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Macroeconomic Forecasts and the Nature of Economic Shocks in Germany

by

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Abstract:

The paper investigates the sources of macroeconomic forecast errors in Germany. The predictions of the so-called "six leading" research institutes are analyzed. The forecast errors are discussed within an aggregate demand/supply scheme. Structural Vector Autoregressive Models are estimated to identify the shocks underlying the business cycle. It is tested whether these shocks can explain the forecast errors. The empirical results suggest that, in general, the shocks are helpful in explaining the forecast errors. However, the correlations are rather weak. In addition, lagged shocks help also to explain the mispredictions of the institutes. Thus, forecasters' expectations are not rational.

Zusammenfassung:

Der Beitrag untersucht die Ursachen von Fehlern der Konjunkturprognose der Gemeinschaftsdiagnose der Arbeitsgemeinschaft wirtschaftswissenschaftlicher Forschungsinstitute in Deutschland. Die Prognosefehler werden im Rahmen eines aggregierten Angebot/Nachfrage-Modells interpretiert. Es werden strukturelle VARs geschätzt und mit ihrer Hilfe die Schocks identifiziert, die den deutschen Konjunkturzyklus treiben. Diese Schocks können einen Teil der Vorhersagefehler erklären. Der Anteil der so erklärbaren Prognosefehler ist jedoch klein. Darüber hinaus erweisen sich verzögerte Schocks als signifikant für die Prognosefehler. Dies steht im Widerspruch zu der Annahme, die Prognosen stellten rationale Erwartungen dar.

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I.   Introduction

In the economic literature a broad area of research reflects on the amount of forecast errors made by professional forecasters (see Mills and Pepper 1999, Ash, Smyth and Heravi 1998). Whereas several attempts have been made to understand whether the forecasts are unbiased and efficient, only a few papers discuss the concrete sources of mispredictions. This paper contributes to the discussion. In particular, it is analyzed whether the forecast errors of the common analysis of the so-called "six leading" economic institutes in Germany can be explained by the nature of macroeconomics shocks identified from a structural vectorautoregressive (SVAR) approach. The underlying idea motivating this research strategy is that, for example, supply and demand shocks have typically different dynamic effects on real output and on the inflation rate. Thus, they should have different effects on the quality of business cycle forecasts (Kramer 1994). Moreover, it is often stated that supply disturbances such as oil price shocks are unpredictable by nature. If a good deal of the forecast errors can be attributed to this kind of disturbances mispredictions are not the forecasters' fault.

The main results are that a simple aggregate demand (AD)/aggregate supply (AS) scheme is too simple to explain the forecasters errors. Neither do the observed mispredictions of the institutes fit into such a scheme well nor do the forecast errors correlate strongly with structural residuals of a bivariate SVAR estimated to identify the nature of macroeconomic shocks. A system taking into account both spending (IS) and monetary (LM) shocks is found to perform better in explaining the forecast errors. An identification inspired by monetarist theory does not improve the fit to the forecast errors. Generally, the share of errors explained by the underlying shocks is quite small. Moreover, since some lagged

structural shocks also help to explain the real-time forecast errors, the expectations of the institutes are not fully rational.

The paper is organized as follows: Section 2 reviews the evidence on the sources of forecast errors made by professional forecasters with a special emphasis on German data. Section 3 analyzes the real-time forecast errors of the six institutes. In particular, it is discussed whether these forecast errors fit into an aggregate supply shock/demand shock scheme that can be developed from a simple AS/AD model. Section 4 discusses the econometric methodology used to identify the underlying shocks driving the business cycle. Section 5 gives the empirical results of these exercises and discusses briefly whether these pinnings make sense from the perspective of economic theory. Section 6 elaborates on the question whether the shocks derived in the previous part of the paper are helpful to understand the forecast errors made by the institutes. The last part concludes.

II.   Explanations of Forecast Errors

Most studies conclude that, in general, business cycle forecasts in Germany are unbiased and efficient (Döpke and Langfeldt 1995). However, several systematic errors have been reported within the literature. Helmstädter (1989) argues - contrary to the evidence reported by other researchers (for example Döpke and Langfeldt 1995, Kirchgässner 1991) - that the business cycle forecast errors are autocorrelated. Heilemann (1998) reports that recessions have been nearby always missed by the forecasters. Döpke and Langfeldt (1995) present evidence supporting the idea that output is generally underestimated in an upswing and overestimated during a contraction period. Hagen and Kirchgässner (1997) as well as Harvey (1991) find evidence that equations based on monetary variables outperform the institutes' forecasts. This implies that the latter could not be efficient. Helmstädter (1991) claims that simple polls regarding the question whether

people are generally (that is not only economically) optimistic or not can produce as good forecasts as the institutes.[1] Last but not least, the overall forecast errors remain important quantitatively. With respect to the institutes' forecasts one might also conclude that: "these forecasts are usually incorrect, that is, substantial differences arise between the forecast and the final economic growth" (Pons 2000: 53).

Given this evidence for - possibly systematic - forecast errors, the question arises whether an explanation for the forecast errors can be given. Whereas it exists a relatively rich literature upon the question whether or not macroeconomic forecasts are unbiased and efficient, only a small strand of it deals with the specific reasons behind false business cycle forecasts. There are only some noteworthy exceptions. Nierhaus (1998) gives a detailed explanation of the problem underlying the predictions of one of the ifo institute. Hinze (1996) argues that the German unification as well as the process of European integration have been harmful for the statistical accuracy of business cycle forecasts in Germany.

A first line along which forecast errors have been explained refers to technical reasons. These include e.g. data revisions or the implied statistical over- and underhang of the time series to be forecasted. Practitioners tend to put the largest share of blame for forecast errors on such circumstances. However, though empirical studies show that these reasons have some influence, data problems show no systematic pattern (Runkle 1998). Therefore, it is not possible to show that forecast errors are generally smaller with respect to the last recent revised data of

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[1] Note, however, the related critique by van Suntum (1991).

the outcome than with respect to the very first publication (Döpke and Langfeldt 1995).

A second line along which forecast error can be explained is connected with the analysis of the behavior of the forecaster's (Zarnowitz 1998, Fintzen and Stekler 1999). Models are build, for example, on the idea of intentional forecasts, i.e. an event is predicted to stimulate policy measures to avoid it (Morgenstern 1928, Grunberg and Modigliani 1954). In an empirical study for Germany, Stege (1989) provides some anecdotal evidence supporting this hypothesis with respect to German forecasting institutions. Another possibility to model forecasters' behavior resorts to the argument that forecasters follow an opportunistic strategy. They may stick to some kind of consensus forecast to preserve reputation even in the case that the own predictions are wrong. In an investigation of the behavior of American forecasters, McNees (1992) reports that professional forecasters heavily rely on some kind of consensus forecast. This idea has been particularly successful in explaining forecaster' behavior with respect to the development in financial markets (Löffler 1999). Finally, forecasters have been accused to be too conservative, that is they don't change forecasts enough when the underlying assumptions have altered (McNees 1992).

A more specific view on the underlying motives of economic policy advisers in Germany is taken by Kirchgässner (1996, 1998) who argues that under the standard assumption of rent-seeking behavior economic advisers they could be seen as corrupt. If this hypothesis is correct, the forecasts should have some kind of a political bias or a tendency to forecast developments useful for the rent-seeking success. Such a political-economy approach seems promising in the light of the results of Batchelor and Dua (1990) who find that the underlying models and theoretical beliefs of the forecasters have no significant influence on forecasting

quality. In particular, following a Keynesian or Monetarist ideology is of no importance for the accuracy of the published forecasts.

Broadly, two lines of explanations of prediction failures can be distinguished. The first claims that there are systematic components in the forecast errors, whereas some authors and of course the forecasters themselves rely on the proposition that random unpredictable shocks must be blamed for wrong forecasts. In the following it will be discussed whether such shocks can be identified and to what extent they help to explain the real-time forecast errors.

III. The Link Between Growth and Inflation Forecast Errors

This section will give a first impression of the relation between inflation and growth forecast errors in Germany. Normally, in this context it is tested whether or not the forecast errors regarding inflation or real GDP growth correlate with each other (Zarnowitz 1992: 428 ff, Heilemann 1998: 95). The underlying argument behind this kind of analysis is that on average an underestimation of inflation should correspond with an overestimation of real GDP. Hence, the forecasts of changes in nominal GDP should be better than predictions of real GDP (Zarnowitz 1992: 429). However, using the dataset of the six German forecasting institutes a significant relation between the two errors cannot be obtained. A regression yield the following results:

$$(\hat{Y}_t^e - \hat{Y}_t) \quad = \quad \underset{(0.51)}{0.16} \quad + \quad \underset{(0.04)}{0.01} \quad (\hat{P}_t^e - \hat{P}_t) \quad + \quad \hat{u}_t$$

where $\hat{P}$ denotes the inflation rate, $\hat{Y}$ the change of real GDP and the index e characterizes predicted values. t-values are in brackets.
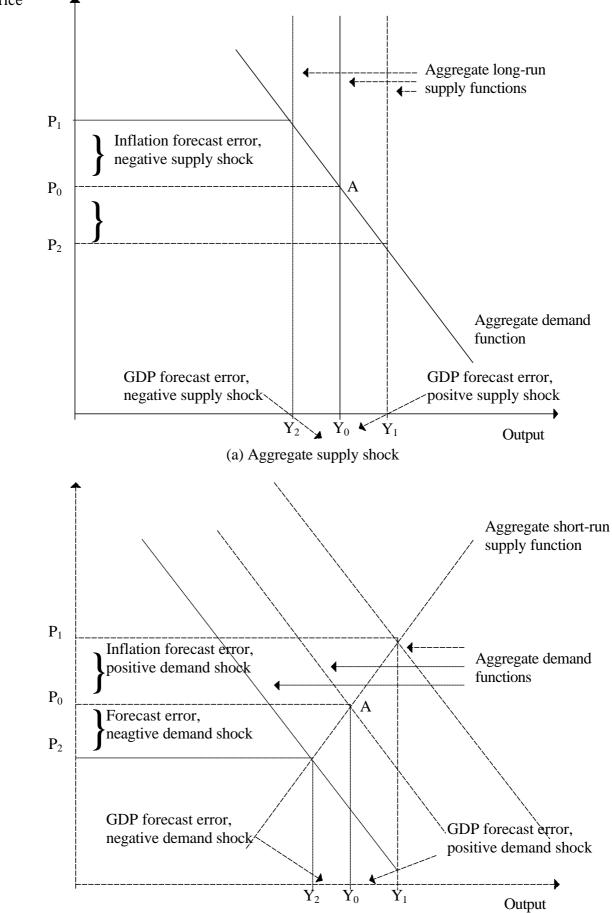
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Figure 1: Unexpected Shocks and Forecast Errors

Price

(a) Aggregate supply shock

(b) Aggregate demand shock

The perspective taken in this paper argues that this relation between inflation and growth forecasts errors itself might serve as a distinction between the several shocks hitting the economy. Consider for example figure 1.

Assume that, the forecast coordinates are given by point A in the price/output diagram. The nature of an unexpected shock can be characterized by the forecast errors. On the one hand, a negative supply shock will shift the aggregate supply curve to the left (see panel (a) of figure 1) pushing inflation above and the growth rate below their expected values, respectively. On the other hand, a positive supply shock will lead to an underestimation of growth and an overestimation of the inflation rate. A similar line of reasoning can be applied to aggregate demand shocks: a positive demand will go in line with a growth projection which is too pessimistic and an inflation forecast which is too low et vice versa. The following classification scheme for forecast errors summarizes this insights:

$$
\begin{array}{llll}
\hat{P}^e - \hat{P} < 0 & \wedge & \hat{Y}^e - \widehat{Y} > 0 & \Leftrightarrow \quad \text{negative supply shock} \\
\hat{P}^e - \hat{P} > 0 & \wedge & \hat{Y}^e - \widehat{Y} < 0 & \Leftrightarrow \quad \text{positive supply shock} \\
\hat{P}^e - \hat{P} > 0 & \wedge & \hat{Y}^e - \widehat{Y} > 0 & \Leftrightarrow \quad \text{negative demand shock} \\
\hat{P}^e - \hat{P} < 0 & \wedge & \hat{Y}^e - \widehat{Y} < 0 & \Leftrightarrow \quad \text{positive demand shock}
\end{array}
\tag{1}
$$

using the same symbols as above.

Figure 2 depicts the forecast errors in Germany made by the so-called common analysis of the leading forecasting institutes from 1963 to 1998. The horizontal axis gives the forecast errors with respect to the change of real GDP in percentage points. A positive (negative) number indicates an under(over-) estimation of the respective growth rate. Similarly, a positive (negative) number on the vertical axis indicates an over(under-) estimation of the inflation rate.
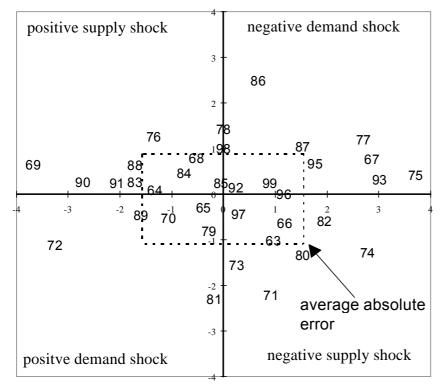
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Figure 2: Forecast Errors and Possible Macroeconomic Shocks in Germany

The overall impression derived from figure 2 is that the classification of the forecast errors according to scheme (1) is sometimes, but not always, in line with economic prejudices. For example, it is reasonable to argue that Germany was hit in the years 1974 and 1980 by negative supply shocks due to the first and the second oil-price crises. The year 1971 also matches into this category since the sharp increase in real wages has worsened the supply conditions in Germany. In contrast, 1986, which is often seen as a text-book example for a positive supply shock, does not fall into this class. According to the professional forecasters' errors it does not fit into this category because real GDP growth was over- rather than underestimated. The years following German unification cannot be classified clearly. Whereas the underestimation of GDP growth makes clear that - if any - a positive shock occurred, the forecast errors of the inflation rate are too small to allow a distinction between a demand and a supply disturbance. Most of the errors are smaller than the average absolute forecast error which is 0.8

percentage points. Since in 1990 and in 1991 the inflation rate was underestimated, a positive supply shock is a little more likely. This is in contrast to the course of fiscal policy in these years. The impulse given by fiscal policy in 1990 was the highest ever within the investigation period (Boss 1996). The years 1977 and 1987 are categorized as more or less pronounced negative demand shocks. The fact that the economic development in the years 1967, 1980 and 1982 must be counted as negative supply shocks rather than negative demand disturbances is in contrast to the conventional position claiming that deep recessions are often caused by a decline in demand. However, the latter seems to have caused the 1993 contraction.

To summarize, although the classification of the underlying shocks on the basis of the forecast errors makes sense in some years, the approach is often not successful. Of course, the main reason is that more than one shock might drive the economy. To formulate in more formal terms, the identification problem is completely neglected by this rather descriptive approach. This argument motivates the procedures to identify the underlying shocks discussed and applied to analyze the reasons for the forecast errors in the proceeding section.

IV. Identifying the Underlying Shocks Driving the Business Cycle

Following the seminal paper by Blanchard and Quah (1989) a broad literature has emerged which uses identifying restrictions derived from economic theory to disentangle the driving shocks behind the business cycle. These approaches have also been successfully applied to German data. Funke (1997a) and Knudsen, Stahlecker and Wohlers (1999) use a bivariate system including real GDP and the inflation rate to evaluate the relative importance of demand and supply shocks. The original approach by Blanchard and Quah uses the unemployment rate to measure the development of aggregate demand. However, this is not probate for

German data, since the employment rate is - as in most other European countries - not returning to its pre-recession level after an economic downturn and is supposed to be integrated of order one. The bivariate systems have been enriched to account for a more detailed pattern of possible shocks than just demand and supply shocks. For example, Jordan and Lenz (1999) add a long-term interest rate to take into account spending (IS) and monetary (LM) shocks. Weber (1996) and Funke (1997b) discuss the sources of German economic fluctuations in larger systems using neoclassical long-run restrictions to identify the shocks. In the following section systems following Funke (1997b) and Jordan and Lenz (1999) are adopted to identify macroeconomic shocks in Germany. Since the focus of the paper is on real-time forecast errors, annual data from 1963 to 1999 are used.

The starting point of the analysis is a bivariate vectorautoregressive model including the change of real GDP (ΔY) and the change of the price level (ΔP).[2] The moving average representation of the underlying structural model can be written as:

$$(2) \qquad \begin{pmatrix} \Delta \ln Y_t \\ \Delta \ln P_t \end{pmatrix} = \sum_{i=0}^{\infty} L^i A_i e_t$$

where A is a polynomial matrix, L the lag operator and e are white noise residuals capturing supply and demand shocks. Within this system a long-run neutrality restriction is imposed, i.e. it is assumed that the impact of a change in the inflation rate on the change of real output is zero. More technically, the matrix of long-run multipliers A(1) is upper triangular:

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[2]   The lag length of the VAR is determined on the basis of information criteria. The statistics are given in the appendix.

(3) $\quad \sum_{i=0}^{\infty} A_{11,i} = 0$

Moreover, to achieve the necessary number of restrictions to identify the structural residuals from the disturbances of an unrestricted VAR the variances of the two shocks are normalized to unity.

A more detailed identification of the shocks can be derived by using a system that includes a long-term interest rate. Such a specification implies that the underlying demand shock is split into a monetary (LM) and a spending (IS) shock following the approach outlined by Jordan and Lenz (1999). Broadly, the restrictions implied assumes that an increase of real GDP growth which goes in line with rising long-term interest rates are caused by a spending (IS) shock, whereas faster GDP growth in the presence of declining long-term interest rates is driven by a monetary (LM) shock. Hence, to take into account spending as well as monetary shocks, the change in the long term interest rate is included within the system. Furthermore, it is assumed that innovations in the equation representing the change in real GDP can have long lasting effects on both the changes in the interest rate and on the inflation rate. The error term in the equation for the differenced interest rates, in contrast, can have long-run effects on the inflation rate, but not on real GDP. Finally, inflation innovations are assumed to exhibit no long-run effect on the other variables in the system. The unrestricted model to be estimated takes the form:

(4) $\quad \begin{pmatrix} \Delta \ln Y_t \\ \Delta R_t \\ \Delta \ln P_t \end{pmatrix} = \sum_{i=0}^{\infty} L^i A_i u_t$

with R representing the long-term interest rate.

A third approach alternatively again includes the change of the prices and the change of real GDP. However, the restriction scheme is different as compared to the first model. It is developed in a monetarist spirit (Bullard and Keating 1995: 480). The unrestricted VAR takes the form:

$$(5) \quad \begin{pmatrix} \Delta \ln P_t \\ \Delta \ln Y_t \end{pmatrix} = \sum_{i=0}^{\infty} L^i A_i e_t$$

The identifying restrictions in this case are that an demand shock has no long-run impacts on the inflation rate. In contrast, the demand impact on real GDP is not restricted.

All three systems are estimated in the next section and the results are discussed and confronted with the predictions of economic theory as well as with the institutes forecasts.

V. Empirical Results on the Shocks Underlying the German Business Cycle

The dynamic response of the German economy to demand and supply shocks obtained by estimating and identifying the bivariate system in equation (2) are given in figure 3.

The shapes of the impulse response functions are reasonable. A positive supply shock permanently increases the output growth and lowers prices. A positive demand shock permanently increases the inflation rate and leads to a transitory increase in output growth. Given the plausible reaction of the system, one may want to compare this kind of shocks to the real-time forecast errors made by the six institutes. Performing a variance decomposition, it is found that most of the variance of the change in real GDP is due to supply shocks even in the short run

(see Funke 1997b). Changes in the price level are dominated by demand shocks in the short as well as in the long run. The great importance of supply shocks is also documented in figure 4.
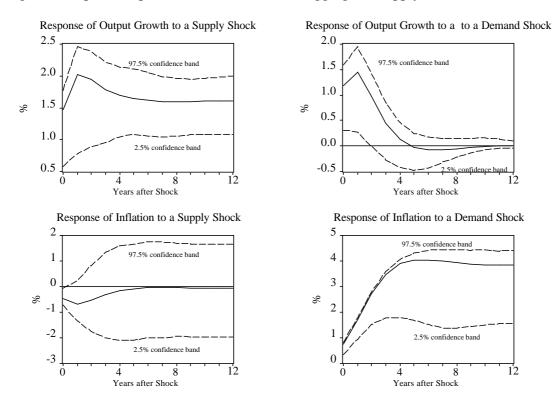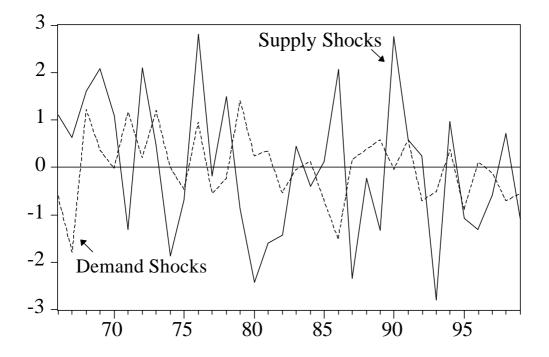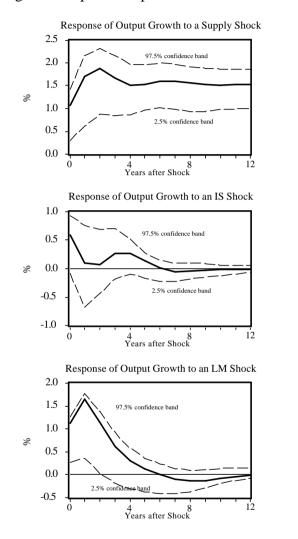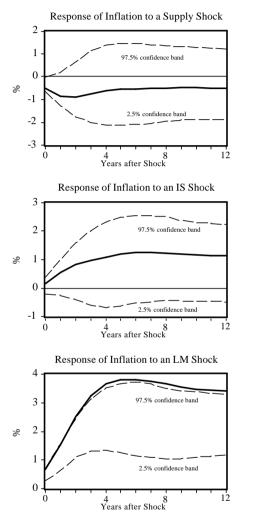
Figure 3: Impulse response functions within the aggregated supply / demand scheme

Figure 4: Demand and Supply Shocks identified from the AS/AD model

Figure 5: Impulse Response Functions within the IS/LM/AS System

Response of Output Growth to a Supply Shock

Response of Inflation to a Supply Shock

Response of Long-term interest rates to a Supply Shock

Response of Output Growth to an IS Shock

Response of Inflation to an IS Shock

Response of Long-term Interest Rates to an IS Shock

Response of Output Growth to an LM Shock

Response of Inflation to an LM Shock

Response of Long-term Interest Rates to an LM Shock

The figure depicts the supply and demand shocks according to the Blanchard/ Quah decomposition suggested in the preceding section. The graphs plotted in the figure can also be interpreted economically. For example, both oil-price crises are identified as negative supply shocks. Moreover, decreasing import prices in 1986 is seen as a strong positive supply shock. However the recession in 1993 is identified as a pure negative supply shock. This is in sharp contrast, for example, to estimates of the output gap derived for this period (Council of economic advisers 1998: 255). The same does hold for the recession at the beginning of the 80's. According to the results obtained, demand plays almost no role during the economic downswing. Only one demand-driven recession can be observed (1967). While the prominent role for supply shocks is in line with the results of Funke (1997b) and Sterne and Bayoumi (1995) who uses a similar setup, it is in contrast to widespread beliefs about the nature of economic development during the investigation period.

An attempt to paint a more precise picture is to disentangle the demand shocks into a spending (IS) and a monetary shock following Jordan and Lenz (1999). Overall, the results are more promising than those of the simple aggregate demand/supply scheme used above. The implied impulse response functions plotted in figure 5 makes sense economically. A supply shock permanently increases output, whereas the effects of IS and LM shocks are temporary due to the invoked restriction. The effects of both demand shocks last for by about 4 years. However, the confidence bands show that, given the small numbers of observations, the estimates are quite uncertain. Demand shocks permanently increase prices, whereas a positive supply shock lowers the inflation rate. The effect of a supply shock on long-term interest rates is relatively small. In contrast, a spending shock pushes the long-term interest rates upwards significantly. The change in long-term interest rates following a LM shock is of a temporary nature

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only. Taken all impulse-response functions together, the results allow to take a closer look on the underlying shocks.

The results are more promising than the ones obtained by the simple AS/AD model. In particular, the recession in 1993 is now attributed to both a negative supply and a negative demand shock: A pronounced negative spending (IS) shock and small negative LM shock are observed. Moreover, in 1991, a positive spending shock helps to explain the boom following the German unification. Despite this, all the features with respect to the dominance of supply shocks remain more or less unchanged.

Figure 6: Underlying Shocks According to the IS/LM/AS Model

— Supply Shocks

— IS Shocks

— LM Shocks

The last system used in this paper to shed light on the driving forces of the business cycle in Germany is derived from a monetarist interpretation of economic 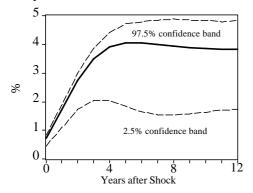fluctuations (Bullard and Keating 1995). The impulse-response functions obtained by performing this exercise are plotted in figure 7. A demand shock lead to a permanent increase of the inflation rate. The response of inflation to a supply shock is restricted to zero in the long-run, reflecting the monetarist proposition that inflation is always and everywhere a monetary phenomenon. It is noteworthy that the impact of demand shock on real GDP growth is of only temporary nature despite the fact that no such restriction is implemented. As is the case in the first bivariate system a supply shock results in a permanent higher GDP growth.
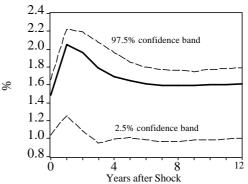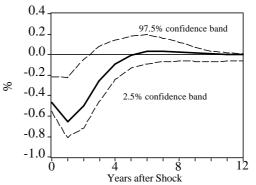
Figure 7: Impulse Response Functions Using the Monetarist Identification

The structural shocks obtained from this system are plotted in figure 8. In line with the more Keynesian model discussed above the recession of 1993 is identified merely as a pronounced negative supply shock. Three other negative supply shocks can be observed. Two of them correspond to the oil-price shocks. The third, however is located in the year 1987 which is somewhat surprising. The demand shocks play obviously a much smaller role in explaining real GDP movements when using this identification scheme.

Figure 8: Underlying Shocks According to the Model Using the Monetarist Identification

To summarize, the estimated systems have led to impulse response functions and to time series of underlying shocks that make at least some sense from the perspective of economic theory. In other words, they pass the duck test: "It walks like duck, it quacks like duck, so it must be a..." (Funke 1997b). Moreover, the models include a relatively wide range of macroeconomic schools of thought. The first model is often seen as a support for a real business cycle interpretation of economic fluctuations since the importance of supply shocks is great even in

the short run. The second model shows the German business cycle seen with more Keynesian glasses. The last model gives a monetarist interpretation of the German economic development. Thus, in the next section, the time series can be used to test whether the estimates structural shocks can explain the forecast errors of the institutes.

VI. Is there a Correlation between Shocks and Forecast Errors?

Given the time series of structural disturbances it is possible to shed light on the relation between the shocks driving the business cycle and the forecast errors made by the institutes. Table 1 reports the sample correlation coefficients of the time series of structural shocks and the real-time growth and inflation prediction errors.

Table 1: Correlation of Real time Forecast Errors and Structural Shocks

	Growth Forecast errors	Inflation Forecast errors
	Bivariate System	
Supply Shocks	-0.60	0.40
Demand Shocks	-0.45	-0.46
	AS/IS/LM Model	
Supply Shock	-0.34	0.43
Spending (IS) Shock	-0.26	-0.26
Monetary (LM) Shock	-0.37	-0.36
	Monetarist Identification	
Supply Shock	-0.61	0.39
Demand Shock	-0.43	-0.47

Source: Own calculations.

To begin with, the correlation of the demand and the supply shocks derived from the bivariate system with respect to the growth forecast have the expected sign. Positive supply and demand shocks on average corresponds with a negative value of $(P - R)_t$ that is the difference between the predicted value (P) and the outcome (R) and ,therefore, an underestimation of real growth. Both positive

demand and supply shocks on average lead to an underestimation of the change in real GDP (i.e., to a negative value of the series of real-time forecast errors since they are defined as prediction minus outcome). The same holds for the inflation forecasts: a positive demand shock leads to an underestimation of the inflation rate. The time series of structural supply shocks correlates with the inflation forecast error with a negative sign, i.e. supply shocks lead to an overestimation of the inflation rate. This is reasonable since positive supply shocks should lower inflation and, therefore, imply a tendency to overestimate the inflation rate in advance.

Turning to the system including both spending and monetary shocks instead of a single demand shock, the results are again in line with expectations. The inflation forecast correlation is somewhat closer with respect to monetary shocks than with spending shocks.

The correlations with the structural residents from the monetaristic system are quite similar to the correlations with the shocks derived from the first bivariate system. In particular, both positive demand and supply shocks correspond with an underestimation of real GDP growth. The correlation to the inflation error is positive in case of a demand shock and negative in case of a supply shock.

To get more insights into the relationship between shocks and the institutes' real-time the latter are regressed on the shocks derived from the structural VARs:

$$(6) \qquad (P - R)_t = a_0 + a_1 e_t^I + a_2 e_t^{II} + a_3 e_t^{III} + u_t$$

where P denotes the predicted value for the period under investigation, R the realization observed for that year. $e_t^I, e_t^{II}, e_t^{III}$ represent the structural shocks derived from the analysis above. "I" stands for the first structural shocks identified

above, "II" for the second, and "III" for the third. More specifically, "I" and "II" stand for supply and demand shocks, repetitively in models (2) and (5). "I", „II", and "III" indicate supply, IS-, and LM shocks in the approach given starting with the VAR according to (4).

Some caution is necessary in interpreting these equations. Firstly, the underlying structural shocks add up to a forecast error itself, since they are calculated from the one-period-ahead forecast errors of an unrestricted VAR. Hence, a perfect fit is impossible since the forecast errors of the VAR can not match the ones made by the institutes (in fact, the VAR errors are much larger on average). Secondly, a possible significant influence of a structural shock says nothing on the efficiency of the forecast of the institutes). The shocks identified above are unpredictable by nature. Hence, even if they can explain the forecast errors, so far nothing is won for improving the forecasts. The forecasts are not in contradiction to the hypothesis of rational expectations as long as the information which can explain forecast errors is not yet available when the prediction is published (Holden and Peel 1990). Nevertheless the analysis might be useful. If the defense of the institutes that their forecast errors are due to unpredictable events is true, the structural shocks should help to explain a large share of the real-time forecast errors.

The results depicted in table 2 do not support this idea. Rather, the part of forecast errors explained by exogenous shocks is significant but in most of the cases rather small. Supply and demand shocks enter the equation for the real GDP forecast errors with a negative sign, i.e. positive shocks lead to a smaller value of P-R and, thus, indicate an underestimation of GDP growth on average. With respect to the inflation forecast error, a positive demand shock goes in line with an underestimation of the inflation rate. The coefficient of the supply shock is

also in line with economic common sense since a positive supply shock lead to an overestimation of the inflation rate.

Table 2: Real Time Forecast Errors as a Function of Structural Shocks

Dependent Variable	a_0	a_1	a_2	a_3	R^2
Model (2)		Supply Shock	Demand Shock		
Forecast error real GDP	0.14 (0.64)	-1.12 (-3.79)***	-0.74 (-5.12)***	(-)	0.57
Forecast error inflation	0.06 (0.43)	0.27 (2.78)***	-0.65 (-3.24)***	(-)	0.37
Model (4)		Supply Shock	IS Shock	LM Shock	
Forecast error real GDP	0.15 (0.55)	-0.57 (-2.27)**	-0.60 (-1.76)*	-0.98 (-2.44)**	0.32
Forecast error Inflation	0.06 (0.39)	0.41 (3.00)***	-0.40 (-1.87)*	-0.55 (-2.55)**	0.39
Model (5)		Supply shock	Demand Shock		
Forecast error real GDP	0.14 (0.64)	-0.74 (-5.2)***	-1.08 (-3.70)***		0.56
Forecast error Inflation	0.06 (0.43)	0.26 (2.71)**	-0.65 (-3.30)***		0.37

In brackets: t-values. * (**,***) denotes significance at the 10 (5,1) percent level.

Source: own calculation

Generally, the fit of the equations is not improved significantly as compared to the case with two distinct shocks if one turns to the system with three variables. However, the coefficients have the expected signs. A positive supply shock leads to an underestimation of GDP and an overestimation of the inflation rate. Both demand shocks enter the equations with a negative sign, i.e. a positive spending or monetary shock leads to an underestimation of both the real growth rate and the inflation rate.

Given the monetarist identification scheme, the coefficients in the equation explaining the forecast errors of real GDP growth are reasonable and quite similar to the results obtained by the first bivariate system. The same holds for the in-

flation equation since the correlation of the structural shocks from both systems is very large.

So far, nothing has been said on the efficiency of the institutes' forecasts. However, since the impulse-response functions show some typical behavior of the time series once a shock has occurred it is possible to analyze whether or not past shocks can explain today's mispredictions. If this is the case, it can be concluded that the institutes miss the correct dynamic response of supply and demand shocks. This research is motivated by results obtained by Hagen and Kirchgässner (1997) who claim that the short term interest rate of the past year might help to improve forecasts and, thus the institutes must be blamed for using all available information. To test this idea, we use the equations (6) outlined above and analyze whether or not the lagged structural shocks exhibit a significant influence on today's forecast errors. If this were the case, the institutes forecasts must be considered as inefficient. The results of this exercise are given in table 3.

It can be seen that the lagged shocks do not have a large effect on the current forecast errors. However, there are some important exceptions. Pre-years demand shocks identified within the bivariate system help to explain current inflation mispredictions. More specifically, the institutes underestimate the long-run effects of inflationary shocks. With respect to the growth forecast, the structural lagged residuals of the bivariate system have no explanatory power with respect to the institutes failures. The larger system including the long-term interest rate leads to similar results. Both IS and LM shocks lagged one period are useful to predict the real-time growth forecast error. Thus, according to these results, the institutes do not fully take into account the dynamic effects of previous shocks. This finding is thus in line with Hagen and Kirchgässner (1997) and Harvey (1991). In both cases one can conclude that the institutes don't make efficiently

use of available information. Moreover, lagged LM shocks lead to a tendency to underestimate the inflation rate. This result is plausible since the lags following a monetary expansion are normally estimated to be long with respect to the inflation rate.

Table 3: Real Time Forecast Errors as a Function of Lagged Structural Shocks

Dependent Variable	a_0	a_1	a_2	a_3	R^2
Model (2)		Supply Shock	Demand Shock		
Forecast error real GDP	0.13 (0.39)	-0.38 (-0.85)	0.15 (0.68)	(-)	0.04
Forecast error inflation	0.09 (0.53)	-0.58 (-2.50)**	0.08 (0.72)	(-)	0.19
Model (4)		Supply Shock	IS Shock	LM Shock	
Forecast error real GDP	0.15 (0.51)	-0.09 (-0.33)	0.78 (2.08)**	-0.83 (-1.86)*	0.08
Forecast error inflation	0.09 (0.51)	-0.18 (-1.15)	-0.28 (-1.34)	-0.52 (-2.06)**	0.20
Model (5)		Supply shock	Demand Shock		
Forecast error real GDP	0.13 (0.39)	0.14 (0.66)	0.38 (-0.86)		0.03
Forecast error inflation	0.09 (0.53)	0.08 (0.67)	-0.57 (-2.51)**		0.19

In brackets: t-values.

Source: own calculation.

To summarize, the structural shocks are responsible in part for the forecast errors, although they are not the main source of forecast errors. Moreover, there are some hints that forecasters do not make use of all available information since some lagged structural residuals are significant in explaining the mispredictions.

VII. Conclusion

The paper elaborates on the question whether the forecast errors made by professional forecasters can be explained by the variation of exogenous shocks. Data

from the German common business-cycle forecast of the so-called six leading institutes from 1963 to 1999 are used to empirically shed light on this question.

The explanations for forecast errors discussed here belong to two competing schools of thought. One attributes the forecast errors to unexpected exogenous shocks and, thus, concludes that the predictions are in line with the hypothesis of rational expectations. The other explanations searches the reasons for mispredictions in models of the forecaster's behavior. If the first theory is correct, one should be able to establish empirically a close link between macroeconomic shocks and forecast errors.

In the first step of empirical analysis, it has been argued that the forecast errors itself can be interpreted as the response to an unexpected macroeconomic shock. For example, a positive aggregate supply shock should typically lead to an underestimation of GDP growth and an overestimation of inflation. The forecast errors can be grouped along this line of argumentation into responses to positive and negative demand and supply shocks, receptively. Since most of the shocks identified makes sense economically, this finding is taken as prima facie evidence that macroeconomic shocks might be helpful for understanding forecast errors. However, there are some noteworthy exceptions. It is concluded that the underlying assumption of the analysis, the hypothesis that only one shock occurs at a time, is not reasonable.

For this reason, in the second part of the empirical analysis, the of structural VAR approach is employed to identify the shocks driving the German business cycle. The Blanchard/Quah (1989) decomposition is used to identify the shocks. Three systems are analyzed. The first includes output growth and the inflation rate to identify demand and supply shocks, the second features an additional long-term interest rate to disentangle the demand shocks into LM and IS shocks,

and the third one uses a monetarist identification. For all systems, the underlying orthogonal structural shocks are recovered. The shocks are found to show an economically reasonable pattern.

The third part of the empirical investigation elaborates on the question whether or not the identified shocks can be blamed for the real-time forecast errors. It turns out that the forecast errors of the common analysis of the six institutes can only to a small extent be attributed to the identified shocks. If the demand shocks are disentangled into IS and LM shocks, the results do not become much better. The monetarist identification lead to similar results as the first bivariate system.

Moreover, adding lagged structural VAR residuals into an equation modeling the institutes forecasts helps to explain the latter to some extent. Hence, the institutes' predictions do not make use of all available information. This is not in line with rational expectations.

What can be learned from the result with respect to the forecast errors? The first point is that the macroeconomic shocks can explain only a relatively small fraction of the forecast errors made by the six institutes. Hence, theories that explain forecast errors from other sources should be discussed seriously. Secondly, the shocks are unpredictable only within the estimated model. One can surely hope to find better forecasting models than the underlying VARs used here to identify the shocks. For example, a estimated monetary reaction function may help to predict interest rates and the course of monetary policy more accurately and, therefore, reduce the size of unexpected shocks. More elaborated models should then help to explain mispredictions in the past give a hint where to concentrate further research on forecasting tools. Since supply shocks are one main source of forecast errors it would be helpful to analyze the dynamics of real GDP following

such shocks more carefully. The influence of spending shocks can probably be reduced by studying the demand components more closely (Smolny 1998).

One possible drawback of the results above regards a more technical issue. If the identified shocks are only of limited information with respect to real-time forecast errors, one might conclude that the underlying models are too simple. If the step from two to three shocks improves the results, a more sophisticated system might be able to explain the misprediction more accurately. In this respect, an analysis of quarterly data might be useful. Moreover, the identified shocks or course heavily rely on the assumptions made to calculate them. Hence, other identification schemes should be discussed. For example, Rudebusch (1998) doubts that monetary shocks are identified properly by structural VARs.

To summarize, the forecast errors of the six institutes might be explained to some extent by macroeconomic shocks. However, the part of the errors which can be explained by such shocks is rather small. The influence of lagged structural shocks, however, clearly shows that forecasts can and should be improved.

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Appendix 1

Table 1: Determining the Lag Length of the Vector Autoregressive Models

Lag Length	Akaike Information Criterion	Baysian Information Criterion	Portmanteau Test on Autocorrelation
Included variables	Output growth, inflation		
1	1.096	1.624*	131.30 [0.17]
2	1.028*	1.961	129.59 [020]
3	1.333	2.679	117.90 [0.46]
Included variables	Output Growth, Long-term interest rate, inflation		
1	9.06	9.58*	116.11 [0.00]
2	8.83*	9.76	126.25 [0.26]
3	9.20	10.54	115.19 [0.53]

* denotes minimum of the criterion. Number in brackets are marginal significance levels.

Appendix 2

Data and Sources

Growth forecasts: - predicted change of real GDP. Source: Arbeitsgemeinschaft wirtschaftswissenschaftlicher Forschungsinstitute, several years, Berlin. In case of interval forecasts the average is used. Numbers refer to West Germany up to 1992, to Germany from 1993 to present.

Inflation forecasts: - predicted change of the deflator of private consumption. Source: Arbeitsgemeinschaft wirtschaftswissenschaftlicher Forschungsinstitute, several years, Berlin. In case of interval forecasts the average is used. Numbers refer to West Germany up to 1992, to Germany from 1993 to present.

Real GDP, deflator of private consumption, the prices of imported energy ("oil prices") are taken from the CD "Fünfzig Jahre Deutsche Mark" published by the Deutsche Bundesbank. The values do not take into account the new system European of National Accounts with the exception of 1999.