OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

WORKSHOPS

Proceedings of OeNB Workshops

International Trade & Domestic Growth: Determinants, Linkages and Challenges

September 27, 2007

Stability and Security.

No. 14

Synchronization of Business Cycles of Germany and Austria

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Abstract

In this paper, we analyze the synchronization of the German and the Austrian business cycles for the time span from 1972 to 2007. We find a high comovement of the output gaps of both countries, which increases over time. Looking at demand components, we find the highest degree of comovement between German and Austrian exports as well as imports. Austrian GDP was lagging behind German GDP by one quarter in the 1970s and is now leading by two quarters. Looking at the production side, we find the strongest comovement for the industrial sectors, whilst the construction and the service cycles exhibit only a weak correlation.

JEL classification: E32, F41
Keywords: business cycle, synchronization, Austria, Germany

1. Introduction

Austria as a small open economy always had a strong orientation towards its largest neighbor Germany. The existence of a common border, a common language, similar institutional settings and last but not least a tempestuous common history have created strong economic ties between these two countries. Consequently, there is a considerable impact of the German business cycle on the Austrian one. 30% of Austrian exports are going to Germany and 40% of its imports are coming from Germany. The German share in Austrian inward foreign direct investment reaches 40%. Since the early 1980's, the nominal exchange rate between both countries is de facto fixed. Whilst trade and financial links between

[1] We would like to thank all the participants of the workshop in helpful comments and discussions.

the two countries have steadily increased over the past decades, the relative importance of Germany has declined since the opening up of Eastern Europe und the surge of Austrian trade volumes and foreign direct investments in this region. This could give rise to the hypothesis of a gradual decoupling of the two business cycles. At the same time, the increasing integration of both countries into the world economy and the occurrence of global shocks could trigger an increase of the business cycle synchronization. The aim of this paper is therefore to evaluate whether one of these effects is dominating. To this end, we analyze the synchronization of the German, the Austrian business cycle, and its changes over the last 35 years.

At a global level, the literature on the synchronization of international business cycles finds that the degree of comovement among developed economies evolved remarkable stable over the past decades, whilst the volatility of the cyclical fluctuations has decreased considerably.[2] 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.[3] 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.[4]

Several aspects of the business cycle links between Germany and Austria have been analyzed so far. Brandner and Neusser (1992, 1994) determine the static correlation between different macroeconomic variables. They find a high contemporaneous correlation for GDP and investment but only a 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)

[2] 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).

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

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

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. Fenz and Schneider (2006, 2007) have analyzed the transmission of German structural shocks to Austria within a two-country VAR framework. Using sign restrictions on impulse response functions, they have identified German supply, demand and monetary policy shocks. The average reaction of the Austrian economy to German shocks amounts to around 40% of the German reaction and remains broadly stable over time. German demand shocks have, relative to the size of the shock, the smallest impact on the Austrian economy, while German monetary shocks have an almost equally strong output effect in Austria as in Germany itself.

Our contribution to the literature is an analysis of the comovement of the business cycles of the two countries. We therefore look at GDP and its demand components as well as on the production side of GDP. We employ different measures of comovement. The paper is organized as follows. The degree of comovement is analyzed in section 2. Section 3 gives a brief overview over the economic links between Austria and Germany. Finally, we summarize the results in section 4.

2. Synchronization of Business Cycles of Germany and Austria

In this section, we analyze the comovement between the Austrian and the German economy and its change over time. We look at the output gaps of GDP and its demand components in the period 1970Q1 to 2007Q3. We have computed the output gap as percent deviation from a HP-filtered trend of seasonally and working-day adjusted data. We employ a variety of different measures of comovement, which we compute for two subsamples (1970Q1 to 1989Q4 and 1990Q1 to 2007Q3) 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. In addition, we look at the production side of GDP for which data since 1991 are available.

Measures of Comovement

We use five different measures of bivariate comovement between Austrian and German output gaps. 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. These 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 coherency* (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.

In addition, we address the question whether GDP (or one of its components) in one country (y) is helpful for forecasting the respective series in the other country (x). Therefore, we conduct simple Granger-causality tests as presented by Hamilton (1994) for one to four lags. 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.

Results for GDP and Demand Components

A visual inspection of the output gaps of GDP and its demand components (chart 1) reveals some first immediate results. First, the output gaps in Germany and Austria showed a smaller degree of comovement in the second half of the 1970s and the 1980s than thereafter. In Austria, this period was characterized by the adoption of a hard currency policy coupled with Keynesian deficit spending. In addition, the German economy suffered stronger from the first oil price shock in the 1970s than Austria. From 1990 onwards, the business cycles of both countries were much more synchronized. At the beginning of the 1990s, the economic effects of German reunification caused – not only in Germany itself but also in Austria – an economic boom followed the recession in 1993. The boom in 2000 and the following downturn as well as the recovery were largely driven by global factors and affected Germany and Austria to a similar extent.

Table 1 reports the measures of comovement presented above for the time from 1970 to 2007 as well as for both subsamples. The increase of the static correlation coefficient from 0.54 to 0.79 documents the strong increase in the synchronization of the two business cycles. Besides this increase in synchronization, their relative position in time has shifted. Whilst the Austrian business cycle was lagging behind the German cycle until the first half of the 1980s, it is now leading the German one. According to the average delay at business cycle frequencies, Austrian GDP was lagging behind German GDP by one quarter in the 1970s and is now leading by two quarters (chart 1). Overall, the cyclical position of Austrian GDP relative to Germany has moved by 3 quarters. Looking at the two subsamples, we see an average lag of 0.86 quarters for the period from 1970 to 1989 and an average lead of 0.99 quarters for the period from 1990 to 2005 (see table 1). Looking at maximum correlations at different leads/lags, we get a similar – albeit less precise

– result. The German economy was leading by one quarter in the period from 1970 to 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 (table A-2) confirm our hitherto results. Whilst German GDP had predictive power for Austrian GDP in the first subsample, the change in the relative position in time has caused the Granger-causality to vanish (at least for up to two quarters). On the other hand, Austrian GDP does Granger-cause German GDP in the second subsample but not in the first one.

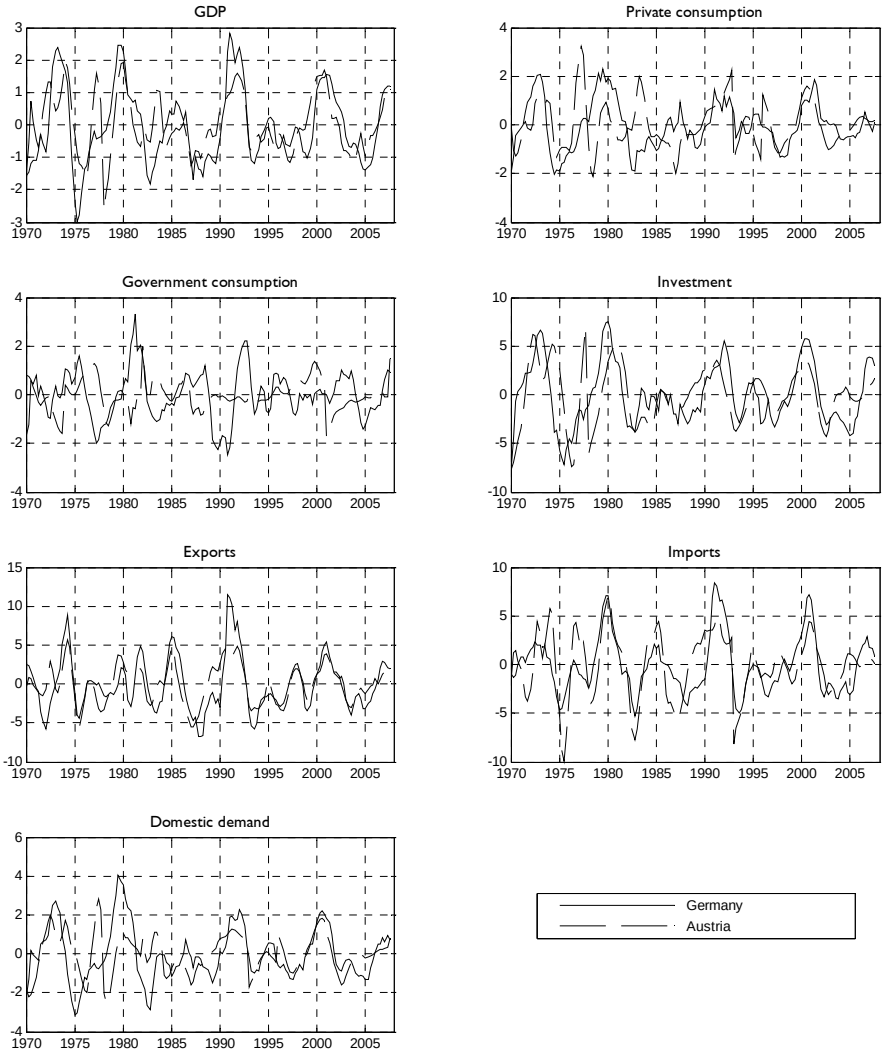
This increase in synchronization can be observed in almost all demand components, but is strongest in *private consumption*. Whilst consumption in both countries was almost uncorrelated in the first subsample, its comovement increased from 1990 onwards. A rising correlation of consumption patterns across countries can be well explained from a theoretical perspective. Under the assumption of strong wealth effects, cross border portfolio diversification can lead to highly correlated consumption patterns between countries.[5] Thus, the increasing financial linkages between Austria and Germany may have triggered the increase in synchronization in private consumption between both countries.

Government consumption behaved very differently in both countries. The second half of the 1970s in Austria was characterized by the increase in deficit spending to dampen the negative effects of the first oil price shock. In the 1980s, some efforts to consolidate the budget were undertaken. In the first half of the 1990s, German fiscal policy was clearly influenced by re-unification, which pushed up government expenditure and consequently increased the fiscal burden. Initial consolidation through spending restraint – given increasing debt and requirements for EMU accession – was undertaken from the mid-1990s onward. In Austria this consolidation phase started already in 1993, but was mainly driven by a rise of the fiscal burden.

Since Germany and Austria are both very open economies highly integrated into the international production process, it seems natural that *exports* are the demand component with the highest degree of comovement. Especially in the second subsample, the export performance of the two countries developed in parallel. A similar picture can be obtained for *imports*. The increasing synchronicity in foreign trade over time is a consequence of global trends that are also strongly visible in the bilateral trade flows between Germany and Austria. As shown in chapter three the share of intra industry trade flows and vertical integration between both countries is steadily increasing over time thereby boosting business cycle synchronization.

[5] Imbs (2004) gives an overview of theoretical and empirical results. For the increasing financial links between Austria and Germany see chapter 3.

Chart 1: Output Gaps for GDP and Demand Components in Germany and Austria from 1970 to 2007



Source: WIFO, Bundesbank, authors' calculations.

The fact that the Austrian business cycle was lagging the German one in the first subsample but is leading it in the second subsample seems to be mainly driven by the behavior of *investment*. Investment activity in Austria considerably lagged behind Germany until the mid-1980s and now leads the German investment cycle (chart 2). The erratic fluctuations of the delay of private consumption in the 1970s and 1980s and of government consumption over the whole horizon in chart 2 is due to the weak correlation (and hence to the low power of the spectral estimate) and can therefore not be interpreted.

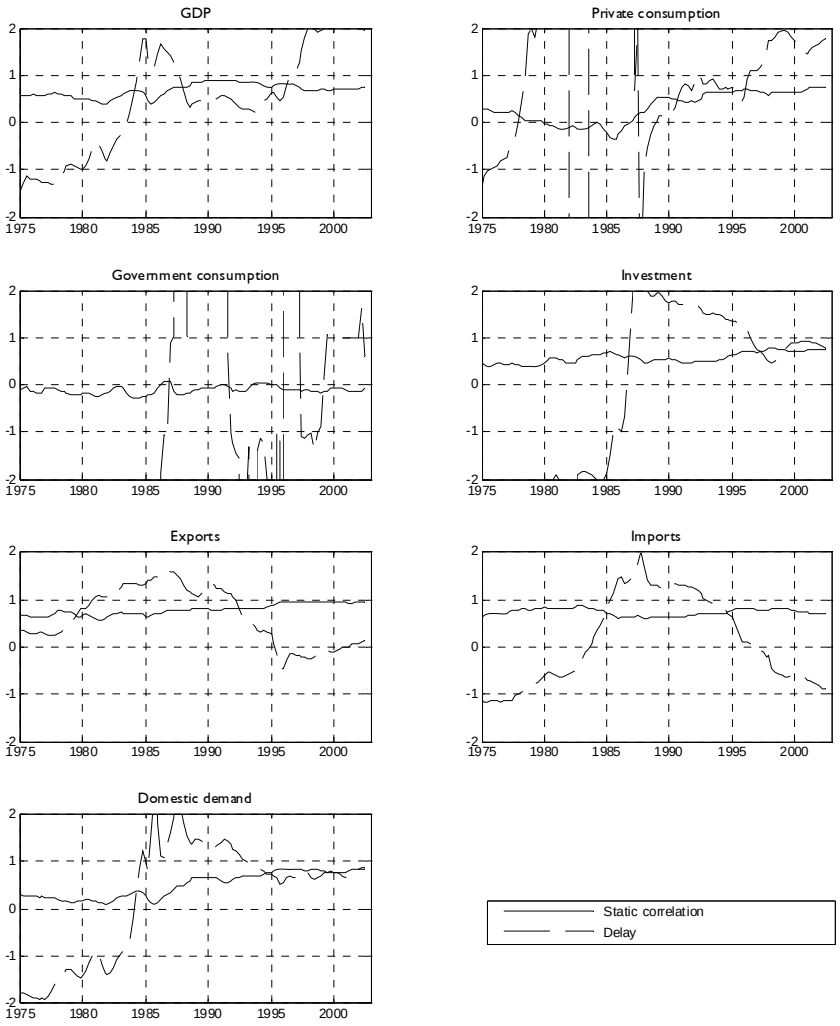
Table 1: Comovement between the Austrian and the German Economy between 1972 and 2007

	Static correlation			Dynamic	Dynamic	Delay
	Contemp.	Maximum		correlation	coherency	(quarters)
GDP						
1970Q1-2007Q3	0.64	0.64	0.00	0.66	0.66	-0.05
1970Q1-1989Q4	0.54	0.56	(-1)	0.56	0.56	-0.86
1990Q1-2007Q3	0.79	0.83	(1)	0.80	0.81	0.99
Private consumption						
1970Q1-2007Q3	0.29	0.39	(0)	0.30	0.31	0.22
1970Q1-1989Q4	0.14	0.16	(-1)	0.14	0.15	-0.77
1990Q1-2007Q3	0.64	0.72	-1	0.69	0.71	1.31
Government consumption						
1970Q1-2007Q3	-0.10	-0.25	(3)	-0.11	0.17	-6.02
1970Q1-1989Q4	-0.17	0.40	(-4)	-0.18	0.27	-5.38
1990Q1-2007Q3	0.00	-0.15	(4)	-0.01	0.04	-0.86
Investment						
1970Q1-2007Q3	0.52	0.58	(-2)	0.53	0.54	-1.77
1970Q1-1989Q4	0.48	0.71	(-3)	0.49	0.55	-2.58
1990Q1-2007Q3	0.64	0.67	(1)	0.65	0.66	1.01
Exports						
1970Q1-2007Q3	0.76	0.77	(1)	0.77	0.78	0.65
1970Q1-1989Q4	0.67	0.70	(1)	0.67	0.70	0.79
1990Q1-2007Q3	0.87	0.87	(0)	0.88	0.88	0.26
Imports						
1970Q1-2007Q3	0.66	0.66	(0)	0.67	0.68	-0.26
1970Q1-1989Q4	0.67	0.68	(-1)	0.67	0.68	-0.64
1990Q1-2007Q3	0.75	0.75	(0)	0.79	0.79	0.24
Domestic demand						
1970Q1-2007Q3	0.42	0.43	(-1)	0.43	0.43	-0.79
1970Q1-1989Q4	0.27	0.37	(-3)	0.27	0.30	-1.82
1990Q1-2007Q3	0.78	0.80	(1)	0.80	0.81	0.80

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.

Source: WIFO, Bundesbank, authors' calculations.

Chart 2: Comovement between German and Austrian GDP Demand Components between 1972 and 2007 (10 Year Rolling Windows, Centered [a])



[a] *The years refer to the centre of the 10 year window.*
Source: WIFO, Bundesbank, authors' calculations.

Production Side

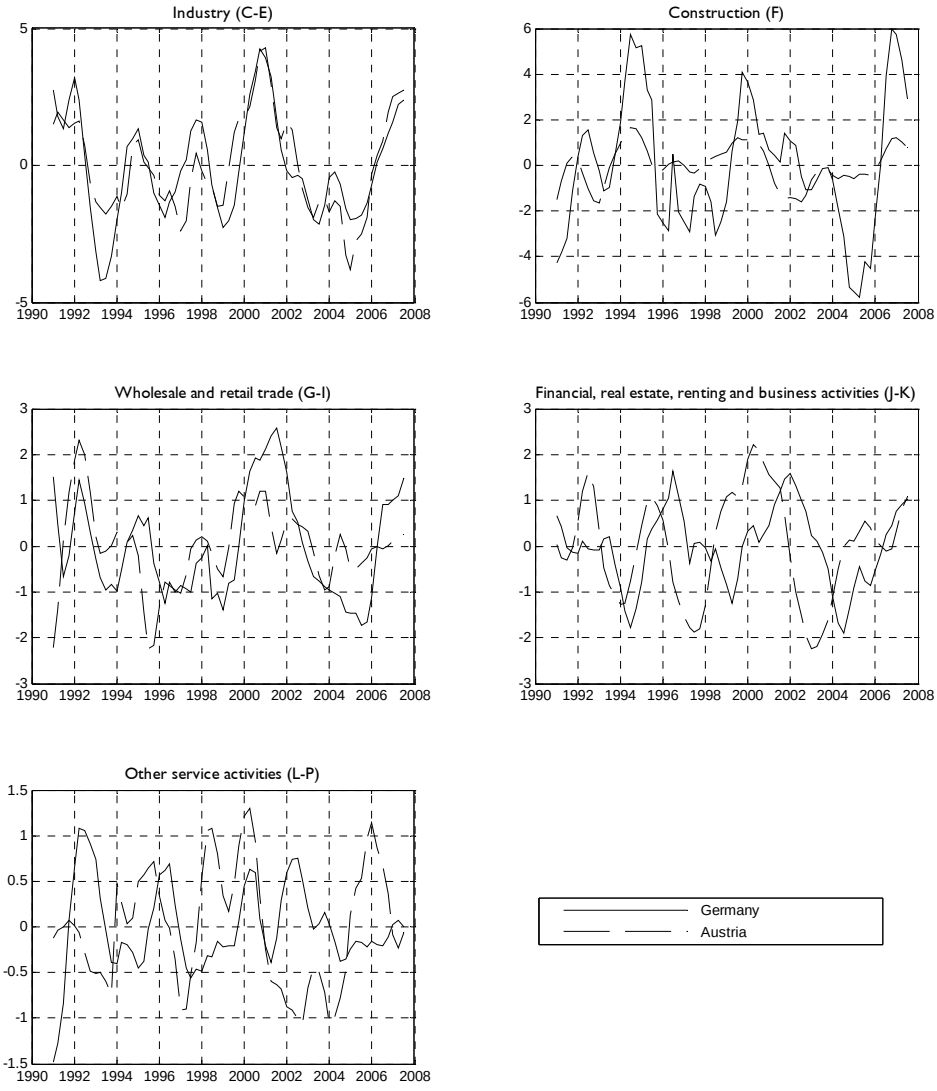
Now we turn to the production side of GDP. Our data set covers the period from 1991Q1 up to 2007Q3 for five sectors. Due to the short time span, we refrained from computing the comovement measures for subsamples and rolling windows. A look at chart 3 shows that the *industry* sector is the one with the highest degree of comovement. In addition, there is no systematic lead of one country. The *construction* cycles have a relatively high correlation coefficient of 0.54 (table 2), but very different amplitudes. The comovement of services is much weaker than for industry. The different behavior of d*istribution services* (NACE G-I) can be partly attributed to the special role of tourism in Austria. Although the *financial, real estate, renting and business activities sectors* (NACE J-K) are contemporaneously uncorrelated, the Austrian sector seems to lead its German counterpart by two quarters. *Other service activities* (NACE L-P) behave very differently in both countries. This result is not surprising, given the important role of public services in this sector.

Table 2: Comovement between the Austrian and the German Economy between 1991 and 2007 (Production Side)

	Static correlation			Dynamic correlation	Dynamic coherency	Delay (quarters)
	Contemp.	Maximum				
Industry (C-E)	0.81	0.81	(0)	0.82	0.82	-0.02
Construction (F)	0.55	0.60	(1)	0.56	0.58	0.99
Wholesale and retail trade (G-I)	0.36	0.54	(2)	0.41	0.44	1.81
Financial, real estate, renting and business activities (J-K)	0.07	0.66	(4)	0.06	0.36	1.78
Other service activities (L-P)	-0.12	-0.51	(-3)	-0.14	0.28	6.94

Source: WIFO, Bundesbank, authors' calculations.

Chart 3: Output Gaps of the Production Side of German and Austrian GDP 1991 to 2007



Source: WIFO, Bundesbank, authors' calculations.

3. Economic Ties between Austria and Germany

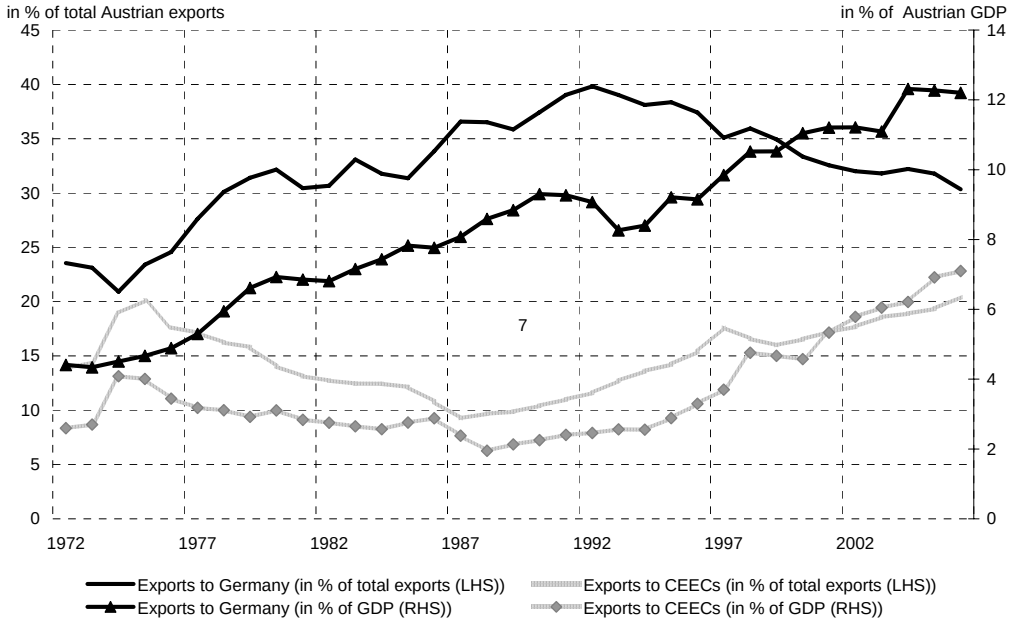
Intensive ties characterize the economic relations between Austria and its largest trading partner Germany. Whilst trade has always played an important role, financial integration became a strong growing link since the full liberalization of the capital account in Austria at the end of the 1980s.

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 2006 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 around 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.

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 2006 (see chart 4). In relative terms, we see substantial changes of the importance of Germany over time. The share of 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.

Chart 4: Austrian Exports of Commodities to Germany and the CEECs[6]



Source: Statistics Austria.

The development of the export share of the CEECs mirrors this picture. Since the mid-1970s 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[7]. A high degree of intra-industrial trade is

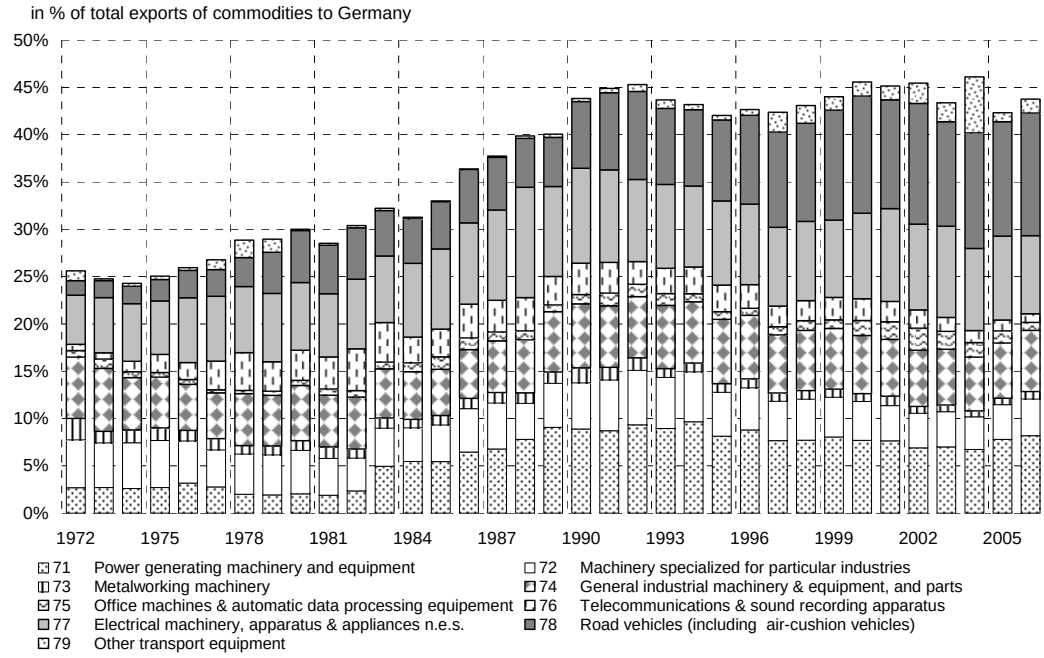
[6] CEECs includes Albania, Bulgaria, Croatia, Czech Republic, Slovakia, Poland, Romania, Hungary, Estonia, Latvia, Lithuania, Macedonia, Slovenia, Bosnia-Herzegovina, Russia, Ukraine, Belarus.

[7] 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

characteristic for developed economies with similar production structures and economies of scale in the production and leads to an increase in the synchronization of business cycles.

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 1970s 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 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 44% in 2006 and of the subcomponent road vehicles from 2% to 13% reflects that fact (see chart 5).

Chart 5: Composition of Austrian Exports of Machinery and Transport Equipment (SITC 7) to Germany



Source: OECD – OLIS database.

of commodities of sector i. The Grubel-Lloyd-Index is reported for two-digit SITC-commodities.

Foreign Direct Investment: Steady Growth of Outward FDI to CEECs

Financial integration developed even more dynamically than trade integration over the last 17 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 6% of GDP in 1990 to more than 20% each in 2005 (see table 3). 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 3: Stocks of Austrian Foreign Direct Investment

	1990	1995	2000	2003	2005
in % of total inward (outward) FDI					
Inward from Germany	38.2	41.9	46.8	39.9	38.2
Outward to Germany	24.4	19.4	19.0	16.1	12.7
Inward from CEECs	1.3	1.4	1.1	1.5	1.0
Outward to CEECs	11.0	28.0	30.1	36.8	43.6
in % of Austrian GDP					
Inward from Germany	2.4	3.5	7.3	7.5	9.2
Outward to Germany	0.7	1.0	2.4	3.2	2.9
Inward from CEECs	0.1	0.1	0.2	0.3	0.2
Outward to CEECs	0.3	1.4	3.8	7.2	9.9
Total FDI (mill. EUR)					
Total outward FDI (mill. EUR)	3,683	8,674	26,674	44,308	55,476
Total outward FDI (in % of GDP)	2.7	4.9	12.7	19.6	22.6
Total inward FDI (mill. EUR)	8,513	14,458	32,704	42,632	58,874
Total inward FDI (in % of GDP)	6.2	8.2	15.5	18.8	24.0

Source: OeNB.

4. Summary

In this paper, we have analyzed the comovement of the German and the Austrian economy. We find an increase of synchronization of the two business cycles over time. The relative position in time has shifted. Whilst the Austrian output gap was lagging behind the German one by one quarter at the beginning of the 1970s, it is now leading by two quarters. The increase in synchronization can be observed in all demand components with the exception of government consumption. Especially exports exhibit a nearly perfect comovement since 1990. Turning to the production side of GDP, we identify industry as the sector with the highest degree of comovement, whilst construction and the service sectors show much less

comovement. Summing up the results, we see no indication of a decoupling of the Austrian economy from Germany.

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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

Table B1: Correlations for Different Lags and Leads between the Output Gap of German and Austrian GDP and Its Demand Components[1]

	GDP	Private consumption	Government consumption	Investment	Exports	Imports	Domestic demand
1970Q1-2007Q3							
4	0.29	0.14	-0.24	0.07	0.34	0.16	0.06
3	0.41	0.18	**-0.25**	0.19	0.50	0.31	0.16
2	0.51	0.23	-0.24	0.31	0.67	0.46	0.27
1	0.60	0.28	-0.18	0.42	**0.77**	0.59	0.36
0	**0.64**	**0.29**	-0.10	0.52	0.76	**0.66**	0.42
-1	0.61	0.27	-0.02	0.57	0.63	0.65	**0.43**
-2	0.53	0.20	0.03	**0.58**	0.40	0.54	0.39
-3	0.41	0.12	0.13	0.55	0.15	0.37	0.33
-4	0.26	0.04	0.19	0.46	-0.07	0.17	0.25
1970Q1-1989Q4							
4	0.10	-0.03	-0.32	-0.10	0.29	0.01	-0.14
3	0.21	-0.01	-0.34	0.04	0.45	0.18	-0.05
2	0.32	0.03	-0.35	0.17	0.61	0.37	0.06
1	0.46	0.09	-0.26	0.32	**0.70**	0.55	0.17
0	0.54	0.14	-0.16	0.48	0.67	0.67	0.27
-1	**0.56**	**0.16**	-0.04	0.59	0.49	**0.68**	0.31
-2	0.52	0.12	0.06	0.68	0.20	0.60	0.35
-3	0.44	0.06	0.26	**0.71**	-0.12	0.44	**0.37**
-4	0.32	0.01	**0.40**	0.69	-0.38	0.24	0.35
1990Q1-2007Q3							
4	0.61	0.52	**-0.15**	0.45	0.38	0.34	0.50
3	0.71	0.59	-0.11	0.56	0.57	0.51	0.64
2	0.80	0.66	-0.08	0.64	0.75	0.64	0.75
1	**0.83**	**0.72**	-0.05	**0.67**	0.86	0.73	**0.80**
0	0.79	0.64	0.00	0.64	**0.87**	**0.75**	0.78
-1	0.70	0.52	0.00	0.55	0.80	0.71	0.69
-2	0.57	0.39	-0.03	0.40	0.68	0.59	0.53
-3	0.40	0.29	-0.06	0.20	0.53	0.39	0.31
-4	0.21	0.13	-0.09	-0.02	0.34	0.16	0.09

[1] *'+' ('-'): Austria leads (lags) Germany.*
Source: WIFO, Bundesbank, authors' calculations.

Table B2: Tests for Granger-Causality between the Output Gap of German and Austrian GDP and Its Demand Components (pValues)

	H0: Germany does not Granger-cause Austria at				H0: Austria does not Granger-cause Germany at			
	1 quarter	2 quarters	3 quarters	4 quarters	1 quarter	2 quarters	3 quarters	4 quarters
GDP								
1970Q1-2007Q3	0.07	0.00	0.00	0.13	0.59	0.08	0.02	0.00
1970Q1-1989Q4	0.04	0.04	0.02	0.56	0.26	0.55	0.36	0.02
1990Q1-2007Q3	0.17	0.13	0.00	0.00	0.00	0.00	0.00	0.35
Private consumption								
1970Q1-2007Q3	0.51	0.26	0.44	0.08	0.65	0.17	0.03	0.29
1970Q1-1989Q4	0.51	0.59	0.40	0.24	0.31	0.71	0.59	0.53
1990Q1-2007Q3	0.49	0.25	0.36	0.00	0.00	0.00	0.00	0.03
Government consumption								
1970Q1-2007Q3	0.17	0.49	0.01	0.02	0.05	0.14	0.03	0.01
1970Q1-1989Q4	0.18	0.54	0.00	0.02	0.04	0.15	0.02	0.00
1990Q1-2007Q3	0.69	0.85	0.94	0.70	0.80	0.66	0.70	0.98
Investment								
1970Q1-2007Q3	0.00	0.00	0.00	0.40	0.01	0.75	0.75	0.00
1970Q1-1989Q4	0.00	0.00	0.00	0.31	0.00	0.41	0.82	0.00
1990Q1-2007Q3	0.11	0.20	0.22	0.12	0.02	0.10	0.11	0.24
Exports								
1970Q1-2007Q3	0.02	0.14	0.00	0.00	0.00	0.00	0.00	0.02
1970Q1-1989Q4	0.01	0.03	0.00	0.02	0.00	0.37	0.00	0.02
1990Q1-2007Q3	0.85	0.01	0.01	0.00	0.00	0.00	0.00	0.03
Imports								
1970Q1-2007Q3	0.01	0.00	0.00	0.75	0.32	0.57	0.70	0.00
1970Q1-1989Q4	0.02	0.00	0.06	0.06	0.02	0.07	0.28	0.09
1990Q1-2007Q3	0.02	0.00	0.00	0.35	0.22	0.37	0.64	0.00
Domestic demand								
1970Q1-2007Q3	0.07	0.07	0.12	0.30	0.31	0.17	0.20	0.17
1970Q1-1989Q4	0.12	0.16	0.17	0.34	0.04	0.31	0.46	0.30
1990Q1-2007Q3	0.78	0.00	0.00	0.10	0.00	0.01	0.12	0.00

Table B3: Correlations for Different Lags and Leads between the Output Gap of German and Austrian GDP Production Side[1]

	Industry (C-E)	Construction (F)	Wholesale and retail trade (G-I)	Financial, real estate, renting and business activities (J-K)	Other service activities (L-P)
1991Q1-2007Q3					
4	0.14	0.22	0.27	**0.66**	0.07
3	0.38	0.39	0.43	0.58	0.07
2	0.60	0.54	**0.54**	0.44	0.07
1	0.76	**0.60**	0.50	0.26	0.01
0	**0.81**	0.55	0.36	0.07	-0.12
-1	0.75	0.40	0.29	-0.15	-0.30
-2	0.59	0.20	0.22	-0.35	-0.44
-3	0.39	0.03	0.14	-0.53	**-0.51**
-4	0.20	-0.11	0.10	-0.62	-0.48

[1]'+' ('-'): Austria leads (lags) Germany.
Source: WIFO, Bundesbank, authors' calculations.

Table B4: Tests for Granger-causality between the Output Gap of German and Austrian GDP Production Side (p-values)

	H0: Germany does not Granger-cause Austria at				H0: Austria does not Granger-cause Germany at			
	1 quarter	2 quarters	3 quarters	4 quarters	1 quarter	2 quarters	3 quarters	4 quarters
Industry (C-E)	0.53	0.04	0.00	0.08	0.27	0.01	0.03	0.07
Construction (F)	0.02	0.90	0.94	0.10	0.01	0.01	0.03	0.98
Wholesale and retail trade (G-I)	0.83	0.20	0.13	0.01	0.00	0.01	0.00	0.06
Financial, real estate, renting and business activities (J-K)	0.00	0.08	0.00	0.00	0.00	0.01	0.03	0.07
Other service activities (L-P)	0.00	0.01	0.01	0.02	0.07	0.37	0.09	0.01

Source: WIFO, Bundesbank, authors' calculations.