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The monetary transmission mechanism in the euro area: A VAR-analysis for Austria and Germany

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Working Paper No. 452

**The Monetary Transmission Mechanism in the Euro Area:
A VAR-Analysis for Austria and Germany**

by

Bernhard Bartels

June 2009

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The monetary transmission mechanism in the Euro Area: A VAR-analysis for Austria and Germany*

Bernhard Bartels[†]

02.06.2009

Abstract

With the transition to the European Monetary Union (EMU), the instrument of monetary policy for individual member countries has been abolished. This step has led to serious challenges for the different states to stabilize their economies to various economic shocks. Different labor market rigidities lead to different responses to monetary impulses in the countries. This paper deals with this problem by setting up a VAR-analysis to investigate the different shocks on Germany and Austria. The results show that Germany experiences less fluctuation in growth and unemployment than Austria which can be assigned to higher labor market rigidities.

JEL Classification: D21, F14, L22

Keywords: monetary transmission mechanism, vector autoregression

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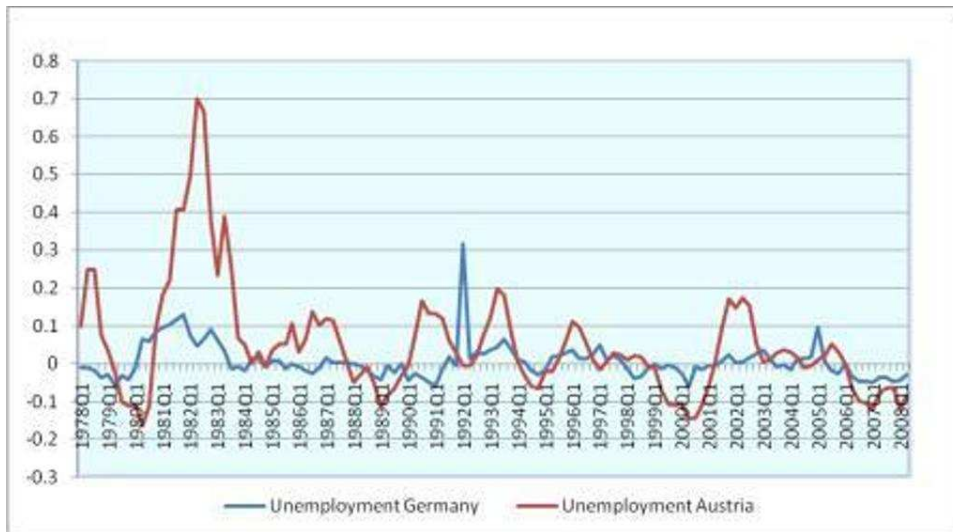
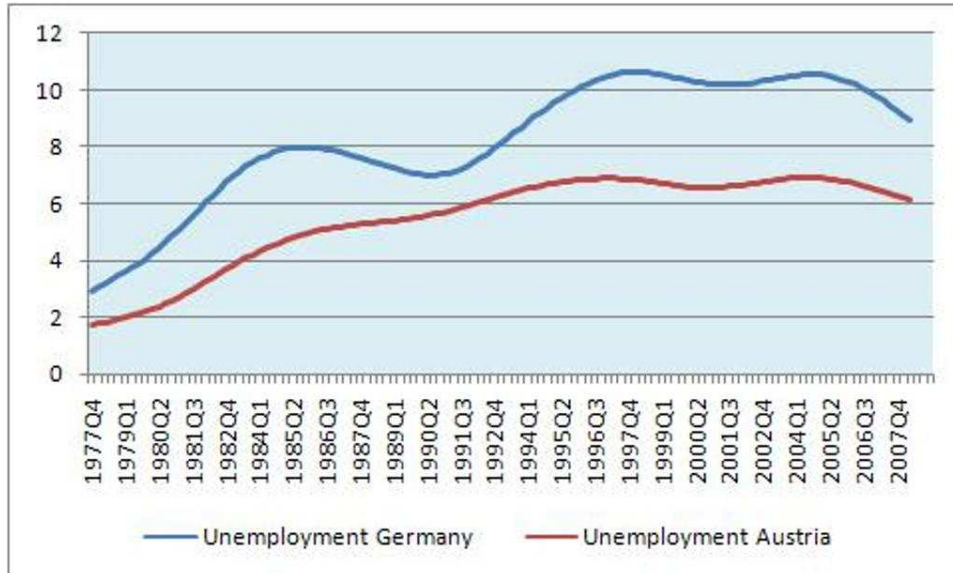
1 Introduction

How do different labor market institutions affect business cycles across countries? Especially since the fundamental criticism of the traditional Phillips curve trade off by Friedman and Phelps, empirical studies about the influence of labor market rigidities on economic growth have become widely acknowledged in the theoretical and empirical literature. Important contributions during recent years have to be attributed to Ljungqvist & Sargent (1998) or Saint-Paul (1997), both discussing different reasons for rising unemployment in Europe and its persistence in general. Also Blanchard & Wolfers (2000) investigate why especially European countries differ with respect to their unemployment trends.

A recently published paper by Merkl & Schmitz (2009) studies the effect of different labor market institutions on macroeconomic volatilities. While they find a significant negative effect on output volatility, no evidence could be found for inflation volatility being influenced by institutions (Merkl & Schmitz 2009, p.2).

The presented paper will concentrate on the question in how far different reactions to shocks on two European economies may have an impact on the effectiveness of monetary policy. For our case, we select Germany and Austria as examples. Both countries have comparable structural features with respect to their economic structure, however, unemployment rates have moved in adverse directions during recent years which points to differences in rigidities (Nickell 2003, p. 14). The following two figures illustrate broadly the unemployment growth of both countries as percentage changes year-on-year and as trend-adjusted growth rates (by applying the Hodrick-Prescott filter):

Figure 1: unemployment trend and year on year growth



Source: calculated by author with data from the World Bank

With the exception of a structural break during the first quarter of 1992 due to the German reunification, we see a higher volatility in the Austrian rate compared to German unemployment in Figure 1. This may lead to the assumption that firms in Austria are able to adjust employment faster to economic shocks than employers in Germany. The trend growth shows that Germany has experienced higher trend growth of unemployment over time. However, compared to the 1970s, both countries suffer from a higher trend rate today.

To investigate cyclical impacts on unemployment with separating from trend behavior, a VAR-analysis will be used to apply a number of different shocks on both countries. We will set up one VAR-system for each country to compare the impact of similar shocks on the volatility of unemployment and economic growth. The remainder of the paper will be as follows: The next section will cope with the data and the econometric method before section 3 will identify the model. In section 4, the main results are presented before concluding remarks are presented in section 5.

2 Data and empirical method

2.1 Data

For the following model a quarterly dataset of five variables from 1978:4 to 2008:2 for both countries will be used. The included variables are real GDP, CPI inflation, the unemployment rate, real wages and a three-month interest rate. The series have been chosen according to related papers from Blanchard (1989) and Funke (1997). One innovation compared to the former studies concerns the choice of an interest rate to apply monetary shocks to the system. Whereas Blanchard (1989) and Blanchard & Quah (1989) used the money supply as endogenous variable, a three-month interest rate will be included in the here presented paper ¹. Following Mojon & Peersman (2001), monetary aggregates will be excluded, since the interest rate seems to be better suited as an explanatory variable for monetary shocks, whereas money aggregates play only a secondary role. A third innovation

¹We will use the LIBOR and the EURIBOR (which replaced the LIBOR in 1999)

compared to the analysis of Blanchard/Quah and Funke concerns the inclusion of exogenous variables to capture foreign impacts. Following Mojon & Peersman (2001), we included the US three-month interest rate, US GDP growth and each country's nominal exchange rate.

One condition of a valid VAR-analysis is the requirement of seasonal adjustment for the series included. Except for unemployment, all series have been adopted as seasonal adjusted from the International Financial Statistics (IFS) database of the International Monetary Fund (IMF). However, the unemployment and wage series have been taken from the German Bundesbank for Germany, respectively from EUROSTAT and the IFS for Austria. Unemployment had to be transformed into quarterly data by taking monthly averages.

To fulfill necessary conditions of stationarity in the VAR-framework, we transform all variables into logs and first differences to exclude trend behavior. Augmented Dickey Fuller (ADF)- tests for all variables show that the series are stationary in log differences and will therefore be characterized as I(1) processes ².

2.2 Empirical method

Existing studies examining transmission differences of monetary policy across countries use a variety of empirical methods (Peersman 2004, p.287ff.). However, most recent papers apply a VAR-model to explain output responses to monetary shocks (Mojon & Peersman 2001, p.7). Since studies investigating explicitly the behavior of unemployment as a response to various shocks are missing, we now set up a VAR-system to analyze unemployment fluctuations.

The main advantage of the vector autoregression analysis is the use of several endogenous variables in one model, whereas simple regressions only divide between endogenous and exogenous variables by assumption and therefore take the risk of being confronted with misspecifications. However, in a VAR-analysis, every variable is modeled as being dependent on specified time-lags of itself and the other variables in the system. Therefore it is possible to explain dynamic responses of exogenous

²The tables are presented in the Appendix of the paper

shocks to these variables by introducing time-lags as additional explanatory factors.

A stationary set of time-series in a VAR setting allows several applications, often being used the Granger causality test, a derivation of impulse response functions or the forecast error variance decomposition.

Here, we concentrate on impulse response functions which display the reaction of a variable over time to a shock that is caused to one of the other variables in the system. Since the cyclical behavior of variables is considered, these shocks are supposed to die out after several periods. However, to compute impulse response functions, the VAR-model has to be transformed in a reduced form so that it is possible to compute all regressors of the model.

In their structural form (leaving the exogenous variables aside), the equations of every endogenous variable in the system will have the following form in matrix representation:

$$A_0 y_t = a_1 y_{t-1} + \dots + A_p y_{t-p} + D \epsilon_t \tag{1}$$

In this form, y represents the vector containing all endogenous variables and A stands for the according matrix including the corresponding regressors. ϵ represents the vector with the disturbance terms of all equations and the matrix D includes all shock regressors.

In its structural form represented in (1) the whole system is underrepresented and can therefore not be estimated. Consequently, several further steps have to be applied. First, the structural form will be transformed into a reduced form by multiplying (1) with A_0^{-1} .

After this computation, all equations can be estimated consistently, however, only if the values of A_0 and D are known. The reduced form will be written as follows:

$$Y_t = B_1 Y_{t-1} + \dots + B_p y_{t-p} + u_t \tag{2}$$

The transformed variables in (2) are defined as follows ³:

$$B_i = A_0^{-1}A_i \tag{3}$$

and

$$A_0^{-1}D\epsilon_t = u_t \tag{4}$$

Since A_0 and D are unknown, we further assume that all disturbances ϵ_t are not correlated with each other and will therefore be leading to a diagonal covariance matrix D . However, there still remain parameters in matrices A and D which can not be estimated. Consequently, some identifying restrictions for the regressors in A_0 are necessary. This will be done by applying the so called Choleski decomposition which transforms the original matrix A_0 into a lower triangular matrix. Since all elements of A_0 are regressors of the contemporaneous relationships between the endogenous variables in the system, economic theory is needed to exclude some causal links between variables where theory suggests them to be contemporaneously independent. For example, real GDP growth is often seen as not being contemporaneously related to nominal and real shocks, since the transmission process takes time to affect economic growth (Blanchard & Quah 1989, p.660). We present the results of this identification for our model in the next section.

3 Identification

3.1 Choleski-Decomposition

As already mentioned above, the VAR-model will consist of the logs of real GDP, unemployment, CPI inflation, real wages and interest rates for both countries.

With the imposed restrictions, the system will be stated as follows:

³For a detailed analysis, see (Helmut Lütkepohl 2004, p:172ff.)

$$u_y = d_{11}\epsilon_y \tag{5}$$

$$u_u + a_{21}u_y = d_{22}\epsilon_u \tag{6}$$

$$u_p = d_{32}\epsilon_u + d_{33}\epsilon_p \tag{7}$$

$$u_w + d_{42}u_u + d_{43}u_p = d_{42}\epsilon_u + d_{44}\epsilon_w \tag{8}$$

Here, y , u , p , w and i represent real GDP, unemployment, inflation, wages and interest rates. Economically, the following reasoning stands behind the chosen structure which has been adapted from Funke (1997) and Blanchard (1989). Disturbances in economic growth are only affected by a demand shock (ϵ_y) in the same quarter. All other variables have long-run impacts, since nominal rigidities prevent the economy from simultaneous adjustment (Funke 1997, p.15). A disturbance in the unemployment rate is interpreted as a reaction on business fluctuations or supply-side (productivity) shocks (ϵ_u). Price changes are affected by their own innovations and by supply shocks, but are modeled as not being affected by demand shocks, according to the argument of nominal rigidities. Wages respond to structural innovations in unemployment and its own disturbance term

and to reduced-form innovations in unemployment and prices. Finally, the interest rate as the most endogenous variable in the system depends on every other variable in the model and is also subject to its own innovations (ϵ_i) (Funke 1997, p.15f.).

3.2 Lag-length specification

Before estimating the VAR-model, it is necessary to make a decision about the optimal lag-length of the system. The problem related to the use of numerous lags is that too many degrees of freedom are wasted in case of including lags that do not contribute significantly to the explanation of the system. However, if significant lags are excluded, this may lead to a misspecification, since important explanatory variables are missing. A number of tests exist, that display recommendations about the optimal lag length of VAR-systems. The results for Germany and Austria are shown in the following figure:

Figure 2: Lag-length results for Germany and Austria

VAR Lag Order Selection Criteria						
Endogenous variables: GDPG UNEMPG CPIG WAGEG INTEREST						
Exogenous variables: C REERG INTERESTUS GDPUS						
Date: 03/02/09 Time: 10:20						
Sample: 1978Q1 2008Q2						
Included observations: 95						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	1318.685	NA	9.20e-19	-27.34075	-26.80309	-27.12349
1	1401.342	149.6512	2.74e-19	-28.55456	-27.34483*	-28.06574*
2	1419.182	30.42309	3.21e-19	-28.40384	-26.52203	-27.64345
3	1439.414	32.37002	3.61e-19	-28.30344	-25.74957	-27.27149
4	1488.081	69.75595	2.35e-19	-28.75981	-25.53386	-27.45608
5	1517.909	44.22353	2.13e-19	-28.90334	-25.00532	-27.32825
6	1547.262	37.69587*	2.08e-19*	-28.99499*	-24.42490	-27.14833
7	1564.159	19.92101	2.70e-19	-28.82441	-23.58224	-26.70618
8	1590.848	28.65536	2.95e-19	-28.85996	-22.94572	-26.47017
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

VAR Lag Order Selection Criteria						
Endogenous variables: GDPA UNEMPA CPIA WAGEA INTEREST						
Exogenous variables: C REERA INTERESTUS GDPUS						
Date: 03/02/09 Time: 10:20						
Sample: 1978Q1 2008Q2						
Included observations: 108						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	1527.798	NA	5.14e-19	-27.92215	-27.42546*	-27.72078
1	1581.875	99.14480	3.01e-19	-28.48065	-27.34309	-28.00752
2	1604.273	38.98986	3.17e-19	-28.41247	-26.67405	-27.70760
3	1651.234	77.39904	2.14e-19	-28.81916	-26.45987	-27.86255
4	1730.339	123.0521	8.00e-20*	-29.82110	-26.84095	-28.61278*
5	1744.651	20.93788	1.00e-19	-29.62317	-26.02216	-28.16309
6	1757.478	17.57758	1.31e-19	-29.39774	-25.17587	-27.68593
7	1782.173	31.55467	1.40e-19	-29.39210	-24.54936	-27.42854
8	1831.900	58.93536*	9.61e-20	-29.85000*	-24.38840	-27.63471
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Source: calculated by Eviews

The results of the application of different information criteria to Germany show an overall recommendation to adapt a lag ordering of between one and five periods. However, the Schwarz information criterion (SC) as an exception represents generally a more rigid calculation compared to AIC or the HQ- criterion for large time series (Helmut Lütkepohl 2004, p.33f.) ⁴.

The results for Austria are similar to the ones for Germany. Therefore, being confronted with the same problem of only 114 observations as in Germany (108 obs.), an optimal lag length of two periods is also chosen here. Additional tests with different lag lengths did not lead to significantly diverging results.

The following section will present the empirical results of the VAR-estimation.

4 Empirical results

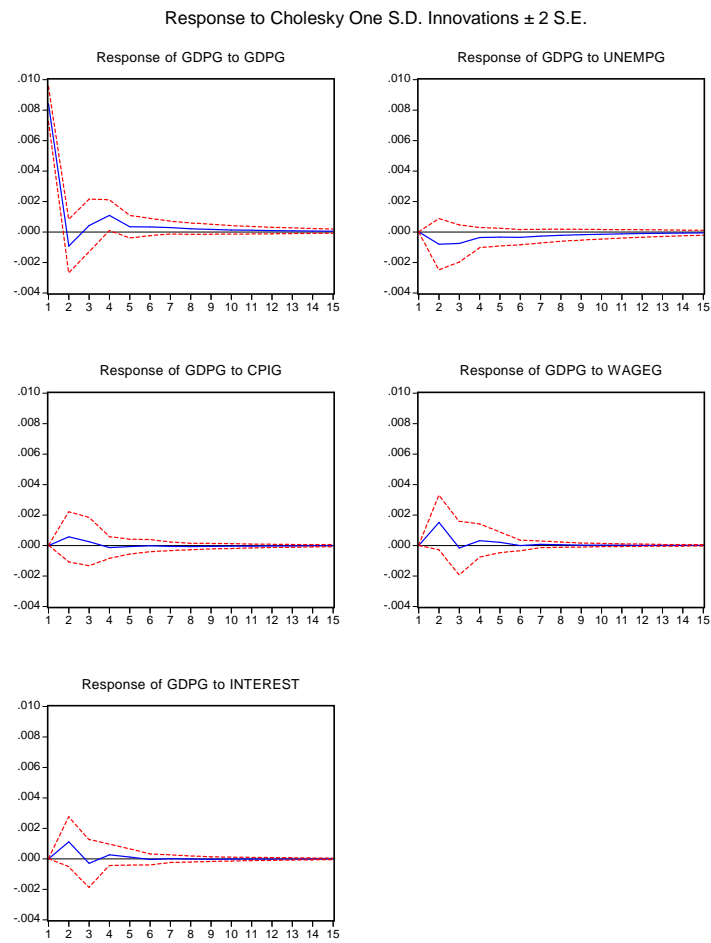
4.1 Impulse-Response Functions for business fluctuation

The following figures show the impulse response functions with two standard error bands (red color dotted lines) above and below the function ⁵:

⁴Funke (1997) and Mojon & Peersman (2001) use also a lag length of order two

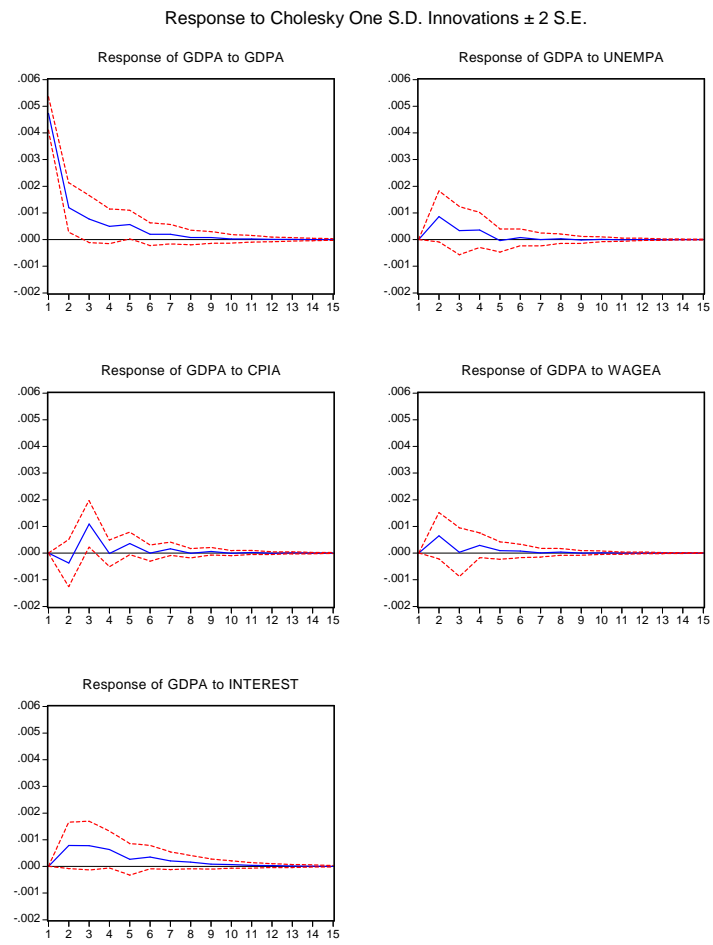
⁵The impulse-response-functions of all variables are shown in the Appendix of the paper

Figure 3: Impulse-Responses for German GDP



Source: calculated by Eviews

Figure 4: Impulse-Responses for German GDP



Source: calculated by Eviews

4.1.1 Demand shocks

As already stated by Funke (1997), demand shocks have a significant impact on the business cycle in Germany which is quite persistent for about two years. The same is true for Austria, where the effect of demand innovations has by large the strongest impact on the economy. As expected, a positive demand shock leads to rising GDP in both countries. These results are in line with the Keynesian model with sticky prices, which suggests a temporary rise in economic growth that is stimulated by increased government spending or expanding investment, consumption or export shares.

4.1.2 Supply and wage shocks

An adverse supply shock leads to decreasing growth in Germany, being persistent for more than two years. By interpreting an adverse supply shock as declining productivity, this result makes also sense and is again broadly in line with the findings of Funke (1997) for Germany.

Regarding Austria, we come to the surprising result of expanding GDP in response to a negative supply shock. However, the impulse responses also show that the direction of the shock is not significant with respect to the two standard error bands. Nevertheless, it is interesting that Austrian GDP seems therefore not to respond to a productivity decline.

Wage shocks in both countries do not affect economic growth. Although we can see a slightly positive reaction of GDP in Germany and Austria, the effect is not significant. Blanchard (1989) comes to a similar result for the United States.

4.1.3 Price and interest rate shocks

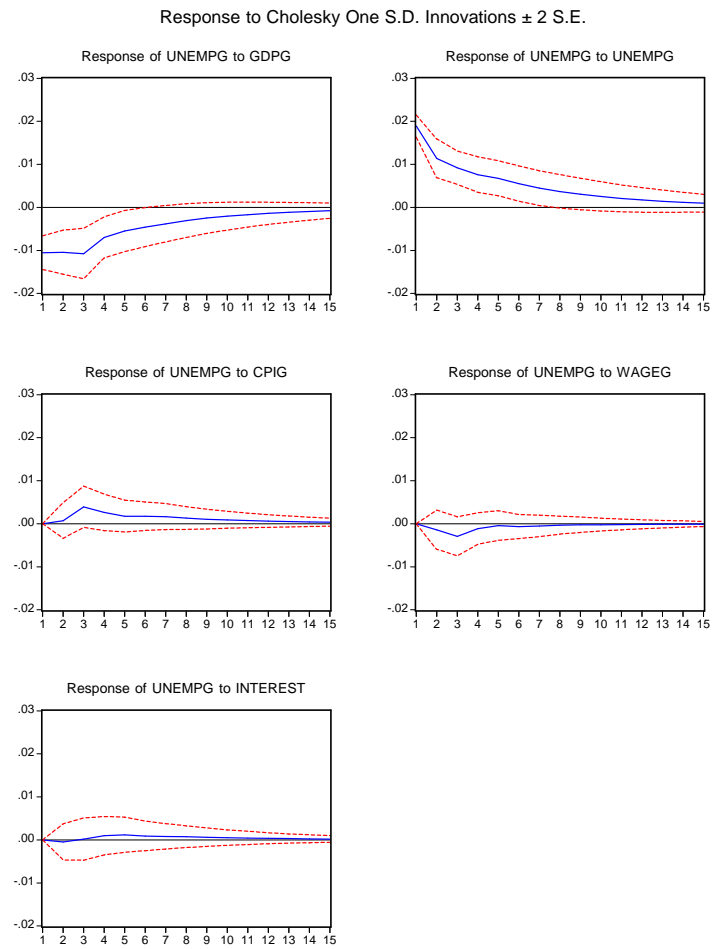
With respect to price and interest rate shocks, we can observe no reaction of GDP in Germany. The result is surprising insofar as that even after a lag of several periods no response of economic growth to interest rate impulses or price shocks can be detected. However, if we assume central banks to successfully anticipate fluctuations in economic growth, the result becomes more reasonable. For Austria, the result is also not significant in most periods. However, we can see a pro-cyclical response

of GDP to interest rate shocks during the first year which is quite surprising. For inflation, a less clear result is observed, but we see a slight upturn of the economy during the fourth quarter after the appearance of the shock. The stronger reaction of GDP may be due to the fact that Austria had no independent monetary policy during the observation period, since they either followed the German Bundesbank in the European Monetary System or belonged to the European Monetary Union. In the following, section 4.2 will show the results for unemployment reactions to various shocks.

4.2 Impulse response functions of unemployment

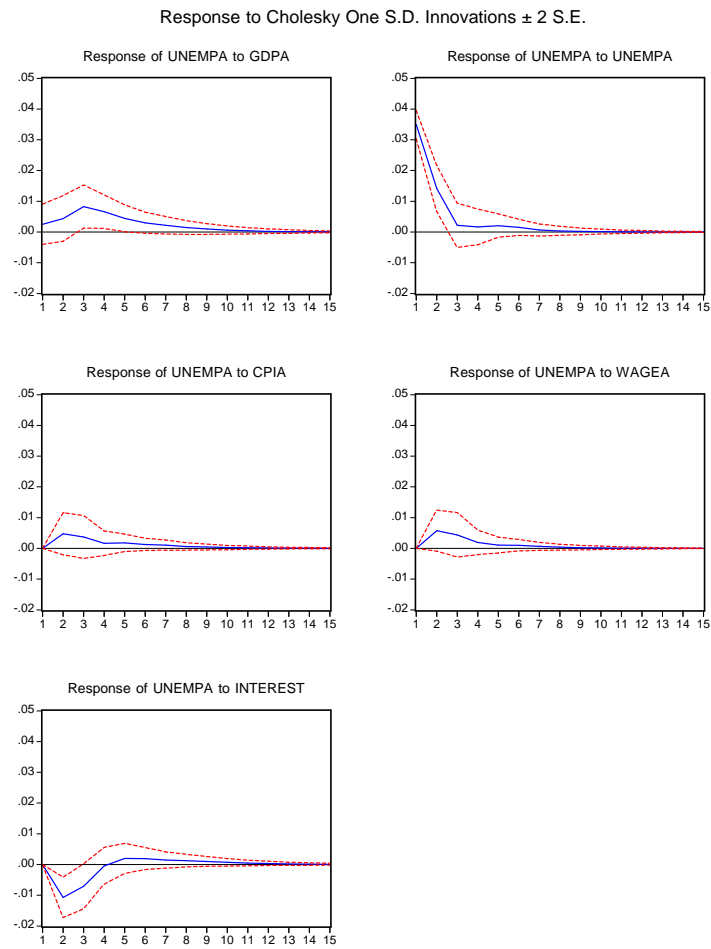
The following figures present the impulse response functions for unemployment in both countries:

Figure 5: Impulse-Responses for German unemployment



Source: calculated by Eviews

Figure 6: Impulse-Responses for Austrian unemployment



Source: calculated by Eviews

4.2.1 Demand shocks

Regarding the response of unemployment in Germany to a demand shock, we find significant evidence for a positive reaction of the labor market to increasing consumption or investment expenditures. Similar results have been obtained for Germany by Funke (1997) and Blanchard (1989) for the United States. On the contrary, Austria is confronted with rising unemployment in response to a positive demand shock. Although the result is not significant for most periods, no tendency for a decrease in unemployment during the whole observation period could be observed. This result contradicts with our theory insofar that the labor market seems to respond more quickly on shocks in Germany than in its neighbor country although the rigidities have been observed to be greater than in Austria. This led us to the assumption of a less volatile labor market. However, with decreasing unemployment as a response to a demand shock in Germany, the results are contradicting to the underlying theory.

4.2.2 Supply and wage shocks

Coming to adverse supply shocks, Germany experiences a significant rise in unemployment for roughly eight quarters. This result is consistent with the observations of Funke (1997) who observes a similar effect. The same direction for the shock can be shown for Austria. However, the magnitude of a supply innovation in Austria is higher during the first periods than in Germany. A second difference can be observed with respect to the length of the shock: Whereas the shock in Germany is significant for around 8 periods, it dies out already after one year in Austria. These observations support our theoretical assumption of experiencing a tighter labor market in Germany compared to Austria, since it takes more time for firms to fire their workers as a reaction to productivity declines. However, both results are contradicting to the findings of Gali (1999). In his paper, the author finds evidence for the United States and the G7 (except Japan) that employment is actually decreasing after a positive productivity shock. This is due to sticky prices and monopolistic competition, where employers accommodate demand at existing prices, producing the same quantity with less working hours and therefore reducing employment in the first period. If this causality also holds in times of a

productivity decline, our results are significantly different from Gali (1999) who also finds a reduction in working hours as a response to positive productivity shocks in Germany. The different effects may have the following reason: Whereas Gali (1999) uses working hours as a proxy for employment we have taken the unemployment series to find evidence for a rigid labor market. However, if firms are not able to fire workers as a direct response to the positive productivity shocks, they probably just reduce new entries of workers or reduce the working hours of employees (but do not fire them).

Concerning wage innovations, we find no significant influence on unemployment for Germany. This result is broadly in line with our theory of a regulated labor market, where firms are not able to simultaneously adjust employment when being confronted with higher wage costs. For Austria, we find evidence for higher unemployment in response to rising wages during the first year. Nevertheless, the magnitude is quite small and not always significantly positive. However, the positive reaction can be interpreted as a more flexible reaction of firms in Austria when being compared to the impulse response function in Germany.

4.2.3 Price and interest rate shocks

With respect to price and interest rate shocks, no significant response for Germany can be detected. These results support our hypothesis of a highly shock-isolated labor market that does not respond instantaneously to monetary impulses or price changes. On the contrary, we observe a reaction of unemployment to interest rate shocks in Austria. However, the direction is surprising, since unemployment falls in response to interest rate hikes during the first year before the shock dies out and becomes insignificant. This result may be due to the problem of having no independent monetary policy in during most of the observation time, leading to pro-cyclical interest rates in the country. We saw the same problem for Austria already with respect to economic growth before.

5 Concluding remarks

In the previous analysis we investigated the responses of growth and unemployment in Germany and Austria to various shocks. The results of the VAR-analysis should give us some insights to the different reactions of growth and unemployment to demand and supply innovations, wage, price and interest rate shocks.

Our theoretical assumption of the German labor market being less responsive to shocks than the Austrian labor market could be also observed empirically by applying a VAR-estimation procedure. Except for demand shocks we could not find significant changes in unemployment in Germany for price, wage or interest rate shocks. With respect to impacts of the shocks on GDP, we also find evidence for a weaker response in Germany: Interest rate, price and supply shocks lead to fewer fluctuations in the business cycle than in Austria which further supports our hypothesis of more rigidities on the German labor market.

Several implications follow from these results. First, the different responses have an impact on the European Monetary Union, since the common monetary policy will have to take different labor market structures into account when setting the interest rate to stabilize cycles in the union as a whole. This problem was already seen for Austria, reacting pro-cyclical on interest rate shocks in our analysis.

With sticky prices and a rigid structure of labor markets, it can therefore be optimal for the monetary authority to react pro-cyclical on shocks to force a rigid economy towards a faster adjustment. Nevertheless, in the European Union, we still face the problem of differing labor market institutions which demand for different policies to adjust their business cycles to various shocks. This would result in a trade-off of monetary policy to either react pro-cyclical in order to stabilize more rigid economies as Germany or to apply a counter-cyclical policy to accommodate shocks in more flexible economies as Austria.

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Appendix

Figure 7: Unit Root tests for GDP

Augmented Dickey-Fuller Unit Root Test on GDPG

Null Hypothesis: GDPG has a unit root Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic based on SIC, MAXLAG=12)				
		t-Statistic	Prob.*	
Augmented Dickey-Fuller test statistic		-11.80970	0.0000	
Test critical values:	1% level	-4.037668		
	5% level	-3.448348		
	10% level	-3.149326		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(GDPG) Method: Least Squares Date: 03/03/09 Time: 11:01 Sample (adjusted): 1978Q3 2008Q2 Included observations: 118 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPG(-1)	-1.094686	0.092694	-11.80970	0.0000
C	0.006404	0.001767	3.624191	0.0004
@TREND(1978Q1)	-1.82E-05	2.39E-05	-0.762903	0.4471
R-squared	0.548093	Mean dependent var		0.000204
Adjusted R-squared	0.540234	S.D. dependent var		0.013362
S.E. of regression	0.009060	Akaike info criterion		-6.544701
Sum squared resid	0.009441	Schwarz criterion		-6.474260
Log likelihood	389.1373	F-statistic		69.73857
Durbin-Watson stat	2.008956	Prob(F-statistic)		0.000000

Augmented Dickey-Fuller Unit Root Test on GDPA

Null Hypothesis: GDPA has a unit root Exogenous: Constant, Linear Trend Lag Length: 3 (Automatic based on SIC, MAXLAG=12)				
		t-Statistic	Prob.*	
Augmented Dickey-Fuller test statistic		-2.118582	0.5298	
Test critical values:	1% level	-4.038365		
	5% level	-3.448681		
	10% level	-3.149521		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(GDPA) Method: Least Squares Date: 03/03/09 Time: 11:02 Sample (adjusted): 1979Q2 2008Q2 Included observations: 117 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDPA(-1)	-0.248507	0.117299	-2.118582	0.0364
D(GDPA(-1))	-0.628501	0.114681	-5.480448	0.0000
D(GDPA(-2))	-0.630920	0.098251	-6.421485	0.0000
D(GDPA(-3))	-0.532642	0.079757	-6.678294	0.0000
C	0.002300	0.001409	1.632705	0.1054
@TREND(1978Q1)	-1.40E-05	1.35E-05	-1.037587	0.3017
R-squared	0.571003	Mean dependent var		-3.80E-05
Adjusted R-squared	0.551679	S.D. dependent var		0.006285
S.E. of regression	0.004208	Akaike info criterion		-8.053598
Sum squared resid	0.001966	Schwarz criterion		-7.911948
Log likelihood	477.1355	F-statistic		29.54860
Durbin-Watson stat	1.826077	Prob(F-statistic)		0.000000

Source: calculated by Eviews, upper table represents Germany, lower table represents Austria, the same applies for all subsequent tables below

Figure 8: Unit Root tests for Unemployment

Augmented Dickey-Fuller Unit Root Test on UNEMPG

Null Hypothesis: UNEMPG has a unit root Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic based on SIC, MAXLAG=12)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.618009	0.0326
Test critical values:	1% level		-4.039797	
	5% level		-3.449365	
	10% level		-3.149922	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(UNEMPG) Method: Least Squares Date: 03/03/09 Time: 11:04 Sample (adjusted): 1979Q2 2008Q2 Included observations: 115 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPG(-1)	-0.209569	0.057924	-3.618009	0.0004
C	0.005113	0.004510	1.133741	0.2593
@TREND(1978Q1)	-6.94E-05	6.23E-05	-1.114744	0.2673
R-squared	0.105711	Mean dependent var		-0.000402
Adjusted R-squared	0.089741	S.D. dependent var		0.023349
S.E. of regression	0.022277	Akaike info criterion		-4.744806
Sum squared resid	0.055580	Schwarz criterion		-4.673199
Log likelihood	275.8264	F-statistic		5.619554
Durbin-Watson stat	2.003806	Prob(F-statistic)		0.001918

Augmented Dickey-Fuller Unit Root Test on UNEMPA

Null Hypothesis: UNEMPA has a unit root Exogenous: Constant, Linear Trend Lag Length: 2 (Automatic based on SIC, MAXLAG=12)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.802086	0.0197
Test critical values:	1% level		-4.037668	
	5% level		-3.448348	
	10% level		-3.149326	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(UNEMPA) Method: Least Squares Date: 03/03/09 Time: 11:06 Sample (adjusted): 1979Q1 2008Q2 Included observations: 118 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNEMPA(-1)	-0.406058	0.106799	-3.802086	0.0002
D(UNEMPA(-1))	-0.100077	0.090165	-1.019402	0.3102
D(UNEMPA(-2))	-0.301725	0.085782	-3.517342	0.0006
C	0.011459	0.007613	1.506237	0.1351
@TREND(1978Q1)	-0.000127	0.000102	-1.239323	0.2173
R-squared	0.360437	Mean dependent var		-0.000927
Adjusted R-squared	0.337798	S.D. dependent var		0.043374
S.E. of regression	0.030296	Akaike info criterion		-3.900660
Sum squared resid	0.140774	Schwarz criterion		-3.691258
Log likelihood	229.7109	F-statistic		15.92082
Durbin-Watson stat	1.913403	Prob(F-statistic)		0.000000

Source: calculated by Eviews

Figure 9: Unit Root tests for Inflation

Augmented Dickey-Fuller Unit Root Test on CPIG

Null Hypothesis: CPIG has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 3 (Automatic based on SIC, MAXLAG=12)				
		t-Statistic	Prob.*	
Augmented Dickey-Fuller test statistic		-2.118582	0.5298	
Test critical values:	1% level	-4.038365		
	5% level	-3.448601		
	10% level	-3.149521		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(CPIG)				
Method: Least Squares				
Date: 03/03/09 Time: 11:07				
Sample (adjusted): 1979Q2 2008Q2				
Included observations: 117 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPIG(-1)	-0.248507	0.117299	-2.118582	0.0364
D(CPIG(-1))	-0.628501	0.114681	-5.480443	0.0000
D(CPIG(-2))	-0.630920	0.098251	-6.421485	0.0000
D(CPIG(-3))	-0.532642	0.079757	-6.678294	0.0000
c	0.002300	0.001409	1.632705	0.1054
@TREND(1978Q1)	-1.40E-05	1.35E-05	-1.037587	0.3017
R-squared	0.571003	Mean dependent var	-3.80E-05	
Adjusted R-squared	0.501679	S.D. dependent var	0.006285	
S.E. of regression	0.004208	Akaike info criterion	-8.053598	
Sum squared resid	0.001966	Schwarz criterion	-7.911948	
Log likelihood	477.1355	F statistic	29.54860	
Durbin-Watson stat	1.826077	Prob(F-statistic)	0.000000	

Augmented Dickey-Fuller Unit Root Test on CPIA

Null Hypothesis: CPIA has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 3 (Automatic based on SIC, MAXLAG=12)				
		t-Statistic	Prob.*	
Augmented Dickey-Fuller test statistic		-2.514749	0.3206	
Test critical values:	1% level	-4.038365		
	5% level	-3.448681		
	10% level	-3.149521		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(CPIA)				
Method: Least Squares				
Date: 03/03/09 Time: 11:08				
Sample (adjusted): 1979Q2 2008Q2				
Included observations: 117 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CPIA(-1)	-0.374613	0.148966	-2.514749	0.0133
D(CPIA(-1))	-0.664333	0.126337	-5.176451	0.0000
D(CPIA(-2))	-0.575379	0.111222	-5.173259	0.0000
D(CPIA(-3))	-0.630604	0.073866	-8.537106	0.0000
c	0.004227	0.001978	2.138430	0.0347
@TREND(1978Q1)	-2.70E-05	1.69E-05	-1.596737	0.1132
R-squared	0.787029	Mean dependent var	-2.76E-05	
Adjusted R-squared	0.777435	S.D. dependent var	0.009883	
S.E. of regression	0.004663	Akaike info criterion	-7.848660	
Sum squared resid	0.002413	Schwarz criterion	-7.706910	
Log likelihood	465.1408	F statistic	82.03940	
Durbin-Watson stat	1.715825	Prob(F-statistic)	0.000000	

Source: calculated by Eviews

Figure 10: Unit Root tests for Wages

Augmented Dickey-Fuller Unit Root Test on WAGEG

Null Hypothesis: WAGEG has a unit root Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic based on SIC, MAXLAG=12)				
	t-Statistic		Prob.*	
Augmented Dickey-Fuller test statistic	-12.22397		0.0000	
Test critical values:	1% level	-4.036648		
	5% level	-3.447383		
	10% level	-3.148761		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(WAGEG) Method: Least Squares Date: 03/03/09 Time: 11:10 Sample (adjusted): 1978Q2 2008Q2 Included observations: 121 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
WAGEG(-1)	-1.117582	0.091425	-12.22397	0.0000
C	0.014388	0.002019	7.124733	0.0000
@TREND(1978Q1)	-0.000104	2.48E-05	-4.205382	0.0001
R-squared	0.558755	Mean dependent var	-3.21E-05	
Adjusted R-squared	0.551277	S.D. dependent var	0.013372	
S.E. of regression	0.008957	Akaike info criterion	-6.568187	
Sum squared resid	0.009468	Schwarz criterion	-6.498870	
Log likelihood	400.3753	F-statistic	74.71269	
Durbin-Watson stat	1.966578	Prob(F-statistic)	0.000000	

Augmented Dickey-Fuller Unit Root Test on WAGEA

Null Hypothesis: WAGEA has a unit root Exogenous: Constant, Linear Trend Lag Length: 3 (Automatic based on SIC, MAXLAG=12)				
	t-Statistic		Prob.*	
Augmented Dickey-Fuller test statistic	-5.490576		0.0001	
Test critical values:	1% level	-4.037668		
	5% level	-3.448348		
	10% level	-3.149326		
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(WAGEA) Method: Least Squares Date: 03/03/09 Time: 11:11 Sample (adjusted): 1979Q1 2008Q2 Included observations: 118 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
WAGEA(-1)	-1.468219	0.267407	-5.490576	0.0000
D(WAGEA(-1))	0.102024	0.214218	0.476262	0.6348
D(WAGEA(-2))	-0.144375	0.153742	-0.939073	0.3497
D(WAGEA(-3))	-0.302980	0.089561	-3.379167	0.0010
C	0.005708	0.001905	3.030545	0.0030
@TREND(1979Q1)	-3.47E-05	2.25E-05	-1.543780	0.1255
R-squared	0.729341	Mean dependent var	-0.000127	
Adjusted R-squared	0.717258	S.D. dependent var	0.014838	
S.E. of regression	0.007990	Akaike info criterion	-6.758944	
Sum squared resid	0.006972	Schwarz criterion	-6.656062	
Log likelihood	407.0197	F-statistic	60.36108	
Durbin-Watson stat	2.084475	Prob(F-statistic)	0.000000	

Source: calculated by Eviews

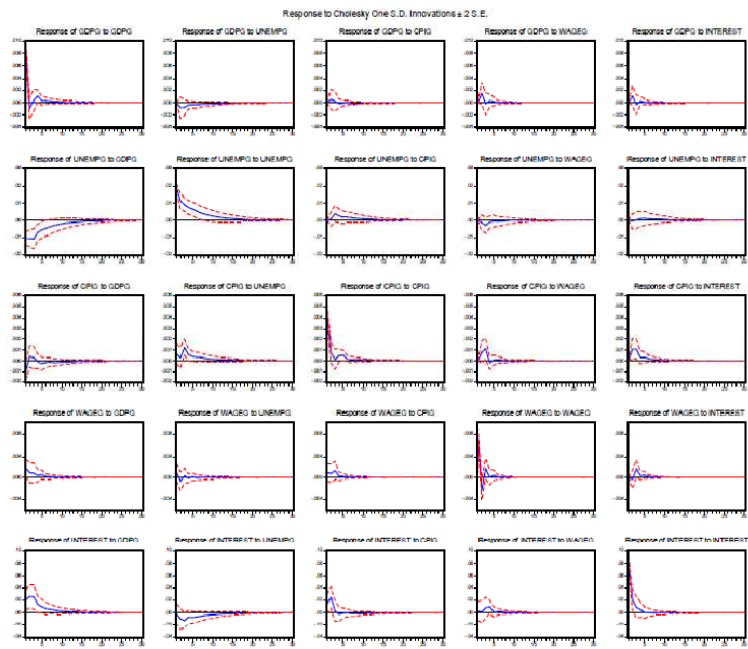
Figure 11: Unit Root tests for Interest rates

Augmented Dickey-Fuller Unit Root Test on INTEREST

Null Hypothesis: INTEREST has a unit root				
Exogenous: Constant, Linear Trend				
Lag Length: 0 (Automatic based on SIC, MAX_LAG=12)				
			t-Statistic	Prob*
Augmented Dickey-Fuller test statistic			-6.422533	0.0000
Test critical values:	1% level		-4.039075	
	5% level		-3.449020	
	10% level		-3.149720	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(INTEREST)				
Method: Least Squares				
Date: 03/03/09 Time: 11:12				
Sample (adjusted): 1979Q3 2008Q2				
Included observations: 116 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTEREST(-1)	-0.534796	0.083269	-6.422533	0.0000
C	0.006073	0.018452	0.329114	0.7427
@TREND(1978Q1)	-8.60E-05	0.000257	-0.334332	0.7387
R-squared	0.267759	Mean dependent var		-0.000260
Adjusted R-squared	0.254799	S.D. dependent var		0.106947
S.E. of regression	0.082322	Akaike info criterion		-1.901541
Sum squared resid	0.963144	Schwarz criterion		-1.830327
Log likelihood	113.2894	F-statistic		26.66043
Durbin-Watson stat	2.014889	Prob(F-statistic)		0.000000

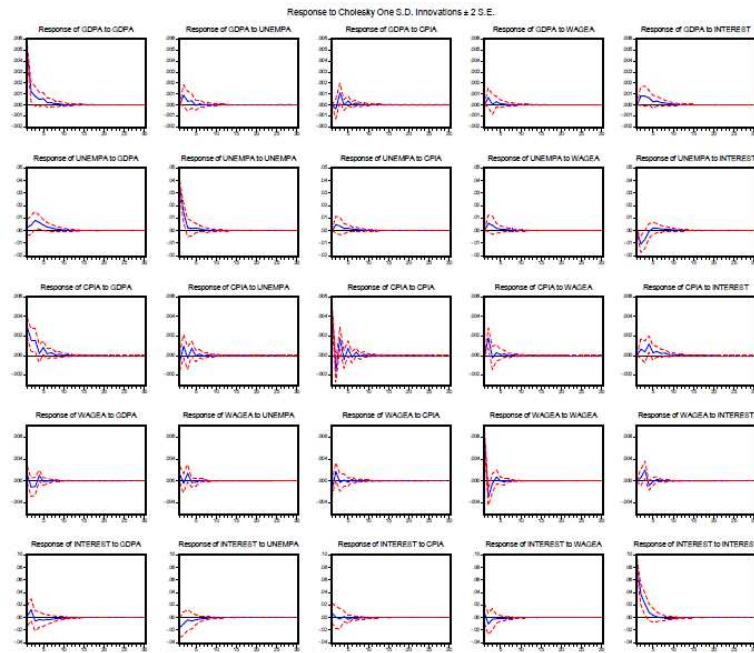
Source: calculated by Eviews

Figure 12: Impulse-Response-Functions Germany [all]



Source: calculated by Eviews

Figure 13: Impulse-Response-Functions Austria [all]



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