackets; *** significant at 99%; **significant at 95%; – level; AIC Akaike Criterium; SIC Schwartz Criterium; SE Standard Error of Regression

The results show that the lead structure changes when the sample length is shortened. The lead of the US indicator seems to increase. Again also for these periods an improvement by the inclusion of the US indicator can be achieved. In contrast to the whole sample period even in case of trend deviation a reduction of the value of the information criteria compared to the benchmark situations is obtained. All these estimation results indicate that an estimation of an equation for the ifo indicator including the US indicator improves results.

Table 3

Granger Causality Test

US Outlook on German Confidence
– Dependent Variable: IFO Expectation Index –
Period after structural Break

Variable	(1) Benchmark	(2) Δ USIND	(3) Benchmark	(4) USINDDEV
	1994.01 – 2002.04		1999.01 – 2002.04	
CONSTANT	0.77***	0.23		
	(2.93)	(0.89)		
IFO (-1)	1.16***	1.05***	1.38***	0.88***
	(12.1)	(10.4)	(9.091)	(5.78)
IFO (-2)	-0.20*	-0.10	-0.41**	0.01
	(1.99)*	(0.99)	(2.15)	(0.09)
IFO (-5)			-0.46**	-0.30
			(2.27)	(2.02)*
IFO (-6)			0.65***	0.15
			(2.80)	(0.76)
IFO (-8)			-0.36***	-0.17
			(3.36)	(1.75)
IFO (-9)	-0.15***	-0.14***		
	(5.84)	(5.69)		
Δ USIND		0.69		
		(1.66)		
Δ USIND (-1)		0.50		
		(1.01)		
Δ USIND (-2)		1.07**		
		(2.47)		
USINDDEV				2.02***
				(5.42)
R^2	0.97	0.97	0.96	0.98
DW	1.95	1.99	2.03	2.15
SE	2.37	2.14	2.71	1.98
AIC	4.61	4.42	4.95	4.35
SIC	4.71	4.62	5.16	4.60
Observations	99	99	39	39

SE-Standard Error of Regression, AIC; Akaike Criterium, SIC Schwarz Criterium; *** significant at 99% – level; ** significant at 95% – level; *significant at 90% – level; t- values in brackets

4. Estimation Results

To derive an optimal equation both variables with their lags up two twelve months were initially included into the estimated equation. In contrast to the previous estimation now all insignificant variables were removed from the estimation. So a general to specific approach was applied. Thus for the period from 1982.01 to 2002.04 the respective lags of both variables were removed from the equation when being insignificant or the AIC and SIC were improved by the omission. The results of the procedure are shown in table 4, columns (1) and (3).

No constant was significant in above estimations. It turns out that the one period lagged value of the absolute change of the US indicator was clearly significant in the first estimation. So again this speaks for some informational content of US outlook on German business expectation. At the first glance the same applies to the trend deviation. But several lags of this variable also prove to be significant with an opposing sign. Moreover, the sum of coefficients is not significantly different from zero. Therefore these estimations indicate that rather the change of trend deviation feeds into the expectation formation than the trend deviation itself.

It is at least surprising that it takes up to four months (equation 3) until firms use information on the US outlook when at the same time the contemporaneous value is not significant. This is only rational when the US indicator would not be available in a timely fashion. But given the publication structure outlined above the contemporaneous value of USIND should be significant in all estimations. In fact they were insignificant in both estimated approaches. The second point to be taken into consideration is that both equations show some signs of instability.

A CUSUM test of equation (1) showed no instability. However, the CUSUM of squares test of the same equation yields the result that the estimated equation is stable at the margin only. In order to test the result another estimation was done starting 1992.01, when the CUSUM of squares test is at the margin. Testing this equation leads to an indication for a break in 1994. An additional Chow test leads to the conclusion that a structural break in 1994.01 can not be rejected at the 1 % confidence level. The above procedure for finding an equation was applied again for the period from 1994.01 onwards. The search ended up with equation (2) in table 4. Stability tests of this equation showed that CUSUM again did not indicate any instability whereas CUSUM of squares delivered results at the margin. But in this case additional Chow tests did not give any hint for a structural break. Hence this equation was taken to be stable for the rest of the sample period.

For equation (3) the results are similar. Again 1992 the CUSUM of squares test shows that stability is at the margin. While the CUSUM test also in this case indicated stability. The respective Chow test however cannot reject the hypothesis of a structural break for 1992.01 at the 5 % level.

Further estimations from 1992 onwards were unable to detect a stable relationship before 1999.01. Therefore this period from 1999.01 onwards, although rather

Table 4

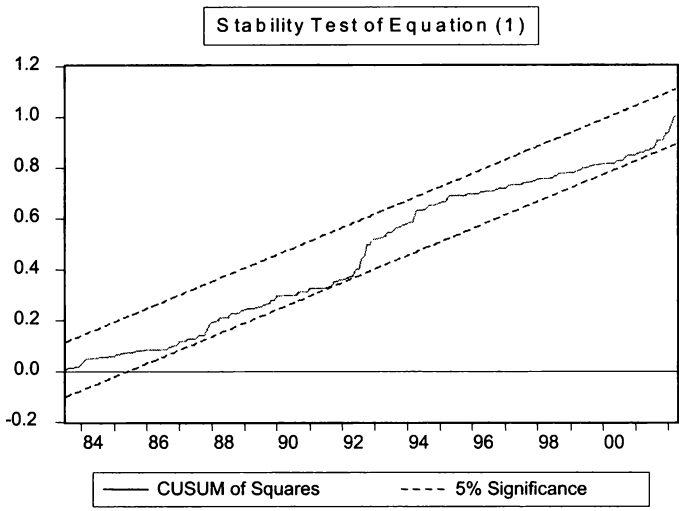
Estimation Results

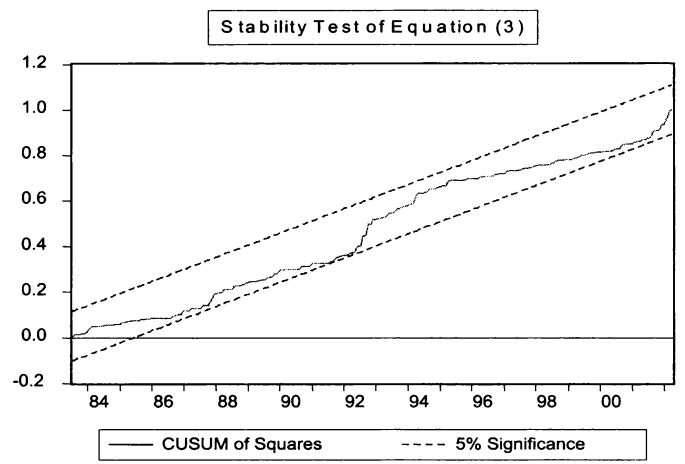
Dependent Variable: IFO-Expectation Indicator

	(1)	(2)	(3)	(4)
Variable	1982.01 – 2002.04	1994.01 – 2002.03	1982.01 – 2002.04	1999.01 – 2002.03
IFO (-1)	1.08*** (43.8)	0.95 (54.6)	1.10 (39.62)	0.72*** (14.01)
IFO (-5)	-0.22*** (2.97)		-0.24*** (3.14)	
IFO (-6)	0.15* (1.86)		0.15* (1.86)	
IFO (-8)	-0.11*** (2.67)			-0.30*** (8.43)
IFO (-9)		-0.14*** (8.95)	-0.22*** (2.8)	
IFO (-10)			0.23* (1.92)	
Δ USIND		1.04*** (3.02)		
Δ USIND (-1)	1.04*** (3.93)			
Δ USIND (-2)		1.55*** (4.60)		
USINDDEV				1.39*** (2.77)
USINDDEV (-1)			0.88*** (4.18)	1.23* (1.92)
USINDDEV (-3)			-1.69*** (3.64)	
USINDDEV (-4)			0.88*** (2.44)	
R^2	0.96	0.97	0.96	0.98
SE	2.42	2.14	2.41	2.00
DW	1.86	1.82	1.89	2.00
AIC	4.63	4.40	4.64	4.33
SIC	4.70	4.50	4.76	4.50
Structural Break	1994.01	- -	1996.01 / 1999.01	- -
Observations	236	99	234	39
Log Likelihood	-541,3	-213.8	-534.7	-80.4

SE-Standard Error of Regression, AIC; Akaike Criterion SIC Schwarz Criterion; *** significant at 99% – level; ** significant at 95% – level; *significant at 90% – level; t-values in brackets

short, was finally used to estimate an equation (4) in Table 4 which in the end proved to be stable.





Looking at the results of equations (2) and (4) one realises that in each equation the contemporaneous US indicator is highly significant. So for the periods in question an immediate spill over of US forecast to German producer sentiment is present. What is striking is that the influence of the US indicator has increased markedly. The long term impact[9] of a one point increase of the US indicator on the ifo expectation index is 10.4 for equation (1) and 13.3 for equation (2) a rise of more than 30 %. Even more pronounced is the higher influence for equation (3) and (4).

[9] Cf. For calculation see Appendix.

The long term impact for a one percentage point higher trend deviation in equation (3) is 0.875. For equation (4) the respective value is 4.57 more than 5 times the previous one. A symmetric estimation of first part of the sample, starting 1982 and 1993 rsp. 1998, corroborates the conclusion (cf Table A- 1 in the appendix). For these estimations no significant relation between the USIND indicator and IFO could be derived. For USINDDEV there was a significant impact but the long term impact is 3.44, which is lower than for the period since 1999. One has to consider in this case that the estimation ends not earlier but 1998.12. Furthermore the impact occurs faster more recently. During the earlier parts of the respective sample it takes one month and more until the US information becomes relevant. In later part of the sample there is a strong contemporaneous influence and only up to one month lagged information is relevant. From all this one can conclude there is a stable relationship since at least since the mid nineties.

It is not rational that people use "old" information. Even if one allows for the fact that US information was at times later in the month available than the ifo indicator no longer lags than two should occur. Using latest available information implies one month lag. If the change of the indicator is considered relevant the lag should be extended by just one more period. From this one may conclude that those estimation which show a first significant impact only after more than two months are not very plausible. Then all estimation results for equations starting in the eighties are not very convincing. A more rational form of spill over can then only be traced since the mid nineties.

These results indicate that the connection between the US outlook and expectations of German firms have not become just closer since the mid nineties it may have been established only then. But now since it exists any worsening of the US outlook will feed into sentiments of investors in Germany. This will have consequences for the business cycle in Germany. Given the good forecasting properties of the ifo expectation[10] indicator it implies that business cycles fluctuation in the US and Germany, should be more in line with each other than previously. Some analyses exactly come to such a conclusion.[11]

5. Asymmetric Effects

A major question is whether the impact from the US development differs according to the nature of these influences. Firms may react differently with their expectations when the outlook turns negative compared with a situation when it is positive. From theoretical considerations this hypotheses is justified when the aggregate short run supply curve is convex.[12] Such a shape implies that a positive

10 Cf. Fritsche / Stephan, (2002).

11 SVR (2001), IMF (2001).

12 Cf. Ball / Mankiw (1994).

shock produces a relatively higher impact on prices than on quantities. Since in that case there may be capacity constraints and firms then prefer to rise their prices rather than to increase their production. Accordingly a negative impact shows more effects on quantities than on prices. Instead of lowering prices firms choose not to use their full capacities. In such an environment also confidence should react asymmetrically depending on the nature of the news. If leading indicators for the US have a negative sign there should be a more pronounced reduction of expectations on the further development of the German economy than in the symmetric case. An expected positive development in the US should incite an absolutely lower reaction of expectations for Germany.

Furthermore, there could be psychological reasons why negative news are more impressive than positive news, because people are more afraid of the former than they are happy with the latter. Therefore in the following the relationship between IFO and USIND is analysed to detect possible asymmetries.

To do so two dummy variables for each equation are constructed. The first one (DUMPOS) is one as long as the shock is positive and zero, when it is negative. The second one (DUMNEG) is simply equal to 1- DUMPOS. That means its value is one when the shock is negative and zero when it is positive. The respective USIND and USINDEV transformations are then multiplied by two dummies and enter the estimation equation as USINDPOS (USDEVP) or USINDN (USDEVN) respectively. They express the respective value of USIND in phases were this variable is positive or negative. The times series properties are not changed by these transformations.

$$(3) \quad IFO_t = \sum_{i=1,5,6,8} \alpha_{1i} IFO(t-i) + \beta_{1p1} \Delta USINDP(t-1) + \beta_{1n1} \Delta USINDN(t-1)$$

$$(4) \quad IFO_t = \sum_{i=1,9} \alpha_{2i} IFO(t-i) + \beta_{2p0} \Delta USINDP + \beta_{2p3} \Delta USINDP(t-3) + \beta_{2n1} \Delta USINDN(t-1)$$

$$(5) \quad IFO_t = \sum_{i=1.5.6.9.10.} \alpha_{3i} IFO(t-i) + \beta_{3n0} USDEVN + \beta_{3n2} USDEVN(t-2) + \beta_{3n7} USDEVN(t-7) + \beta_{3n8} USDEVN(t-8)$$

$$(6) \quad IFO = \sum_{i=1,8} \alpha_{4i} IFO(-i) + \beta_{4p1} USDEVP(-1) + \beta_{4n0} USDEVN$$

The subscript p and n denote the coefficient for positive and negative signals from the US. The equations were derived starting from the results in Table 4. But the indicator variable USIND (USINDDEV) was replaced by USINDP (USDEVP) and USIND (USDEVN). A positive coefficient was expected for each of the both variables. When it turned out that the estimated coefficient was insignificant it was left out of a further estimation when information criteria also worsened. Estimations led to the following results.

Table 5

Asymmetric Effects

	(1)	(2)	(3)	(4)
Variable	1982.09 – 2002.04	1994.01 – 2002.03	1982.09 – 2002.04	1999.01 – 2002.04
IFO (-1)	1.08*** (43.7)	0.95*** (53.4)	1.11*** (37.9)	0.72*** (14.7)
IFO (-5)	0.22*** (2.94)		-0.22*** (2.87)	
IFO (-6)	0.15* (1.82)		6.12 (1.50)	
IFO (-8)	-0.11*** (2.61)			-0.27 (8.88)
IFO (-9)		-0.15*** (3.09)	-0.22*** (2.76)	
IFO (-10)				0.13* (1.97)
Δ USINDP		1.14*** (2.79)		
Δ USINDP (-1)	0.90*** (2.98)			
Δ USINDP (-3)		1.68*** (3.82)		
Δ USINDN (-1)	1.41*** (2.89)	2.11*** (3.67)		
Δ USINDN (-3)				
USDEVP				2.31 (5.89)
USDEVP (-1)				
USDEVN			0.91*** (3.83)	0.98** (3.39)
USDEVN (-2)			0.70*** (2.79)	
USDEVN (-7)			-97** (2.29)	
USDEVN (-8)			0.87** (2.14)	
R^2	0.96	0.97	0.96	0.98
SE	2.42	2.24	2.41	2.03
DW	1.86	1.91	1.88	1.95
Observations	236	99	233	39
Log Likelihood	-540.9	-213.3	-531.8	-80.31
AIC	4.63	4.41	4.64	4.37
SIC	4.72	4.54	4.78	4.59

SE-Standard Error of Regression, AIC; Akaike Criterium, SIC Schwarz Criterium; *** significant at 99% – level; ** significant at 95% – level; *significant at 90% – level; t- values in brackets

At a first glance it seems that the negative coefficient are greater in value than the positive ones. For some equations, (5) and (6), the positive impacts proved to be insignificant altogether. Just applying these coefficients for simulation purposes would lead to the impression of existing asymmetries. In order to precisely assess whether there is an asymmetry or not, a Wald test for equality of the respective coefficients is done. Thereby it will be checked whether the observed differences are significant. Coefficients in question are shown by the following equations, which are ordered according to the columns in Table 5.

The applied Wald test will check whether the coefficients for the positive impact are the same as for the negative ones for the respective equations, this means the following hypotheses are tested.

(7) $$\beta_{1p1} = \beta_{1n1}$$

(8) $$\beta_{2p0} + \beta_{2p3} = \beta_{2n1}$$

(9) $$\beta_{3n0} + \beta_{3n2} + \beta_{3n7} + \beta_{3n8} = 0$$

(10) $$\beta_{4p1} = \beta_{4n0}$$

The following table contains the respective probabilities of rejection for the hypotheses. The results unanimously lead to the conclusion that there is no asymmetry of reaction. For all equations and for all sample sizes analysed the impact of positive and negative shocks were not significantly different. In particular this applies for the most recent periods and thus for the more reliable estimations.

Table 6

Wald Test on Asymmetry

Equation	7	8	9	10
Probablity	0.36	0.28	0.51	0.27

The asymmetries which have been detected in other investigations cannot be confirmed by these results.[13] One reason could be that another transmission channel, production expectation is analysed and not production or the output gap as in the SVR paper. But if there would be a difference it would imply that confidence transmission is not rational since it ignores the existing asymmetries. A more convincing explanation is that in the SVR papers a different method is used to show the asymmetries. There were two different VAR estimations one including positive shocks from the US another containing negative shocks. The asymmetry was mea-

[13] Cf. SVRt (2001), Ziffer 466.

sured as the difference between the two response functions of both estimations. Following this method some of above estimations would lead to the same result. The estimated impact of negative shocks is greater than the positive ones in estimation (1) and (3) in table 4. For the more recent period however results in estimation (2) and (4) are the other way round. The point is, the Wald tests reveal there is no significant difference between the impact – a test not being done in the SVR paper.

6. Conclusion

Above results confirm, there is a confidence channel at least between Germany and the US. The hypothesis that the ifo expectation indicator for the German economy contains information on the outlook of the US economy cannot be rejected, at least not since mid nineties. There are indication that this relationship has become closer recently. But asymmetries between phases of economic upturns and downturns could not be detected in contrast to other studies.

This finding does not prove any real economy impact of confidence changes. The aim of the paper was less ambitious. In order to measure transmission of confidence to production several channels like exports, interests rate movements and share prices would have to be analysed. But before doing so one should try to expand this research to other countries than Germany. If firms consider the outlooks of major economies. Then this should happen on a global scale. In a further step it should be analysed how these informations affect the real economy.

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Appendix

1. Calculation of long term impact (LTI).

The LTI is defined as $LTI \equiv \frac{\Delta Y_t}{\Delta X_t}, t \to \infty$

Consider the equation where Δ is the discrete differential operator:

$\Delta Y_t = \sum_{j=1}^{K} \alpha_j \Delta Y_{t-j} + \sum_{i=0}^{N} \beta_i \Delta X_{t-i}$, then the *LTI* for $t \to \infty$ is

$$\frac{\Delta Y_t}{\Delta X_t} = \frac{\sum \beta_i}{1 - \sum \alpha_j}$$

Table A-1

Estimation Results: Earlier Periods

Dependent Variable: IFO-Expectation Indicator

	(1)	(2)
Variable	1982.09 – 1993.12	1983.01- 1998.12
IFO (-1)	1.04*** (45.21)	1.06*** (37.01)
IFO (-2)		-0.15*** (8.25)
IFO (-8)	-0.13*** (3.01)	
Δ USIND (-1)	0.72 (1.54)	
Δ USIND (-3)	0.65 (1.43)	
Δ USIND (-2)	-057 (2.63)	
		0.69*** (-3.01)
USINDDEV (-1)		
USINDDEV (-3)		-1.18*** (3.02)
USINDDEV (-5)		1.58** (2.46)
USINDDEV (-6)		-1.29** (2.35)
USINDDEV (-9)		0.64* (1.89)
USINDDEV (-11)		-0.99* (1.76)
USINDDEV (-12)		0.86 (2.12)**
R^2	0.95	0.96
SE	2.44	2.32
DW	1.88	1.98
Observations	1.36	1.92
log likelihood	-311.36	-429.84

US Outlook and German Confidence – Does the Confidence Channel Work? A Comment

By Christian Dreger*

Despite the former dominate view, the introduction of the Common Market and the European Monetary Union has not resulted in an increased robustness of the Euro area to world economic developments. The economic downturn which has begun in the year 2000 and affected all major economies almost simultaneously shows clearly that the internal economic situation in the Euro area and Germany depends to a large extent on the global economy and particularly on the development in the US. The size of the dependence seems to be hardly explained by traditional business cycle linkages (i.e. trade) alone. With the increasing globalisation of markets, additional transmission mechanisms have become more important (International Monetary Fund, 2001).

The new channels suspected to transmit business cycles include, among others, foreign direct investment behaviour of multinational firms, the rising integration of international capital markets, and confidence spillovers. The paper to be discussed deals with the importance of the latter channel. Here, some co-movement of confidence indicators regarding future economic prospects is expected. Due to spillovers, shocks arising in single countries spread over other economies as well, shaping a more common international business cycle.

In the paper, the linkages between US and German leading indicators are examined by means of simple regression models. After stationarity is achieved for the series employed, tests on Granger causality are performed. As a result, there seems to be a unidirectional relationship running from the US to the German indicator. Hence, the US information is relevant for the German index but not vice versa. In addition, the presence of asymmetric effects is tested, since negative news on the US economy may have a larger impact than a positive outlook, due to risk averse agents. In the application, no asymmetries were detected. On the other hand, the Wald test may be biased in favour of the null hypothesis because of the very short sample period.

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I will concentrate only on a few remarks and suggestions which may eventually help to improve the paper. Criticial is the missing link between the leading indicators and the real economic performance. Such a relation is essential in order to decide, whether correlations between national confidence indicators -may they be either static or dynamic- are really important for the business cycle. Even in the case of strong co-movements of leading indicators, these measures may not provide reliable information about the course of the economy. At least, there is some doubt concerning the forecasting performance of popular leading indicators for future business cycle developments (Banerjee, Marellino, 2003, Dreger, Schumacher, 2003).

As an extension to this point, the paper gives no idea regarding the relative importance of confidence spillovers for the business cycle, in particular when compared to other possible channels of transmission. For example, the confidence channel may only reflect more fundamental processes. If the latter are included in an overall model, confidence indicators may lose significance at all. Alternatively, confidence spillovers may have their own justification. From the analysis presented in the paper, it can not be uncovered which interpretation is the appropriate one. At least, the relevant literature has to be discussed.

Concerning the relation between the indicators, ordinary regression techniques are applied. However, additional analysis is indispensable in order to underpin the robustness of the results. This comment refers to both the data series and the econometric procedure employed.

Regarding the data set, the analysis should be extended to include measures of consumer confidence as well. Consumer confidence is available for both countries. It is stationary without any further transformation, so problems in searching the appropriate filtering method are avoided. Furthermore, the US and German series would be more comparable. In fact, the US composite leading indicator is build on the whole economy, while the ifo expectation index seems to be limited to the industrial sector. Therefore the indicators employed in this paper refer to different measures. To illustrate the estimation issue, figure 1 reveals the conditional variances of the stationary indicators used in the paper. It may be interpreted as a measure of uncertainty concerning the future course of the economy in each country.

The German series may reflect the uncertainty stemming from the unification to a large extent, especially in the first half of the 90s, while the US series is dominated by the sudden death of the ICT boom in 2000. Both series display clearly the September 2001 terrorist attack. However, as a striking feature, uncertainty seems to be not very much related across the different economies. In the example, the contemporaneous correlation coefficient between the two measures is 0.11, which is hardly different from 0 at standard levels of significance. At least, there is some doubt whether a confidence channel exists or not.

Moreover, all the empirical evidence relies on the assumption of parameter stability. In the case of a varying parameter regime, estimates are biased and conclu-

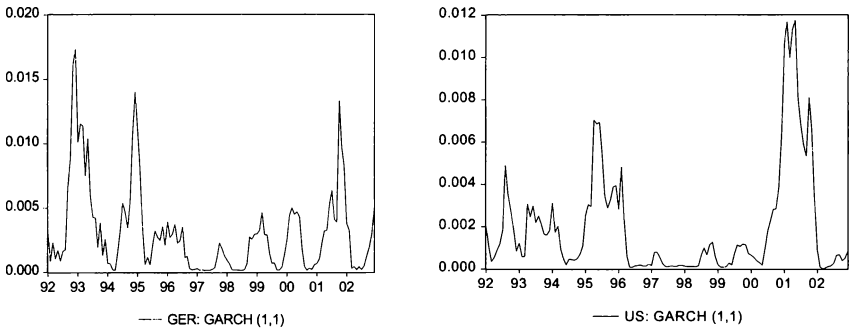

Figure 1: Uncertainty in Germany and the US[1]

sions can be misleading. In fact, the paper detects some signs of instability by means of tests for structural breaks. Since the break point parameter is not identified under the null hypothesis, the critical values from Andrews and Ploberger (1994) should be employed for the Chow test. According to the structural breaks, subperiods of the entire sample are defined, in which the null of stability seems to be not rejected. However, an indication is not very informative in this case. Since the number of observations is often very small, these tests lose power, and high type I errors are likely. This should also kept in mind, when the Wald test is applied to identify possible asymmetric adjustment processes.

In any case, the estimation period is often too short to draw hard conclusions. For example, some of the periods investigated start in 1999, see tables 3, 4 and 5. At least a length of a full business cycle should be included. Furthermore, the results look sometimes counter-intuitive. Given the impulse responses, the maximum effect of a confidence shock in the US on the German measure is expected to be observed after half a year, and it is still in place after a period of 10 month. Intuitively, the dynamics embedded in the bivariate autoregressive system should lead to a gradual decline in the impulse responses, where the maximum is expected to appear in the first periods.

To sum up, I would opt for a different estimation strategy. Since a confidence channel – if there is any – may be more prominent in recent times, instabilities are an inherent part of the method employed. Appropriate solutions include the estimation of Markov Switching models or even simply rolling regressions, perhaps in a moving window. In addition, some kind of nonlinearities can be considered. For example, within a threshold the signals may be inconclusive to the agents, and therefore, no spillovers are generated.

[1] For the US composite leading indicator, the figure is based on y-o-y growth rates. For Germany, a weighted average of the expected component of the ifo business climate index is considered, given a weight of 0.9 to the West German series. In order to obtain the uncertainty measure, symmetric GARCH-M models are estimated over the period from 1992.01 to 2001.12.

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Interactions between U.S. and German GDP: The Role of Stock Markets

By Michael Schröder*

Abstract

The aim of this study is to quantify the relationships between U.S. and German GDP and to analyse the specific role of stock markets in the transmission of shocks from one country to the other. In addition to earlier studies the investigation tries to separate the pure expectation effects of stock markets from their causal influence on GDP. This is done by including confidence indicators into the econometric model. From a methodological point of view our analysis considers both short-term and long-term effects within the framework of a vector error correction model (VECM). The results show that the confidence indicators cannot fully explain the influences of stock indices on future GDP. This means that a causal impact from stock prices to GDP could really exist.

Keywords: Business cycle fluctuations, stock markets, causal effects, expectations

JEL classification: E32, E44

1. Introduction

The slow growth in gross domestic product (GDP) in many industrialised countries and the coinciding downturn in the international stock markets have turned attention to the question whether stock markets increased the strength and speed of international business cycle transmissions.[1] Of particular interest is the strong comovement of the U.S. stock market and European stock markets and the transmission of business cycle shocks from the United States to Europe.

The aim of this study is to quantify the relationships between U.S. and German GDP and U.S. and German stock markets. In addition to earlier studies the investi-

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[1] For an overview of recent research on the international transmission of business cycle shocks and the role of stock markets and confidence indicators see Schröder and Westerheide (2003), chapters 2 and 5.

gation tries to separate the pure expectation effects of stock markets from their potential causal influence on GDP. This is done by including confidence indicators into the econometric model. The confidence indicators represent expectations on the future situation of the economy and are gained by monthly surveys amongst purchasing managers (USA) and industrial companies (Germany). From a methodological point of view the analysis considers both short-term and long-term effects within the framework of a vector error correction model (VECM).

There are several studies that investigate the international interactions between business cycles of different countries. Peiro (2002) looks at the correlations between the GDP of the United States, Germany and Japan. He finds strong contemporaneous relationships which are, however, rather unstable over time. But Peiro only considers short term effects and does not account for conditional comovements by using additional variables within a multivariate framework. Weyerstraß (2002) analyses the relationships between the output gaps of the EU, Germany and the U.S. using a vector autoregressive (VAR) model that also incorporates short-term interest rates. His results show a significant reaction of the business cycles of Europe and Germany to business cycle shocks in the United States. These reactions are also relatively stable over time. As the output gaps are by definition stationary his approach is not suitable to investigate long-term relationships with a VEC-model. Both papers do not include stock markets as additional channels of business cycle transmissions.

Peiro (1996) tests for Granger causalities between stock indices, short- and long-term interest rates, industrial production and / or GDP of the four countries France, Germany, United Kingdom and United States. He uses the variables only in first differences without considering cointegration. His results show inter alia that real stock returns have a lead to industrial production but not vice versa. He also shows that the consideration of interest rates as additional variables reduces the forecasting ability of stock returns, particularly for the European countries.

Choi, Hauser and Kopecky (1999) and Binswanger (2001) look at the leading characteristics of stock markets concerning the economic activity for the G7 countries. Whereas Choi et al. find cointegration relations between stock indices and industrial production for all countries Binswanger only finds cointegration for the United States. The different results could be due to the different observation periods: Choi et al. use the period from 1957 to 1996 and Binswanger 1960 until 1999. As the overlap of the two periods is quite large the different results might be an indication of relatively unstable cointegration relationships in the periods under consideration. Both papers find a significant forecasting capability of stock returns to future production for the United States, Canada, Japan, the United Kingdom and partly also for Germany. Binswanger reports instabilities of the forecasting power due to the large overvaluation of the stock prices in the late 1990s.

Edison and Sløk (2001a, b) try to find out whether the stock market influences future consumption and investment in seven OECD countries (G7 countries with-

out Italy but including the Netherlands). The authors differentiate between stocks of the TMT sectors (= Telecommunication, Media and Information-Technology) and the stocks of all other sectors. They apply VAR-models using the variables in levels. The results of their impulse-response analyses suggest that stock indices have a strong impact on consumption and investment particularly for Canada, the United Kingdom and the United States.

For the topic of our study the aforementioned studies have one major shortcoming: they cannot distinguish between the expectations concerning the future economic activity that are part of stock prices and a possible causal influence. According to the popular dividend discount model stock prices mainly reflect expected future dividends and interest rates. As dividends and interest rates are related to the overall economic activity of a country the stock prices should also reflect expectations on future production and GDP. But there might be in addition a causal influence from stock prices to the economy. For example, in case of private consumption there exists an obvious relationship between stock market wealth and the future income of private households: Changes in the valuation of the stock market might cause changes in the expected future income of households and as a consequence also in private consumption. Stock markets could also have an effect on company investments by changes in the price of equity. In our study we try to separate the expectation effect from the causal influence by considering confidence indicators as additional explanatory variables. An influence of stock prices on GDP beyond the effect of confidence indicators could be an indication either of a causal influence of stock prices on the economy or of the superior quality of the expectations contained in the prices of stocks.

In contrast to the studies mentioned above there are also several studies that concentrate on micro data applying cross-sectional or panel regressions. The results of these studies are mixed. Poterba and Samwick (1995), for example, do not find a significant causal effect from stock prices on private consumption, whereas Dynan and Maki (2001) conclude that wealth (including investments in stocks) has a strong causal influence on consumption. Concerning investments, e.g., Morck, Shleifer and Vishny (1990) reject the hypothesis of causality from stock prices on future investments of companies. Our analysis investigates these relationships using macroeconomic time series data. This gives additional insights into the interactions between stock markets and future economic activity.

Two studies (Jansen and Nahuis (2002), Otoo (1999)) show that there are strong contemporaneous relationships between confidence indicators and stock indices. Thus, the inclusion of confidence indicators in our study in addition to stock indices could capture – at least partly – the expectations that are inherent in the stock prices. But as they also find a lead of the stock markets to the confidence indicators the stock prices might contain more information about future economic activity than the confidence indicators.

This paper is organised as follows. In the next chapter the characteristics of the data are described including the results of non-stationarity tests. Chapter 3 conducts cointegration tests as well as stability tests for the cointegrating relationships. Then the VEC-models are estimated and analysed. Chapter 4 shows the results of the Granger causality tests and the impulse-response analyses using these VEC-models. Chapter 5 concludes.

2. The Data[2]

At the centre of our analysis are the relationships between U.S. and German GDP. For both countries seasonally adjusted GDP series are used in real terms for the period from Q1 1975 until Q2 2002. Due to the German reunification and the change in the European system of national accounts there are structural breaks in the German GDP series at the beginning of the 1990s. For the period from 1975 until Q4 1990 the GDP series for West-Germany is used and from Q1 1991 on the GDP series for Germany.[3] The two German GDP series have been concatenated at the first quarter of 1991 to simplify the econometric analysis.

As the study aims at quantifying causal relationships between stock markets and GDP we use stock indices that represent the total market valuations of the U.S. and the German stock markets. Both indices are constructed by Thomson Financial Datastream and are total return indices, i.e., they include not only the stock prices but also all cash flows paid to the investors. The stock indices have been converted to real terms using GDP deflators.[4]

To separate the pure expectation effect of stock prices from a causal influence on economic activity we include confidence indicators as additional endogenous variables. For the United States we use the ISM purchasing managers index[5] and for Germany the ifo business expectations[6]. Both indices are based on the results of monthly surveys that ask for the future economic situation. In these surveys the participants are asked if they expect the economic situation in six months to be better, worse or equal compared to the current situation. The indicators are con-

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2 Most of the data are collected using the Thomson Financial Datastream database.

3 The West-German GDP is constructed according to ESVG 2. Auflage and the German GDP according to ESA95. Both series are from the DIW (Deutsches Institut für Wirtschaftsforschung) in Berlin.

4 For Germany two GDP-deflator series of the DIW are used: for the period 1975 – 1990 the deflator for the West-German GDP and from 1991 on for Germany. As the DIW does only provide a deseasonalised GDP deflator from 1991 on, the deflator series from 1975 – 1990 has been deseaonalised using the Census X12-procedure of EViews 4.1.

5 ISM is the abbreviation of Institute for Supply Management. Since May 2001 this is the new name of the National Association of Purchasing Managers (NAPM).

6 "Future expectations of business situation – West Germany" constructed by the ifo (Institut für Wirtschaftsforschung, Munich).

structed from the difference between the share of "better" and "worse" answers. Several studies show that both indicators contain information about future real GDP and industrial production.[7] Thus, these two indicators might be appropriate to capture the expectations on the future state of the economy that are prevailing also in the capital markets. The time series of the confidence indicators as well as of the stock indices are quarterly averages. The GDP series and the stock indices are used in logarithms.

The first step of the analysis is the test for non-stationarity. We apply the augmented Dickey-Fuller (ADF) test. The lag length has been chosen according to the AIC+2 rule of Pantula et al. (1994). This means that we choose that lag length which minimises the AIC criterion and add two lags.

Table 1 shows the results for the ADF-tests when either a trend and a constant or only a constant is used in the ADF-equation. For both the U.S. and Germany we find the same results: for the levels of real GDP and the real stock indices the null hypothesis of non-stationarity cannot be rejected at conventional significance levels, but the first differences are clearly stationary. For the two confidence indicators the hypothesis of non-stationarity is in both cases rejected at the 1% significance level.

Table 1

Results of the ADF-Tests (Null-Hypothesis: Non-Stationarity)

Period: Q1 1975 – Q2 2002

	Trend and Intercept		Intercept	
	Level	First Differences	Level	First Differences
USA				
Real GDP	N	1%	N	1%
Real Stock Index	N	1%	N	1%
ISM Confidence	5%	–	1%	–
Germany				
Real GDP	N	5%	N	5%
Real Stock Index	N	1%	N	1%
ifo Business Expectations	1%	–	1%	–

Notes: The figures show the significance level at which the test is rejected. N means non-stationary, i.e., the null hypothesis is not rejected. The number of lags of the ADF-tests has been chosen according to the AIC criterion plus two additional lags (see Pantula et al. (1994)).

[7] See, e.g., Estrella and Mishkin (1998) for the NAPM/ISM indicator and Breitung and Jagodzinski (2001) as well as Hüfner and Schröder (2002) for the ifo business expectations and other German indicators.

3. The Econometric Models

To investigate the relationships between the real GDP of the United States and Germany and their interactions with the real stock indices we use a VEC-model. Before the construction of the VEC-model we test for the number of cointegrating relationships amongst the variables by applying the Johansen approach.[8] As these four variables exhibit a trend we consider the following two specifications of the Johansen approach as appropriate for the cointegration tests: (1) intercept in both the cointegrating equation and in the short-term part of the model (= case 1) and (2) intercept and linear trend in the cointegrating equation and intercept in the short-term part (= case 2). Specifications without intercept in the short-term model are clearly not suitable as the variables exhibit an upward trend and a specification applying a quadratic trend is not economically meaningful for the data under consideration.

As the residuals of the equations of the Johansen model in some cases exhibit significant deviations from the normal distribution the use of the trace statistic might be more appropriate than the maximal-eigenvalue statistic.[9] Therefore, only the trace statistics are reported.[10] The lag length for the Johansen test has been chosen according to the lag length that minimises the AIC criterion. For all models reported the optimal lag length is *one* for the model in first differences.

To get deeper insights into the characteristics of the data the first step is to test for cointegration between all pairs of the non-stationary variables, i.e., U.S. and German GDP, U.S. and German stock indices, GDP and stock index of the U.S. as well as GDP and stock index of Germany. For the period from Q1 1975 until Q2 2002 cointegration seems to exist only between German GDP and the German stock index. For the other three pairs of variables the hypothesis of no cointegration could not be rejected. Table 2 summarises the results of the tests.

The hypothesis of no cointegration between the German GDP and the German stock index can be rejected at either the 1% or at the 5% significance level, depending on the specification chosen for the Johansen test.[11]

The next step is the to test for cointegration amongst the system that contains all four non-stationary variables. The tests reveal that one cointegrating relationship probably exists amongst the four variables. The test results reported in table 3 show that the hypothesis of no cointegrating relationships is in both cases rejected at the 1% significance level.

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8 The Johansen test has been conducted using the EViews 4.1 program.

9 See Cheung and Lai (1993). Nevertheless, the two test statistics have given the same results in all cases considered in our study.

10 In the following the original values of the trace statistic are reported. The small sample correction proposed by Reimers (1992) does not change the interpretation of the results.

11 The hypothesis of R<=1 has not been rejected at conventional significance levels in both cases.

Table 2

Cointegration Tests for Pairs of Variables, Period: Q1 1975 – Q2 2002

Null-Hypothesis: No Cointegration Relationship (Rank R = 0)

	Specification	Trace Statistic	5% Critical Value	1% Critical Value
U.S. GDP and German GDP	Case 1	9.38	15.41	20.04
	Case 2	22.83	25.32	30.45
U.S. GDP and U.S. stock index	Case 1	8.00	15.41	20.04
	Case 2	15.93	25.32	30.45
German GDP and German stock index	Case 1	**19.01**	15.41	20.04
	Case 2	**34.44**	25.32	30.45
U.S. stock index and German stock index	Case 1	12.48	15.41	20.04
	Case 2	15.99	25.32	30.45

Notes: The appropriate lag length has been chosen using the AIC criterion. Bold figures indicate significance at least at the 5% level.

Table 3

Cointegration Tests for the System of the Four Non-Stationary Variables: U.S. and German GDP, U.S. and German Stock Indices, Period: Q1 1975 – Q2 2002

	Hypothesis	Trace Statistic	5% Critical Value	1% Critical Value
Case 1	$R = 0$	**59.87**	47.21	54.46
	$R \leq 1$	21.33	29.68	35.65
	$R \leq 2$	6.55	15.41	20.04
	$R \leq 3$	0.19	3.76	6.65
Case 2	$R = 0$	**72.87**	62.99	70.05
	$R \leq 1$	34.25	42.44	48.45
	$R \leq 2$	16.55	25.32	30.45
	$R \leq 3$	4.67	12.25	16.26

Notes: The appropriate lag length has been chosen using the AIC criterion. Bold figures indicate significance at least at the 5% level.

As the two stock indices are transformed in real terms using the GDP deflators the cointegrating relationship might only be due to cointegration between the two deflator series. Therefore, in addition, the system was also analysed using the stock indices in nominal terms. As the Johansen test also indicates one significant cointegrating relationship the result for the system with real stock indices does

probably not only come from the GDP deflators but indicates a true cointegrating relationship of the system.

This model is now expanded by the U.S. and German confidence indicators as two additional endogenous variables. These two confidence indicators reflect expectations concerning the future state of the economy. If the forecasting ability of stock markets concerning future GDP is mainly driven by expectations the use of the confidence indicators could significantly reduce the influence of stock markets on future GDP. If an impact of stock markets on GDP is still significant after controlling for the confidence indicators this means that either a causal relationship between stocks and GDP exists or that the stock prices contain superior information about the future state of the economy than the confidence indicators.

The results of the cointegration tests for the full system are shown in table 4. For both test specifications (cases 1 and 2) two cointegrating relationships are found. As the two confidence indicators are stationary this could mean that there exist no cointegration relationships besides these two stationary variables. Such an interpretation would contradict the results found for the system without confidence indicators (table 3): as one cointegrating relationship was found amongst the four non-stationary variables. Including the two stationary confidence indicators to the system three cointegrating relationships should exist and not only two.

Table 4

Cointegration Tests for the Full System including the two Confidence Indicators, Period: Q1 1975 – Q2 2002

	Hypothesis	Trace Statistic	5% Critical Value	1% Critical Value
Case 1	R = 0	**158.12**	94.15	103.18
	R <= 1	**87.39**	68.52	76.07
	R <= 2	41.48	47.21	54.46
	R <= 3	20.10	29.68	35.65
	R <= 4	6.87	15.41	20.04
	R <= 5	0.11	3.76	6.65
Case 2	R = 0	**173.09**	114.90	124.75
	R <= 1	**102.36**	87.31	96.58
	R <= 2	56.44	62.99	70.05
	R <= 3	35.03	42.44	48.45
	R <= 4	17.49	25.32	30.45
	R <= 5	4.37	12.25	16.26

Notes: The appropriate lag length has been chosen using the AIC criterion. Bold figures indicate significance at least at the 5% level.

An explanation for this result could be that within the Johansen procedure one of the confidence indicators is not identified as a stationary variable. But the application of the Johansen test to only the two confidence indicators reveals that the hypothesis of only one cointegrating relationship is clearly rejected at the 1% significance level. Thus, the Johansen test also finds that both confidence indicators are stationary.

The test of specific restrictions on the two long-run stochastic relationships could give additional insights: if the two cointegrating relationships reported in table 4 are only due to the confidence indicators then the cointegrating equations can be restricted so that each equation consists of only one of the confidence indicators. In this test the coefficients of the four non-stationary variables in the two long-run equations are restricted to zero and the coefficients of the confidence indicators are set to one:

$$\begin{pmatrix} 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \end{pmatrix} \begin{pmatrix} US-Stocks \\ Ger-Stocks \\ ISM \\ Ifo \\ US-GDP \\ Ger-GDP \end{pmatrix} = \begin{pmatrix} \overline{CE1} \\ \overline{CE2} \end{pmatrix}$$

These restrictions are clearly rejected at a p-value of 1.4%. Thus, the two cointegrating relationships do not only reflect the two stationary confidence indicators.

As a consequence of these tests we assume that *three* cointegrating relationships exist and try to identify the coefficients of the three long-run equations by imposing restrictions that are based on the results of the foregoing tests.

The following formula shows the restrictions imposed on the three cointegrating equations:

$$\begin{pmatrix} 1 & a & 0 & 0 & b & c \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \end{pmatrix} \begin{pmatrix} US-Stocks \\ Ger-Stocks \\ ISM \\ Ifo \\ US-GDP \\ Ger-GDP \end{pmatrix} = \begin{pmatrix} CE1 \\ CE2 \\ CE3 \end{pmatrix}$$

The first cointegrating equation *CE1* consists of the four non-stationary variables: the two stock indices and the two GDP series. The coefficient for the U.S. stock index is set to one and the other three parameters (*a, b* and *c*) are estimated. This equation is therefore equal to the cointegrating relationship reported in table 3. The second equation (*CE2*) is equal to the US confidence indicator *ISM* and the third one (*CE3*) is equal to the German confidence indicator *Ifo*. In addition, it is assumed that the two confidence indicators are weakly exogenous with regard to *CE1*, i.e., that the confidence indicators do not react to deviations from the long-run equilibrium expressed by *CE1*. As the p-value of the test statistic is 13.0%

these restrictions are not rejected and are therefore used in the following analysis. The estimation of the VEC model and the test of the restrictions have been performed using only an intercept in the cointegrating equations: a χ^2-test of the different specifications of the deterministic components revealed that the VECM with only an intercept in both the short-term and the long-term parts of the model is the most restrictive specification that is not rejected by the test.[12]

Table 5 shows the parameter estimates and the corresponding p-values[13] (in brackets) for the coefficients of *CE1*. The results of the Wald test show that the hypothesis that one of the coefficients is zero (given all other restrictions) is rejected for each single coefficient at least at the 10% significance level. Thus, all four non-stationary variables are part of *CE1*. The parameters of the cointegrating equation are difficult to interpret as the units of measurement for the levels of the four variables are arbitrary and thus only the signs of these parameters should be interpreted. Interestingly, the two U.S. variables have the opposite sign than the two German variables. Thus, the long-run equilibrium is determined by the difference between the combination of U.S. GDP and U.S. stock market on the one side and the corresponding German variables on the other side.

Table 5

Parameters Estimates of the Cointegrating Equation 1 (*CE1*), Period: Q1 1975 – Q2 2002

U.S. Stocks	German Stocks	U.S. GDP	German GDP
1.00	-1.94	4.22	-3.60
(2.00%)	(0.52%)	(2.4%)	(7.7%)

Notes: All variables enter the equation in (logarithmic) levels. The cointegration space is identified by setting the parameter of the U.S. stocks equal to one. The p-values correspond to the hypothesis that the corresponding parameter is equal to zero (Wald test).

An additional test of the stability of the three cointegrating equations revealed that the hypothesis of no structural break could not be rejected.[14]

4. Results

The model selected in chapter 3 is now investigated using Granger causality tests and impulse-response analyses.

12 The test has been performed with the software MALCOLM 2.5.

13 The p-values refer to the hypothesis (Wald test) that the corresponding parameter is equal to zero.

14 The stability test has been performed using the software MALCOLM 2.5.

Table 6

Results of the Granger Causality Tests, Period: Q1 1975 – Q2 2002

	US Stocks	German Stocks	ISM Indicator	Ifo Indicator	US GDP	German GDP
US Stocks (t-1)	0.23 (3.9%)	N	15.79 (1.2%)	N	N	0.058 (0.33%)
German Stocks (t-1)	N	0.25 (1.8%)	N	N	0.02 (3.1%)	-0.039 (4.6%)
ISM (t-1)	N	N	N	N	0.0005 (3.2%)	-0.0004 (6.9%)
Ifo (t-1)	N	0.0035 (8.8%)	N	0.43 (0.0%)	N	N
US GDP (t-1)	1.30 (6.3%)	N	N	N	N	N
German GDP (t-1)	N	1.59 (0.04%)	N	N	N	-0.29 (1.7%)
CE1 (t-1)	N	0.145 (0.01%)	N	N	N	-0.011 (0.52%)
CE2 (t-1)	-0.0036 (1.1%)	N	-0.30 (0.01%)	N	0.0006 (0.1%)	N
CE3 (t-1)	N	N	N	-0.22 (0.01%)	N	N

Notes: First figure = parameter estimate, second figure (in brackets) = p-value of the Wald test (using Newey-West corrected standard errors), N = not significant at least at the 10%-level. All variables enter the model in first differences, the three CE-equations in levels.

Table 6 shows the results of the Granger causality tests for all six variables. Only those parameter estimates are reported which are significant at least at the 10% level. The figures in brackets are the p-values of the Wald test applying standard errors that are corrected according to the Newey-West (1987) procedure. All six variables enter the model in first differences. The three cointegrating equations (*CE1, CE2* and *CE3*) are included in levels. All variables on the right hand side of the six equations are lagged by one period.

First of all, only the German stock index and the German GDP are not weakly exogenous regarding the cointegrating equation *CE1*. This means that deviations from the long-run equilibrium (*CE1*) only influence these two variables. All other significant coefficients shown in table 6 concern the short-term part of the VEC model as *CE2* and *CE3* only reflect the stationary confidence indicators.

The significant short-term influences on the U.S. stock index stem from the lagged U.S. stock index, the U.S. GDP and the U.S. confidence indicator (*CE2*).

The equation for the German stock index shows very similar results: significant influences come from the lagged German stock index, the ifo confidence indicator (in first differences), the German GDP and *CE1*. The stock indices are therefore dependent on economic growth in the own country and the expectations on future growth. In addition, the German stock index adjusts to a disequilibrium in the long-run relationship between the United States and Germany.

It is difficult to interpret why the GDP series influence future stock returns. Perhaps this is a consequence of a publication lag: the GDP of period (t-1) is not published before (t). Thus the concrete value of the GDP in (t-1) is a new information in period (t) and the significant parameters should be interpreted as a reaction of the stock indices to this new information.

Another interesting result is that the stock indices are not Granger-caused by the lagged stock index of the other country. This is probably due to strong contemporaneous linkages between the two stock indices: the correlation of the residuals of the two stock index equations is about 55%. Thus, most of the information that is relevant for the pricing of stocks is transmitted between the stock markets within a relatively short period of time. As a consequence, the lagged stock indices have no additional explanatory power.

The U.S. confidence indicator (ISM) is only influenced by changes in the U.S. stock index and the own lagged values (*CE2*), whereas the German confidence indicator (Ifo) only reacts to the own past values. Thus, Ifo is the only strongly exogenous variable of the VEC model.

In the equation of the U.S. GDP only the German stock index and the U.S. confidence indicator exhibit significant coefficients. The U.S. confidence indicator is also a predictor of the German GDP whereas the German confidence indicator has no additional predictive power. The other significant parameters in the equation of the German GDP are those of the German and U.S. stock indices, the lagged values of the German GDP themselves and the deviations from the long-run equilibrium (*CE1*). Thus, the two stock indices and the U.S. confidence indicator are predictors of future changes of the GDP series in both countries.

To summarise, the analysis of the short-term model shows that both the U.S. stock index, the U.S. GDP as well as the two confidence indicators are weakly exogenous with regard to *CE1*. Deviations from the long-run equilibrium therefore only influence GDP and stock prices of Germany. Thus, the model adjusts to a new long-term equilibrium by changes of only these two German variables. It is also interesting to note that both stock indices contain expectations about future GDP of the other country, in case of Germany also of the own country. The confidence indicators forecast future changes of the own stock index and the U.S. confidence indicator has also predictive power for the U.S. and the German GDP.

The next step of the analysis is to perform impulse-response analyses. One major difference between the impulse-response analysis and the Granger-tests is that

the impulse-response analysis considers both the long-term and the short-term dynamic relationships amongst the variables, whereas the Granger causality tests only consider short-term reactions. Thus, the results of the impulse response analyses are more appropriate to answer the question whether dynamic relationships exist amongst stock indices and GDP.

For the impulse response analysis the ordering of the variables is important. In the following analysis two different orderings are applied:

- Ordering no. 1:
  U.S. confidence → German confidence → U.S. stocks → German stocks → U.S. GDP → German GDP
- Ordering no. 2:
  U.S. stocks → German stocks → U.S. confidence → German confidence → U.S. GDP → German GDP

In ordering no. 1 it is assumed that the impulse chain begins with the confidence indicators and then the stock indices and the GDP follow. When this ordering is applied the confidence indicators have a relatively strong explanatory power and the influence of the stock indices on GDP should be relatively low. In ordering no. 2 the impulses originate with the stock indices and then spread to the confidence indicators and the GDP. Thus, in this ordering the influence of the stock indices should be stronger than for ordering no. 1. Both orderings assume that the impulses originate in the United States and are then transmitted to Germany.[15]

The left panel of each of the figures 1 – 4 shows the responses when ordering no. 1 is used and the right panel applies ordering no 2. The scales of the graphs are the same for both panels so that the graphs can be compared directly. The lines in the middle represent the responses of a one standard deviation shock. The shocks and the responses correspond to the *level* of the corresponding variable. The other two lines indicate the range of a 95%-confidence interval for the response line.[16]

Both panels in figure 1 show a significant impact of shocks in the U.S. stock index to U.S. GDP. As expected the response is positive. The response reaches its full level after 3 quarters. When ordering no. 1 is applied the response function is less significant compared to ordering no. 2. Thus, the confidence indicators do not rule out an influence from stock prices to GDP. It is difficult to interpret what this impact of stock prices on GDP means: it could either be due to a causal relationship or to the superior quality of expectations that are part of the stock indices. In

[15] Experiments with the two other orderings: U.S. confidence → U.S. stocks → German confidence → ... and U.S. stocks → U.S. confidence → German stocks → German confidence ... have given results very similar to those of the orderings no. 1 and 2.

[16] The 95%-confidence interval apply an asymptotic distribution of the impulse response functions (see Lütkepohl (1990)). The calculations have been done using the software MALCOLM 2.5.

any case, the stock prices contain information about future GDP for about 3 quarters ahead.

Figure 2 tells more or less the same story for the relation between German stocks and German GDP. But the response functions are less significant than the U.S. counterparts shown in figure 1. As the stock market is relatively unimportant for corporate finance and private savings in Germany[17] it can be assumed that a large part of the total impact of the German stock market is only due to expectations about the future changes in GDP.

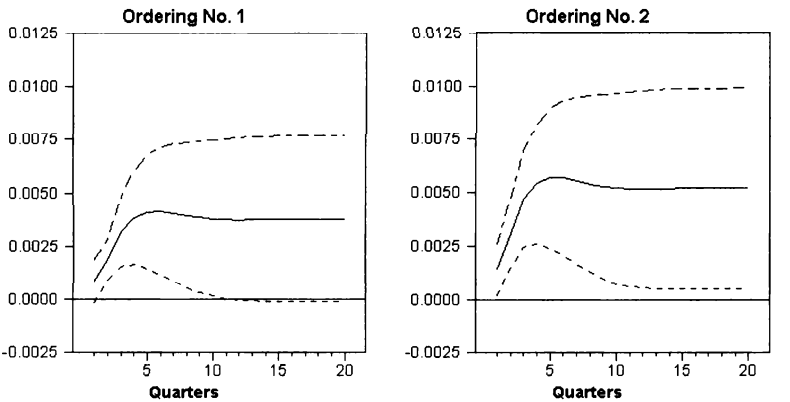

Figure 1: Response of U.S. GDP to Impulse of U.S. Stocks (One Std. Dev. Shock)
Upper and Lower lines indicate a 95%-Confidence Interval

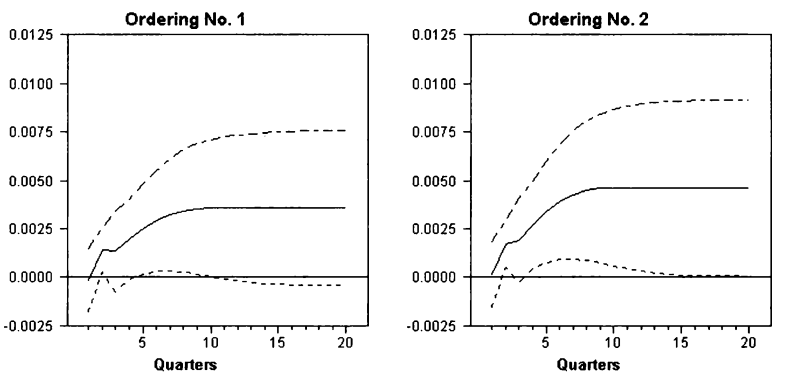

Figure 2: Response of German GDP to Impulse of German Stocks (One Std. Dev. Shock)
Upper and Lower lines indicate a 95%-Confidence Interval

[17] See Schröder and Westerheide (2003), chapter 2.1.4.

The next two figures show the cross-country effects of shocks in the stock index to GDP. As figure 3 indicates there could be some impact from the U.S. stock market to German GDP when ordering no. 2 is applied. But the significance of this effect is relatively low. When ordering no. 1 is used the effect is insignificant, although the response line is always positive. Figure 4 shows the expected result that there are no effects from the German stock index to U.S. GDP.

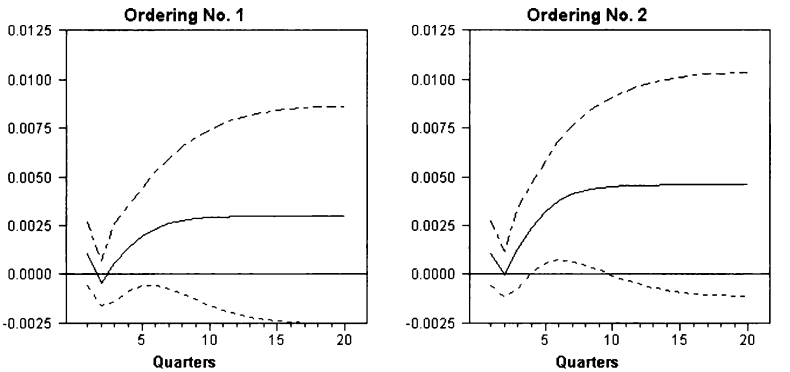

Figure 3: Response of German GDP to Impulse of U.S. Stocks (One Std. Dev. Shock)
Upper and Lower lines indicate a 95%-Confidence Interval

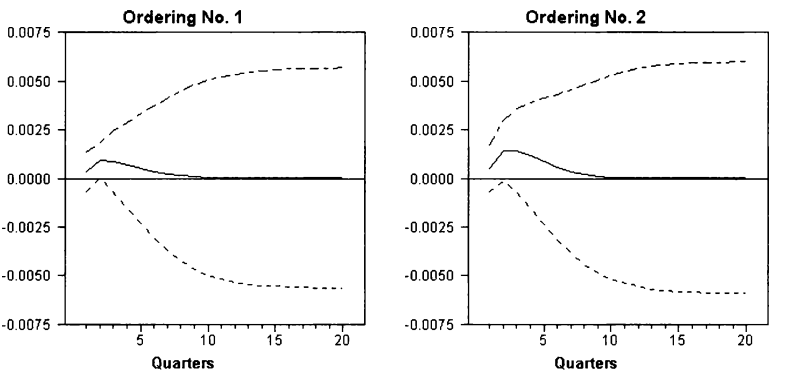

Figure 4: Response of U.S. GDP to Impulse of German Stocks (One Std. Dev. Shock)
Upper and Lower lines indicate a 95%-Confidence Interval

The last two figures exhibit the relationships between U.S. and German stock indices (figure 5) and U.S. and German GDP (figure 6) using ordering no. 2.[18]

Figure 5 shows – as expected – that there is a dynamic influence from the U.S. to the German stock market but not vice versa. A change in the real U.S. stock index causes a shift in the valuation of the German stocks in the same direction. The relation of the long-run impact to the maximum impact in quarter 2 shows that about 50% of the short-term response of the German stock index is permanent.

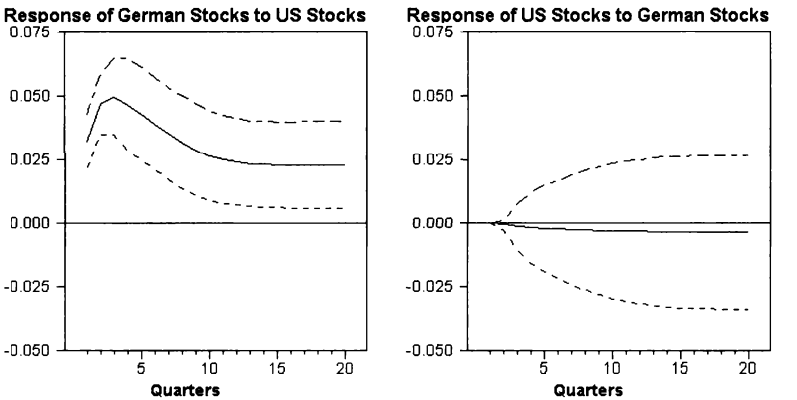

Figure 5: Response of Stocks to Impulse of Stocks in the other Country (One Std. Dev. Shock)
Upper and Lower lines indicate a 95%-Confidence Interval

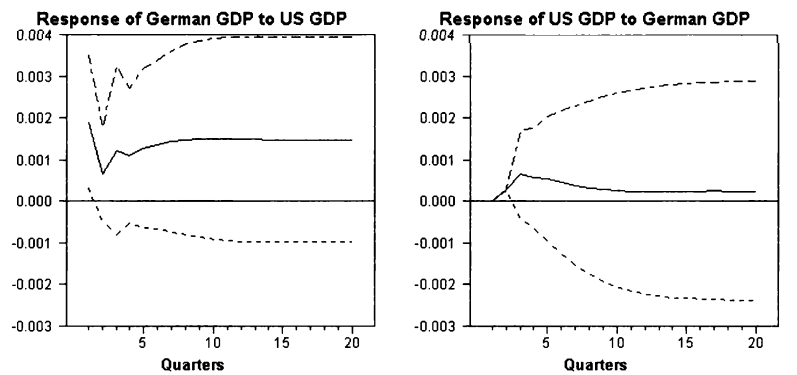

Figure 6: Response of GDP to Impulse of GDP of the other Country (One Std. Dev. Shock)
Upper and Lower lines indicate a 95%-Confidence Interval

[18] The results are almost identical when ordering no. 1 is used.

Figure 6 reveals that there are no significant long-term interactions between the U.S. and the German GDP. The response is only significant for the first quarter. Although the response of the German GDP to an impulse of the U.S. GDP has a relatively high positive value it is not significant at the 5%-level. This result is in line with the findings of Peiro (2002) who reports very low correlations between U.S. and German GDP using quarterly data. Recent publications show that the relationships between U.S. and German GDP are more pronounced when the analysis concentrates on business cycles.[19] Thus, the interactions between U.S. and German GDP might be only relevant in the short- and medium-term but not when also the long-term relations are taken into account as in our analysis.

What do the results of this study mean for the international transmission of business cycle shocks and how are stock prices influencing this transmission?

Only one part of the transmission path from stocks to GDP seems to be clear: there is a significant influence from the U.S. stock index to the German stock index. Most of this effect occurs within one quarter as the Granger-tests did not reveal significant cross-country influences between the two stock markets. And this effect is also clearly not due to expectations as stock prices are near-martingales and thus almost unpredictable.

Stock indices seem to have some impact on future GDP even beyond the effect of the confidence indicators. These impacts seem to be stronger for the U.S. economy than for Germany. There are also slightly significant influences from the U.S. stocks to German GDP. But it is still unclear if a causal relationship really exists. The significant influence from stock indices to GDP might be only due to the more valuable information of the stock prices compared to the confidence indicators. This is confirmed by the impulse-response relationships between stock indices and confidence indicators that can be calculated using the above VEC-model: For Germany there are significant dynamic relationships between real stock returns and the ifo confidence indicator in both directions, whereas for the United States the stock returns predict future changes in the ISM confidence indicator but not vice versa. Thus, additional research should make use of additional leading variables that could better explain expectation on future GDP than the two confidence indicators used in this study.

5. Conclusions

The aim of the study is to quantify the relationships between real GPD and real stock prices for the United States and Germany and to apply the resulting models to analyse the role of stock markets in the transmission of changes in GDP.

In addition to earlier studies the investigation tries to separate the pure expectation effects of stock markets from their causal influence on GDP. This is done by

[19] See Weyerstraß (2002) as well as Schröder and Westerheide (2003), chapter 1.

including confidence indicators – the ISM purchasing managers index and the ifo business expectations for West-Germany – into the econometric model. From a methodological point of view our analysis considers both short-term and long-term effects within the framework of a vector error correction model (VECM).

The cointegration analysis showed that there exists a cointegrating relationship (*CE1*) amongst the four variables U.S. and German GDP and U.S. and German stock indices. The analysis of the VEC-model revealed also that the two U.S. variables are weakly exogenous whereas the two German variables are not. Thus, the adjustment to a new long-run equilibrium is driven by changes in these two German variables only. The long-term equilibrium (*CE1*) is equal to the difference of a combination of the U.S. variables on the one side and the German variables on the other side. The Granger causality tests for the VEC-model in first differences also showed that the stock indices contain expectations on future GDP.

The other two cointegrating equations found are each equal to one of the stationary confidence indicators. Both confidence indicators are weakly exogenous with regard to *CE1* and are Granger-causal both for the stock indices and GDP.

The impulse-response analyses showed that both stock indices have a significant effect on future GDP of the own country. The U.S. stock index also has an dynamic impact on German GDP. There are also strong influences from U.S. stocks to German stocks but not vice versa. Interestingly, the dynamic linkages between U.S. and German GDP are relatively weak. Although the response of German GDP to shocks in U.S. GDP is relatively high it is not significant at the 5% level. The significance of these effects depends only slightly on the ordering of the variables.

It is difficult to answer the question whether the effects from stock indices to GDP should be interpreted as causal effects or merely as forecasting power of the expectations that are part of the stock prices. For example, it could be the case that the two confidence indicators do not fully represent the expectations of the stock markets. As a consequence, the stock prices might contain expectations on GDP that are not part of the confidence indicators and, thus, these expectations could have forecasting power for future GDP.

The use of additional variables (e.g., the slope of the term structures, other confidence indicators, etc.) could show if a better approximation of these expectations still leaves scope for causal influences from stock market to GDP.

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Interactions between U.S. and German GDP: The Role of Stock Markets A Comment

By Horst Entorf*

It is a pleasure to comment on Michael Schroeder's (henceforth, MS) article which is of high quality and which was stimulating to read for at least three reasons: Firstly, it hints at an important issue of current macroeconomic policy; secondly, it provides rigorous up-to-date econometric estimation techniques and, thirdly, it is, to my knowledge, the first paper that tries to combine strands of literature on the so called "wealth effect" (i.e. the propensity of people to respond to changes in the value of their – realised and unrealised – assets) with the idea of the transmission of business cycles.

The focus of the paper is the link between stock prices and GDP. Though MS mentions parts of the relevant literature in the introduction, some deficiencies of the paper reside in the missing presentation of existing channels of influence between stock prices and GDP. In order to understand MS' econometric results, it would have been helpful to have provided some theoretical background. Otherwise it is not perfectly clear which hypotheses are going to be tested and how results should be interpreted.

Theoretical Background: The Wealth Effect. The main background of the paper is the controversial debate on the so-called wealth effect. As is well known from economic theory and empirical evidence, it is not just current disposable income that determines consumption (as was the idea of Keynes' former General Theory), but there have to be changes in permanent and long-run income, i.e. wealth, to change consumer behaviour (these ideas were put forward by Friedman' s permanent-income hypothesis, 1957). The latest innovation in this line of theory is to consider discounted unrealised future income, which means that changing stock wealth might lead to changes in actual consumer expenditures. The meaning and importance of "stock wealth" can be understood by employing the popular "dividend discount model" (dating back to Williams, 1938), according to which the fundamental current price of an asset is the discounted value of *all* future dividends. The bottom line is that when the value of equities rises, so does our (feeling of) wealth and disposable income, and we feel more comfortable about spending. Some authors argue that the wealth effect has helped to boom the U.S. economy as

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it did during the 90ies (see Poterba 2000). The reversal part of the wealth effect has become a growing concern since 2001, when stock prices started falling. Lower stock markets today would cause people to cancel consumer expenditures, meaning that people would be out of jobs and incomes would actually decline, and we would be in a recession.[1]

Controversial Discussion of the Wealth Effect. However, the wealth effect is discussed in a controversial way. Opponents argue that the overall savings rate has not really fallen during the long period of bullish markets, a fact that, if true[2], might arise because of the unequal distribution of stock holders in the U.S. and Germany.[3] Burns (1998) reports that in 1995, for instance, families with incomes of $50.000 to $99.999 ($25.000 to $49.999) owned stocks with a median value of $21.300 ($8.000), which is much less than their median house value of $120.000 ($80.000). Thus, if there were any wealth effects, changing values of residences would be much more important than changing stock prices which were of minor importance for the majority of consumers. In Germany, the importance of owned stocks is even less important. German households hold only 12% of their financial assets as stock assets (Schroeder 2003, p. 42).

Moreover, given that individuals do consume more in the face of higher (future) wealth, it is not clear where changes of current stock values really come from, and what the aggregate effects of individual behaviour are. Given the validity of the dividend discount model for explaining the current value of stock prices, the reason for changes of current stock prices might be either anticipated changes of future profits (dividends) or changes of discount factors. In the latter case, market participants, i.e. households and investors, may have reassessed the riskiness of future profits, or changing fiscal policies might have changed the risk-free interest rate (remember that the sum of the risk-free interest rate and of the equity premium equals the discount rate). Thus, the interaction of stock-market wealth and consumption depends on many other features of the economy, and it is necessary to model not only the household sector but the entire remaining economy as well. Moreover, households' expectations of future income, profits and rates of return play an important role and need to be considered. Many authors have pointed out that, from a theoretical view, stock-price movements should have different effects on household spending depending on whether they are caused by changes of future (expected) profits or from changes in discount rates. Even in the case of the "pure" wealth effect represented by, say, increasing future profits as a consequence of

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[1] This is the reason why many economists argue that monetary policy should take care of the stock market.

[2] Difficulties arise due to heterogeneous saving rates among high and low income groups, consideration of pre- and after-tax saving rates, in particular with respect to realised capital gains, etc.

[3] This argument would hold a fortiori in Germany, where the distribution of shares among consumers is even much more unequal than in the U.S. and where still only a minority of households hold substantial amounts of equities.

implementing new technologies, the story is more complicated because additional aggregate demand would lead to rising interest rates such that aggregate effects are unclear.[4]

All that has been said above concerns the most popular link between stock prices and GDP. MS does not mention the wealth effect in an explicit way but I presume that his econometric work is embedded along these lines of theory. Unfortunately, given the absence of a clarifying theoretical background or crucial variables such as the interest rate, it is difficult, if not impossible, to identify existing channels of influence in more detail.

Low Stock Prices Affect Firms. MS focuses on the econometric link between stock prices and GDP. There is a direct link from stock prices to GDP that might be even more important than the indirect link through the wealth effect of consumption: Stock prices might directly affect firm behaviour. Lower stock prices, for instance, especially induced by profit warnings, increase shareholders pressure on managers to cut costs by laying off workers and scaling back investment. Moreover, declining stock prices spur investors to demand higher risk premiums leading to higher costs of financing investment. In particular, increased uncertainty associated with lower stock prices reduces the availability of venture capital investment which particularly hurts e-business and e-consumer service firms (Duca, 2001). Thus, in order to understand the impact of stock prices on GDP it would be useful if MS could have a deeper look at the micro level. This complementary research strategy would help to uncover the savings consumption behaviour of households (are they indeed significantly affected by changing stock prices? if they sell at higher prices, do they use these windfall profits for consumption or do they save them for retirement?) and the individual corporate investment behaviour (does short-sighted shareholder pressure force firms to postpone investment or to cut costs by laying off workers?) at their roots.

Stock Prices as Leading Indicator of Economic Activity. Another drawback of empirical tests of the wealth effect concerns the validity of stock prices. According to the "wealth-consumption-GDP link", stock prices should represent fundamental (intrinsic) values of future income streams in the sense of the dividend-discount model. However, econometric estimations of financial models such as CAPM or APT reveal that individual portfolios strongly correlate with overall stock market movements, and that these are well described as the reflection of general expectations or confidence about the future of the economy. Some strong criticism of the wealth effect therefore denies any possibility of testing any independent wealth effect.

One of the major strengths of the MS paper is to tackle this problem by including confidence indicators as additional endogenous variables in the system of potentially cointegrated variables. Influences beyond the effect of confidence indicators, as they turn out in the paper[5], could be an indication of the existence of

[4] See, for instance, Gramlich (2002) for a more detailed description of the link between stock-market wealth and consumption.

wealth effects. However, as MS himself correctly points out, the proof is deficient because chosen confidence indicators (ifo business expectations, ISM indicator) might be rather poor and the stock prices themselves contain additional information not (yet) settled in conducted confidence surveys. Thus, using the approach followed in the paper, the wealth effect escapes detection. More promising seem to me to be rigorous tests of complete theoretical models, and use of micro data. Moreover, event studies should study consumer behaviour during and after periods of crises, as they happened in 1987, 1997 or after 9 – 11 – 2001.

U.S. Economy has the Lead. Looking at the empirical results of the paper, the main contribution of the paper is the analysis of the transmission mechanism of business cycles between the U.S. and the German economy. Table 6 and Figures 3 to 6 of the paper cover central results. It becomes obvious that the U.S. economy has the lead over the German economy. There are several indicators for this conclusion. First, Table 6 reveals that only German stocks and German GDP are endogenous with respect to the error correction term CE1 (whereas neither US stocks nor US GDP are endogenous) which means that any disturbance of the joint U.S.-German long-run "pas-de-deux" leads to some corrections and adjustment in Germany, whereas the US economy remains unaffected. This impression is confirmed by impulse-response functions in Figures 3 and 4 (Germans GDP "reacts" to U.S. stocks, but U.S. GDP does not respond to German stocks), Figure 5 (German stocks respond to US stocks, but not vice versa) and Figure 6 (German GDP responds to U.S. GDP, but not vice versa).

Prominent Role of ifo Business Expectation. Something worth noting besides these main results is that the only exogenous variable of the system presented in Table 6 is the ifo business expectation. It seems to be nicely suited as early indicator which confirms my own previous tests of alternative leading business cycle indicators of the German economy (Entorf 1990, Chapter 7, Entorf 1993). However, as calculations of cross-correlations in Figure 1 reveal, the correlation is becoming less significant over time. Using growth rates with respect to corresponding quarters of preceding years, i.e. DLGDP_4 = $(1 - L^4)\log(GDP)$ and DLIFO_4 = $(1 - L^4)\log(ifo)$, the maximal cross-correlation was 0.37 for the period 1973:1 to 1982:4 (at a lead of one quarter of ifo business expectations ahead of GDP, see bold figures), whereas the maximum was only 0.16 for the period 1983:1 to 2002:2 (with an insignificant and unrealistic lead of four quarters). Thus, it seems as if the leading indicator information of the ifo business expectation has lost some of its previous predictive power. Significant correlations found for the whole period 1973 to 2002 (see the upper panel of Figure 1) might possibly be a result of the more marked co-movement during the seventies and early eighties.[6]

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[5] Table 6 shows some influence of stock prices on GDP, impulse response functions in Figures 1 and 2 indicate that stock prices contain information about future GDP three quarters ahead.

[6] I thank Michael Schröder for kindly providing me with his data base.

Sample: **1973:1 2002:2**
Included observations: 118
Correlations are asymptotically consistent approximations

DLIFO_4,DLGDP_4(-i)	DLIFO_4,DLGDP_4(+i)	i	lag	Lead
. |*. |	. |* . |	0	0.0544	0.0544
.*| . |	. |** |	1	-0.0642	0.1931
**| . |	. |** |	2	-0.1857	**0.2436**
***| . |	. |** |	3	-0.2609	0.2203
***| . |	. |** |	4	-0.2778	0.2198
***| . |	. |** |	5	-0.2589	0.1936
***| . |	. |** |	6	-0.2463	0.1714
**| . |	. |* . |	7	-0.1995	0.1294

Sample: **1973:1 1982:4**
Included observations: 40
Correlations are asymptotically consistent approximations

DLIFO_4,DLGDP_4(-i)	DLIFO_4,DLGDP_4(+i)	i	lag	Lead
. |*** |	. |*** |	0	0.3028	0.3028
. |* . |	. |**** |	1	0.1431	**0.3679**
. | . |	. |*** |	2	-0.0322	0.3324
.**| . |	. |*** |	3	-0.1526	0.3043
.**| . |	. |*** |	4	-0.2086	0.2828
.**| . |	. |*** |	5	-0.2049	0.2710
.**| . |	. |** . |	6	-0.1729	0.2321
. *| . |	. |* . |	7	-0.1398	0.1408

Sample: **1983:1 2002:2**
Included observations: 78
Correlations are asymptotically consistent approximations

DLIFO_4,DLGDP_4(-i)	DLIFO_4,DLGDP_4(+i)	i	lag	Lead
**| . |	**| . |	0	-0.2003	-0.2003
**| . |	. | . |	1	-0.2260	0.0085
**| . |	. |* . |	2	-0.2232	0.1370
**| . |	. |* . |	3	-0.1914	0.1286
.*| . |	. |** |	4	-0.1081	**0.1574**
.*| . |	. |* . |	5	-0.0636	0.1235
.*| . |	. |* . |	6	-0.1019	0.1196
.*| . |	. |* . |	7	-0.0810	0.1194

Note: Lag τ^- of (negative) minimum corresponds to $\tau^- = (T/2) - \tau^+$, where τ^+ = Lead at (positive) maximum, T = length of cycle $\Rightarrow T = 2(\tau^- + \tau^+)$ (see Entorf, 1993, for details on the lead-lag analysis of cyclical time series)

Figure 1: Leads and lags between GDP (real) and ifo business expectations – evidence from cross-correlation functions

Econometric Details. Finally, some minor technical notes are in order concerning chosen estimation strategies:

1. Use of data on a quarterly basis is rather long, given that stock prices might react even within seconds.
2. Using daily U.S. and German stock returns, Bender (2001) shows that U.S. Stocks "Granger cause" German stocks (confirming MS).[7]
3. Application of the same lag (one quarter) for all variables in Table 6 seems rather rigid. Have any tests of correct lag lengths been done?

Summing up, the paper has shown that rigorous econometric tests lead to well documented and serious findings. However, more economic theory would be needed in order to disentangle the wealth effect of stock prices in a proper way.

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[7] More precisely, based on cross-correlation analysis and using daily data of the period 1988 – June 1st 2000 (incl. subsamples), Bender (2001, p. 11 – 13) showed that US stock market returns have a one-day-lead over German stock market returns. This lead vanishes (the maximum of the cross-correlation function is at lag 0) after the change of the closing time of the Frankfurt stock exchange from 5.30 p.m. to 8.00 p.m. which happened at June 2nd, 2000. Since the N.Y. stock exchange closes at 10 p.m. (CET), the overlapping trading period of both places has become longer (4.5 hours instead of 2.5 hours) after June 2nd, 2000, such that the cross-correlation function now more effectively reflects common simultaneous events that drive stock prices of both stock exchanges.

The International Transmission of Monetary Policy Shocks: Evidence for Selected OECD Countries

By Annette Kuhn*

Abstract

This paper examines the international transmission of monetary shocks. In a first step I compare the theoretical predictions of the traditional Mundell-Fleming model to that of the micro-founded Obstfeld-Rogoff model. I then use a Vector Autoregression (VAR) model to investigate empirically whether two countries exhibit symmetric or asymmetric output reactions following a unilateral interest rate increase. This analysis is conducted with two groups of countries – one following a flexible exchange-rate regime (Japan and Germany vis-à-vis the United States), the other a fixed exchange-rate regime (the Netherlands and Austria vis-à-vis Germany). My empirical results suggest that the expenditure switching transmission mechanism via the exchange rate is not as important as the transmission via the co-movement of international interest rates. The output of the two countries tends to move symmetrically as a reaction to a unilateral interest rate increase regardless of the exchange-rate regime.

Keywords: Monetary policy; International business cycles correlation; VAR

JEL classification: E32; E52; F41; F42

1. Introduction

This paper examines the international transmission of monetary policy shocks both in the context of flexible exchange-rate regimes and in the case where one country adopts unilaterally fixed exchange rates. Do other OECD countries undergo a recession because there is an unanticipated interest rate increase in the United States or do they profit from the increased competitiveness through the appreciation of the dollar? Are countries with a flexible exchange rate able to isolate from international monetary policy shocks and do they conduct independent monetary policies or is there a positive correlation between interest rates?

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Even though these questions have long been discussed theoretically, they still remain controversial.

The traditional Mundell-Fleming model established a framework for a straightforward analysis of macro policy transmission. It does not provide unambiguous results, however. In the Mundell-Fleming framework this ambiguity is mostly explained by differences in capital mobility – high capital mobility making a positive foreign output reaction to an increase of home interest rates more likely. While capital markets have become almost perfectly integrated, empirical results show, that production in most countries seems to be correlated positively even though the standard Mundell-Fleming would suggest an asymmetric transmission of monetary policy shocks under flexible exchange rates and high capital mobility.

This paper investigates whether there is a mismatch between traditional theory and empirical evidence and whether more elaborate models of the New Open Economies Macroeconomics (NOEM) provide an alternative framework that better fits the empirical findings. In the second section the paper gives a short summary of the most important theoretical models used for analyzing international monetary transmission. In the third section, I estimate a Vector Autoregression (VAR) model to provide empirical evidence on the direction of output movements following an international monetary policy shock. To find out whether the exchange-rate regime affects the direction of business cycle transmission, I analyze two sets of countries. The first group of countries, which include the United States, Germany and Japan, follow a flexible exchange-rate regime. In the second set, which comprises Germany, the Netherlands and Austria, exchange rates are unilaterally fixed over the period analyzed. The fourth section concludes by summarizing the main findings.

2. Theoretical Background

When analyzing the international transmission of monetary shocks in an open economy the Mundell-Fleming model is the standard theoretical framework. In the early 1960s, Mundell (1962) and Fleming (1962) independently developed a model to describe the international transmission of national macro policies. At that time, when exchange rates were still fixed under the Bretton Woods system, their major concern was to determine whether countries were able to use their national monetary policies to bolster shocks to the economy. They found that, if exchange rates are fixed and capital mobility is high, central banks of small countries cannot conduct independent monetary policies. Instead, the interest rates are bound by the world interest rate.

After the breakdown of the Bretton Woods system, the standard Mundell-Fleming model had to be adjusted to take into account movements of the exchange rates. Dornbusch (1976) introduced rational expectations of the exchange rate into

the model and thus provided the basis for a large body of research on exchange rates. In this Mundell-Fleming-Dornbusch (MFD) framework economies are linked via the exchange rate. An unexpected increase in the interest rate of one country in this model, say the United States, leads to capital inflows into the US resulting in an appreciation of the dollar. As a consequence for uncovered interest rate parity to hold this appreciation has to be so strong that it generates the expectations of a future depreciation of the dollar. This is the so-called overshooting effect. In this sticky price model the interest rate increase has an impact on real variables in the short run. US output is bound to fall as a reaction to the contractionary policy. The impact on foreign output is ambiguous, however. The reduction in US output lowers aggregate demand and thus dampens foreign output – the so-called income absorption effect. The expenditure switching effect on the other hand brings about an increase in foreign output: As prices cannot adjust in the short run, the nominal appreciation leads to a proportional real appreciation[1] making US products more expensive than foreign ones. Demand is switched in favor of foreign products. The early MFD model put more emphasis on the exchange rate mechanism, claiming that the latter effect prevailed, so that an increase in the US interest rate unambiguously led to a rise in foreign output and thus an asymmetric movement in the output of both economies. Wohltmann and Clausen (2001) claim, however, that only a country with low interest rate sensitivity of demand can benefit from the expenditure switching effect. For a country with a high interest rate sensitivity of demand, the negative effect of the crowding out through higher real interest rates dominates the improvement of the trade balance.[2]

In a system of credibly fixed exchange rates real interest rates have to be equal because the expected change in the exchange rate is zero. After an unanticipated increase of the US interest rate, the foreign interest rate has to increase by the same amount, thus directly passing through the contractionary impulse to the foreign economy. In this case the output in both economies contracts and they exhibit symmetric movements. The standard MFD model therefore predicts a symmetric output reaction in the case of fixed exchange rates and an asymmetric (or ambiguous) reaction in the case of freely floating exchange rates.

Do these results carry over to the modern micro-founded models of the NOEM?[3] Obstfeld and Rogoff (1995) introduced a monopolistic supply side into their Redux model. The most fundamental innovation of the Obstfeld-Rogoff (OR) model was, however, the introduction of micro foundations by incorporating indi-

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[1] This appreciation is both in nominal and real terms when prices are sticky. Kollmann (2001) finds that real exchange rates follow the nominal exchange rate almost one to one, contrary to what the Real Business Cycles theory that postulates flexible prices predicts.

[2] Clausen (2001:18) suggests that the structure of aggregate demand may be responsible for different interest rate sensitivities of demand. If a high share of aggregate demand in the foreign country is interest-sensitive investment, an increase in the world interest rate is more likely to lead to a contraction in foreign output.

[3] For a literary survey on the NOEM see Lane (2001).

vidual utility maximization. This extends the standard MFD model to an analysis of wealth and welfare effects. Even if one is not interested in these effects per se, they still have to be taken into account when analyzing output effects because they change individuals' behavior and reaction to monetary shocks. In this framework, the real interest rates are determined by the inter-temporal rate of preference of the representative consumer. In two economies with identical goods and identical preferences the real interest rate thus always has to be the same across countries.

In the Redux model, a permanent increase in the nominal interest rate of one country raises the real world interest rate in the short run – while the real interest rate in the long run is bound by the rate of time preference. At the same time the home currency appreciates. This appreciation leads to a current account deficit via the expenditure switching effect. However – this is where the story starts to differ from the standard MFD model –, it also decreases home's long run wealth. With the current account deficit, home loses claims on future output to the foreign country (wealth effect). Because home now faces relatively lower wealth it substitutes labor for leisure (welfare effect) – increasing the output of goods. This lowers the price of domestic goods in the long run leading to a deterioration of the terms of trade, which makes an overshooting appreciation unnecessary. As a result, the nominal exchange rate immediately reaches its new long run equilibrium as in the case with completely flexible prices. The consequences for real variables, however, are very different.

Through the introduction of wealth into the model, a permanent increase in the nominal interest rate[4] can have long run effects on real variables. The main mechanism at work here is consumption smoothing. A reduction in wealth induced by an appreciation of the home currency leads to a permanently lower level of consumption. However, consumption smoothing leads consumption to fall by less than income in the time after the shock, so that the additional demand has to be satisfied with foreign products. Home demands more goods from foreign during the period of the appreciation. With this current account deficit they lose claims to the foreign country. Altogether, a rise in interest rates leads to temporarily higher world interest rates and lowers the international demand for goods. *Consumption* is decreasing in both countries, the effect on foreign *output* is ambiguous, however. Because of the appreciation of the currency some world demand is shifted from home to foreign products, so that the output effect on foreign can be positive. This would then mean that we have an (ambiguous) asymmetric output effect for the two economies as in the case of the standard MFD model.[5] The OR Redux model,

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[4] In the OR model monetary policy is modeled by changes in the stock of money. A reduction in the money supply leads to an increase in the interest rate. I leave out this step in my analysis.

[5] In their analysis Obstfeld and Rogoff stress the fact, that even though output effects may be well defined, the effects on welfare do not necessarily provide the same conclusions. In this case, foreign output might be higher than domestic output, but the increased amount of labor necessary to produce this output might actually decrease welfare in foreign and vice versa.

thus, still reaches the same results concerning the effects of monetary policy on output abroad. But the results do differ in their quality as there are different transmission mechanisms and there is no overshooting of the exchange rate. Also, it opened a whole world of possible transmission and interaction channels that is being incorporated in the new body of literature based on the OR model. In the following I will shortly elaborate on the different assumptions that determine the direction of the output effect.

As in the MFD model, asymmetric output effects depend on the relative strength of the expenditure switching mechanism through the exchange rate.[6] There are, however, extensions of the OR model that challenge this standard expenditure switching mechanism. Betts and Devereux (2000a, 2000b) augment the model by introducing the idea of pricing-to-market. In their model not all goods are priced in the currency of the seller. Instead, part of the goods are priced in the currency of the buyer. In the case of full pricing-to-market, there is no exchange rate pass-through to export prices. There is, therefore, no additional demand for exports and monopolist producers do not expand their production, instead they increase their profits because of a higher mark-up. In this case the only transmission channel for foreign output is the lower overall demand due to the higher world interest rate. This model, thus, predicts symmetric movements in foreign and home output.

Tille (2001) also challenges the standard expenditure switching effect by allowing for different elasticities of substitution across and within countries in the OR framework.[7] When there is a rise in home interest rates followed by an appreciation of the home currency, the demand for foreign output only increases if foreign goods are substitutes to home goods. Otherwise, the overall effect of the higher world interest rate will prevail and dampen foreign activity, so that there is a symmetric output reaction in the home and the foreign country.[8]

So far, I have considered symmetric movements in output due to a lack of expenditure switching. Another interesting case is when the most important transmission channel is no longer the exchange rate, but when the co-movement of international interest rates causes a positive output correlation. Borondo (2000) develops an extension of the OR model in which central banks follow a specific interest rate rule stabilizing the price level. Through this rule, the interest rate becomes endogenous. In the case of a shock to the home interest rate rule, the currency appreciates and the terms of trade improve in favor of the home country. Import prices

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6 The expenditure switching effect is higher – an asymmetric output reaction more likely – the higher international capital mobility.

7 Low substitutability between home and foreign goods is particularly likely for a small country whose production is highly specialized.

8 Hau (2000) developed another way of allowing for a smaller expenditure switching effect by taking into account nontradable goods and home bias. For an overview see also Borondo (2001).

and with them the foreign consumer price level increase. This causes the foreign central bank to raise interest rates as well. The interest rate increase along with the overall reduced demand from the home country more than offset the positive expenditure effect, so that we end up with a symmetric output movement.

In summary, the standard MFD model predicts an asymmetric movement of home and foreign output as a reaction to an unanticipated increase in the home interest rate in an environment of flexible exchange rates. Even though this framework also allows for ambiguous results, the emphasis on the exchange rate channel makes the asymmetric reaction of home and foreign output the most likely result. This ambiguity with a bias towards asymmetric reactions carries over to the Redux model. Extended versions of the NOEM, however, provide a theoretical background that can explain symmetric output movements.

3. Empirical Analysis

As a framework for the empirical analysis, I use a Vector Autoregression (VAR), because it sets a minimum of identifying restrictions and does not confine the analysis to a specific theoretical model.[9] I estimate the reduced form equations of a structural form VAR that describes the economy. To ensure that structural disturbances are mutually uncorrelated I identify the model using a Choleski decomposition. The ordering of the variables sets the restrictions on contemporaneous transmissions of shocks and thus identifies them.

3.1 The Econometric Model

The model closely follows Eichenbaum and Evans (1995). It is made up of monthly data[10] for seasonally adjusted industrial production, nominal interest rates, the consumer price indexes and bilateral real exchange rates.[11] All variables are in logarithms except for the interest rates. The real exchange rate is calculated by subtracting the relative consumer price index from the nominal exchange rate. Following Eichenbaum and Evans (1995), I order industrial production and prices

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9 There are, however, also critics of this approach. Rudebusch (1998) criticizes, that the VAR modeling heavily relies on the assumption that shocks to monetary policy are exogenous and that they cannot mirror the behavior of a (more realistic) endogenous monetary setting (see Christiano et al. (1999) for a survey on different identification assumptions). While researchers are looking for feasible alternatives, the VAR model is still used as the econometric model for analyzing monetary policy transmissions (see for example Kim (2001)).

10 All data are from International Financial Statistics (IFS).

11 I do not consider the ratio of nonborrowed to total reserves which Eichenbaum and Evans (1995) used as a monetary aggregate for the United States. Leaving out this aggregate does not qualitatively change the results of the model.

first. More specifically, in this VAR model, I impose the recursive ordering $\{y, p, y^*, p^*, i, i^*, q\}$, where y is home industrial production, p is the home consumer price index, i is the home interest rate and q stands for the real exchange rate. Foreign variables are denoted with an asterisk.

This ordering is the only restriction that has to be imposed and it can also be questioned.[12] It seems plausible, however, that real output should not respond to interest rates within the same month. At the same time, the restriction that prices do not react immediately to changes in the interest rate is based on the assumption of sticky prices. Home variables are put ahead of foreign variables because in my two groups of countries the home country is always the large country and thus more likely to have a contemporaneous impact on the foreign (small) country. For the same reason I also put the home interest rate ahead of the foreign one, contrary to Eichenbaum and Evans (1995). This does not change the results qualitatively, however. The lag order of the variables is chosen to be 6, in accordance with Eichenbaum and Evans (1995).[13, 14]

With this VAR model, I investigate the impact of an unanticipated interest rate hike in one country on output in a number of other countries. The first group of countries analyzed are the United States, Germany, and Japan. These countries have adopted floating exchange-rate regimes since the breakdown of the Bretton Woods system. The sample period is 1974:01 to 2002:05. The second group of countries comprises Germany, the Netherlands, and Austria. The latter two countries have had their exchange rates fixed vis-à-vis the D-Mark.[15] Here, the sample period is 1974:01 to 1998:12, because these countries have had the same monetary policy conducted by the European Central Bank since 1999. I include two dummy variables for German reunification to take into account the structural break that occurred in Germany in the beginning of the 1990s.[16]

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12 A whole body of literature about structural VAR models is concerned with finding theoretical arguments for imposing different restrictions also on long-run relationships between the variables. Authors like Bernanke (1986) and Sims (1986) and Leeper et al. (1996) adopt alternative approaches regarding the restrictions of the model. Clarida and Gali (1994) use a structural VAR in a NOEM framework.

13 The analysis of several information criteria proved to be inconclusive, suggesting between 3 and 13 lags.

14 A test for cointegration in the VAR suggested that there might be about 2 cointegration relations in the model. I refrained from estimating a Vector Error Correction model, however, following Sims, Stock, and Watson (1990) who claim that this is unnecessary as the cointegration relation is implicitly estimated in the general VAR model.

15 In the exchange rate classification database by Levy-Yeyati and Sturzenegger (2002) which considers "de facto" exchange rates these economies are identified as fixed exchange-rate systems. In a more refined distinction of the database the Netherlands are sometimes listed as following a "dirty or crawling" peg.

16 These are two 0/1 dummies. The first one takes the value of one during the period of 1991:01 and 1992:12 and the second one takes the value of one during the period of 1993:01 and 1993:03 (Sachverständigenrat 2001).

3.2 Empirical Results

In the following I present the impulse responses for a shock to the home interest rate. To assess the statistical significance of these results it is essential to include the appropriate error bands to the impulse responses into the analysis. I use error bands computed by a Monte Carlo Integration following Sims and Zha (1999). The authors suggest that the use of conventional one or two standard error bands can be misleading as impulse responses have highly asymmetrical distributions. As a result, they suggest using fractiles with 0.16 and 0.84 instead of the one standard deviation band and fractiles of 0.025 and 0.975 rather than two standard deviations.

I am interested in the co-movements of home and foreign output after a shock to the home interest rate. The results are summarized in Figures 1 to 4. In a first step, I check whether the unanticipated interest rate increase at home has the expected effects on home variables. Figure 1 and Figure 2 (column 'i-US', row 'Y-US') show the impact of the shock to the US federal funds rate on industrial production in the United States. I find that, in line with theoretical predictions, output of the home country is reduced by this "contractionary shock". The same result holds in the case where Germany is the home country (Figure 3: i-D, Y-D; Figure 4: i-D, Y-D).[17]

Concerning the reaction of foreign output, I find, that industrial production in Germany and Japan fall following the unanticipated increase in the federal funds rate (Figure 1: i-US, Y-D; Figure 2: i-US, Y-J).[18] Surprisingly, I get the same results, when looking at the reaction of Dutch and Austrian industrial production to an increase in the German interest rate (Figure 3: i-D, Y-NL; Figure 4: i-D, Y-A). One should have expected different co-movements as these countries belong to a different exchange-rate system. Thus, I ask, whether the impact of the exchange rate transmission mechanism is maybe not as big as predicted by theory.

As discussed in Section 2, the transmission of the exchange rate works via an expenditure switching process. The reaction of the D-Mark and Yen exchange rates vis-à-vis the dollar are similar to what Eichenbaum and Evans (1995) labeled a "delayed overshooting". The dollar appreciates against both currencies and – in contrast to the predictions of the Dornbusch (1976) model – the appreciation continues for an extended period of time (Figure 1: i-US, q; Figure 2: i-US, q).[19]

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[17] Surprisingly, home prices increase after the interest rate hike. This price puzzle has also been observed by other studies. It has been suggested by Holstein (1999), that this reaction might be due to central banks' anticipation of an impending rise in prices. However, this explanation does not go along well with the theory and the VAR modeling in which monetary policy has to be completely exogenous and the shock to the interest rate has to be completely unanticipated. We experimented with including the HWWA index for world commodities into the model, as we suspected a misspecification. Including this index made the reaction of prices close to statistically insignificant.

[18] In Japan, however, the fall in production is statistically not significantly different from zero.

[19] Pierdzioch (2003) shows that adding noise trading to a pricing-to-market NOEM model helps to explain both nominal and real "delayed" overshooting.

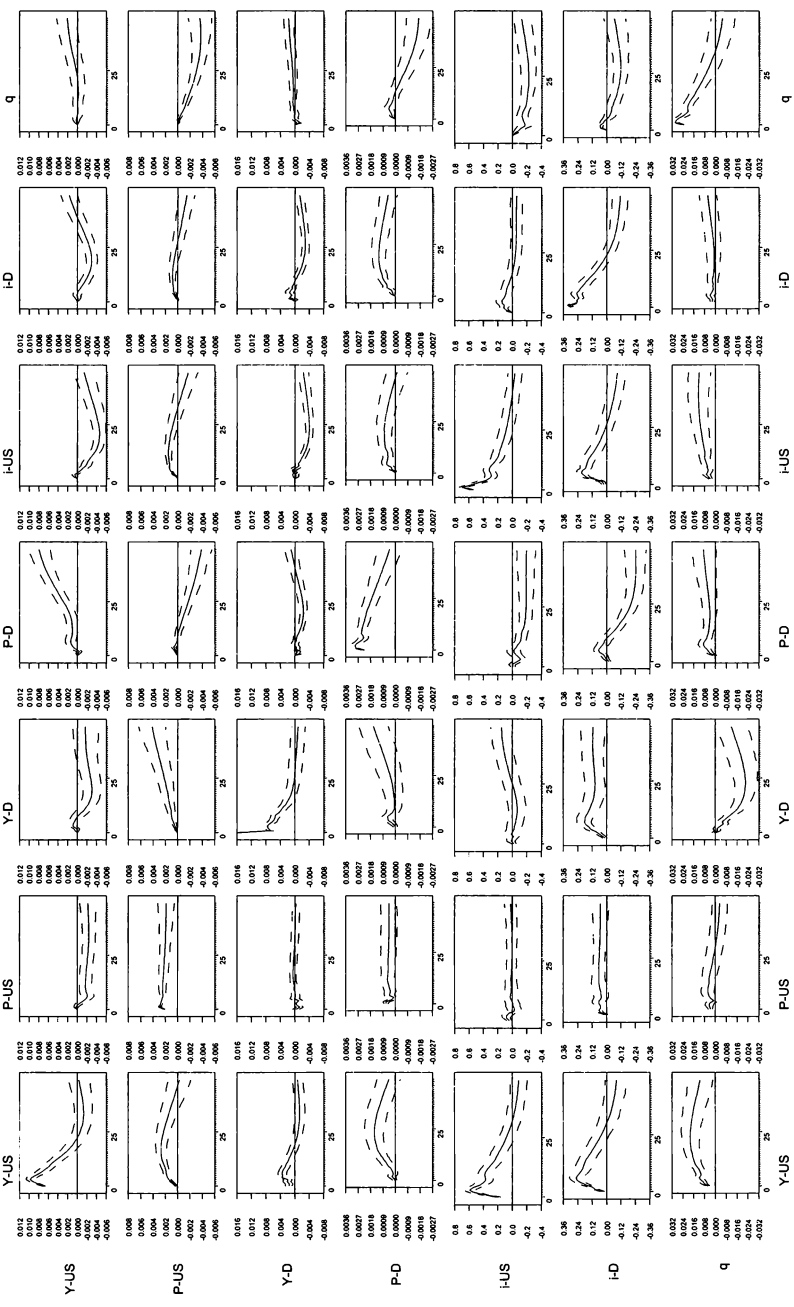

Figure 1: Impulse Responses United States / Germany

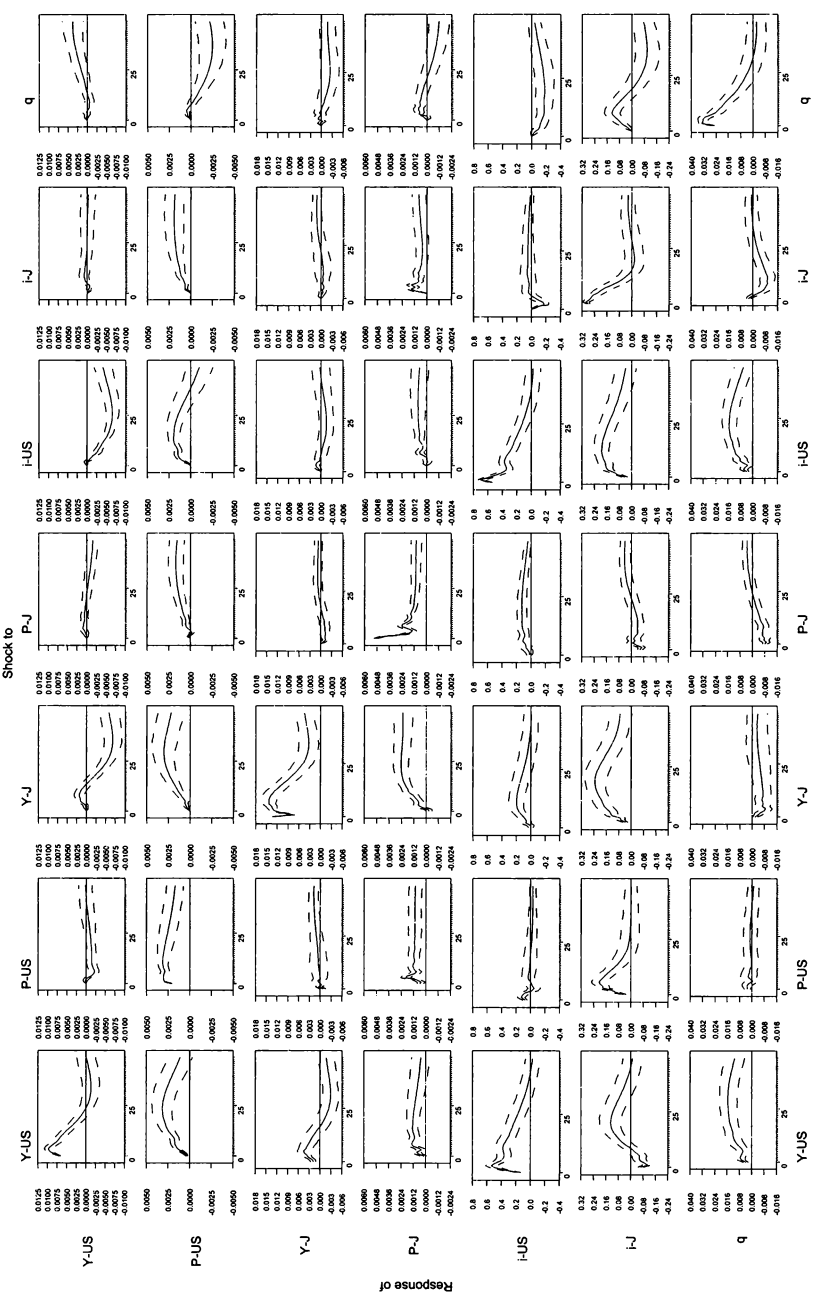

Figure 2: Impulse Responses United States / Japan

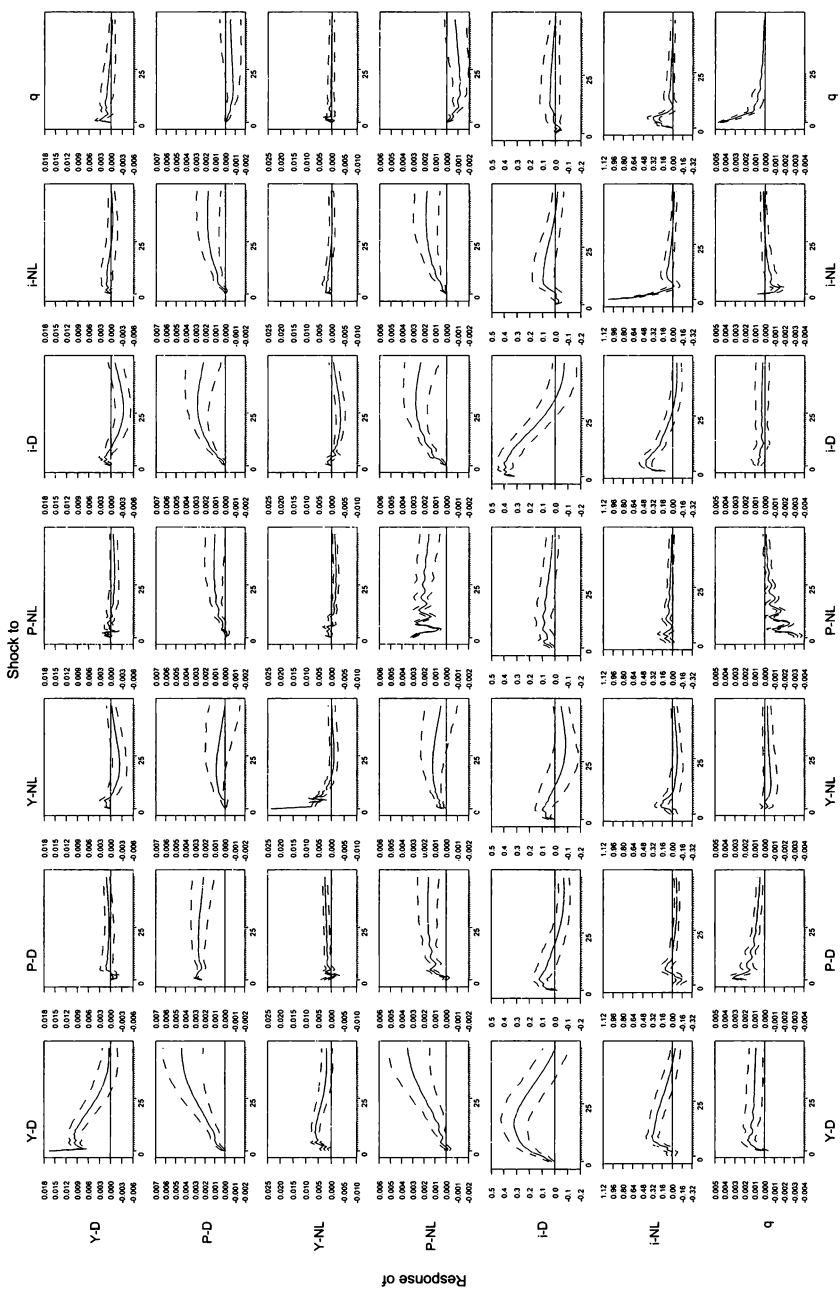

Figure 3: Impulse Responses United States / Netherlands

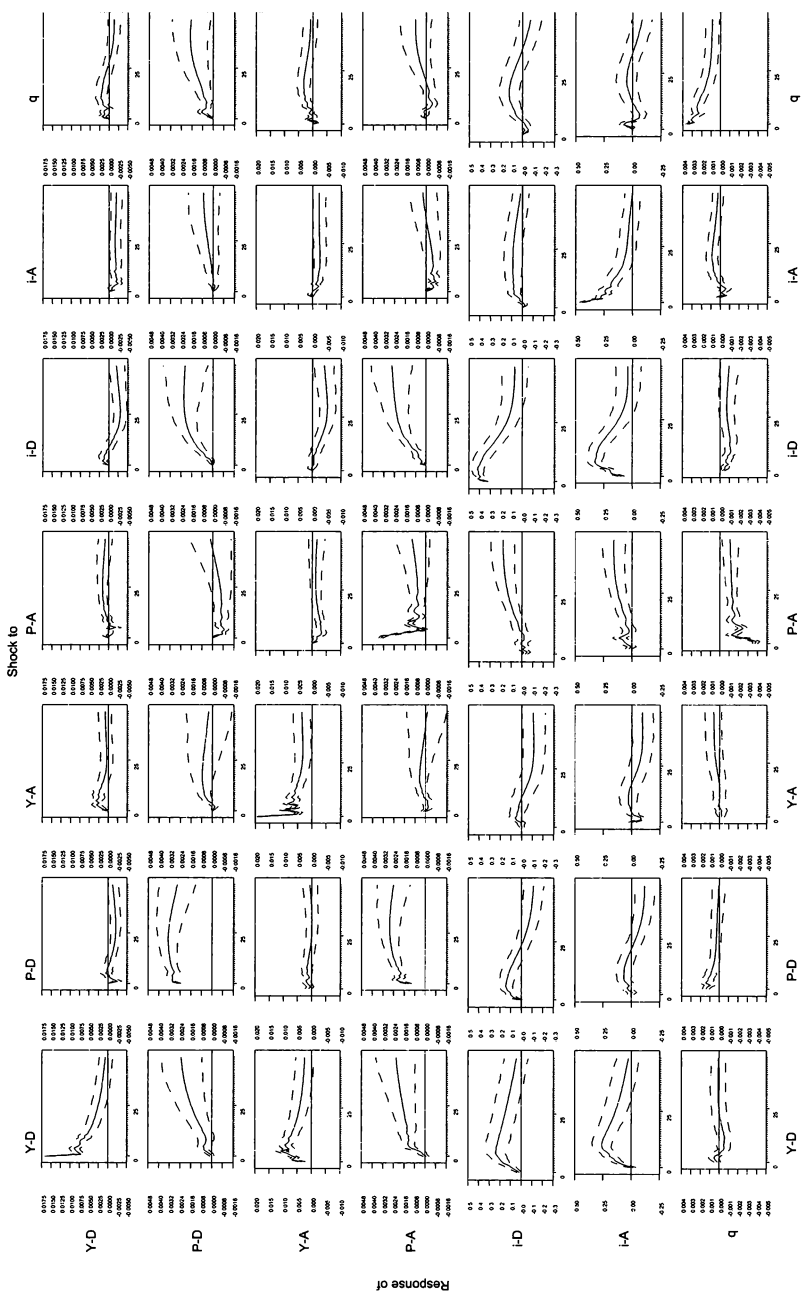

Figure 4: Impulse Responses United States / Austria

So why, then, does this depreciation of the D-Mark and the Yen not lead to a positive impulse for the relevant industrial production? There are two reasons why this transmission mechanism as described by the standard theory might fail. First, the exchange rate movement could leave foreign output unchanged because the depreciation of the foreign currency does not have the expected positive impact on foreign output. From the impulse responses I can indeed observe that a shock to the real exchange rate does not seem to have any significant impact on either German or Japanese output (Figure 1: q, Y-D; Figure 2: q, Y-J). This could be due to pricing-to-market as described in Section 2. Second, a positive expenditure switching effect on output could be outweighed by a more than proportional negative effect of a higher world interest rate.

To determine which variables have the highest power of explanation for the movement in foreign output, I conduct a forecast-error-variance decomposition. The power of explanation of the autoregressive part of the model becomes lower as the other variables gain importance with time. For German output, the explanatory power of the federal funds rate rises to more than 28 percent after four years (Table 1). Surprisingly, the U.S. interest rate seems to have more impact on German output than the German interest rate, which can only explain 13 percent of the fluctuation in German output after four years. Another important message for my analysis is the almost negligible explanatory power of exchange rate movements. This is an indicator for the fact that the exchange rate transmission mechanism may be less important than expected.[20] The forecast-error-variance decomposition for Japan provides a slightly different picture. Here, neither the exchange rate nor the interest rates seem to provide much explanatory power for the movement in Japanese industrial production. This is probably due to the fact that the traditional monetary transmission mechanism in Japan has been disturbed since the bursting of the bubble in the beginning of the nineties. If we run the regression only up to the year 1990, the federal funds rate has very high and the exchange rate some explanatory power (Table 1).

These results suggest that the foreign interest rate is quite essential in explaining output abroad, while the transmission channel does not seem to be the exchange rate as suggested by the standard MFD theory. Rather, there is a significant co-movement in interest rates, which could be the reason for the symmetric output reaction. The impulse responses for the Netherlands and Austria give an idea of the importance of this direct transmission via the co-movement of interest rates.[21] With unilaterally fixed exchange rates the small country cannot follow an independent monetary policy. Therefore, the national interest rates have to move propor-

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[20] Already in 1989, Baxter and Stockman (1989) challenge theoretical models that predict a strong influence of the exchange rate on real economic variables, the so-called "Exchange Rate Disconnect Puzzle". Flood and Rose (1995) confirm their finding that output volatility does not change much across exchange-rate systems.

[21] See also Table 2 for the forecast-error-variance decomposition for Dutch and Austrian Output.

Table 1

Forecast-Error-Variance Decomposition for German and Japanese Output

Country	After month	Standard Error	Y-US	P-US	y^*	p^*	i-US	i^*	q
Germany	12	0.03	11.3	0.6	82.8	1.1	2.7	1.1	0.5
	48	0.04	7.7	0.4	41.9	6.0	28.3	13.3	2.5
Japan	12	0.04	6.0	0.08	92.8	0.6	0.3	0.1	0.1
	48	0.06	8.2	1.4	84.5	0.7	1.1	0.6	3.6
Japan '90	12	0.03	37.9	0.1	58.1	0.1	2.7	0.2	0.8
	48	0.04	25.0	0.4	30.8	0.3	34.9	2.5	6.2

Notes: In this table Y-US stands for the industrial production of the United States, P-US for the consumer price index of the US, i-US for the federal funds rate and q for the real exchange rate. y^* and p^* are German and Japanese industrial production and consumer price index respectively. i^* stands for the short run interest rates in these countries. Japan '90 presents the forecast-error-variance decomposition of the estimation for Japan up to 1990, which was included due to a structural break in Japanese data.

Table 2

Forecast-Error-Variance Decomposition for Dutch and Austrian Output

Country	After month	Standard Error	Y-D	P-D	y^*	p^*	i-D	i^*	q
Netherlands	12	0.03	24.8	2.6	65.9	1.0	2.0	2.9	0.9
	48	0.04	31.3	8.0	38.7	5.2	14.3	1.9	0.6
Austria	12	0.04	42.1	1.4	48.1	4.7	0.5	1.6	1.6
	48	0.06	32.2	0.8	33.1	4.1	18.5	5.7	5.5

Notes: In this table Y-D stands for German industrial production, P-D for the consumer price index of Germany, i-D for German short run interest rates and q for the real exchange rate. y^* and p^* are Dutch and Austrian industrial production and consumer price index respectively. i^* stands for the short run interest rates in these countries.

tionally for the uncovered interest rate parity to hold. The empirical results confirm this theoretical finding. Dutch and Austrian interest rates move almost proportionally to the German interest rate (Figure 3: i-D, i-D; i-D, i-NL, Figure 4: i-D, i-D; i-D, i-A). These findings fit in well with what standard theory predicts and they provide a good explanation for symmetric output movements.

If I compare these results with the ones I get for the supposedly flexible exchange-rate systems, I can see that the symmetric co-movements in output can probably be attributed to the strong co-movements in interest rates.[22] They do not

[22] Monacelli (2001) provides a NOEM theoretical background in which the model delivers positive cross-country correlations of interest rates even for the case of flexible exchange-rate systems. However, in his framework, the output correlation is still negative due to the expenditure switching mechanism.

move proportionally (Figure 1: i-US, i-US; i-US, i-D; Figure 2: i-US, i-US, i-US, i-J), however, so that some of the adjustment has to come from the exchange rate. One reason for the co-movement in interest rates could be that countries do not conduct completely independent monetary policies even under a flexible exchange-rate regime. Instead, central banks include exchange rates into their calculations to stabilize the price level. They raise home interest rates as a reaction to a foreign interest rate hike because the depreciation of the exchange rate would otherwise put upward pressure on prices due to an increase in import prices.

Summarizing, I find that the reason for the strong positive correlation between home and foreign output as a reaction to a shock to the home interest rate can be ascribed to two facts. First, there is a more important channel of transmission than the exchange rate. Even in a flexible exchange-rate system, the interest rates perform most of the adjustment necessary to keep the interest rate parity intact. Second, even though the shock to the interest rate leads to a movement in the real exchange rate, this exchange rate movement does not have the expected expansionary impact on foreign output.

4. Conclusion

In this paper I estimate a VAR model to examine the international transmission of monetary shocks. I compare these results with what different theoretical models predict. The Mundell-Fleming model suggests that there should be an asymmetric transmission of monetary shocks with flexible exchange rates and a symmetric transmission with fixed exchange rates. The transmission channels at work are the world real interest rate or co-movement in interest rates for both regimes and the exchange rate for the flexible exchange-rate regimes. A rise of the interest rate in one country leads to higher world interest rates and depresses ceteris paribus economic activity in both countries so that they exhibit a symmetric output decline. For the case of flexible exchange rates, the lower aggregate demand can be more than offset by an increased demand of home for foreign products due to the appreciation of the home currency. Although the Obstfeld-Rogoff (1995) Redux model puts more emphasis on individual utility maximization and on different transmission channels, it mainly reaches the same results concerning output co-movements.

The empirical result show, however, that there is no asymmetric co-movement of output, neither for flexible nor for fixed exchange rates. German as well as Japanese output fall after an unanticipated increase in the federal funds rate. The same negative output reaction can be observed for the Netherlands and Austria when there is a positive shock to German interest rates. Whereas the latter reaction is what can be expected from the theory, one could have expected the results for the flexible exchange-rate regimes to be different. After all, flexible exchange rates should provide the necessary monetary independence to avoid a transmission of this contractionary shock. Even though there is a "delayed" overshooting appre-

ciation of the home currency as in Eichenbaum and Evans (1995), this exchange rate movement is not enough to offset the contractionary pressure of the increased world interest rate. Even countries with flexible exchange rates raise their interest rates in response to an increase in foreign interest rates, instead of letting their own currency depreciate to such an extent that they could profit from the positive expenditure switching effect.

In addition, the empirical results show that the exchange rate does not have any significant effect on foreign output. Even though the interest rate hike at home leads to a depreciation of the foreign exchange rate, the expected expenditure switching in favor of foreign goods does not take place. Models from the NOEM that include elements of pricing-to-market, different elasticities of substitution or home bias are able to provide an explanation for the persistent symmetric comovement of home and foreign output observed in the empirical findings.

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The International Transmission of Monetary Policy Shocks: Evidence for Selected OECD Countries A Comment

By Volker Clausen*

The debate on the monetary transmission process among central bankers, academics and economists has been extremely active in the recent decade. This is partly due to methodological advances but also to the enormous stimulus from the establishment of European Monetary Union (EMU). Apart from this, the ongoing international integration of goods and financial markets generally raises the potential for international spillover effects of policies and shocks. The paper by Annette Kuhn fits nicely into this context and deals with very important policy issues.

More specifically, the paper investigates the role of the exchange rate regime for the direction of the international transmission of monetary policy shocks. Most standard theoretical models predict that the direction of international policy transmission depends on the exchange rate regime. With fixed exchange rates, a restrictive monetary policy in the home country generally leads to lower output at home and abroad, which implies a positive correlation of output movements. With flexible exchange rates, the appreciation of the home currency resulting from a unilateral interest rate increase improves the international competitiveness of the foreign country and ultimately generates a negative correlation of output movements.

In order to test this proposition, two country groups are considered – one with flexible exchange rates (US, Germany and Japan) and one with fixed exchange rates (Germany, Austria and the Netherlands). It is shown that in contrast to the predictions of standard theoretical models, output movements in response to a unilateral interest rate shock are positively correlated *irrespective* of the exchange rate regime. It is also concluded that international interest rate linkages dominate the exchange rate mechanism in the international transmission of monetary policy shocks. Concerning the impact on Germany, the paper generates the somewhat surprising result that the US interest rate has a stronger impact on German output than the German interest rate.

Overall, I very much enjoyed reading the paper. The strengths of the paper are that the lessons from theory are carefully and eloquently derived. Furthermore, the

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empirical analysis draws upon recent developments in the VAR analysis of open economies. Nevertheless, some caveats remain: before the empirical results can be considered as sufficiently reliable, it seems necessary to perform specification tests and more robustness checks of the model.

The more detailed comments which follow below refer to the theoretical background and to the criticisms of the VAR methodology.

1. Theoretical background

The paper argues convincingly that standard models of international policy transmission predict that the direction of international policy spillovers depends on the exchange rate regime. I agree with most statements made in this part of the paper. However, I would like to draw attention to two points. First, a simple extension of the Mundell-Fleming model by including the consumer price level in the money demand function already raises the possibility of symmetric policy transmission under flexible exchange rates. The reason is that the depreciation of the foreign currency increases import prices, which lowers the foreign real money stock. The resulting contractionary impact on the LM curve may outweigh the expansionary effect from increased foreign competitiveness on its IS curve. This reaction of the LM curve hinges on the assumption that a monetary aggregate represents the policy variable and this leads to the second criticism. Almost all models considered take a monetary aggregate as the policy variable. This holds for the Mundell-Fleming setup as well as for the Redux model paradigm by Obstfeld and Rogoff and most of its extensions. In contrast, the empirical implementation uses – in line with most VAR analyses in this area – a short-term interest rate as the policy variable. In this respect, there is a "mismatch" between the empirical implementation and the theoretical background. Overall, I would like to see beyond the cited analyses of Borondo more reference to theoretical work on international monetary policy transmission using interest rates as policy variables.

Endogenizing foreign monetary policy by means of a Taylor type reaction function presumably lowers international interest rate differentials, strengthens international interest rate linkages and weakens the exchange rate responses. Suppose the central bank only responds to the output gap and to consumer price inflation. Both variables are linked to exchange rate developments. The incipient depreciation resulting from the increase in world interest rates requires a rise in domestic interest rates in order to stabilize exchange rates. In an open economy, any inflation targeting regime therefore implicitly includes some form of exchange rate targeting. The relationship between interest rates and exchange rates definitely merits more attention, especially because the author wants to draw conclusions concerning the relative importance of interest and exchange rate developments in the international transmission of monetary policy shocks. It has already been noted by McCallum (1994) in the investigation of uncovered interest parity that the proper

specification of the monetary policy reaction function with respect to exchange rates is of prime importance.

2. Criticism of the VAR Methodology

While VAR models have established some empirical regularities or stylized facts concerning the transmission of monetary policy it has to be noted that these efforts have been much less successful than in the context of open economy models. In the interpretation of the results and the assessment of their reliability, several issues have to be considered:

First, while numerous impulse responses are "plausible" or at least consistent with conventional wisdom, there are also several responses that raise skepticism with respect to the structural interpretation and the reliability of the results. While the price puzzle has already been noted in the paper, there are further examples of this kind. As one example, a shock to the real exchange rate appears to ultimately affect the US and Germany in the same (!) direction (Figure 1 in the paper). In the presentation of the empirical results, I prefer to see more specification tests in order to assess the validity of the underlying VAR framework and the statistical tests. Kuhn chooses the lag order of the system to be six as in Eichenbaum and Evans (1995) and in other studies in this field. While this facilitates the comparability of results across studies, it is interesting to learn whether this lag order is sufficient to remove serial correlation in the system. The presence of heteroscedasticity might indicate outliers and structural breaks and affects the validity of confidence intervals around the impulse responses. The variance covariance matrix of the residuals of the unrestricted reduced form might be reported in order to assess the reliability of the results with respect to the ordering of the variables.

Second, the model is estimated over a rather long time span and presumably includes some structural changes. It is well known from the relevant literature that monetary policy rules changed over time, which constant coefficient VAR models fail to capture. For example, there was a shift in the US monetary policy regime in the period 1979 – 1982, which presumably affected the "innovations" in the US interest rate equation. Furthermore, looking at the bilateral international interest rate linkages over time in Europe these typically increased considerably after the strengthening of the EMS in 1987 (see graph below). It may be useful to introduce dummy variables or to investigate appropriate sub-periods.

Third, the widespread recursive identification scheme based on the Choleski decomposition is harder to defend in the context of open economy models. This identification scheme implies in models where the exchange rate is ordered last that neither central bank reacted contemporaneously to changes in the exchange rate. While this assumption may be justified for the Fed as long as it neglects Dollar movements, it is questionable for Germany and even more questionable for Austria and the Netherlands.

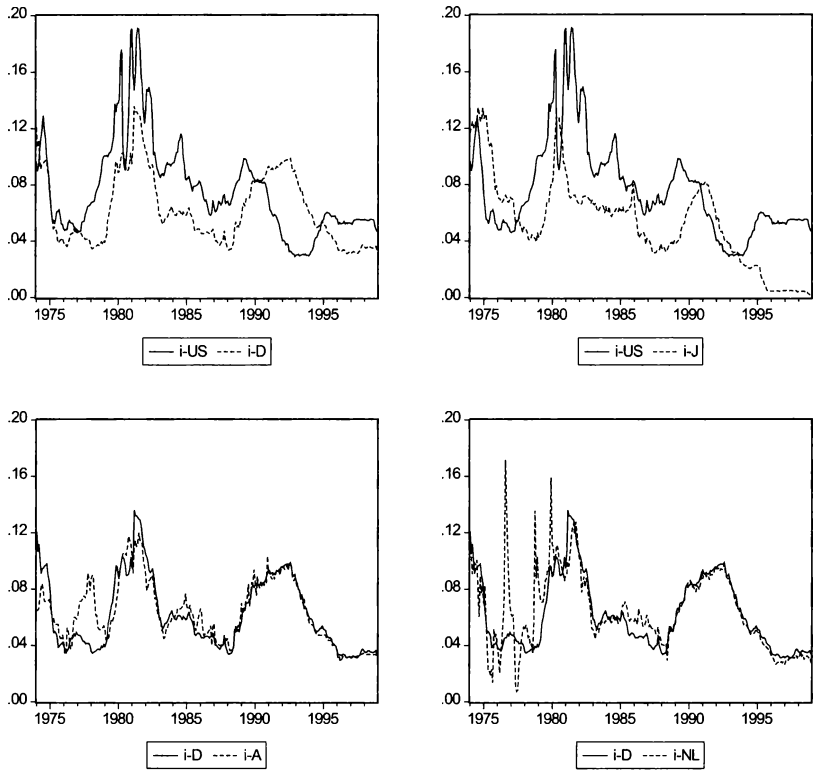

Figure 1: International Interest Rate Linkages

Fourth, the key and very fundamental problem of VAR analyses is the interpretation of the "innovations" in the policy equations as truly "exogenous" policy shocks. These innovations reflect – analogous to conventional regressions – variables or relationships that are omitted from the model. VAR results will suffer from the well-known omitted variable bias if the omitted variables are correlated with the included variables. For example, a common experience in VAR analyses is that prices (or inflation) typically increase after a tightening of monetary policy. It is well known that the inclusion of the commodity price index in the VAR solves the famous "price puzzle" in closed economy models. In fact, it has become standard practice to include commodity prices in a VAR in an effort to control for predicted future inflation (Stock and Watson, 2001). Favero (2001) shows in a very similar analysis on international policy transmission between the US and Germany that the inclusion of commodity prices substantially modifies the impulse responses (see Favero, 2001, p. 185 ff.). For example, while in the benchmark specification without commodity prices, a restrictive monetary policy shock in the US

also triggered an increase in German interest rates, it failed to do so in the specification including commodity prices. For this reason, it appears necessary to check the robustness of the results of the current paper with respect to the inclusion of the commodity price index. The paper only refers to the price response and to the price puzzle, but not to the other results of the impulse responses.

Fifth, VARs are by construction limited to systems of a relatively small dimension. Other variables, which may affect the cyclical developments such as fiscal policies and technological shocks (see, e.g., Canova and Marrinan 1998) and also may have triggered some monetary policy response, remain outside this analysis.

Sixth, McCallum (2001) argues, among others, that in the analysis of the monetary transmission mechanism much more emphasis ought to be placed on the systematic or predictable part of monetary policy, simply because the innovations account only for a very small portion of the overall variability of the monetary policy instrument.

These criticisms serve to put the empirical results into perspective. Despite these criticisms, VAR models now belong to the standard toolkit in the analysis of the monetary transmission mechanism. My suggestions for future research therefore recommend to examine within the chosen VAR framework the modifications mentioned above.

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Business Cycle Transmission and MNE Activity – Macroeconomic Patterns and Microeconomic Evidence

By Torge Middendorf and Nils A. Radmacher-Nottelmann*

Abstract

The growing importance of multinational enterprises (MNEs) has led to a scientific discussion on whether this increased MNE prevalence might contribute to a stronger transmission of economic business cycles. Yet, from a theoretical perspective, the associated effects on synchronization are ambiguous and the matter is entirely empirical. An illustrative investigation of the correlations of national investment figures indeed indicates an increased synchronization of investment behavior in certain European countries. However, our micro-econometric analysis based on firm-level data evinces only a weak impact of MNEs on the synchronization of business cycles. If anything, the results point at a weaker dependence of MNEs upon the domestic economic development, which would result in a flattening of the cycle.

Keywords: Business cycle; Transmission; Multinational enterprises; Investment

JEL classification: E32; F23; C 23

1. Introduction

In recent years the activities of multinational enterprises (MNE) have been characterized by two aspects, most importantly the dramatic growth of foreign direct investment flows since the mid 80s. In addition, the recent worldwide economic downturn has led to a scientific discussion on whether a global business cycle might be emerging (Cheung and Westermann 2002; Dalsgaard et al. 2002). Specifically, it is discussed, whether the growing prevalence of MNEs might contribute to a stronger transmission of economic business cycles. MNEs can be expected to re-inforce cycle transmission, since cross-border transactions within a single company can often be performed at lower transaction costs than market transactions

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between independent firms (Coase 1937, Williamson 1998). Thus, MNE activities might establish an additional transmission channel for business fluctuations.

Numerous articles address the "classical" channels like foreign trade or interest rates (Kirchgässner and Wolters 1995; SVR 2001: 264 f.; Weyerstraß 2002: 159; Kose et al. 2003) as well as the coherence of stock markets (Dwyer and Hafer 1988; Bowden and Martin 1995; IMF 2001). Though the importance of a possible transmission via MNEs is increasingly acknowledged, only a small number of these publications carries out an empirical analysis.[1] This paper seeks to close this gap by explicitly analyzing whether MNEs constitute an independent channel for the transmission of business cycles from foreign regions into the home country.

We start our analysis at the macro-economic level with a comparison of national investment figures of the G7 (without Canada). As the growing impact of MNEs should result in a more uniform investment behavior, an increase in cross-country correlations could provide a first indication for the existence of an MNE channel of transmission. The analysis on the macro-level is diluted by the effects of the other transmission channels though, making a micro-economic approach indispensable. We therefore analyze annual investments of several German MNEs in comparison to solely national companies and test for an influence of economic cycles on domestic investment activity. Overall, our results do not indicate a strong link between the state of the economic cycle abroad and domestic investment activity of MNEs.

This paper is organized as follows: Section 2 discusses the theoretically ambiguous impact of MNEs on the transmission of business cycles. The results of the correlation analysis of national investments are reported thereafter, followed by the microeconometric investigation of domestic investment activity. The contribution is concluded by section 5, a summary of our results and a discussion of further research.

2. The Role of MNEs in the Transmission of Business Cycles

MNEs might influence the international transmission of business fluctuations either directly through their activity, or indirectly by altering existing transmission channels.

- Direct influence

The direct transmission impact of MNEs can amplify or moderate the initial cyclical impulse. If the foreign subsidiary is in financial distress, the domestic mother company might seek to strengthen it due to the high sunk costs that are

[1] Some recent examples are Forbes (2000) for monetary transmission, Dietrich (2002) for economic development of developing countries, Jansen and Stockman (2002) for effects on labor markets and ZEW (2002).

associated with investment abroad. Consequently, additional resources are bound and not available for domestic activities, which works into the direction of a stronger transmission of business fluctuations (SVR 2001: 264). On the other hand, these MNEs might simultaneously benefit from a diversification effect through more steady sales and profits. This would lower the costs of external finance (ZEW 2002: 85). Another factor which could work into the opposite direction is that – under otherwise identical conditions – MNEs might prefer investments in the mother country to secure domestic employment to some extent. This is the so-called *home-bias* attenuating a transmission of recessions towards the home country of the MNE.

- Indirect influence

MNEs might indirectly impinge upon the trade channel as local affiliates of an MNE may bring about an alteration of the export flows towards that country. On the one hand, the intra-firm trade between the affiliate and the headquarter will change the export structure in favor of intermediary goods. Hence, the unit value of exports will decrease. On the other hand, the local affiliate may support the distribution activities in the foreign market as well, thus raising trade volumes and the corresponding value of exports. Moreover, in cases of pure vertical integration of local affiliates, like for instance assembly sites, the complete intra-firm trade will be added to the export volume. For this reason, the direction of possible effects is ambivalent.[2]

The interest rate channel might be influenced by the MNE, if the enterprise realizes interest rate arbitrages. Raising credits in countries with lower financing costs and cross-subsidizing this capital within the company group towards high-cost regions pushes demand for liquidity in the former countries with the effect of convergence of interest rates. Finally, the coherence of stock market prices is affected if multinational companies are listed at stock markets in different countries. Equity prices in one stock market directly influence share prices in the markets abroad. Especially with the growing number of private equity holders the increasing volatility of equity values will also influence private consumption and national GDP (Doyle and Faust 2002: 428).

3. Empirical Investigation of a Greater Synchronization of Business Cycles at the Macro Level

3.1 Data Description

Previous empirical research on the synchronization of business cycles has mainly focused on the investigation of co-movements in the Gross Domestic Pro-

[2] For Germany, empirical investigations display a tendency towards a complementary effect on foreign trade. (Broll 1990: 26; Henneberger et al. 2000). Internationally however there is no clear tendency apparent, see Lipsey (2002) for a summary of studies.

duct or industrial production.[3] To investigate whether a so called *world business cycle* (that means qualitatively and quantitatively similar economic fluctuations occurring at the same time) does exist, either time series of growth rates or output gaps are analyzed. This marks the distinction between the classical cycle and the growth cycle. But not only has the pure existence of a high synchronization been the aim of empirical research, but also its development over time. An increase in the correlation of growth rates or output gaps is thereby taken as the principal evidence for a rise in the synchronization of business cycle fluctuations.

The impact of MNEs on the cycle linkages should be reflected most visibly in their investment behavior. We therefore only investigate a part of the GDP, notably the investments in machinery and equipment.[4] Specifically, we investigate the co-movement of the rates of growth of business investment over time by using moving correlation coefficients.[5] As mergers & acquisitions surged in the past decade (UNCTAD 2001: 56), a rise in the correlation during that time might hint at a greater importance for the business cycle linkages.

The series are quarterly, seasonal adjusted data for investments in metal products, machinery and transport equipment from Germany, France, Italy, Japan, the UK and the USA.[6] The series date back to 1970:1, except for France (1978:1) and Japan (1980:1). To take into account breaks in the data in the case of German reunification (1991) and of the methodological modification of the statistics in the case of Japan (1st Quarter of 2001) these periods are omitted from the analysis. Growth rates of investment are calculated as the differences of the logarithms of the series.[7]

3.2 Indication of a Greater Synchronization of Investment Cycles from Macro Data

To examine the development of the correlation coefficients between German investments and those of the selected countries, these were computed over a

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3 For recent empirical research see Peiró (2002) and Doyle and Faust (2002).

4 Business construction is omitted because it is largely affected by country-specific tax-law, land prices and subsidization, the best example being the development in the reunited Germany in the first half of the 90s. Furthermore, from a statistical point of view, it is often not stated separately but combined with the public constructions.

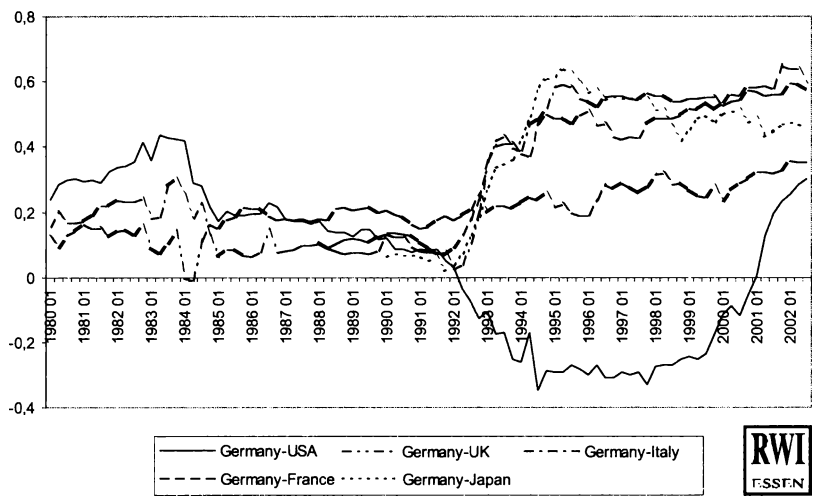
5 The problem of common shocks overstating the correlation coefficient, argued by McDermott and Scott (2000), is only apparent if the correlation coefficient is unusually high. This was only the case during the large oil price shocks in the mid 70s and early 80s.

6 Source: OECD Quarterly National Accounts. The source for the German data is the Federal Statistical Bureau DESTATIS.

7 For all series, the null hypothesis of a unit root in the first difference of the series can be rejected at the 1% level, except for the Japanese and French investments (rejection of a unit root at the 5% level), using the Schwarz Information Criterion to determine the number of lags and including a constant in the test regression.

moving window horizon of 40 quarters. The results obtained are illustrated in Figure 1.

At first glance, the estimated correlations of German investment growth with that of France, Italy and Japan increased remarkably during the mid-80s. This coincides with the growing worldwide importance of Foreign Direct Investments. The increase in correlations was quite smaller for the UK while the correlation with US investments became even negative. These patterns are consistent with the impression of a rather common investment behavior during the 90s across the two European countries and Japan, while the investments in the UK and the US showed, what could almost be labeled as an "unsustainable investment boom" (Pelgrin 2002). Yet, other research confirmed these results concerning GDP[8], although it seems to be common notion that the U.S. economy sets the pace for Germany.[9]



Source: Authors' computations based on quarterly OECD data. Average contemporaneous correlation for the 20-quarter moving window centered at the end of the window.

Figure 1: 40-quarter moving correlation of the inverstment growth rate of Germany and selected counties 1980:1 – 2002:3

A rise in the correlation between the growth rates of investment must not necessarily have its origin in an increased covariance of the two series, but could also be the result of decreased standard deviations. However, investment became even

[8] In particular see Weyerstraß (2002).

[9] The direction of influence concerning investments was analyzed by Granger Causality Tests and is reported in Appendix Table A.

more volatile during this period. Thus, the rise in correlation is attributable to an increased covariance. It is unclear, whether the increased correlation is indeed a consequence of the emergence of MNEs. Therefore the development of the other transmission channels has also to be taken into account, as for example more intense trade could trigger synchronous investment behavior. As other research suggests, the trade channel has not gained in relevance for the G7 (IMF 2001: 70 f.).

Another factor which affects investment demand are long term real interest rates. The relationship between German and international long term real interest rates indeed got stronger during the last decade (ZEW 2002: 64), so that the rise in MNEs should only be one factor underlying the stronger correlation in investment behavior. Another reason to be skeptical regarding the role in business cycle transmission is the quantitative importance of US affiliates of German MNEs (see OECD 2002: 141), which is, for instance, not reflected in the correlation coefficient. In consequence, the higher correlation between the business investments of Germany, France, Italy and Japan could not be a reliable evidence of a stronger transmission of business fluctuations via MNEs. Evidence should therefore be sought at the micro level using company data.

4. Impact of MNEs on the Synchronization of Business Cycles from Micro-Level

4.1 Specification of the Investment Function

Data Source

Despite the growing scope of cross-border affiliate groups and their potentially increasing influence on national developments, the statistical sources displaying linkages between foreign activities and the domestic economic situation of a single company are rare. Therefore, the RWI Essen developed the "Company Database Globalization". This database comprises annual firm-level information for more than 280 German affiliated groups, regularly collected from the company's annual reports[10]. It is structured in an unbalanced panel form, starting in 1990, or likewise the earliest year available. A number of key figures describes the degree of internationalization and the geographical orientation of selected business activities of the firm. Additionally, they inform about its overall economic performance.

Using the data published in annual reports offers the opportunity to survey a large number of firms. Nevertheless, there are some restrictions, especially concerning the choice of data. For instance, the spatial differentiation of firm profits, local cost structures or oligopolistic relationships to multinational competitors

[10] For a detailed description of the "Company Database Globalization" see Döhrn and Radmacher-Nottelmann (2001).

would be valuable information, but are unfortunately unavailable. Additionally, the reported details vary considerably. While key figures like the amount of regional revenues are described at length, data concerning the spatial distribution of investment or research expenditures are offered rather on case by case base. Even the contents of reports of the same company may differ between the years due to changes in the firm's information policy.

Variables observed

Given these shortcomings, the variables included in the investment function to be estimated will therefore entail the firm's domestic investments and revenues, supplemented by the development of business cycles in Germany as well as the USA representing an important foreign market for German companies. Moreover, the firms' financing capabilities are approximated by *liquidity*[11] (Table 1). *Domestic investments* serve as the dependent variable.

Table 1

Description of Variables

Dependent variable	
domestic investments $_t$	domestic investments (in Mio. €) per employee
Independent variables	
(domestic_revenues) $_{t-1}$	domestic revenues (in Mio. €) per employee
liquidity $_{t-1}$	cash flow devided by revenues
(domestic_value_added) $_{t-1}$	growth rate of national value added
(US_value_added) $_{t-1}$	growth rate of U.S. value added
MNE	dummy (1 = company is an MNE, 0 = otherwise)
US	dummy (1 = business activity in North America, 0 = otherwise)
Manufacturing	dummy (1 = manufacturing sector, 0 = service sector)
Year $_i$	dummies for the years 1993 to 2001

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[11] As follows from the contribution of Modigliani and Miller (1958) there is no role for the firm's capital structure to influence investment behaviour in case of a perfect capital market. Empirically however liquidity proxies, esp. cash flow, are highly significant in most investment equations based on firm level data (for current studies on investments and financial factors see Ashworth and Davis (2001), Chirinko and Kalckreuth (2002), Bond et al. (2003)). Accountable for these findings, it is argued, is a premium on external financing caused by capital market imperfections such as moral hazard and adverse selection (for an overview see Hubbard (1998)).

Theoretically, such investments should first and foremost depend on the company's recent financial development, which is represented in the relative values of revenues and liquidity respectively. Thus, these figures are incorporated as lagged variables. Furthermore, the development of the economic environment in the recent past should have an impact on the investment plans. Therefore lagged growth rates of national value added, $((domestic\_value\_added)_{t-1})$ are included into the investment function as an additional covariate. The impact of this variable on investment activity is expected to be positive as a sound economic surrounding will stimulate growth expectations, which again are one of the main motives for investments.

Clearly, MNEs typically display another investment behavior than firms operating only nationally. In addition, we expect the cycle to impinge upon MNE's activities differently than on other companies. The dummy variable *MNE* together with an interaction term of the MNE-indicator with the previous year's growth rate of domestic value added should capture this differential impact. A statistically significant estimate of the coefficient of this interaction term would indicate that the impact of the domestic business cycle is different for MNEs compared to non-MNEs.

Along the same lines, the lagged impact of the growth of the US economy should entail different consequences for companies with and without business activities in the USA respectively. Again, these companies might differ in aspects other than their sensitivity to the US cycle. This difference is captured by the indicator *US*. In consequence, the two parameters of interest for our study are β_6 and β_9 in equation (1) below.

Finally, an indicator for the company belonging to the manufacturing sector is included, besides year dummies for the years 1993 to 2001. All regressors other than the interaction terms are incorporated into the regressions for the sole purpose of balancing differences between MNEs and non-MNEs. The complete investment function estimated in the following section is

$$
\begin{aligned}
(domestic\_investments)_t = {} & \beta_1 + \beta_2(domestic\_revenues)_{t-1} + \beta_3(liquidity)_{t-1} + \\
& \beta_4 MNE + \beta_5(domestic\_value\_added)_{t-1} + \beta_6 MNE \times (domestic\_value\_added)_{t-1} \\
& + \beta_7 US + \beta_8(US\_value\_added)_{t-1} + \beta_9 US \times (US\_value\_added)_{t-1} \\
& + \beta_{10} Manufacturing + \sum_n \beta_n(Year\_Dummies) + \varepsilon_t
\end{aligned}
\tag{1}
$$

4.2. Description of Data

The sample of MNEs chosen for analysis from the "Company Database Globalization" includes firms with complete data for investments, employees and revenues at least for the time period 1997 to 2000. With these criteria an unbalanced panel

containing a number of 67 companies was created. This at first glance rather small sample already represents 10 per cent of total national business investments (year: 2000) and more than 36 per cent of investments in the manufacturing sector (see Table 2). Within these 67 companies the non-MNE comparison group comprises 14 firms. They do not engage in any noteworthy investment activities abroad.

Table 2

Coverage of the sample (2000)

	Number of companies	Gross business Investments[1] (in Mio. EUR)
Germany[2)]	2.909.150	234.680
Sample	67	23.551
in per cent		10.0
German manufacturing sector[2)]	40.798	53.287
Sample manufacturing sector	45	19.448
in per cent		36.5

1) Gross investments excluding public investments and private building investments
2) Liable to tax on sales/purchases; turnover >16.617 €
3) Mining and manufacturing
- authors' calculations based on data from the German Federal Statistic Bureau Destatis

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Moreover, 11 observations had been identified as outliers using scatter plots of studentized residuals and values of DF-Beta for the alternative variables. Due to the heterogeneity of the data a definite critical value, e.g. in terms of standard error, is not useful. Instead, observations have been omitted if irregular high values of DF Beta in comparison to the rest of the sample can be observed. Values are assessed as more influential the more the appropriate DF Beta and the residual increases. This correction of the data set is necessary, since we observe sharp increases in the growth of the companies due to mergers and takeovers of competitors in recent years (Radmacher-Nottelmann 2001). Thus, to ward off an exceptionally high impact of single observations on the estimated coefficients we excluded them from the sample. For comparison purposes the final results with and without the outliers are presented in the appendix Table B.

Of the observations in the sample, 472 form the sub-sample of MNE-observations and 105 cases are included in the non-MNE sub-sample. Table 3 reports some summary statistics of our samples. There is considerable heterogeneity in our data, but our main emphasis lies on the comparison of the characteristics across

sub-samples. In the ideal case MNEs and non-MNEs would be identical, on average, apart from differences in the engagement in business activities abroad.

Regrettably, the sub-sample is somewhat biased as service industries are over-represented compared to their importance on national aggregate level. Only few companies are willing to supply detailed annual figures but meanwhile did not already become a multinational enterprise. To some degree, this also gets obvious from a glance at the descriptive statistics of the samples (Table 3). Here, the standard deviation of several variables in the non-MNE sub-sample exceeds the appropriate values of the MNEs, speaking for a greater inhomogeneity in the sub-sample of non-MNEs. As is apparent from the descriptive statistics, the sub-sample of MNEs consists mainly of companies from the manufacturing sector that are also engaged in the US.

Additionally, most of the major econometric problems linked to studies dealing with firm level data apply in an analogous manner to our investigation.[12] As concerns sample selection bias, our analysis contains mostly firms quoted on the stock exchange. Although it could be argued that the rise of MNEs should be mainly centered to listed companies it focuses upon the more successful firms in the market with good investment opportunities.[13] This gets obvious from the divergent representativeness concerning number of companies and investment covered. Yet another problem is the unavailability of sufficient data to construct a reasonable factor for the cost of capital, which could cause a bias because of omitted variables.

4.3. Results

These OLS estimation results are reported in Table 4.[14] The specifications 1 to 4 contain different variables to test the robustness of our results. The first two specifications examine the impact of MNEs and US-activity. The third and forth one contain interaction terms which test for a differential impact of the national and American business cycle on domestic investment if the company is an MNE or engaged in the US.

Through all specifications the domestic revenues show the expected positive impact on the domestic investment behavior. The significant positive effect of cash flow is in line with recent research on financial constraints. Throughout the computations there are also significant sector effects.[15]

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[12] For an overview of the problems associated with studies based on firm level data see Börsch-Supan and Köke (2002).

[13] This causes need for capital and is therefore the reason for going public.

[14] The detailed table is depicted as Table C in the Annex.

[15] Because of this, supplemental computations only based on companies from the manufacturing sector were carried out. The results are depicted in the appendix Table D. However the results have to be scrutinized because of the small comparison group of Non-MNEs.

Table 3

Descriptive statistics of the firm-level sample

Variable	# of observations	Mean	Standard Deviation	Minimum	Maximum
Complete sample					
(domestic_investments)$_t$	576	0,021	0,078	0,001	1,075
(domestic_revenues)$_{t-1}$	474	0,144	0,138	0,023	1,250
liquidity$_{t-1}$	420	0,098	0,063	-0,151	0,556
(domestic_value_added)$_{t-1}$	479	0,030	0,015	0,018	0,087
(US_value_added)$_{t-1}$	505	0,060	0,009	0,029	0,071
MNE	577	0,818	0,386	0	1
US	577	0,575	0,495	0	1
Manufacturing	577	0,733	0,443	0	1
sub-sample: MNE-Dummy = Yes					
(domestic_investments)$_t$	472	0,011	0,008	0,001	0,047
(domestic_revenues)$_{t-1}$	387	0,124	0,078	0,023	0,629
liquidity$_{t-1}$	354	0,091	0,044	-0,110	0,231
(domestic_value_added)$_{t-1}$	381	0,047	0,229	-0,466	0,787
(US_value_added)$_{t-1}$	393	0,044	0,016	0,012	0,076
MNE	472	1	0	1	1
US	472	0,667	0,472	0	1
Manufacturing	472	0,809	0,393	0	1
sub-sample: MNE-Dummy = No					
(domestic_investments)$_t$	104	0,063	0,176	0,001	1,075
(domestic_revenues)$_{t-1}$	87	0,232	0,262	0,042	1,250
liquidity$_{t-1}$	66	0,133	0,115	-0,151	0,556
(domestic_value_added)$_{t-1}$	93	0,044	0,155	-0,466	0,787
(US_value_added)$_{t-1}$	93	0,049	0,015	0,012	0,076
MNE	105	0	0	0	0
US	105	0,162	0,370	0	1
Manufacturing	105	0,390	0,490	0	1

Authors' calculations from Database Globalization

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In contrast the impact of the business cycle variables is rather weak. This could be because the development of domestic revenues, as the tighter measure, is crucial for the investment decisions. The specification 4 implementing both interaction terms shows an albeit weak significant difference between MNEs and non-MNEs in the impact of the domestic business cycle. The MNEs seem to be more

independent of the domestic economic situation and thus hamper the national cycle. In addition, companies engaged in the US exert the expected stronger dependence upon the US economy, as shown by the positive interaction term implementing the US value added.

Summarizing, the evidence for a differential dependence of MNEs upon the domestic business cycle is rather weak. The results show a lack of robustness and are only slightly significant.

Table 4

OLS-Regressions for domestic investments - selected results

coefficients x10^2; t-values in parentheses; significant at the: 1% (***), 5% (**) and 10% (*) level resp.

Specification	1	2	3	4
# of observations	356			
adj R^2	0.3430	0.3645	0.3476	0.3730
MNE	0.1 (0.47)	-0.1 (-0.84)	1.0* (1.90)	0.7 (1.47)
US		0.4*** (3.55)		-1.2 (-1.35)
MNE * (domestic value added) $_{t-1}$			-9.3 (-0.41)	-36.7* (-1.84)
US * (US value added) $_{t-1}$				24.7* (1.77)
domestic value added $_{t-1}$	4.8 (0.66)	4.0 (0.56)	39.8* (1.95)	38.7* (1.94)
US value added $_{t-1}$	17.6 (0.68)	14.6 (0.57)	17.7 (0.69)	-2.1 (-0.08)

Authors' calculations from "Database Globalization"

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5. Concluding Remarks

The increasing scope and value of equity linkages within German MNEs suggests a growing influence on the business cycle transmission. From a theoretical perspective, however, the effects on the synchronization are ambiguous and the matter is entirely empirical.

This paper provides first an analysis on the macro-level, which indicates a higher degree of synchronization of business investments. However, this result is more prevalent in France, Italy and Japan and the correlation is somewhat volatile over the observed time period. The increase in correlation in the '90s might stem from a

growing importance of MNEs as a transmission channel of business cycle fluctuations. Since aggregate data does not allow discriminating between different sources of business cycle transmission – increasing trade between these countries might also be responsible for a common investment behavior – we investigated investments at the firm level.

Utilizing data from the RWI Company Database Globalization we examined the investment behavior of German MNEs and Non-MNEs. Besides the expected positive impact of domestic revenues and cash flows there is only scarce evidence of a differential dependency of MNEs upon the domestic business cycle and therewith an influence of the business cycle on their part. Thus we found only weak indications for an impact of MNEs on the synchronization of business cycles. If anything, the results speak in favor of a weaker dependence of MNEs upon the domestic business activity which would result in a flattening of the business cycle.

Because of the missing comparability of our results they might act as an initiation of a more elaborate investigation of MNEs and their impact on the synchronization of business cycles. In general, the firm level investigation should be put on a broader basis supplementary to accommodate the problem of sample selectivity.

Appendix

Table A

Granger causality tests for German investments

Variable	H_0: Considered series is not granger causal for German investments F-Statistic	H_0: German investments are not granger causal for the considered series F-Statistic	Result
Investments France	2.54*	1.66	$Inv_F \rightarrow Inv_D$
Investments Italy	1.21	2.83**	$Inv_D \rightarrow Inv_I$
Investments Japan	2.63*	1.68	$Inv_J \rightarrow Inv_D$
Investments UK	2.87**	5.82***	Feedback
Investments USA	1.02	0.48	no causality

Source: Authors' calculations on the basis of quarterly data from the OECD. Granger causality based on a lag of 3 quarters. ***: significant at the 1% level. **: significant at the 5% level. *: significant at the 10% level.

Table B

Impact of single observations in OLS-Regressions for domestic investments

coefficients x10^2 ; t-values in parenthesis

	including outliers	excluding outliers
# of observations	358	347
adj R^2	0.3913	0,3720
domestic revenues $_{t-1}$	7,7 (11.12)	3,6 (5.83)
liquidity $_{t-1}$	10,5 (9.14)	10,4 (12.5)
MNU	-0.5 (-2.17)	-0.2 (-1.45)
US	1.3 (2.76)	-0.1 (-0.18)
MNU * (domestic value added) $_{t-1}$	1,2 (1.12)	2,6 (2.32)
US * (US value added) $_{t-1}$	-16.5 (-1.76)	9,2 (1.35)
domestic value added $_{t-1}$	-1,5 (-1.17)	-3.0 (-2.38)
US value added $_{t-1}$	10,2 (0.93)	-9.1 (-1.15)
Manufacturing	-0,4 (-2.25)	-3.1 (-2.14)
Constant	-0.8 (-1.37)	0.4 (1.16)

Authors' calculation from "Database Globalization"

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Table C

OLS-Regressions for domestic investments

coefficients x10^2 ; t-values in parentheses; significant at the: 1% (***), 5% (**) and 10% (*) level resp.

Specification	1	2	3	4
# of observations	356			
adj R^2	0.3430	0.3645	0.3476	0.3730
domestic revenues $_{t-1}$	3.1*** (5.20)	3.5*** (5.91)	2.9*** (4.73)	3.3*** (5.38)
liquidity $_{t-1}$	9.8*** (12.40)	9.9*** (12.74)	9.5*** (11.98)	9.5*** (12.19)
MNU	0.1 (0.47)	-0.1 (-0.84)	1.0* (1.90)	0.7 (1.47)
US		0.4*** (3.55)		-1.2 (-1.35)
MNU * (domestic value added) $_{t-1}$			-9.3 (-0.41)	-36.7* (-1.84)
US * (US value added) $_{t-1}$				24.7* (1.77)
domestic value added $_{t-1}$	4.8 (0.66)	4.0 (0.56)	39.8* (1.95)	38.7* (1.94)
US value added $_{t-1}$	17.6 (0.68)	14.6 (0.57)	17.7 (0.69)	-2.1 (-0.08)
Manufacturing	-0.3** (-2.21)	-0.3** (-2.30)	-0.3** (-2.40)	-0.3*** (-2.67)
Dummy1993	-0.4 (-0.96)	-0.3 (-0.86)	-0.3 (-0.68)	-0.2 (-0.60)
Dummy1995	-0.1 (-0.38)	-0.1 (-0.30)	-0.1 (-0.35)	-0.1 (-0.28)
Dummy1998	-0.1 (-0.37)	-0.1 (-0.27)	-0.1 (-0.36)	-0.1 (-0.26)
Dummy1999	-0.3 (-0.85)	-0.2 (-0.73)	-0.3 (-0.94)	-0.2 (-0.83)
Dummy2000	0.1 (0.39)	0.1 (0.54)	0.1 (0.45)	0.2 (0.58)
Dummy2001	-0.2 (-0.37)	-0.1 (-0.23)	-0.2 (-0.40)	-0.1 (-0.22)
Constant	-0.9 (-0.68)	-0.9 (-0.67)	-1.8 (-1.19)	-0.6 (-0.38)

Authors' calculation from "Database Globalization"

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Table D

OLS-Regressions for domestic investments (Manufacturing only)

coefficients x10^2 ; t-values in parentheses; significant at the: 1% (***), 5% (**) and 10% (*) level resp.

Specification	1	2	3	4
# of observations	280			
adj R^2	0.4535	0.4569	0.4585	0.4638
domestic revenues $_{t-1}$	0.9 (1.28)	1.3* (1.67)	0.8 (1.07)	1.1 (1.40)
liquidity $_{t-1}$	9.3*** (10.45)	9.3*** (10.52)	9.2*** (10.32)	9.0*** (10.07)
MNU	-0.7*** (-3.23)	-0.7*** (-3.50)	0.3 (0.57)	0.2 (0.29)
US		0.2 (1.63)		-1.0 (-1.19)
MNU * (domestic value added) $_{t-1}$			-38.7* (-1.86)	-36.7* (-1.76)
US * (US value added) $_{t-1}$				19.8 (1.40)
domestic value added $_{t-1}$	5.7 (0.83)	5.2 (0.77)	42.4** (2.03)	39.9* (1.92)
US value added $_{t-1}$	25.0 (1.01)	23.4 (0.95)	24.1 (0.98)	19.8 (1.40)
Dummy1993	-0.4 (-1.10)	-0.4 (-1.04)	-0.3 (-0.84)	-0.3 (-0.77)
Dummy1995	-0.2 (-0.74)	-0.2 (-0.68)	-0.2 (-0.69)	-0.2 (-0.66)
Dummy1998	-0.1 (-0.20)	-0.1 (-0.16)	-0.1 (-0.11)	-0.1 (-0.11)
Dummy1999	-0.2 (-0.59)	-0.2 (-0.54)	-0.2 (-0.56)	-0.2 (-0.56)
Dummy2000	0.2 (0.61)	0.2 (0.65)	0.2 (0.69)	0.2 (0.69)
Dummy2001	-0.1 (-0.26)	-0.1 (-0.22)	-0.1 (-0.21)	-0.1 (-0.2)
Constant	-0.8 (-0.55)	-0.8 (-0.55)	-1.6 (-1.12)	-0.7 (-0.46)

Authors' calculation from "Database Globalization"

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Business Cycle Transmission and MNE Activity – Macroeconomic Patterns and Microeconomic Evidence A Comment

By Andre Jungmittag*

The background and motivation of the paper I have to discuss is one of a situation in which, on the one hand, a dramatic increase of foreign direct investment flows can be observed since the end of the 80s, and, on the other hand, there is a flourishing scientific and public debate on whether a stronger international synchronisation of business cycles is emerging. These two phenomena give rise to the question whether the activities of multinational enterprises (MNE) might establish an independent additional channel for the transmission of economic fluctuations. More especially, Torge Middendorf and Nils A. Radmacher-Nottelmann ask whether the foreign affiliates of MNE transmit foreign business cycles into the respective home countries and approach this relevant research question by collecting presumptive evidence.

After discussing shortly the theoretically ambiguous impact of MNE on the transmission of business cycles, the authors initially investigate at a macro-economic level whether there is at all an increasing synchronisation of investment cycles. Then they examine at a micro-economic level (firm level) whether domestic and US growth rates of value added have a significant impact on the domestic investment activities of German MNE. In my comments I will follow this structure of the paper by first proposing that from a theoretical point of view international rent sharing within MNE can constitute a further direct channel for the transmission of business cycles. Then I will concentrate on a few remarks with regard to the empirical analyses at the macro- and micro-economic level which may eventually help to obtain more robust and meaningful econometric results.

1. International Rent Sharing as a Further Transmission Channel

Besides the transmission channels of business fluctuations discussed by Middendorf and Radmacher-Nottelmann, which might be influenced directly or indirectly by MNE, there might be a further direct channel with an impact not only on aggre-

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gated investment but on aggregated consumption too: international rent sharing within MNE. The basis idea of rent sharing – originally developed for national firms – is that on markets with imperfect competition firms share their profits with workers. This rent or profit sharing is a kind of risk sharing with the implication that profits and wages move together (cf. e.g. Blanchflower, Oswald and Sanfey, 1996). Budd and Slaughter (2002) as well as Budd, Konings and Slaughter (2002) carry over this idea to MNE because international flows of capital, labour, goods and information may have a strong impact on the nature of profit sharing between firms and workers. They show that maximisation over wages w and employment of the firm's utility function $v(\pi^p + \pi^a)$, where π denotes profits and superscripts p and a indicate parents and affiliate, subject to satisfying the minimum-utility constraints of its employees yields for risk averse firms and workers:

$$\frac{\partial w^p}{\partial \pi^a} = \frac{v''(\pi^p + \pi^a)}{\lambda^p u''(w^p)} > 0 \text{ and } \frac{\partial w^a}{\partial \pi^p} = \frac{v''(\pi^p + \pi^a)}{\lambda^a u''(w^a)} > 0 ,$$

where λ is the Lagrange multiplier and $u(\cdot)$ is the workers' utility function. The risk aversion of both the firm and workers imply that $v(\cdot)$ as well as $u(\cdot)$ are concave and the derivates are positive, i.e. parent (affiliate) wages respond to affiliate (parent) profits as a form of risk sharing. A further supposition for this result is that the firm's utility function $v(\cdot)$ is a non-separable function of π^p and π^a Budd, Konings and Slaughter (2002) also mention four other models predicting profit sharing:

(1) Union bargaining models in which unions take into account the company-wide ability to pay which include profits earned in other countries (cf. also Budd and Slaughter, 2002).

(2) Insider-outsider models, where insiders derive their power in negotiations from their ability to not cooperate with new employees if they do not participate in the company-wide profits.

(3) Models of fairness in which not sharing profits is considered to be unjust.

(4) Models of corporate strategy in which MNE share all profits to generate goodwill at all locations.

The approaches of rent sharing provide further interesting arguments for an increasing international co-movement of macro-economic aggregates und should be taken into consideration in the theoretical part of the paper of Middendorf and Radmacher-Nottelmann.

2. Remarks Concerning the Empirical Analysis at the Macro Level

In the empirical analysis at the macro level the authors computed correlation coefficients between growth rates of German investments and those of selected other countries over a moving window horizon of 40 quarters from 1980 until

2002. They find that the correlations of German investments with those of France, Italy and Japan increased considerably in the middle of the 80s, while the increase in correlations was smaller for the UK and became even negative for the US. However, they check in no way the statistical significance of their results. This is indeed a problematic task for the sample correlation coefficients used by the authors because their asymptotic distribution depends on the autocorrelation functions of both time series (cf. Pieró, 2002).

Generally, the asymptotic distribution of the contemporaneous cross-correlation between two independent time series Y_{1t} and Y_{2t} is given by

$$r_{12} \Rightarrow AN\left(0, T^{-1}\left(1 + 2\sum_{k=1}^{\infty} \rho_{11}(k)\rho_{22}(k)\right)\right) ,$$

where r_{12} is the sample correlation coefficient between Y_{1t} and Y_{2t}, AN denotes asymptotically normal, T is the sample size and $\rho_{ii}(k)$ is the autocorrelation of order k of $Y_{it}, i = 1, 2$. However, if both time series are white noise, the asymptotic distribution simplifies and becomes

$$r_{12} \Rightarrow AN\left(0, T^{-1}\right) .$$

Therefore, before computing correlation coefficients all investment series should be filtered by adequate AR(p) models to obtain reliable evidence about the significance of the synchronisation of the growth rates of investments.

3. Remarks Concerning the Empirical Analysis at the Micro Level

My remarks with regard to the empirical analysis at the micro level are divided in two parts. On the one hand, they concern some details of the analysis; on the other hand, they are more fundamental with regard to the chosen econometric model.

Beginning with the details, it can be asked, why the authors do not include firm specific fixed effects in their panel data models. Secondly, they used only growth rates of US value added as a measure of foreign business cycle fluctuations. Thus, the negative influence of US value added on firms domestic investment is not surprising if it is controlled for the firms with business activities in the US, because on the macro level there is a negative correlation between growth of investments in the US and other (e.g. EU-)countries during this period of time. It seems to be more appropriate to include a weighted average of the foreign growth rates of value added in the model, using the regional firm specific turnover shares as weights.

The reason for a more fundamental remark is the suspicion of the authors that the global cash flow has a strong positive impact on domestic investments of the

firm, so that this channel within the MNE could contribute to a transmission of business cycles. If this is the case, the coefficients in the investment function measure only the direct influences, while the indirect influences via the cash flow variable are not taken explicitly into consideration. In such a situation estimating a recursive two stage model would be a way out to identify the direct and indirect effects of foreign business cycle fluctuations. A simplified version of such a two stage model is:

$$INV_{it}^{P} = \alpha_0 + \alpha_1 LIQ_{it} + \alpha_2 VA_{it-1}^{P} + \alpha_3 VA_{it-1}^{a} + u_{it}$$
$$LIQ_{it} = \beta_0 + \beta_1 VA_{it-1}^{P} + \beta_2 VA_{it-1}^{a} + v_{it},$$

where INV_{it}^{p} is domestic investments, LIQ_{it} global cash flow related to revenues, and VA_{it-1}^{p} as well as VA_{it-1}^{a} denote growth rates of domestic and weighted foreign value added. Furthermore, u_{it} and v_{it} are the respective error terms. Due to the recursive structure of the model, the individual equations can be separately estimated by OLS. The coefficients in the second equation represent the indirect effects of the growth rates of domestic and foreign value added through their influence on the global cash flow of the firm. The coefficients in the first equation represent the direct effects of domestic and foreign value added over and about the indirect effects. Consequently, the total effect of foreign business fluctuations on domestic investments of the firm is

$$(\alpha_1\beta_1 + \alpha_3)VA_{it-1}^{a} \ .$$

Therefore, the single equation model used by the authors miss the importance of domestic and foreign business fluctuations which are only picked up in the cash flow equation.

Summary

Summing up, the paper of Middendorf and Radmacher-Nottelmann addresses a relevant question which will gain further importance with increasing globalisation. Because the authors are breaking new grounds the marginal returns of their research are indeed first large, but the results are also often preliminary. On the one hand, further research should investigate the macro-economic links empirically more comprehensively, e.g. the question whether countries that have comparatively intensive FDI relations exhibits a greater degree of output and investment co-movements, and whether these positive correlations become stronger over time (Jansen and Stokman, 2002). On the other hand, besides the already mentioned general refinement of the analysis at the micro level, the question of a multinational rent sharing should be tackled too, because it sets up an approach to analyse the international synchronisation of consumption.

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Abstracts in German

Wirtschaftspolitik im Zeichen neuer Formen des internationalen Konjunkturverbundes

Von Willi Koll

Die wirtschaftliche Entwicklung in den letzten Jahren in Deutschland hat gezeigt, dass der Außenhandel alleine nur ein sehr unvollständiges Bild der tatsächlichen Verbundenheit Deutschlands mit der Weltwirtschaft gibt. Steigende Direktinvestitionen global operierender Unternehmen, internationale Finanzmärkte, die immer enger ineinander greifen, und von internationalen Entwicklungen geleitete Zukunftserwartungen bei Investoren und Verbrauchern haben neue wirksame Übertragungskanäle entstehen lassen. Der Beitrag setzt sich kritisch mit der Frage auseinander, inwiefern der statistische Gleichlauf von Wachstumsraten als Maßstab für die tatsächliche Verflechtung der Weltwirtschaft geeignet ist. Er geht auf die veränderte Bedeutung der sogenannten „neuen" Übertragungsmechanismen ein und zeigt die sich daraus ergebenden Herausforderungen für die Wirtschaftspolitik auf.

Internationale Synchronisation der nationalen Konjunkturzyklen?

Von Gebhard Flaig, Jan-Egbert Sturm und Ulrich Woitek

Diese Studie untersucht, in welchem Ausmaß sich der internationale Konjunkturverbund zwischen den G7-Ländern im Laufe der letzten 50 Jahre geändert hat. Diese Fragestellung wird mit verschiedenen Methoden analysiert, um die Robustheit der Ergebnisse zu überprüfen. Das wichtigste Ergebnis ist, dass die Korrelation zwischen den nationalen Konjunkturzyklen bis Mitte der sechziger Jahre des letzten Jahrhunderts bemerkenswert hoch war, danach aber stark abnahm und teilweise sogar negativ wurde. Die Ölpreisschocks der siebziger Jahre führten wieder zu einer höheren Synchronisation. In den letzten beiden Jahrzehnten beobachten wir im allgemeinen einen relativ stabilen und hohen Zusammenhang zwischen den nationalen Konjunkturzyklen. Für Deutschland ist allerdings der Zusammenhang erst in den letzten Jahren wieder stark angestiegen.

Deutschland und der Europäische Konjunkturverbund – Analyse möglicher Kausalbeziehungen in einem Modell des internationalen Konjunkturzyklus

Von Ferdinand Fichtner

Die Studie analysiert die Bedeutung der deutschen Volkswirtschaft für die Existenz des so genannten Europäischen Konjunkturzyklus, d. h. für die regelmäßig beobachtete Synchronisierung der nationalen Konjunkturzyklen in Europa. Hierzu wird ein Dreiländer-Modell in der Tradition der Real-Business-Cycle-Klasse gemäß den Bedingungen in Europa kalibriert und zur Simulation von Impuls-Antwort-Funktionen verwandt. Dabei erweist sich das Modell als gut geeignet, die charakteristischen Eigenschaften empirisch ermittelter Impuls-Antwort-Funktionen zu replizieren. Gezielt wird die Bedeutung unterschiedlicher Übertragungsmechanismen im Gefolge eines Technologieschocks analysiert, der das deutsche BIP betrifft. Dabei wird deutlich, dass die handelsbedingte Transmission konjunktureller Schwankungen von nur geringer Bedeutung für die Synchronisierung nationaler Konjunkturzyklen ist. Hingegen zeigt sich, dass der Europäische Konjunkturzyklus zentral auf der Wirkung gleichzeitig erfahrener exogener Schocks und technologischer Spillover-Effekte beruht.

US Outlook und deutsche Geschäftsaussichten – wirkt das Vertrauen der Marktteilnehmer als Konjunktur-Koppelung?

Von Gustav-Adolf Horn

Ein neuer Mechanismus der internationalen Übertragung von Konjunkturschocks hat jüngst an Interesse gewonnen: der Vertrauens-Zusammenhang. Ziel dieses Papiers ist es herauszufinden, ob dieser Wirkungszusammenhang zwischen der US- und der deutschen Wirtschaft tatsächlich existiert. Dies wird durch Zeitreihen-Analysen untersucht. Anders als in anderen Studien werden hier der unmittelbare Informationsgehalt von US-Frühindikatoren für den ifo Index der (Produzenten-)Erwartungen und die Signifikanz asymmetrischer Reaktionen auf unterschiedliche Konjunkturschocks getestet. Die Ergebnisse belegen einen Zusammenhang, der während der 90-er Jahre sogar enger geworden ist. Die Asymmetrie-Hypothese muss jedoch zurückgewiesen werden.

Wechselwirkungen zwischen dem US-amerikanischen und dem deutschen Bruttoinlandsprodukt – Die Rolle der Aktienbörsen

Von Michael Schröder

Das Ziel der Studie ist es, die Zusammenhänge zwischen dem Bruttoinlandsprodukt (BIP) von USA und Deutschland zu quantifizieren und speziell die Rolle von Aktienmärkten bei der Übertragung von konjunkturellen Schocks zu untersuchen. Es wird dabei versucht, einen möglichen kausalen Einfluß des Aktienmarktes von den in den Aktienkursen enthaltenen Erwartungen über die zukünftige Wirtschaftsentwicklung zu isolieren. Dies geschieht durch die Hinzunahme von Vertrauensindikatoren, die die Erwartungskomponente der Aktienkurse abbilden sollen. Als methodische Basis dient ein Vector Error Correction Modell (VECM). Die Ergebnisse zeigen, dass die Aktienmärkte einen Einfluss auf das zukünftige BIP ausüben, der über die Prognosekraft der Vertrauensindikatoren hinaus geht. Dies ist ein Hinweis auf eine mögliche kausale Wirkung von Aktienkursen auf das BIP.

Zur internationalen Übertragung monetärer Impulse

Von Annette Kuhn

Diese Studie untersucht die internationale Übertragung monetärer Impulse. Zunächst werden in einem ersten Schritt die theoretischen Prognosen des traditionellen Mundell-Fleming-Modells mit denen des mikroökonomisch fundierten Obstfeld-Rogoff-Modells verglichen. Im Folgenden wird anhand eines Vektorautoregressionsmodells (VAR) empirisch untersucht, ob zwei Länder symmetrische oder asymmetrische Reaktionen der Produktion nach einer Zinsanhebung in einem der Länder aufweisen. Diese Untersuchung wird für zwei Ländergruppen durchgeführt. Eine mit flexiblen Wechselkursen (Japan und Deutschland gegenüber den Vereinigten Staaten) und eine mit festen Wechselkursen (die Niederlande und Österreich gegenüber Deutschland). Die empirischen Ergebnisse legen nahe, dass die Verlagerung der Ausgaben hin zu ausländischen Gütern aufgrund von Wechselkursbewegungen eine vernachlässigbare Rolle spielen. Die Produktion sinkt in beiden Ländern als Reaktion auf eine Zinsanhebung in einem der Länder, da auch der Zinssatz im Ausland angehoben wird. Dies gilt sowohl in dem System von festen als auch in dem System von flexiblen Wechselkursen.

Konjunkturübertragung durch Multinationale Unternehmen – Makroökonomische Evidenz und mikroökonomische Fundierung

Von Torge Middendorf und Nils A. Radmacher-Nottelmann

Angesichts der zunehmenden Verflechtungen multinationaler Unternehmen (MNU) stellt sich die Frage, inwieweit diese zu einer Synchronisation nationaler Konjunkturzyklen beitragen. Theoretisch ist sowohl eine stärkere als auch eine schwächere Transmission von Konjunkturschwankungen möglich. Die Studie untersucht diese Frage daher empirisch, wobei zunächst auf makroökonomischer Ebene tatsächlich eine gestiegene Korrelation des Investitionsverhaltens einzelner Länder erkennbar ist. Die weitere Analyse anhand von Firmendaten zeigt allerdings nur schwache Hinweise darauf, dass MNUs die Synchronisation von Konjunkturzyklen beeinflussen. Wenn überhaupt sprechen die Ergebnisse eher für eine schwächere Abhängigkeit des Investitionsverhaltens multinationaler Unternehmen von der heimischen Konjunktur und damit für eine Dämpfung des Zyklus.

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