Oesterreichische Nationalbank

Eurosystem

Working Paper 137

Transmission of Business Cycle Shocks between Unequal Neighbours: Germany and Austria

Gerhard Fenz and Martin Schneider

Stability and Security.

Statement of Purpose

The Working Paper series of the Oesterreichische Nationalbank is designed to disseminate and to provide a platform for discussion of either work of the staff of the OeNB economists or outside contributors on topics which are of special interest to the OeNB. To ensure the high quality of their content, the contributions are subjected to an international refereeing process. The opinions are strictly those of the authors and do in no way commit the OeNB.

Imprint: Responsibility according to Austrian media law: Guenther Thonabauer, Secretariat of the Board of Executive Directors, Oesterreichische Nationalbank

Published and printed by Oesterreichische Nationalbank, Wien.

The Working Papers are also available on our website (http://www.oenb.at) and they are indexed in RePEc (http://repec.org/).

Editorial

This paper analyses the comovement of the German and Austrian economies and the transmission of German shocks to Austria. Static and dynamic correlation measures show a strong comovement and a change of the relative position in time of these two economies. The transmission of German shocks to Austria is analysed with a two-country VAR model. Using sign restrictions on impulse response functions, the authors identify German supply, demand and monetary policy shocks. They find that the average reaction of the Austrian economy to German shocks amounts to 44% of the German reaction and remains broadly stable over time.

May 14, 2007

Transmission of business cycle shocks between unequal neighbours: Germany and Austria

Gerhard Fenz and Martin Schneider[1]

Oesterreichische Nationalbank

Abstract

This paper analyses the comovement of the German and Austrian economies and the transmission of German shocks to Austria. Static and dynamic correlation measures show a strong comovement and a change of the relative position in time of these two economies. The transmission of German shocks to Austria is analysed with a two-country VAR model. Using sign restrictions on impulse response functions, we identify German supply, demand and monetary policy shocks. We find that the average reaction of the Austrian economy to German shocks amounts to 44% of the German reaction and remains broadly stable over time.

JEL classification: C32, E32, F41
Keywords: business cycle, synchronization, vector autoregression, shock transmission, Austria, Germany.

[1] We would like to thank an anonymous referee, Sylvia Kaufmann, Hans Scharler, Thomas Url and participants of the DIW Macroeconometric Workshop in Berlin in December 2006 for very helpful comments and discussions.

1. Introduction

Linkages between Austria and Germany are manifold. Both countries share a common border, a common language, similar institutional settings and last but not least a tempestuous common history. All these similarities have led to strong economic ties between Austria and its largest neighbour. One third of Austrian exports are going to Germany and 40% of its imports are coming from Germany. The German share in inward foreign direct investment reaches 40%. Since the early 1980's, the exchange rate between the Austrian Schilling and the German Mark is de facto fixed. In absolute terms (i.e. in percent of GDP) the trade and financial links have steadily increased over the past decades. But since the opening up of Eastern Europe und the surge of Austrian trade volumes and foreign direct investments in this region the importance of Germany declined in relative terms (i.e. in % of total exports/FDIs). Also in the area of monetary policy - with the advent of European Monetary Union - the exclusive focus on Germany was given way to a broader European perspective. Against this background, one could expect that the Austrian economy is nowadays less exposed to German business cycles fluctuations than before.

Several aspects of the business cycle links between Germany and Austria have been analysed so far. Brandner and Neusser (1992) determine the static correlation between different macroeconomic variables. They find high contemporaneous correlation for GDP and investment but only small correlation for private consumption. Winckler (1993) emphasizes that the strikingly high comovement of the two economies is mainly the result of Austria's policy orientation towards Germany. Against the background of a constant bilateral exchange rate social partners in Austria closely followed German developments in the wage bargaining process in order to preserve Austria's price competitiveness. Hochreiter and Winckler (1995) identify sector-specific shocks for the period 1973 to 1989 and find no evidence for an increase of symmetry between the two countries. Cheung and Westermann (1999) study the economic relations between Germany and Austria using an error correction model and find a stable long-run relationship for industrial production. Moreover, changes in German industrial production Granger cause changes in the Austrian industrial production but not vice versa. Finally, the International Monetary Fund (Epstein and Tzanninis, 2005) analyses the economic linkages between Germany and Austria and finds a marginal decrease of the static correlation between German and Austrian GDP over the last ten years.

We contribute to that literature in basically two aspects. *First* we analyse the business cycle synchronisation between Germany and Austria and its changes over time using static and dynamic correlation measures. *Second*, we identify German supply, demand and monetary shocks and analyze their transmission to Austria within a two-country VAR model. To identify these shocks, we apply the identification scheme proposed by Canova (2005)[2] and use sign restrictions on the impulse responses.

The paper is organized as follows. Section 2 gives a brief overview over the economic links between Austria and Germany. The degree of comovement is analysed in section 3. In section 4 structural shocks for Germany are identified and the transmission of these shocks to the Austrian economy is determined. We summarize the results in section 5 and draw some conclusions.

[2] Similar identification schemes have been applied amongst others by Faust (1998), Uhlig (2005) and Canova and de Nicoló (2003).

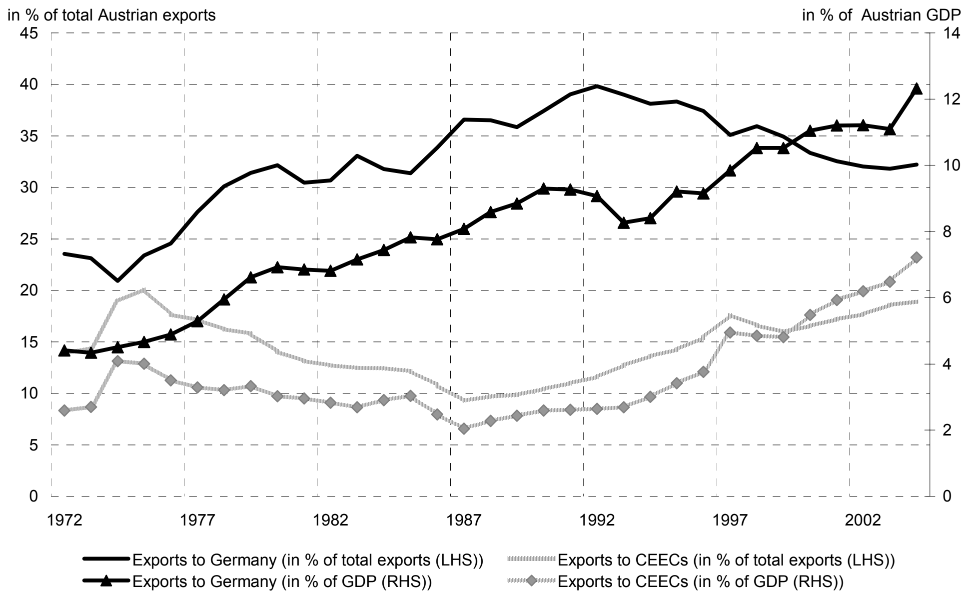
2. Economic linkages between Austria and Germany

Intensive links characterise the economic relations between Austria and its largest trading partner Germany. Whilst trade has always played an important role, financial integration became a strong growing link since the full liberalization of the capital account in Austria at the end of the 1980s. In addition, monetary policy plays an important role in synchronizing the movements of the two economies.[3]

Trade: internationalization of production increases trade intensity

The development of Austria's exports over the last decades was characterized by three main trends: an overall strong increase of trade volumes, a surge in intra-industrial trade and a shift in the regional composition. Following a global trend, trade volumes increased markedly over the last decades. In the period from 1972 to 2005 exports grew almost twice as fast as output. Especially trade in goods showed a very dynamic development. The trade share (sum of total exports and imports in percent of GDP) increased from less than 60% to almost 100%. Besides global developments like the decrease in transport and communication costs and the removal of trade barriers, the accession of Austria to the European Union and the European Monetary Union and the emergence of new markets in Central and Eastern Europe have played a major role.

Figure 1: Austrian exports of commodities to Germany and the CEECs[4].



Source: Statistik Austria.

Germany is by far Austria's most important trading partner and – in absolute terms - became more and more important over time. Exports of commodities to Germany in percent of Austrian GDP increased steadily from 4% in 1972 to 12% in 2004 (see figure 1). In relative terms, we see substantial changes of the importance of Germany over time. The share of

---

[3] Theoretically a common monetary policy can also lead to looser linkages, since countries can no longer respond to country specific shocks using monetary policy instruments.

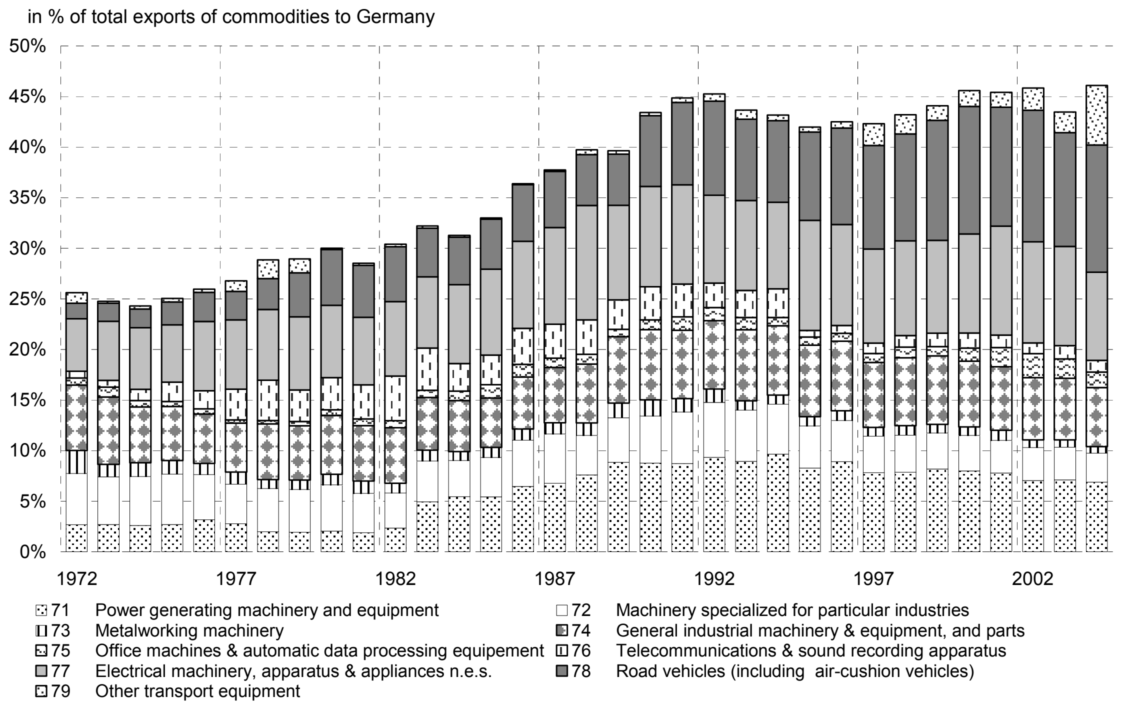
[4] CEECs includes Albania, Bulgaria, Croatia, Czech Republic, Slovakia, Poland, Romania, Hungary, Estonia, Latvia, Lithuania, Macedonia, Slovenia, Bosnia-Herzegovina, Russia, Ukraine, Belarus.

exports to Germany in total exports increased steadily from 21% in 1974 until it peaked at 40% in 1992. Since then - contrary to the absolute role - the relative role of exports to Germany is declining.

The development of the export share of the CEECs mirrors this picture. Since the mid 70ies the share of exports to the CEECs shows a U-shaped profile. The declining role in relative as well as in absolute terms in the second half of the 1970s and in the 1980s is a consequence of Austria's policy towards integration into the European Union and the increased indebtedness of the CEECs. Since the opening up of Eastern Europe, the share of the CEECs in total Austrian exports is steadily increasing at the expense of Germany.

The surge in total trade volumes is also associated with the trend to intra-industrial trade and the phenomenon of vertical integration. According to the Grubel-Lloyd-index, the share of intra-industrial trade with Germany increased from 47% in 1972 to 79% in 2004[5]. A high degree of intra-industrial trade is characteristic for developed economies with similar production structures and economies of scale in the production and leads to an increase in the synchronisation of business cycles.

Figure 2: Composition of Austrian exports of machinery and transport equipment (SITC 7) to Germany



Source: OECD - OLIS database.

At the same time, the phenomenon of vertical integration as reflected by the emergence of cross-border production-chains gained importance. Hummels, Ishii and Yi (2001) show for a panel of 14 OECD countries that since the 70ies vertical integration accounts for 30% of export growth. Moreover, sectors that experienced the strongest export growth are those with a high degree of vertical integration. In the economic relations between Germany and Austria

[5] The Grubel-Lloyd-Index measures the share of intra-industrial trade (IIT) as: $IIH = 1 - \sum_i |X_i - M_i| / \sum_i (X_i + M_i)$, where X_i und M_i denote the exports and imports of commodities of sector i. The Grubel-Lloyd-Index is reported for two-digit SITC-commodities.

the dynamic development of the Austrian automotive supply industry is a prominent example. The sharp rise of the share of machinery and transport equipment in total exports from 26% in 1972 to 46% in 2004 and of the subcomponent road vehicles from 2% to 13% reflects that fact (see figure 2).

Foreign Direct Investment: steady growth of outward FDI to CEECs.

Financial integration developed even more dynamically than trade integration over the last 15 years. A detailed and comprehensive regional breakdown of international capital flows from and to Austria from 1990 onwards - the period of a fully liberalized capital account in Austria - is only available for foreign direct investments. Stocks of total inward and outward FDIs increased from 3% respectively 7% of GDP in 1990 to more than 20% each in 2003 (see table 1). Germany plays a dominating role in inward FDIs with a stable share of around 40%. Outward FDI is dominated by investment in the CEECs which grew very rapidly in recent years. Inward and outward portfolio investment grew at a similar pace as FDI.

Table 1: Stocks of Austrian foreign direct investment

	1990	1995	2000	2003
in % of total inward (outward) FDI				
Inward from Germany	38.2	41.9	46.8	39.9
Outward to Germany	24.4	19.4	19.0	16.1
Inward from CEECs	1.3	1.4	1.1	1.5
Outward to CEECs	11.0	28.0	30.1	36.8
in % of Austrian GDP				
Inward from Germany	2.7	3.8	8.1	8.4
Outward to Germany	0.7	1.1	2.7	3.5
Inward from CEECs	0.1	0.1	0.2	0.3
Outward to CEECs	0.3	1.5	4.3	8.1
Total FDI (mill. EUR)				
Total outward FDI (mill. EUR)	3,683	8,674	26,674	44,308
Total outward FDI (in % of GDP)	3,0	505	1402	21,9
Total inward FDI (mill. EUR)	8,513	14,458	32,704	42,632
Total inward FDI (in % of GDP)	7,0	9,2	17,4	21,1

Source: OeNB.

Monetary policy: the de facto peg of the Austrian Schilling to the German Mark

Germany traditionally played an "anchor role" for the implementation of economic policy in Austria. The most prominent examples were the hard-currency approach ("Hartwährungspolitik") and the orientation of the Austrian monetary policy towards Germany. The hard-currency approached evolved during the mid and the second half of the seventies. It aimed at stabilizing the exchange rate of the Schilling to the German Mark. The purpose was to fight inflationary pressures caused by the first oil price shock and to enforce structural changes by putting pressure on profit margins.

3. Comovement between Germany and Austria

A global phenomenon of business cycles over the last decades is their decrease in volatility. According to Stock and Watson (2003a) output fluctuations in developed countries declined on average by one third over the past 30 years. More than half of the decline in volatility is due to smaller global macroeconomic shocks and therefore potentially only of a temporary nature.[6] A second striking feature of the development of business cycles is that the degree of comovement among developed economies evolved remarkable stable over the past decades.[7] Given smaller international shocks, it is surprising that the correlation of output fluctuations is not decreasing. This indicates that the strength of the transmission mechanism of shocks has become stronger in the course of globalization.[8]

In this section we analyse the comovement between the Austrian and the German economy and its change over time in the period 1972Q1 to 2005Q3. We employ a variety of different measures, which we compute for two subsamples (1972Q1 to 1989Q4 and 1990Q1 to 2005Q3) as well as for ten-year rolling windows. The break point between the two subsamples can be justified by the historical event of the fall of the iron curtain.

A visual inspection of annual GDP growth rates for the period 1972Q1 to 2005Q3 for Germany, Austria and the US – which are used as a proxy for the international environment throughout the paper – shows some comovement of all three series (see figure 3). The comovement was strongest at the beginning of the first subsample - which starts right after the breakdown of the Bretton Woods system - when all three economies were hit by common global shocks. It includes the first and second oil price shock in 1974 and 1979 and the global recession at the beginning of the eighties. In Austria the first subsample was characterized by the adoption of a hard currency policy coupled with Keynesian deficit spending ("Austrokeynesianismus"). At the beginning of the second subsample the economic effects of German reunification caused major discrepancies in the growth pattern of Germany and Austria on the one and the US on the other side. From 1992 onwards, the US economy clearly outperformed Germany and Austria. Finally, the global recession in 2001 marks the beginning of a period of weak growth in all three countries that lasted longest in Germany.

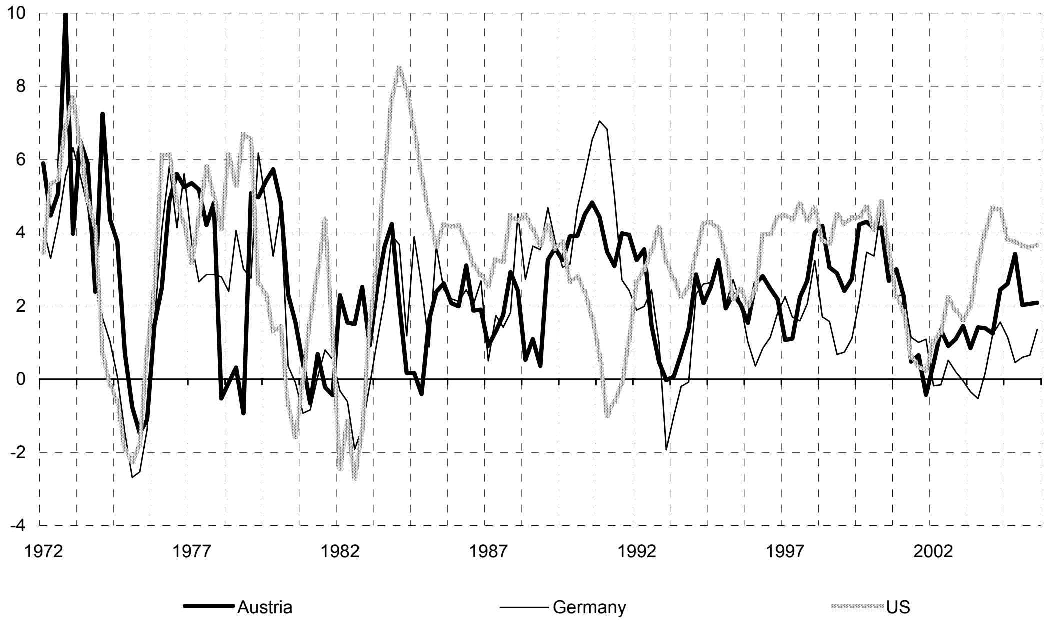
---

[6] See also Dalsgaard, Elmeskov and Park (2002), Monfort et al. (2003) and Helbling and Bayoumi (2003).

[7] See also Helbling and Bayoumi (2003), Kose (2004), Kose, Prasad, and Terrones (2003, 2004), Bordo and Helbling (2003), Heathcote and Perri (2003), Stock and Watson (2003a, 2003b)).

[8] See Kose (2004) for a compact review of the literature.

Figure 3: GDP growth in the US, Germany and Austria (changes to previous year in %)



Source: Statistik Austria, Bureau of Economic Analysis, Eurostat.

Measures of comovement

We use six different measures of bivariate comovement between Austrian, German and US GDP growth rates. Our first measure is the static *contemporaneous correlation coefficient*. Besides the strength of the contemporaneous comovement, we are interested in the lead/lag relationship between the two economies. Therefore we look at the *maximum correlation at different leads and lags* (measure two). This gives us a first hint of the relative position of the series in time.

The static correlation measures in the time domain can be supported by frequency domain analysis. With the help of spectral analysis, we are able to describe the comovement of two variables for different frequencies. Our main interest lays in business cycle frequencies ($\pi/16$ to $\pi/4$, i.e. frequencies with duration between 6 and 32 quarters). We look at the *dynamic correlation* (measure three), which describes the strength of the comovement at certain frequencies disregarding their relative position in time. The *delay* (measure four) tells us by how many periods one series leads or lags the other series. The details of these spectral measures can be found in appendix A.

Next we address the question whether one GDP series is helpful for forecasting another GDP series. Therefore we conduct simple Granger causality tests as presented by Hamilton (1994) for one lag. The null hypothesis is that y does not Granger-cause x. We present the *p-value* of the Granger causality test (measure five). A p-value smaller than the critical value implies that y does Granger-cause x.

Finally we report the *concordance index* (measure six) proposed by Harding and Pagan (2002). It describes the fraction of time in which two economies are in the same phase of their business cycles. It uses a binary variable $s_{x,t}$ ($s_{y,t}$) that takes the value 1 if x (y) is in an expansion phase (defined as the time between trough and peak) and 0 otherwise. The concordance index c_{xy} is defined as:

$$c_{xy} = \frac{1}{T}\sum_{t=1}^{T}\left[s_{x,t}s_{y,t} + (1-s_{x,t})(1-s_{y,t}) \right].$$

c_{xy} equals 1 if x and y are always in the same phase of their business cycle and 0 if they are always in opposite phases. If c_{xy} equals 0.5 then the two series do not show a systematic comovement of their business cycles. In order to compute this measure, we need to identify business cycle turning points. We use the growth cycle turning points published by the Economic Cycle Research Institute (ECRI, 2006; see table A-1).

Results

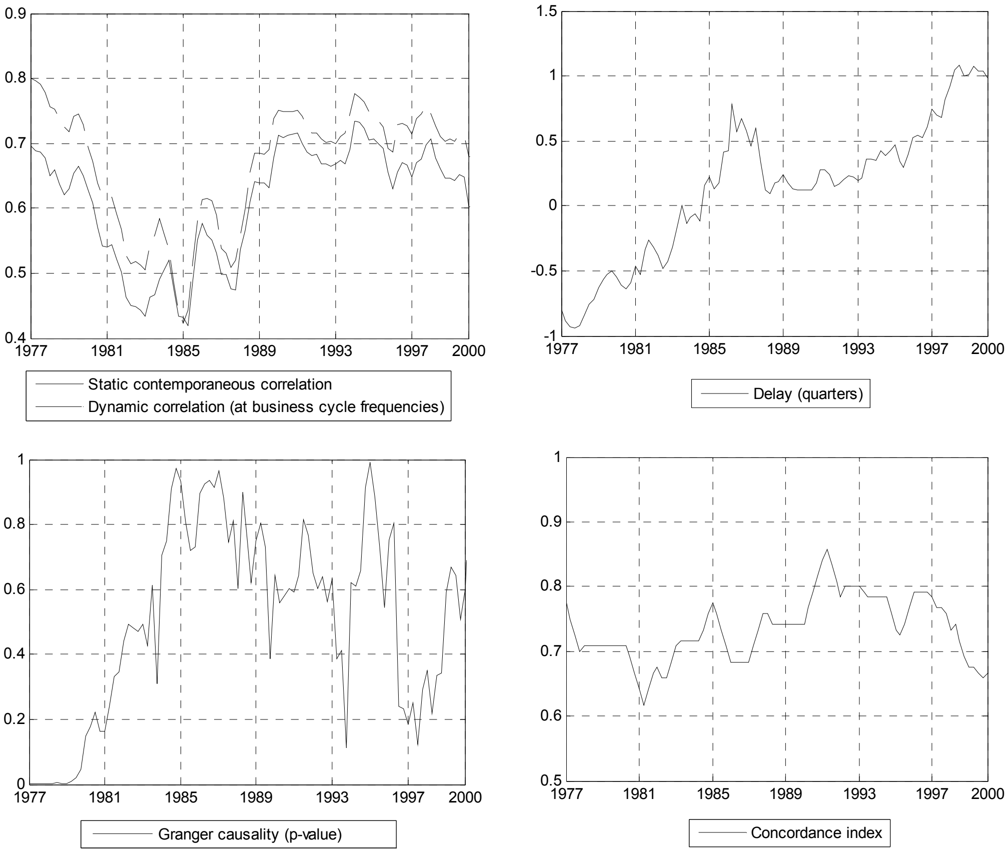
Figure 4 presents five of the six different measures of bivariate comovement between Austria and its main trading partner Germany. Each measure is computed for 10-years rolling windows. The years refer to the centre of the rolling windows.

Our first main finding is that the Austrian economy exhibits a strong and stable comovement with Germany as measured by the static correlation coefficient. After strong comovement in the 1970s driven by the oil price shocks the comovement weakened somewhat in the 80s and became stronger from the beginning of the 90s onwards. The dynamic correlation coefficient (which measures the strength of the comovement disregarding the relative position of the two series) for business cycle frequencies shows a very similar development[9].

What has changed is the relative position of the two economies in time. Whilst the Austrian economy was lagging behind the German economy until the mid of the 80s, the Austrian business cycle is now leading the German one. According to the average delay at business cycle frequencies, Austrian GDP was lagging behind German GDP by 1 quarter in the 70s and is now leading by the same amount of time. Overall, the relative cyclical position of Austrian GDP relative to Germany has moved by 2 quarters. Looking at the two subsamples, we see an average lag of 0.75 quarters for the period 1972-1989 and an average lead of 0.63 quarters for the period 1990-2005 (see table 2).

[9] Note that these two measures coincide for phases where the two economies move contemporaneously.

Figure 4: Comovement between German and Austrian GDP growth rates between 1972 and 2005 (40 quarters rolling windows, centred [a)]



a) The years refer to the centre of the 10-year window.
Source: The author's own calculations.

However, this result does not justify the conclusion that Austria's business cycle has become decoupled from its German counterpart. One reason for Austria's increasing lead may be the dramatic increase in the significance of the automotive supply industry as an upstream stage of production. Looking at maximum correlations at different leads/lags, we get a similar – albeit less precise – result.The two GDP series moved contemporaneously in the period 1972-1989. From 1990 to 2005, the maximum correlation is found at a lead of the Austrian economy of one quarter. The results from the Granger causality test confirm our hitherto results. Whilst German GDP had predictive power for Austrian GDP until the beginning of the 80s, the change in the relative position in time has caused the Granger causality to vanish. On the other hand, Austrian GDP does Granger-cause German GDP in the second subsample but not in the first one. The concordance index shows that the two series are in the same phase of their business cycle for 73% of the periods.

Table 2: Comovement between the Austrian and the German economy between 1972 and 2005 (annual growth rates of real GDP)

	Static correlation			Dynamic correlation 2)	Delay 3)	Granger causality 4)		Concordance 5)
	Contemp.	Maximum1)			(quarters)	AT→GE	GE→AT	
1972-2005	0.62	0.62	(0)	0.68	-0.43	0.25	0.00	0.73
1972-1989	0.60	0.60	(0)	0.66	-0.75	0.82	0.01	0.75
1990-2005	0.72	0.75	(1)	0.76	0.63	0.00	0.80	0.70

1) Numbers in brackets refer to lead (+) resp. lag (-1) (both in quarters) of Austria relative to Germany, at which the maximum correlation can be obtained
2) At business cycle frequencies (i.e. 6 to 32 quarters)
3) +(-): Austria leads (lags) Germany
4) first column: H0: Austria does not Granger-cause Germany
second column: H0: Germany does not Granger-cause Austria
5) Defined as fraction of time that both economies are in the same phase of their business cycles (available until Dec. 2004)

Source: The author's own calculations.

Summing up these results, we find a strong and stable comovement between Austria and Germany. The relative position in time has changed, with the Austrian business cycle now leading the German one.

4. Transmission of German shocks to Austria

The transmission of German shocks to Austria and its change over time is analysed in a two-country VAR model including Germany and Austria. The identification of the shocks and the analysis of their transmission to other countries follow Canova (2005) and is done in two steps.[10] First the German block of the VAR is estimated and three different German shocks (demand, supply and monetary policy) are identified. Second, the impact of these shocks on the Austrian economy is determined. While the identification of the German shocks is done for the whole sample from 1972Q1 to 2005Q3, the transmission of these shocks is analysed separately for two subsamples (1972Q1-1989Q4, 1990Q1-2005Q3) to highlight possible changes in the transmission mechanism over time. Since the number of observations at hand for each sub sample is limited, we decided not to include third countries or regions in the VAR as endogenous variables thereby assuming that any feedbacks between Germany and Austria that work via third countries are negligible. Moreover, given the fact that the German economy is about ten times as large as the Austrian economy, we assume that no transmission from Austria to Germany takes place.

The VAR model

The VAR model consists of three endogenous variables in each country block: real GDP as a measure of real activity, the CPI as a measure of inflation, and short term interest rates (three month money market rate) as a proxy for monetary policy. Additionally, two exogenous variables enter the VAR: US GDP and the HWWA index of raw material prices as proxies for the international environment. Since the focus of the paper is on short-term effects of German idiosyncratic shocks on GDP growth in Austria we opted to use only stationary variables in the VAR. The possible loss of information concerning long run relations by not using levels in the VAR is more than offset by the reduced risk of spurious regressions. Since statistical tests indicate that price indices are I(2) and real GDP and short term nominal

[10] See also similar studies by Faust (1998), Uhlig (2005), Peersman (2005) and Canova and de Nicoló (2003).

interest rates are I(1), we decided to use second differences of price indices and first differences of real GDP and short term nominal interest rates. Given the exogeneity of the German block with respect to the Austrian variables, the corresponding reduced form two-country model is given by:

$$\begin{bmatrix} x_t^{AT} \\ x_t^{GE} \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ 0 & A_{22}(L) \end{bmatrix} \begin{bmatrix} x_{t-1}^{AT} \\ x_{t-1}^{GE} \end{bmatrix} + \begin{bmatrix} B_{11}(L) \\ B_{12}(L) \end{bmatrix} y_t + \begin{bmatrix} \varepsilon_t^{AT} \\ \varepsilon_t^{GE} \end{bmatrix} \qquad \textbf{(1)}$$

where $\left(\varepsilon_t^{AT}, \varepsilon_t^{GE}\right) \sim (0, \Sigma), \Sigma = blockdiag(\Sigma_{\varepsilon^{AT}}, \Sigma_{\varepsilon^{GE}})$. x_t^{AT} represents the set of Austrian variables, x_t^{DE} the set of German variables and y_t the world variables. The underlying structural model is given by:

$$\begin{bmatrix} C_{11} & C_{12} \\ 0 & C_{22} \end{bmatrix} \begin{bmatrix} x_t^{AT} \\ y_t^{GE} \end{bmatrix} = \begin{bmatrix} G_{11}(L) & G_{12}(L) \\ 0 & G_{22}(L) \end{bmatrix} \begin{bmatrix} x_{t-1}^{AT} \\ x_{t-1}^{GE} \end{bmatrix} + \begin{bmatrix} H_1(L) \\ H_2(L) \end{bmatrix} y_t + \begin{bmatrix} u_t^{AT} \\ u_t^{GE} \end{bmatrix} \qquad (2)$$

where $\left(u_t^{AT}, u_t^{GE}\right)' \sim (0, I)$ and u_t^{GE} is the vector of German structural disturbances. According to the Akaike information criteria, a lag length of one was selected.

Identification scheme

We use the identification scheme of Canova (2005) to derive structural shocks from the VAR innovations. The basic idea behind that approach is to use sign restrictions on the cross-correlation of the impulse responses to identify economically interpretable shocks. Instead of imposing restrictions on the contemporaneous relations between the innovations, we systematically search among a large number of admissible decompositions of the VAR innovations and choose these decompositions which are in line with our restrictions on the impulse responses[11].

To be more specific, we start with the VAR innovations $\varepsilon_t^{GE} \sim (0, \Sigma_{\varepsilon^{GE}})$. To identify uncorrelated structural shocks from the correlated innovations, we begin by orthogonalizing the variance covariance matrix of the innovations of the German VAR ($\Sigma_{\varepsilon^{GE}}$) by means of static principal components. Using a standard eigenvalue-eigenvector decomposition gives $\Sigma_{\varepsilon^{GE}} = VDV'$, where V is the matrix of eigenvectors and D a diagonal matrix of eigenvalues. Setting $P = VD^{1/2}$ we can rewrite $\Sigma_{\varepsilon^{GE}} = PP'$ and transform the German block of the VAR in equation (1) to

[11] Compared to alternative identification schemes (Cholesky decomposition, short run restrictions (Sims, 1980), long-rung restrictions (Blanchard and Quah, 1989) and the generalised impulse response function (Pesaran and Shin, 1998) the one proposed by Canova (2005) has two main advantages. First, the statistical problem of orthogonalization is strictly separated from identification, which helps to make all assumptions needed for identification very explicit. Second, no zero restrictions on either the short-run or the long-run impulse responses are needed. These are often inconsistent with a large class of theoretical models (Canova and Piña, 2001).

$$\tilde{x}_t^{GE} = A_{22}(L)\tilde{x}_{t-1}^{GE} + B_{12}\tilde{y}_t + \tilde{\varepsilon}_t^{GE}, \tag{3}$$

where $\tilde{x}_t^{GE} \equiv P^{-1}x_t^{GE}$, $\tilde{y}_t \equiv P^{-1}y_t$, $\tilde{\varepsilon}_t^{GE} \equiv P^{-1}\varepsilon_t^{GE}$, $\tilde{\varepsilon}_t^{GE} \sim (0, I)$.

This transformation guarantees that the transformed residuals are orthonormal. However, the orthogonalization is by no means unique. To see this, notice that for any orthonormal matrix $Q : QQ' = I$, $\Sigma_{\varepsilon^{GE}} = \tilde{P}\tilde{P}' = PQQ'P'$ is an admissible decomposition. Thus, we can construct a set of admissible decompositions by using different orthonormal matrices *Q*. Within the class of orthonormal matrices, rotation matrices are a reasonable candidate to consider. They allow us to cover the whole space of *Q* matrices in a straightforward way. Rotation matrices use sine and cosine functions to rotate the orthogonalized residuals. In a VAR system with *N* variables there are *N(N-1)/2* rotation axes. The German block of the VAR has three endogenous variables which gives us three rotation axes $\theta_i, i = 1,2,3$. The alternative *Q* matrices thus take the form

$$Q(\theta_1, \theta_2\theta_3) = \begin{pmatrix} \cos(\theta_1) & -\sin(\theta_1) & 0 \\ \sin(\theta_1) & \cos(\theta_1) & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \cos(\theta_2) & 0 & -\sin(\theta_2) \\ 0 & 1 & 0 \\ \sin(\theta_2) & 0 & \cos(\theta_2) \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos(\theta_3) & -\sin(\theta_3) \\ 0 & \sin(\theta_3) & \cos(\theta_3) \end{pmatrix}. \tag{4}$$

One can easily verify that $QQ' = I$ holds for any value of $\theta_i \in (0, 2\pi), i = 1,2,3$. Thus there is an infinite number of candidates for the decomposition. To transform this problem into a finite one we vary the rotation angels on a grid. We choose a grid size of 15 which results in 15^3=3375 admissible decompositions.

Identification restrictions

The next step is to identify decompositions with a meaningful economic interpretation. Following Canova (2005) we rotate the orthogonalized disturbances and impose sign restrictions on the cross-correlation of the impulse responses. These sign restrictions are derived from economic theory.

We aim to identify three structural shocks - a demand shock, a supply shock and a monetary policy shock. Standard macroeconomic theory provides us with results for the signs of the theoretical co-movement of the three variables of the German VAR in response to the three structural shocks. A positive demand shock will generate a positive response of output and a rise in inflation. Monetary authorities will increase interest rates thereby generating a positive co-movement between all three variables. Contrary, a positive supply shock will increase output but decrease prices. The decreasing price pressure will lead to a loosening of monetary policy. Therefore, the co-movement between output and inflation on the one hand and output and interest rates on the other hand will be negative while the one between inflation and interest rates will be positive[12]. Finally, a positive monetary policy shock is associated with lower short-term interest rates. The expansionary impulse will cause output and inflation to increase simultaneously while the co-movement between short term interest rates and output, and short term interest rates and inflation is negative. Thus, the three structural shocks are characterized by co-movements between output, inflation and short term interest rates with different signs. These sign restrictions can be derived from a large set of

[12] Farrant and Peersman (2006) emphasize that in case of a supply shock the effect on interest rates remains theoretically ambiguous. However, dropping the sign restriction on the comovement between GDP and interest rates on the one hand and inflation and interest rates on the other hand did not change our empirical results.

theoretical models. They are consistent with the standard textbook aggregate-demand aggregate-supply framework as well as with more advanced models like DSGE models in the line of Smets and Wouters (2003).

Table 3: Identification scheme for German shocks

Structural shocks	Sign of co-movement of variables after a structural shock		
	GDP - Inflation	GDP-Interest rates	Inflation – Interest rates
Demand	Positive	Positive	Positive
Supply	Negative	Negative	Positive
Monetary policy	Positive	Negative	Negative

Source: Canova (2005).

For each of the 3375 decompositions, we check whether the impulse responses match the theoretical restrictions outlined in table 3. To this end we calculate the cross correlation of the impulse response functions for all three pair of variables for all shocks with the moving average representation $\tilde{x}_t^{GE} \equiv C(L)\tilde{\varepsilon}_t^{GE}$ with $C(L) = \{c^{ij}(L)\} = (I - A_{22}(L)L)^{-1}$.

Then the pairwise cross correlation conditional on the orthogonalized shock k is given by

$$\rho_{ij|k}(r) = corr(\tilde{x}_{it}, \tilde{x}_{jt+r} \mid \tilde{\varepsilon}_k) = \frac{(C^i(L)\tilde{\varepsilon}_k)(C^j(L+r)\tilde{\varepsilon}_k)}{\sqrt{(C^i(L)\tilde{\varepsilon}_k)^2(C^j(L+r)\tilde{\varepsilon}_k)^2}},$$

where r denotes the horizon of the response. We drop all decompositions where the contemporaneous impulse responses (r=0) are inconsistent with at least one of the sign restrictions. If the identification is not unique, we increase r until we find either a unique or no valid decomposition. In the first case we are done. In the second case, we use some more informal identification criteria to choose among the valid rotations at horizon *r-1*. We check the plausibility of the size and the shape of the impulse responses and look whether the resulting three orthogonal German shock series look plausible and capture the main historical facts of the German economy in the period under investigation.

Characterisation of German structural shocks

For the identification of German structural shocks we found r≤ 2 (two quarters) to be optimal. The shock series (see figure A-2 in the appendix) look reasonable and seem to capture the main historical episodes of the German economy since 1972. To characterize the relative importance of individual shocks we use the forecast error variance decomposition (FEVD). According to the FEVD demand shocks play a dominant role in explaining German GDP fluctuations. 50% of the 1 quarter ahead forecast error variance in GDP and 54% at a forecast horizon of 20 quarters are explained by demand shocks (see table 4). At short forecast horizons, the supply shock is equally important but its importance diminishes from 50% (one quarter) to 38% (20 quarters). Monetary policy shocks account for an almost negligible part (less than 10%) of output variations, which is consistent with other empirical findings (Christiano, Eichenbaum and Evans, 1999)[13]. Similarly, the role of monetary policy shocks in explaining variations in inflation is almost negligible. Only 4% of the variations in inflation are due to monetary policy shocks while supply shocks account for almost 2/3 and demand shocks for 1/3. On the other hand monetary policy shocks account for most of the short-run variance of interest rates (76%). However, this share declines with the forecast

[13] The fact that monetary policy shocks account only for a negligible part of output and inflation fluctuations does not imply that monetary policy itself has no effect. The systematic component of monetary policy may still have a significant effect on output and prices.

horizon to about 30%. In the long-run, the bulk of interest rate variance is explained by the demand shock (see Evans and Marshall (1998) for a similar finding). The role of supply shocks in explaining interest rate fluctuations remains very limited at all forecast horizons (see also figure A-3 and A-4).

Table 4: Forecast error variance decomposition of German variables (FEVD)

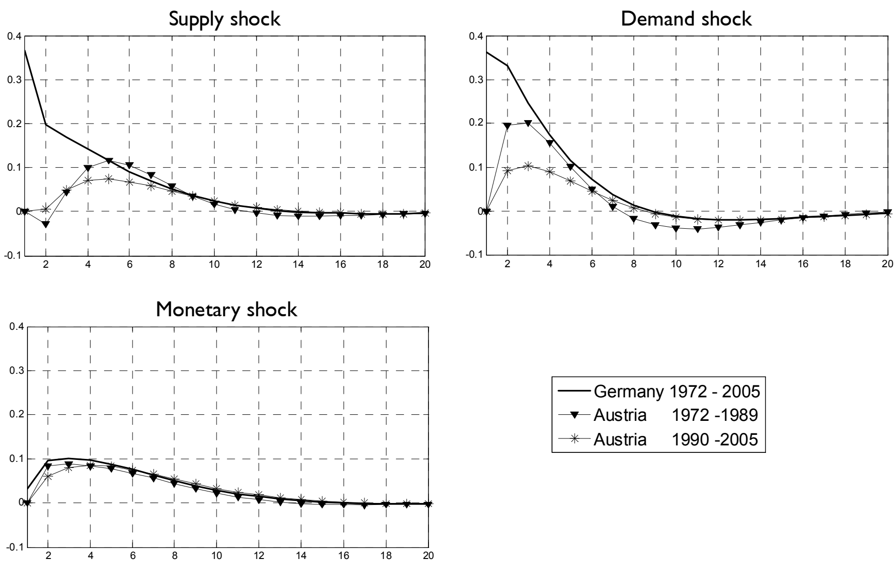
	GDP		Inflation		Short-term interest rate	
	1st quarter	20th quarter	1st quarter	20th quarter	1st quarter	20th quarter
Demand shock	50	54	28	33	19	64
Supply shock	50	38	67	63	5	7
Monetary policy shock	0	8	4	4	76	30

Source: The author's own calculations.

Transmission of German structural shocks to Austria: results

The analysis of the transmission of structural German shocks to the Austrian economy allows us to answer two sets of interesting questions. First, how strong does the Austrian economy react to German shocks? Second, did the strength of the transmission mechanism change over time? To keep track of possible changes over time we split the sample in two subsamples (1972Q1-1989Q4, 1990Q1-2005Q3) and estimate the Austrian part of the VAR model separately for the two subsamples. In the second subsample, only GDP and CPI enter the Austrian block of the VAR.

Figure 5: Mean impulse responses for German and Austrian GDP to German structural shocks (deviations from growth rates, shock size equals one standard deviation)



Due to the de facto exchange rate peg short term interest rates in both countries moved hand in hand rendering a separate identification of both interest rate variables in the VAR impossible. In order to analyse the strength of the propagation mechanism and possible changes over time, we calculate the responses of German and Austrian GDP to each of the three identified German shocks (see figure 5 and A-5)[14].

To ease the interpretation we normalize the shocks in a way that the cumulated average response of German GDP equals one after five years. We see remarkable differences in the transmission for the different shocks. German demand shocks – one of the main sources of output volatility in Germany – have the smallest impact on the Austrian economy. A German demand shock that increases German GDP by 1% causes output in Austria to increase by 0.28% (see table 5). The stronger transmission of supply shocks (36%) looks reasonable given the fact that Austrian wage policy followed German developments very closely in the past. A German monetary policy shock has an almost equally strong output effect in Austria as in Germany itself (83%). Given the de facto peg of the Austrian Schilling to the German mark and the introduction of the single currency in 1999 this result is not surprising.

Table 5: Transmission of idiosyncratic German shocks to Austria [a)]

	Supply	Demand	Monetary	Average
1972-1989	0.37	0.36	0.77	0.46
1990-2005	0.35	0.21	0.89	0.42
1972-2005	0.36	0.28	0.83	0.44
1990-2005/1972-1989	0.95	0.58	1.16	0.91

a) Cumulated response of Austrian GDP after 20 quarters relative to the German GDP response; same shock size for both subsamples; shocks are rescaled so that the cumulated average response of German GDP after 5 years equals one.

Source: The author's own calculations.

Differences in the strength of the propagation between the three structural shocks became more pronounced over time (see table 5). The strength of the transmission declined substantially for the demand shock (from 36% to 21%), but remained almost constant for the supply shock (from 37% to 35%). The transmission of monetary policy shocks (89%) is now somewhat stronger than in the first period (77%). This may be due to the increased monetary integration of the two economies. The weaker transmission of demand shocks is probably caused by a stronger diversification of Austrian trade patterns in the course of globalization and the rapidly growing trade flows with central and eastern European countries. Furthermore, the "nature" of German fiscal (demand) shocks may have changed because of German reunification. Austria's economy probably benefited less from the large fiscal transfers to Eastern Germany than from the fiscal stimuli in the pre-reunification period[15].

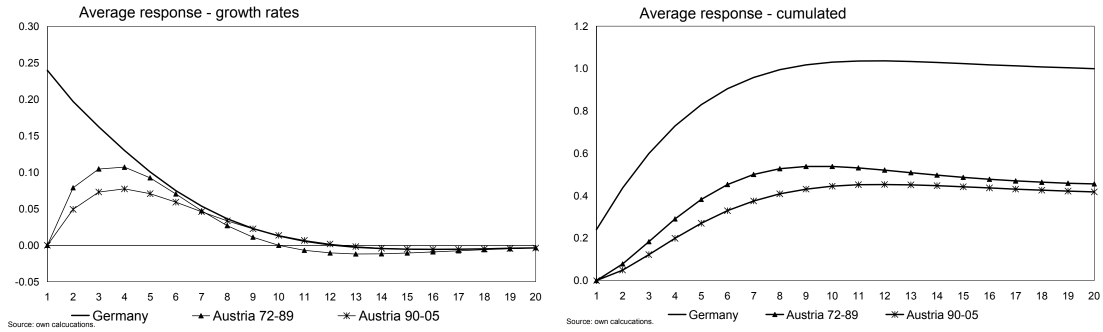
The *average* response of Austrian GDP to the three identified German shocks[16], defined as the arithmetic mean over the three shocks, is relatively strong and stable over the two subsamples. The reaction of Austrian GDP to an average German shock that increases German GDP by 1% after five years declined from 0.46% in the first subsample to 0.42% in the second (see figure 6). Differences in the transmission between the two subsamples are strongest in the short run (after two quarters cumulated output effects in Austria are 50% higher in the first subsample) but these differences are fading out in the long run (less than 10% after 20 quarters).

[14] The size of the shocks is set equal to one standard deviation of the respective shock series.

[15] The results are robust with respect to the starting point of the second subsample. Only the observed drop in the strength of the transmission of German demand shocks is less pronounced if we split the subsamples later. This confirms our conjecture that the weaker impact of German demand shocks in the second subsample is due to changes in the nature of German fiscal policy shocks in the wake of German unification.

[16] The size of the shocks is set equal to one standard deviation of the respective shock series.

Figure 6: Average response of German and Austrian GDP to structural German shocks



In the above calculations, we assumed that the size of German shocks is the same for both subsamples, neglecting the fact that the standard deviation of German shocks declined significantly by 34% on average. Considering this decrease in volatility, the total impact of German shocks on Austria shows a marked decrease over time by 39% (table 6)[17].

Table 6: Total impact of German domestic shocks on the Austrian economy

	Supply	Demand	Monetary	Average
Standard deviation of Germans shocks 1990-2005 relative to 1972-1989				
	0.89	0.70	0.45	0.66
Strength of transmission 1990-2005 relative to 1972-1989 [a)]				
	0.95	0.58	1.16	0.91
Total impact of German shocks 1990-2005 relative to 1972-1989				
	0.84	0.41	0.52	0.61

a) Cumulated response of Austrian GDP after 20 quarters relative to the German GDP response, same shock size for both subsamples

Source: The author's own calculations.

5. Summary

In this paper, we have analyzed the impact of short-term economic developments in Germany on the Austrian economy. We have focused on the synchronisation of output growth and on the transmission of German shocks to Austria.

Concerning the *synchronisation* of GDP growth rates, we find – similar to findings for other industrialized countries – no major changes over time. The Austrian economy shows a strong comovement with Germany, which is stable over time. What has changed is the relative position of the two economies in time. Whilst Austrian GDP growth was lagging behind German GDP growth by 1 quarter at the beginning of the 70s, it is now leading by the same amount of time.

We find a strong *transmission* of idiosyncratic German shocks (demand, supply, and monetary policy) to Austria. On average over all three shocks, a shock that increases German GDP by 1% after five years increases Austrian GDP by 0.44%. There are remarkable

[17] Nevertheless, the *relative* importance of Germany seems to be rather stable. According to Fenz and Schneider (2006) the *relative* role of international shocks as indicated by a forecast error variance decomposition increased at the expense of domestic shocks while the *relative* importance of German fluctuations remained almost unchanged. Both, international and German shocks, account for more than one fourth of output fluctuations in Austria, while the role of domestic shocks has declined to less than one half.

differences between the shocks. We find the transmission to be strongest for the monetary policy shock (83%) and much weaker for the supply (36%) and the demand shock (28%). The strength of the transmission mechanism between Germany and Austria has decreased only slightly over time from 46% in the period 1972-89 to 42% in the period 1990-2005. The finding of an almost unchanged transmission does not imply that the overall effect of German shocks on output fluctuations in Austria did not change. Since the volatility of German shocks – following a global trend – declined significantly, the overall impact of German shocks on Austria declined by 39% from the period 1972-1989 to 1990-2005.

Summarizing our results, we find remarkable stable economic links between Austria and Germany. Neither the degree of synchronisation nor the strength of the bilateral shock transmission changed significantly over the past decades.

Appendix A: Bivariate spectral analysis

Bivariate spectral analysis allows us to describe the relation between two time series by decomposing their covariances into components for different frequencies. Therefore we consider the multivariate spectrum $F_{\{x_t y_t\}}(\omega)$, which can be obtained by a Fourier transformation of the autocovariance matrix of the time series. The diagonal elements of $F_{\{x_t y_t\}}(\omega)$ are the spectra of the time series ($f_x(\omega)$, $f_y(\omega)$), whilst the off-diagonal elements capture the cross-spectrum ($f_{xy}(\omega)$). Since the cross-spectrum is in general a complex number, we can decompose it into a real and an imaginary part

$$f_{xy}(\omega) = c_{xy}(\omega) - iq_{xy}(\omega),$$

where the real part $c_{xy}(\omega)$ is the *co-spectrum* and the imaginary part $q_{xy}(\omega)$ is the *quadrature spectrum*. The *coherency* $C_{xy}(\omega) = \left|f_{xy}(\omega)\right| / \sqrt{f_x(\omega) f_y(\omega)}$ is the frequency domain analogue to the static correlation coefficient. It describes the correlation between the two series at frequency ω. However, it gives us no information about their relative position in time, i.e. shifting one series in time does not affect the coherency. The phase $\varphi_{xy}(\omega) = \tan^{-1}\left(-q_{xy}(\omega) / c_{xy}(\omega)\right)$ measures the phase shift between the two series in radians. If the phase is > 0 then x_t leads y_t at frequency ω. The time delay $-\varphi_{xy}(\omega)/\omega$ transforms this information and tells us by how much periods series x_t leads/lags y_t. In addition to these well-known measures, Croux, Forni and Reichlin (2001) have proposed the dynamic correlation coefficient

$$\rho_{xy,0}(\omega) = \frac{c_{xy}(\omega)}{\sqrt{f_x(\omega) f_y(\omega)}},$$

which measures the contemporaneous correlation between the two series at frequency ω. Note that the dynamic correlation coefficient equals the static correlation coefficient when the two series move contemporaneously.

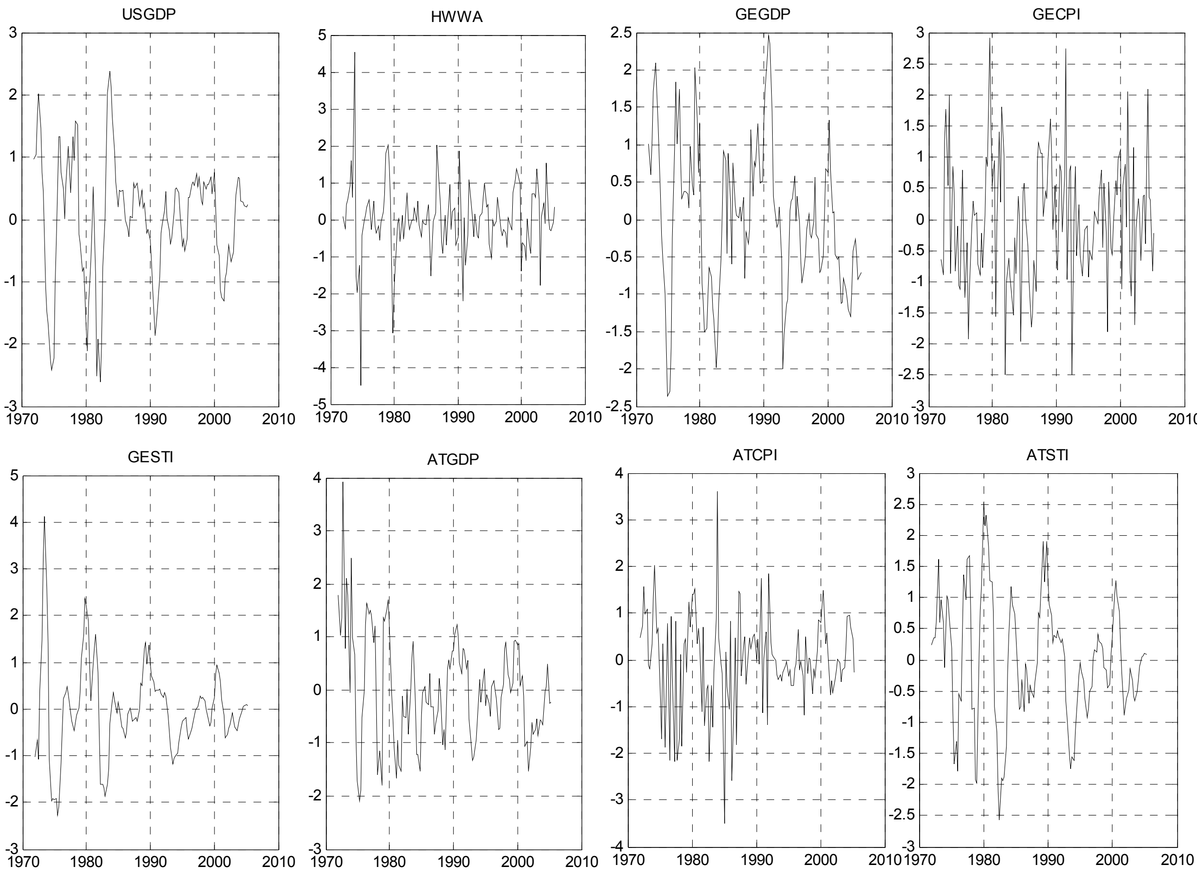
Appendix B: Tables and Figures

Table A-1: ECRI growth cycles turning point dates

Germany		Austria	
		Mar 66	P
Mar 67	T	Jan 68	T
Jan 69	P	Jan 71	P
Sep 71	T	Dec 71	T
Jan 73	P	Dec 72	P
Dec 74	T	May 75	T
Apr 76	P	Nov 76	P
Jul 77	T	Feb 78	T
May 79	P	Dec 79	P
Oct 82	T	Jan 82	T
Apr 86	P	Dec 84	P
Jan 87	T	Mar 87	T
Jan 91	P	Feb 90	P
Jan 93	T	Mar 93	T
Dec 94	P	Nov 94	P
Jan 97	T	Mar 96	T
Mar 98	P	May 98	P
Feb 99	T	Feb 99	T
May 00	P	Jul 99	P
Mar 02	T	Dec 01	T
Sep 02	P	Jan 03	P
Mar 03	T	Dec 03	T
Jun 04	P	Aug 04	P

Note: T: Trough, P: Peak
Source: Economic Cycle Research Institute.

Figure A-1: Variables used in the two-country VAR-model (transformed and standardized)



Code	Variable	Source
ATGDP	Austrian real GDP (year-on-year growth rates)	Eurostat
ATCPI	Austrian consumer price index (first differences of year-on year growth rates)	Eurostat
ATSTI	Austrian 3-months interest rates (year-on-year differences)	Eurostat
GEGDP	German real GDP (year-on-year growth rates)	Eurostat
GECPI	German consumer price index (first differences of year-on year growth rates)	Eurostat
GESTI	German 3-months interest rates (year-on-year differences)	Eurostat
USGDP	US real GDP (year-on-year growth rates)	BEA
HWWA	HWWA Commodity Price Index (first differences of year-on year growth rates)	HWWA

Figure A-2: German structural shocks (standardized)

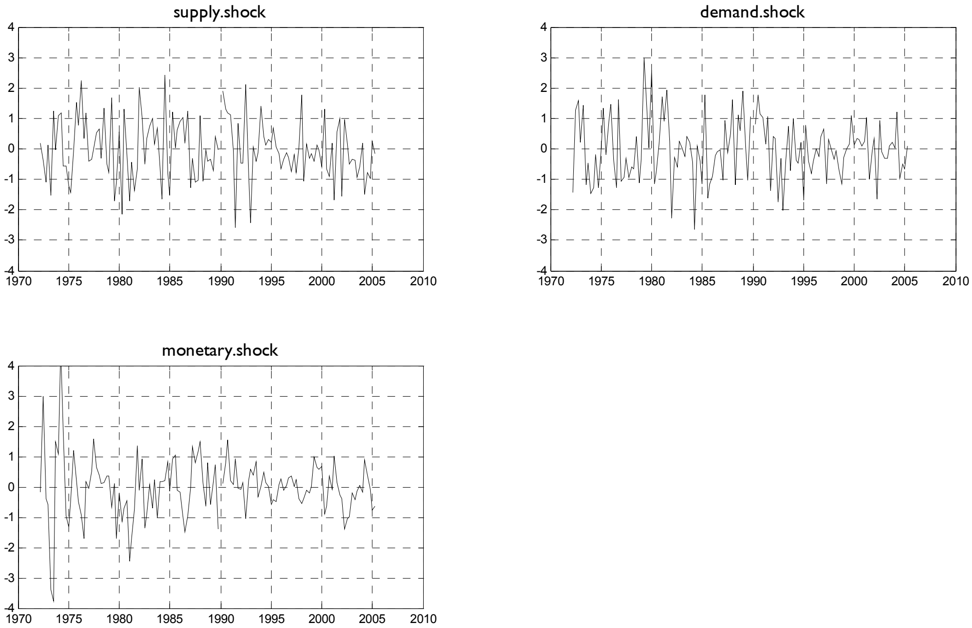


Figure A-3: Forecast error variance decomposition for German short term interest rates (GESTI), inflation (GECPI) and GDP (GEGDP) with respect to German structural shocks (1972-2005)

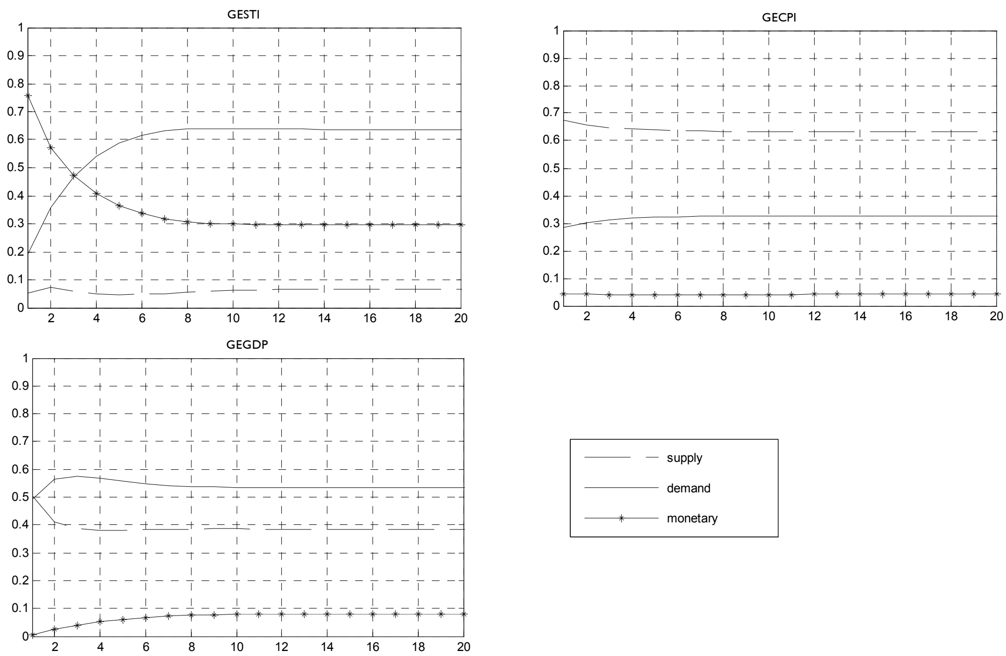


Figure A-4: Mean impulse responses for German variables to German structural shocks (deviations from growth rates, two standard errors confidence bands)[18]

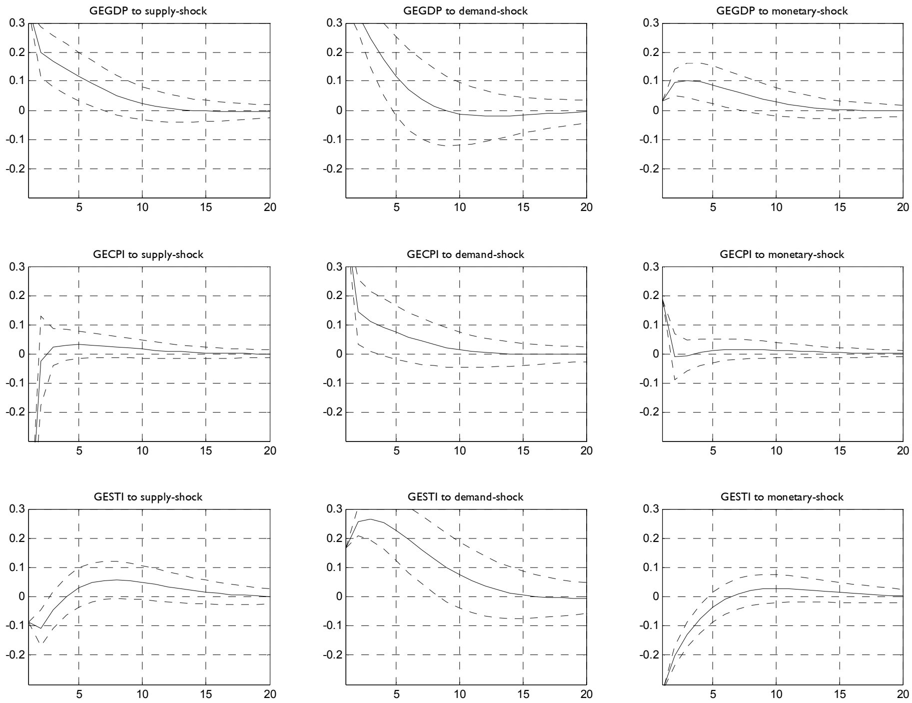
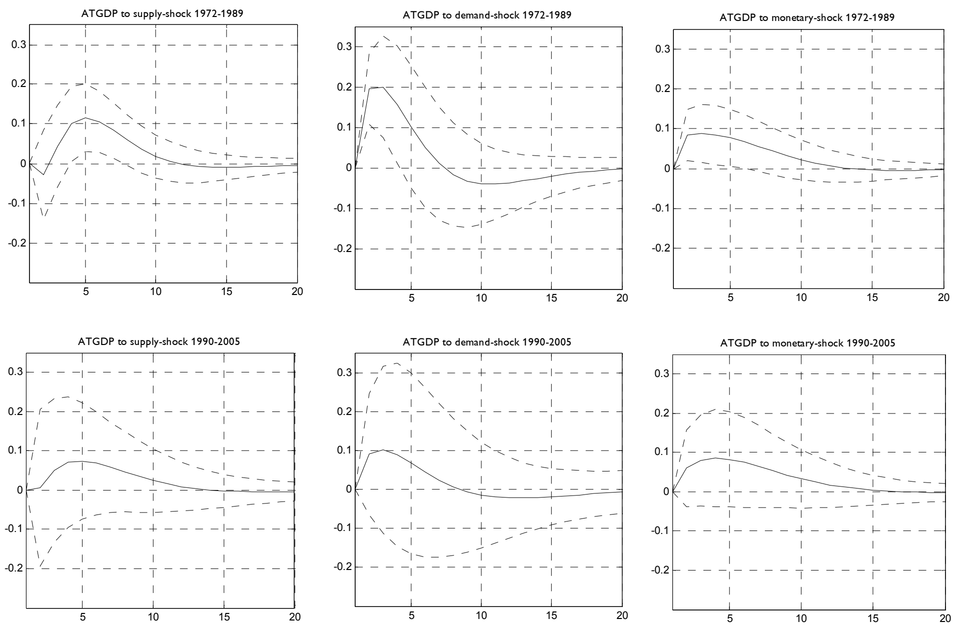


Figure A-5: Mean impulse responses for Austrian GDP growth to German structural shocks 1972-1989 and 1990-2005 (deviations from growth rates, confidence bands w.r.t two standard errors for VAR-coefficients)[18]



---

[18] Confidence bands have been constructed using Monte Carlo sampling for the VAR coefficients (two standard errors).

6. References

Blanchard, O. and D. Quah (1989), 'The Dynamic Effects of Aggregate Demand and Supply Disturbances', *American Economic Review* 79, 655-673.

Bordo, M. D. and T. Helbling (2003), 'Have National Business Cycles Become More Synchronized?', NBER Working Paper No. 10130.

Brandner, P. and K. Neusser (1992), 'Business Cycles in Open Economies: Stylized Facts for Austria and Germany'. *Weltwirtschaftliches Archiv* 128, 67-87.

Canova, F. (2005), 'The Transmission of US Shocks to Latin America'. *Journal of Applied Econometrics* 20, 229-251.

Canova, F. and G. de Nicoló (2003), 'On the Sources of Business Cycles in the G-7', *Journal of International Economics* 59, 77-100.

Canova, F. and J. Piña (2001), 'Monetary Policy Misspecification in VAR models', in: C. Diebolt and C. Krystou (eds.), *New Trends in Macroeconomics*, Springer, New York.

Cheung, Y. W. und F. Westermann (1999), 'An Analysis of German Effects on the Austrian Business Cycle', *Weltwirtschaftliches Archiv* 135, 522-531.

Christiano, L. J., M. Eichenbaum und C. L. Evans (1999), 'Monetary Policy Shocks: What have we Learned and to What End?', in: J. B. Taylor and M. Woodford (eds.): *Handbook of Macroeconomics Volume 1A*, North Holland, Amsterdam.

Croux, C., M. Forni and L. Reichlin (2001), 'A Measure of Comovement for Economic Variables: Theory and Empirics', *The Review of Economics and Statistics* 83, 232-241.

Dalsgaard, T., J. Elmeskov und C. Y. Park (2002), 'Ongoing Changes in the Business Cycle – Evidence and Causes', OECD Economics Department Working Paper No. 315.

ECRI (2006), The Business Cycle Chronologies, available at http://www.businesscycle.com/internationalcycledates.php (accessed at 6 June 2006).

Epstein, N. und D. Tzanninis (2005), 'Austrian Economic Growth and the Linkages to Germany and Central and Eastern Europe', in: *IMF Staff Report on the 2005 Article IV Consultation Discussions with Austria*, IMF, Washington, 38-53.

Evans, C. L. and D. A. Marshall (1998), 'Monetary Policy and the Term Structure of Nominal Interest Rates: Evidence and Theory', *Carnegie-Rochester Conference Series on Public Policy* 49, 53-111.

Farrant, K. and G. Peersman (2006), 'Is the Exchange Rate a Shock Absorber or a Source of Shocks. New Empirical Evidence', *Journal of Money Credit and Banking* 38, 939-962.

Faust, J. (1998), 'The Robustness of Identified VAR Conclusions About Money', *Carnegie-Rochester Conference Series in Public Policy* 49, 207-244.

Fenz, G. and M. Schneider (2006), 'Is Germany's Influence on Austria Waning?' *Monetary Policy & the Economy* 2006(2), 24-45.

Hamilton, J. D. (1994), *Time Series Analysis,* Princeton University Press, Princeton.

Harding, D., and A. R. Pagan (2002), 'Dissecting the Cycle: A Methodological Investigation', *Journal of Monetary Economics* 49, 365-381.

Heathcote J. and F. Perri (2003), 'Why has the U.S. Economy Become Less Correlated with the Rest of the World?' *American Economic Review* 93, 63-69.

Helbling, T. and T. Bayoumi (2003), 'Are They All in the Same Boat? The 2000-2001 Growth Slowdown and the G-7 Business Cycle Linkages', IMF Working Paper 03/46.

Hochreiter, E. and G. Winckler (1995), 'The Advantages of Tying Austria's Hand: the Success of the Hard Currency Strategy', *European Journal of Political Economy* 11, 83-111.

Hummels, D., J. Ishii and K. M. Yi (2001), 'The Nature and Growth of Vertical Specialization in World Trade', *Journal of International Economics*, 54, 75-96.

Kose, M. A. (2004), 'Globalization and Synchronization of Business Cycles', *IMF Research Bulletin* 5, 1-4.

Kose, M. A., E. S. Prasad and M. E. Terrones (2003), 'How Does Globalization Affect the Synchronization of Business Cycles?' *American Economic Review* 93, 57-62.

Kose, M. A., E. S. Prasad, and M. E. Terrones (2004), 'Volatility and Comovement in a Globalized World Economy: an Empirical Exploration', in: H. Siebert (ed.), *Macroeconomic Policies in the World Economy*, Springer, Berlin.

Monfort, A., J. P. Renne, R. Rüffer and G. Vitale (2003), 'Is Economic Activity in the G7 Synchronized? Common Shocks versus Spillover Effects', CEPR Discussion Paper No. 4119.

Peersman, G. (2005), 'What Caused the Early Millennium Slowdown? Evidence Based on Vector Autoregressions', *Journal of Applied Econometrics* 20, 185-207.

Pesaran, M. H. and Y. Shin (1998), 'Generalized Impulse Response Analysis in Linear Models', *Economic Letters* 58, 17-29.

Sims, C. (1980), 'Macroeconomics and Reality', *Econometrica* 48, 1-48.

Smets, F. and R. Wouters (2003), 'An Estimated Dynamic Stochastic General Equilibrium Model of the Euro Area', *Journal of the European Economic Association* 1, 1123-1175.

Stock, J. H. and M. W. Watson (2003a), 'Has the Business Cycle Changed? Evidence and Explanations, in: Federal Reserve Bank of Kansas City (ed.), *Monetary Policy and Uncertainty: Adapting to a Changing Economy – A Symposium*, Kansas City, 9-56.

Stock, J. H. und M. W. Watson (2003b), 'Understanding Changes in International Business Cycle Dynamics', NBER Working Paper 9859.

Uhlig, H. (2005), 'What are the Effects of Monetary Policy? Results from an Agnostic Identification Procedure', *Journal of Monetary Economics* 52, 381-419.

Winckler, G. (1993), 'The Impact of the Economy of the FRG on the Economy of Austria, in: H. van Riekhoff and H. Neuhold (eds.), *Unequal Partners. A Comparative Analysis of the Relations Between Austria and the Federal Republic of Germany and Between Canada and the United States*, Westview Press, Boulder.

Index of Working Papers:

July 11, 2005	Claudia Kwapil, Josef Baumgartner, Johann Scharler	100	The Price-Setting Behavior of Austrian Firms: Some Survey Evidence
July 25, 2005	Josef Baumgartner, Ernst Glatzer, Fabio Rumler, Alfred Stiglbauer	101	How Frequently Do Consumer Prices Change in Austria? Evidence from Micro CPI Data
August 8, 2005	Fabio Rumler	102	Estimates of the Open Economy New Keynesian Phillips Curve for Euro Area Countries
September 19, 2005	Peter Kugler, Sylvia Kaufmann	103	Does Money Matter for Inflation in the Euro Area?
September 28, 2005	Gerhard Fenz, Martin Spitzer	104	AQM – The Austrian Quarterly Model of the Oesterreichische Nationalbank
October 25, 2005	Matthieu Bussière, Jarko Fidrmuc, Bernd Schnatz	105	Trade Integration of Central and Eastern European Countries: Lessons from a Gravity Model
November 15, 2005	Balázs Égert, László Halpern, Ronald MacDonald	106	Equilibrium Exchange Rates in Transition Economies: Taking Stock of the Issues
January 2, 2006	Michael D. Bordo, Peter L. Rousseau (comments by Thorvaldur Gylfason and Pierre Siklos)	107	Legal-Political Factors and the Historical Evolution of the Finance-Growth Link
January 4, 2006	Ignacio Briones, André Villela (comments by Forrest Capie and Patrick Honohan)	108	European Banks and their Impact on the Banking Industry in Chile and Brazil: 1862 - 1913
January 5, 2006	Jérôme Sgard (comment by Yishay Yafeh)	109	Bankruptcy Law, Creditors' Rights and Contractual Exchange in Europe, 1808-1914

January 9, 2006	Evelyn Hayden, Daniel Porath, Natalja von Westernhagen	110	Does Diversification Improve the Performance of German Banks? Evidence from Individual Bank Loan Portfolios
January 13, 2006	Markus Baltzer (comments by Luis Catão and Isabel Schnabel)	111	European Financial Market Integration in the Gründerboom and Gründerkrach: Evidence from European Cross-Listings
January 18, 2006	Michele Fratianni, Franco Spinelli (comments by John Driffill and Nathan Sussman)	112	Did Genoa and Venice Kick a Financial Revolution in the Quattrocento?
January 23, 2006	James Foreman-Peck (comment by Ivo Maes)	113	Lessons from Italian Monetary Unification
February 9, 2006	Stefano Battilossi (comments by Patrick McGuire and Aurel Schubert)	114	The Determinants of Multinational Banking during the First Globalization, 1870-1914
February 13, 2006	Larry Neal	115	The London Stock Exchange in the 19th Century: Ownership Structures, Growth and Performance
March 14, 2006	Sylvia Kaufmann, Johann Scharler	116	Financial Systems and the Cost Channel Transmission of Monetary Policy Shocks
March 17, 2006	Johann Scharler	117	Do Bank-Based Financial Systems Reduce Macroeconomic Volatility by Smoothing Interest Rates?
March 20, 2006	Claudia Kwapil, Johann Scharler	118	Interest Rate Pass-Through, Monetary Policy Rules and Macroeconomic Stability
March 24, 2006	Gerhard Fenz, Martin Spitzer	119	An Unobserved Components Model to forecast Austrian GDP
April 28, 2006	Otmar Issing (comments by Mario Blejer and Leslie Lipschitz)	120	Europe's Hard Fix: The Euro Area

May 2, 2006	Sven Arndt (comments by Steve Kamin and Pierre Siklos)	121	Regional Currency Arrangements in North America
May 5, 2006	Hans Genberg (comments by Jim Dorn and Eiji Ogawa)	122	Exchange-Rate Arrangements and Financial Integration in East Asia: On a Collision Course?
May 15, 2006	Petra Geraats	123	The Mystique of Central Bank Speak
May 17, 2006	Marek Jarociński	124	Responses to Monetary Policy Shocks in the East and the West of Europe: A Comparison
June 1, 2006	Josef Christl (comment by Lars Jonung and concluding remarks by Eduard Hochreiter and George Tavlas)	125	Regional Currency Arrangements: Insights from Europe
June 5, 2006	Sebastian Edwards (comment by Enrique Alberola)	126	Monetary Unions, External Shocks and Economic Performance
June 9, 2006	Richard Cooper Michael Bordo and Harold James (comment on both papers by Sergio Schmukler)	127	Proposal for a Common Currency among Rich Democracies One World Money, Then and Now
June 19, 2006	David Laidler	128	Three Lectures on Monetary Theory and Policy: Speaking Notes and Background Papers
July 9, 2006	Ansgar Belke, Bernhard Herz, Lukas Vogel	129	Are Monetary Rules and Reforms Complements or Substitutes? A Panel Analysis for the World versus OECD Countries
August 31, 2006	John Williamson (comment by Marc Flandreau)	130	A Worldwide System of Reference Rates

September 15, 2006	Sylvia Kaufmann, Peter Kugler	131	Expected Money Growth, Markov Trends and the Instability of Money Demand in the Euro Area
September 18, 2006	Martin Schneider, Markus Leibrecht	132	AQM-06: The Macroeconomic Model of the OeNB
November 6, 2006	Erwin Jericha and Martin Schürz	133	A Deliberative Independent Central Bank
December 22, 2006	Balázs Égert	134	Central Bank Interventions, Communication and Interest Rate Policy in Emerging European Economies
May 8, 2007	Harald Badinger	135	Has the EU's Single Market Programme fostered competition? Testing for a decrease in markup ratios in EU industries
May 10, 2007	Gert Peersman	136	The Relative Importance of Symmetric and Asymmetric Shocks: the Case of United Kingdom and Euro Area
May 14, 2007	Gerhard Fenz and Martin Schneider	137	Transmission of business cycle shocks between unequal neighbours: Germany and Austria