DIW Berlin

German Institute
for Economic Research

Discussion Papers

312

Ulrich Fritsche and
Camille Logeay

Structural Unemployment and the Output Gap in Germany: Evidence from an SVAR Analysis within a Hysteresis Framework

Berlin, November 2002

Opinions expressed in this paper are those of the author and do not necessarily reflect views of the Institute.

DIW Berlin

German Institute
for Economic Research

Königin-Luise-Str. 5
14195 Berlin,
Germany

Phone +49-30-897 89-0
Fax +49-30-897 89-200

www.diw.de

ISSN 1619-4535

Structural Unemployment and the Output Gap in Germany: Evidence from an SVAR Analysis within a Hysteresis Framework[‡]

by Ulrich Fritsche and Camille Logeay[*]

Abstract:

The German unemployment rate shows strong signs if non-stationarity over the course of the previous decades. This is in line with an insider-outsider model under full hysteresis. We applied a "theory-guided view" to the data using the structural VAR model as developed by Balmaseda, Dolado and López-Salido (2000) allowing for full hysteresis on the labour market. Our identification of the model implies long-lasting output gaps for Germany – especially for the disinflation period of the 1980s.

JEL Classification: E12, E32, J64, C32

Key words: Structural unemployment, output gap, structural VAR, insider-outsider model

Contact address:

Ulrich Fritsche
DIW Berlin (German Institute for Economic Research)
Königin-Luise-Str. 5
D-14195 Berlin
phone: +4930/89789315
e-mail: ufritsche@diw.de

---

‡ The authors would like to thank Karl Betz, Gustav Horn, Michael Pflüger, Sven Schreiber, Phillip J.H. Schröder, Boriss Siliverstovs, Silke Tober, Jürgen Wolters, and participants of the 6th International Labour Market Conference, Center for International Labour Market Studies, Robert Gordon University, Aberdeen, for their very helpful comments. Special thanks to Jan Gottschalk – not only for the very fruitful discussion but also for the invaluable assistance in implementing the econometric procedures and for sharing some of his programs.

* Both DIW Berlin (German Institute for Economic Research).

I suggest that to think of unemployment not as a transitory disease, but as a variable that clears the money market, is a useful and significant innovation. Unemployment is an equilibrating mechanism. It seems like a dysfunction, since we think that full employment is what an economy should produce. But unemployment is a systematic feature of an economy relying on money to carry out transactions. To avoid unemployment, it takes continuous care by either setting the right money supply or fixing the right interest rate. There is no other way to get full employment. There is nothing automatic about it.

Franco Modigliani (1999, cf. Barnett/Solow (2000), p. 229.)

Introduction

In this paper, we follow the approach of Balmaseda, Dolado and López-Salido (2000) to estimate a Structural Vector Autoregression model (SVAR thereafter) by using the method of long-run identifying restrictions as developed by Blanchard and Quah (1989). By imposing restrictions on the reduced-form Vector Autoregression model (VAR thereafter) the reduced-form innovations can be interpreted as structural shocks stemming from different sources. Specifically, Balmaseda, Dolado and López-Salido (2000) are able to distinguish between technology shocks, labour supply shocks and aggregate demand shocks within a VAR consisting of real wages, real output and unemployment. This is possible because – in contrast to the original work of Blanchard and Quah (1989) – these authors explicitly model the labour market (insider-outsider framework) within the model. The contributions of the identified structural shocks to the evolution of the mentioned variables enlighten the forces driving unemployment and output growth in Germany and are therefore an alternative to traditional Phillips curve estimates. With these decompositions at hand, measures for the potential output, the output gap, the structural unemployment rate and the unemployment gap can be constructed.

The German (and, indeed, the European) unemployment problem is undoubtedly the most pressing problem that economic policy-makers face. This has been true since the stagflationary 1970s, when the unemployment rate jumped to extraordinarily high levels and never returned to the rates of previous periods. Using standard econometric tests for stationarity, it is precisely the non-stationarity of the unemployment rate that is one of the most striking features of this time series.

For Germany and Europe, this seems to stand in contrast with any theory which implies a constant "natural rate of unemployment".[1] That is why theories that attempt to explain the time series property by time-varying natural rate models, are so popular in recent times. These models have to explain theoretically why the natural rate follows a stochastic trend behaviour.

Within the framework of Balmaseda, Dolado and López-Salido (2000) there is however another possibility to introduce non-stationarity in the unemployment rate on a theoretical level. Whereas Balmaseda, Dolado and López-Salido (2000) assume only strong persistence (they prefer to call it "partial hysteresis"), we decided to assume full hysteresis within the insider-outsider framework. The paper is therefore novel in terms of the explicit assumption of *full hysteresis*. We argue, that our specification of the model is in line with the detection of non-stationarity in Germany's unemployment rate.

The econometric methodology mainly refers to the SVAR methodology with long-run identifying restrictions in the spirit of Blanchard and Quah (1989) which allows a "theory-guided" view on the data. As mentioned above, the framework developed by Balmaseda, Dolado and López-Salido (2000) allows to model the labour market explicitly including the possibility of the existence of long-run non-neutrality with respect to demand shocks because of the presence of full hysteresis. The economic idea behind is that within the insider-outsider framework the unemployed persons are effectively excluded from any influence on the wage-setting process. This in turn implies that the labour market cannot be cleared because the real wage is not allowed to fall. Therefore a very important neoclassical adjustment mechanism is not working at all. The main findings are as follows: Under this identifying restriction demand shocks have strong long-run effects on the German unemployment rate. The historical decomposition confirms that demand policy was very effective in producing unemployment – especially in the 1980s – when the Bundesbank decided to continue the disinflation of the economy over long-lasting periods.

The paper is organised as follows: Section 1 gives a short overview about the applied structural VAR approach. The theoretical model and the data properties are presented in the sections 2 and 3. In section 4 the results are presented. Section 5 discusses and concludes.

[1] Cf Friedman (1968). Friedman, however, did not state that the "natural rate" is constant over time. On the contrary, it depends crucially on institutional factors.

1. The SVAR methodology[2]

Sims (1980) heavily critizised the traditional approach of structural macroeconometric modelling for imposing incredible restrictions and ignoring a lot of feedback effects between the variables. He proposes the VAR approach that takes into consideration all interactions between the variables. Indeed all variables are treated as endogenous variables in a VAR. This is, however, a reduced form approach that does not tell much about the structural relationships unless some identification assumptions are made.

The structural VAR analysis is an attempt to solve the traditional identification problem. Assuming for reasons of simplicity the case of a VAR(1), the structural form of a model can be described by the following equation:

(2.1) $$BX_t = \Gamma_0 + \Gamma_1 X_{t-1} + \varepsilon_t, \qquad \varepsilon \sim N(0, \Sigma_\varepsilon)$$

B is an $n \times n$ matrix that collects the information regarding the contemporanous relationships between the endogenous variables in vector X ($n \times 1$). Γ_1 is an $n \times n$ matrix that contains the information about the lagged relationships. This form, however, is not identified and cannot be estimated directly. But we are able to estimate the reduced form of that model, which is the traditional VAR estimation:

(2.2) $$X_t = A_0 + A_1 X_{t-1} + e_t, \qquad e \sim N(0, \Sigma_e)$$

with $A_0 = B^{-1}\Gamma_0$, $A_1 = B^{-1}\Gamma_1$ und $e_t = B^{-1}\varepsilon_t$.

In order to be able to recover the structural parameters from the reduced ones we need at least n² restrictions. This becomes obvious if we analyse the dimensions (see table below).

- Comparison of Dimensions -

Structural Model		**Reduced Model**	
Variable	Dimension	Variable	Dimension
B	n^2		
Γ_0	n	A_0	n
Γ_0	n^2	A_1	n^2
Σ_ε	n(n+1)/2	Σ_e	n(n+1)/2
Sum	$(5n^2+3n)/2$	Sum	$3/2\ (n^2+n)$

[2] A non-technical introduction to structural VAR analysis can be found in Enders (1995) or in Gottschalk (2001).

From the table one sees that we need at least $(5n^2+3n)/2 - 3/2\,(n^2+n)) = n^2$ restrictions to identify the model.[3] To apply that, we re-write the VAR in its moving average representation:

$$(2.3) \qquad X_t = \mu + C(L)\varepsilon_t$$

with $\mu = \left[I - \left(B^{-1}\Gamma_1\right)L\right]^{-1} B^{-1}\Gamma_0$ and $C(L) = \left[I - \left(B^{-1}\Gamma_1\right)L\right]^{-1} B^{-1} = \sum_{i=0}^{\infty} A_1^i B^{-1} L^i = \sum_{k=0}^{\infty} C(k)L^k$

There are different strategies to impose the restrictions on a model.[4] We follow the way proposed by Blanchard and Quah (1989) and impose n(n+1)/2 restrictions by the assumption of the orthonormality of the structural innovations: that means $\Sigma_\varepsilon = I$ and n(n-1)/2 long-run restrictions. The long-run restrictions impose conditions on C(1) – the long-run multiplier matrix. They force the long-run multiplier of specific shocks to specific variables to be zero. We have three variables (n=3) and impose 3 long-run restrictions (3*(3-1)/2=3).[5] The long-run solution of our specific model with three variables and three zero restrictions (neglecting the deterministic component for a moment) can be expressed in the following long-run representation:

$$(2.4) \qquad \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} C_{11}(1) & 0 & 0 \\ C_{21}(1) & C_{22}(1) & 0 \\ C_{31}(1) & C_{32}(1) & C_{33}(1) \end{bmatrix} \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \end{bmatrix}$$

In analyzing the structural features of the model we employ different techniques: Firstly, we look at the *impulse-response functions*. Since $C(1) = \sum_{k=0}^{\infty} C(k)$ is the long-run multiplier, the plot of k^{th} element of C(L) against k vizualizes the adjustment path after a structural shock occured.

Secondly, the information of the lag polynomial C(L) can be used to calculate the *forecast error variance decomposition* (FEVD thereafter). At different forecast horizons, the FEVD give answer

---

[3] This is not exactly true, because this condition is necessary but not sufficient (but the model is precisely identified in our case).

[4] Cf. Amisano and Giannini (1997), Chapter 1.

[5] The solution of the model (see details below) gives us the restrictions that only supply shocks have long-lasting effects on real wages, whereas supply and demand shocks have long-lasting effects on real GDP (and all three shocks have long-lasting effects on unemployment).

to the question, which portion of the variance of the time series' stochastic part can be explained by each of the structural shocks.[6]

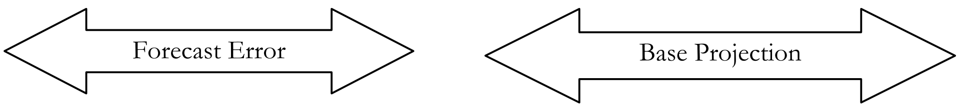
Thirdly, we computed *historical decompositions*. The intuition of that procedure is as follows: The moving average representation of the SVAR (cf. 2.3) can be decomposed. Let's assume a specific date T. Then, the MA representation can be expressed as the forecast for y_{T+j} based on the information in T (which collects all information up to time T, term in brackets) and the part that is mainly based on the time path of the different shocks in the vector of the structural residuals ε_t between T+1 and T+j.

Formally, this can be written as

$$X_{T+j} = \sum_{k=0}^{j-1} C(k)\varepsilon_{T+j-k} + \left[\mu + \sum_{k=j}^{\infty} C(k)\varepsilon_{T+j-k} \right] \qquad (2.5)$$

In formula (2.5), the term in brackets gives the "base projection" of the time series, that is the projection based on the information available in T (the deterministic and the stochastic part up to T) whereas the first part on the right side of equation (2.5) contains for each of the components of ε_t, the part of X that is due to the time path of each component in the time between T+1 until T+j. This first part of the right side of equation (2.5) is the forecast error due to structural shocks – because it is those part which can not be forecasted in T. To illustrate the argument, assume for a moment that T is set to 1970:01 and j is 24 (6 years for quarterly data). According to equation (2.5) the MA representation can be written down as follows:

$$X_{1970:1+24} = C(0)\varepsilon_{1976:1} + c(1)\varepsilon_{1975:4} + \ldots + c(23)\varepsilon_{1970:2} + \left\lfloor \mu + C(24)\varepsilon_{1970:1} + C(25)\varepsilon_{1969:4} + \ldots + C(\infty)\varepsilon_{\text{Big Bang}} \right\rfloor$$



For the decomposition presented here, T is fixed in 1972:03 (due to the loss of some degrees of freedom because of lags in the estimation). The parameter j runs from 1 to 127, that means the historical decomposition collects all information concerning the influence of the structural innovations on the time series' evolution from the starting point of the decomposition until the end of the observation period. That seems to be the appropriate method for the

[6] Cf. Estima (2000), pp. 299 on that topic.

calculation of the potential output and the structural unemployment rate, respectively. An alternative would have been to hold j fixed and move T over the observation period.[7]

To sum up: What the SVAR methodology allows for is a "theory guided view" of the data. To identify the model we refer to restrictions as we can draw from a theoretical model. Such a model is presented in the next section.

2. The Theoretical Model

Below we refer to the model proposed by Balmaseda, Dolado and López-Salido (2000). This model is an extension of the framework used by Blanchard and Quah (1989) which – in contrast to Blanchard and Quah – allows for two different types of supply shocks (productivity or technology shocks and labor supply shocks). Specifically, the model has the following log-linear structure (small letters refer to logs):

- The Model -

1.	$y = \phi(d - p) + a\theta$	Agregate demand equation
2.	$y = n + \theta$	Production function
3.	$p = w - \theta$	Price-setting equation
4.	$l = \alpha(w - p) - bu + \tau$	Labor-supply equation
5.	$w = \arg\{n^e = \lambda l_{-1} + (1 - \lambda)n_{-1}\}$	Wage-setting (insider-outsider framework)[8]
6.	$u = l - n$	Unemployment (definition equation)
7.	$\Delta d = \varepsilon_d$	Demand shocks
8.	$\Delta\theta = \varepsilon_s$	Productivity (= supply) shocks
9.	$\Delta\tau = \varepsilon_l$	Labor supply shocks

The first equation is an *aggregate demand function* with $\phi > 0$. The parameter d is a proxy for nominal expenditure (for the stance of monetary and fiscal policy). In this specification, it is allowed for productivity (θ) to positively affect (a>0) aggregate demand through investment or consumption decisions (permanent income hypothesis).

The second equation stems from a *production function* with constant return to scale technology.

The third equation sets the *price-setting rule.* Here, the mark-up is equal to one. However, we would get the same result with a constant mark-up above one.

[7] Cf. Gottschalk (2002), pp. 87f. on that topic

Equation (4) is a *labour-supply function*. The labour supply depends positively on the real wage (α>0), and negatively on the unemployment rate (b>0). It is assumed that the discouragement effect (bad perspectives discourage the individual labour supply) is stronger than the offsetting effect (if one member of the household loses his job, the other members have incentives to search for a job in order to keep the family's income unchanged). τ represents some demographic effects.

Equation (5) sets the *wage-setting rule*. The model refers to an *insider-outsider framework*. Wages are chosen one period back and in order to achieve an expected value of employment (n^e). This value in turn is a weighted function of actual employment (n_{-1}, the insiders) and labour supply (l_{-1}, the insiders and outsiders). With λ=0, we are in presence of full hysteresis ($w = \arg\{n^e = n_{-1}\}$).[8]

Equation (6) is a definition of the *unemployment rate*. Recall that all variables are in logs, therefore $u \approx -\log(1-u) = -\log(N/L) = \log(L/N) = \ell - n$.

The three structural shocks θ, d and τ are assumed to be random walks (see equations 7 to 9).

There are two possible strategies to solve the model. First, we can assume *partial hysteresis* with $0 < \lambda < 1$ If λ is close to 1, this can be identical with the assumption of high persistence. Both – insiders as well as outsiders – are allowed to influence wage setting. This solution strategy is identical – as Balmaseda, Dolado and López-Salido (2000) have shown – with the assumption that the unemployment rate is an I(0) process. They assumed this as the relevant model for Germany (in fact, they used annual data and a longer time span). This, however, is in contrast with our data properties (refer to table 1 and the discussion in section 3).

Another solution strategy is to assume *full hysteresis* with $\lambda = 0$: Outsiders are completely excluded from the wage setting process.[9] This assumption is identical with the cut of a very important neo-classical equilibrating mechanism. Cutting the neoclassical equilibrating mechanism of having outsiders which can influence the wage setting is one way of introducing a high degree of non-neutrality into a model. In fact, a demand shock now has a permanent effect on output. The long-run solution of that model – neglecting the deterministic for simplicity – is given by:[10]

---

[8] The term "arg" stands for the solution of the problem in brackets.

[9] Cf. Blanchard and Summers (1986), Layard, Nickel and Jackman (1991).

[10] For a detailed solution please refer to the annex.

(3.1) $$\begin{pmatrix} \Delta(w-p) \\ \Delta y \\ \Delta u \end{pmatrix} = \begin{pmatrix} c_{11}(1) & 0 & 0 \\ c_{21}(1) & c_{22}(1) & 0 \\ c_{31}(1) & c_{32}(1) & c_{33}(1) \end{pmatrix} \begin{pmatrix} \varepsilon_s \\ \varepsilon_d \\ \varepsilon_l \end{pmatrix}$$

The most distinguishing feature of that solution is that demand shocks now have long-lasting effects on output because one equilibrating mechanism is excluded.

3. The Data

For the empirical estimation we used quarterly seasonally adjusted German data from 1970 onwards. From 1970 to 1990, the data refers to West Germany, from 1991 onwards, it refers to the reunified Germany. For the elimination of the reunification break, we regressed the differenced series on an impulse dummy and recalculated the level series.[11] All data, except for the unemployment rate, were in log form. Output was given by real GDP, prices were given by the consumer price index, wages were given by the compensation of employees from the German national cccounts and divided by the hours paid as calculated at the DIW Berlin. All time series were seasonally adjusted using the Berlin Method (BV4). The time series are shown in Figure 1.

- Insert Figure 1 about here -

To infer about stationarity we infer augmented Dickey-Fuller (ADF) tests. However, we used the critical values as proposed by Perron (1989) which takes into account the presence of a structural break in the data. Balmaseda, Dolado and López-Salido (2000) correctly argue that traditional ADF tests are not very powerful. That is why they use Johansen's FIML procedure which – again correctly – is assumed to be more powerful than standard ADF tests. Another possibility would have been to use a more powerful unit root tests like those recently proposed by Elliott, Rothenberg, and Stock (1996). All of these mentioned procedures however assume, that there is no structural break in the data. For Germany this is definitely not the case because of the reunification. Therefore these tests cannot be applied and we rely on the results from the Perron test.[12]

---

[11] The reason for this lies in difficulties of calculating historical decomposition if we allowed for a "break" and used dummies instead.

[12] The Perron test indicated a structural break for the time series of output and real wage. The test does, however, not indicate a structural break in the case of the unemployment rate. Consequently, the critical values of a conventional ADF test apply. Taking into account the argument of Balmaseda, Dolado and López-Salido (2000), that a more powerful test is needed, we furthermore considered the test procedure of Elliott, Rothenberg, and

The respective values for the test statistics as well as the specifications are given in Table 1. We found the unemployment rate and the output to be I(1) in levels. There is however a problematic case with the real wage. The test indicates, that the real wage might be I(2). And, indeed, it is a borderline case. For theoretical reasons, we assume the real wage for the examination to be I(1). We concretely assume, that the nominal wage should have the same order of integration as the price level [I(2)] and both time series should be co-integrated. Therefore, the highest possible order of integration of the real wage should be I(1).

- Insert Table 1 about here -

The data properties are in line with our identification scheme. This is in contrast to the data property results of Balmaseda, Dolado and López-Salido (2000), which found the unemployment rate to be stationary. This result might come out, if – like these authors did – the period from 1950 until the middle of the 1990s is investigated under the assumption that there is no structural break. The result of the unit root test then reflects the fact, that the unemployment rate came down from high levels over the 1950s and 1960s and started to increase in the 1970s. In our interpretation, it seems to be very doubtful, that there should be no structural break in the macroeconomic relationships over such a long period. Especially the 1950s and 1960s are typically be seen as the "golden age" of the German post-war economy and surely reflected "catch-up" growth after the huge deterioration of the World War II. Then, however, the sample range applied by Balmaseda, Dolado and López-Salido (2000) is not appropriate anymore. We used a shorter time span, and we included data for the reunified Germany. Then, according to our test results, only the full hysteresis hypothesis is in line with our data properties.

4. The Results of the SVAR Analysis

In this section, we will present impulse-response functions, forecast error variance decompositions, as well as the historical decompositions for the output and unemployment data. Because in this methodological framework of a just identified SVAR we do not have the possibility to test our restrictions, we analyzed the plausibilty of the results according to our understanding of the German economy. The VAR model was estimated using 5 lags of quarterly data (which was suggested by the minimum of the Akaike Information Criteria as

Stock (1996) for the unemployment rate. This did not alter the result, that the German unemployment rate is non-stationary in the relevant sample period. The test results are available from the authors on request.

well as the Hannan-Quinn Criteria, the Likelihood Ratio Test and the Final Prediction Error Criteria). Lag exclusion tests (Wald tests) indicated that the 2nd lag was insignifant. To avoid an overparametrized model this lag was restricted to zero. According to standard tests the residuals of the unrestricted VAR are normally distributed and free of autocorrelation.[13]

The impulse-response functions (accumulated responses of the differenced series give responses in levels) are given in Figure 2. The confidence bands of two standard errors were calculated using a bootstrapping procedure with 5000 repetitions.[14]

- Insert Figure 2 about here -

As imposed by our restrictions, the real wage is not influenced in the long run by demand and labour supply shocks, as is the output by labour supply shocks. Six combinations that have long-term effects remain.

Supply shocks affect all three variables: They increase the real wage and output, and lower probably the unemployment (to a limited extent only). As mentioned above, the non-trivial cutting of an important equilibrating mechanism establishes features of non-neutrality in the model. This can be seen from the positive long-run response of output to a demand shock. The mirror is the unemployment picture, in which a demand shock has a permanent decreasing effect. Not surprisingly, a labour supply shock increases unemployment.

The forecast error variance decomposition (cf. Table 2) shows, that real wages are driven in the long run by far only by technology shocks. However, in the short run, demand shocks are important for the variance of real wages. The output is now mainly driven by demand shocks. In contrast to standard identification schemes and for the discussed reasons these effects do not disappear in the long run. Supply shocks, however, explain a huge part of the output movement, too. It is also interesting, that for the unemployment rate mostly demand shocks matter (note, that no shock was restricted to be zero in the long run). The influence of supply shocks disappears in the long run.

- Insert Table 2 about here -

The graphs for the historical decomposition (Figure 3 and 5 for output and unemployment) contain the information as to how much of the deviation of the base projection (which mainly

---

[13] The results are available on request by the authors.

[14] The bootstrap procedure is based on re-ordering.

detrends the time series as expressed in levels) is explained by the different structural shocks over time.

- Insert Figures 3 and 5 about here -

Regarding output, the two oil price shocks are mainly identified as negative demand shocks for the output series, whereas positive explanantory power for output comes mainly from positive supply shocks. Regarding the unemployment series, the jumps in the German unemployment rate are mainly explained by labour supply and demand shocks.

Furthermore, we used the historical decomposition results to create time series for the output gap and the structural unemployment. In Figure 4, we present a measure of the output gap as given by our model. The potential output measure is defined as the base projection and the sum of the supply and labour supply shocks. The demand shocks drive the deviation from output to potential output. The output gap became negative during the first oil price shock; later, the gap was closed for a short time. The 1980s can be seen as a long period of a negative output gap. The gap was closed during Germany's reunification and opened up again in the mid-1990s – which was an adjustment recession after the reunification boom.

The same exercise was completed for the unemployment series (cf. Figure 6), where the sum of the base-projection and the different supply shocks is called structural unemployment. The unemployment gap is explained by demand shocks. Demand-led unemployment is simply a mirror of our output gap. For that, the disinflationary 1980s created a high level of unemployment.

- Insert Figures 4 and 6 about here -

5. Discussion

The results of the analysis are satisfactory in that the "theory-guided" view on the data – stemming from a hysteresis-based framework – yield reasonable results for the impulse-response functions, the forecast error variance decompositions as well as the historical decomposition in general. The results are in line with our hypothesis that negative demand shocks in the early 1980s and 1990s are mainly responsible for the jumps in unemployment in that period. In the case of Germany, we can interpret the rise in the unemployment rate over the last decades according to approach recently developed by Laurence Ball (1999): In the early 1980s, during the heyday of Monetarism and Supply-Side Economics, the Bundesbank decided to disinflate the German economy to overcome the stagflationary 1970s. Thus, the central bank raised the short-term interest rate, which lead to a negative output gap and higher unemployment.[15] According to the Phillips curve this led to lower inflation. With inflation falling and unemployment rising, the central bank lowered the interest rate. However, Ball argues that in contrast to the Fed in the U.S. the Bundesbank opted for a very gradual approach to disinflation. Thus, the Bundesbank maintained tight conditions over a long period of time, long enough for the equilibrium unemployment rate to follow the actual unemployment rate (hysteresis). When the central bank finally lowered its interest rate, this did not have a great effect on the unemployment rate, because, by then, the equilibrium rate had risen as well. In other words, the disinflationary process initiated by the Bundesbank lasted long enough that hysteresis effects could arise. The evolution of the unemployment rate could therefore be attributed mainly to a lack of effective demand.[16]

Our model implies non-neutrality and is also in line with the observation of a traditional Phillips curve for that period in Germany.[17] However, the assumption of full hysteresis is only one way to establish the result of long-run non-neutrality with regard to aggregate demand shocks. To impose full insider power but assuming no outsider power is a very strong assumption. Other models could be tested which refer to the effects of disinflation on capital accumulation or real balance effect doubts.

Further research should furthermore concentrate on the empirical validity of the established results. This could be done for instance by testing the calculated unemployment gap data in short-run Phillips curve estimations. First results indicate that our unemployment gap measure is indeed helpful in explaining inflation using a traditional Phillips curve. But this resarch goes beyond the scope of this paper. The results of this paper, however, have a strong implication for economic policy. If hysteresis is a relevant phenomenon the analysis implies that demand-side policies matter for output and unemployment – not only in the short-run but also in the long-run.

---

[15] Cf. Keynes (1930: p. 245): *"The* object *of the higher bank rate is to involve entrepreneurs in losses and the factors of production in unemployment, for only in this way can the money rates of efficiency earnings be reduced. It is not reasonable, therefore, to complain when these results ensue."*

[16] Cf. Solow (2000), Modigliani (1996).

[17] Cf. Farmer (2000), Gottschalk and Fritsche (forthcoming).

References

Amisano, G. and Giannini, G. (1997), Topics in Structural VAR Economics. Berlin et. al.

Ball, L. (1999), Aggregate Demand and Long-run Unemployment. In: Brookings Papers on Economic Activity No. 2, pp. 189-251.

Barnett, W. and Solow, R. (2000), An Interview with Franco Modigliani, In: Macroeconomic Dynamics, Vol. 4, No. 2, pp. 222-256.

Balmaseda, M., Dolado, J. and López-Salido, D. (2000), The Dynamic Effects of Shocks to Labour Markets: Evidence from OECD contries. In: Oxford Economic Papers, Vol. 52, pp. 3-23.

Blanchard, O. and Summers, L. (1986), Hysteresis and the European Unemployment Problem, In: NBER Macroeconomics Annual, pp. 15-78.

Blanchard, O. and Quah, D. (1989), The Dynamics of Aggregate Demand and Supply Disturbances. In: American Economic Review, Vol. 79, No. 3, pp. 655-673.

Elliott, Rothenberg, Stock (1996), Efficient Tests for an Autoregressive Unit Root. In Econometrica, Vol. 64, Issue 4 (July), pp. 813-836.

Enders, W. (1995), Applied Econometric Times Series. New York.

Estima (2000), RATS 5.0 Users Guide, Evanston.

Farmer, R. (2000), Natural Rate Doubts. London (= CEPR Discussion Paper Series on International Macroeconomics. 2426)

Friedman, M. (1968), The Role of Monetary Policy. In: American Economic Review, Vol. 58, No. 1, pp. 1-17.

Gottschalk, J. (2001), An Introduction into SVAR Methodology : Identification, Interpretation and Limitations of SVAR models. Kiel (= Kiel working paper. 1072).

Gottschalk, J. (2002), Keynesian and Monetarists Views on the German Unemployment Problem – Theory and Evidence. (= Kiel working paper. 1096).

Gottschalk, J. and Fritsche, U. (forthcoming), How well does the "New Keynesian Model" fit German data? Berlin (IMF Working Paper).

Keynes, J.M. (1930), A Treatise on Money. Vol. 1 (A Pure Theory of Money). In: Collected Writings of J. M. Keynes, Vol. 5, London/Basingstoke 1971.

Layard, R., Nickell, S. and Jackman, R. (1991), Unemployment. Macroeconomic Performance and the Labour Market. Oxford/New York.

Modigliani (1996), The Shameful Rate of Unemployment in the EMS: Causes and Cures. In: De Economist, Vol. 144, No. 3, pp. 363-396.

Perron, P. (1989), The Great Crash, the Oil Price Shock and the Unit Root Hypothesis. In Econometrica, Vol. 57, Issue 6 (November), pp. 1361-1401.

Sims, C.A. (1980). Macroeconomics and Reality. In: Econometrica, Vol. 48, No. 1, pp. 1-48.

Solow, R. (2000), Unemployment in the United States and Europe: A Contrast and the Reasons. In: CESifo Forum (spring).

Annex:

- The solution of the model -

Equation (3) gives (w-p = θ) ⇔ $\boxed{\Delta(w-p) = \Delta\theta = \varepsilon_s}$

Equation (1) gives $y = Ød - Øp + a\theta$
from (3) $y = Ød - Ø(w-\theta) + a\theta$
from (5) with λ=0; $y = Ød + (a+Ø)\theta - Ø(\arg(n_{-1}))$
⇔ $\boxed{\Delta y = Ø\varepsilon_d + (a-Ø)\varepsilon_s}$

Equation (6) gives $u = l-n$
from (4) $u = \alpha(w-p) - bu + \tau - n$
from (3) $(1+b)u = \alpha\theta + \tau - n$
from (2) $(1+b)u = \alpha\theta + \tau - (y-\theta)$
with the expression for y $(1+b)u = (1+\alpha)\theta + \tau - Ød - (a+Ø)\theta + Ø(\arg(n_{-1}))$
yields $u = (1+b)^{-1}\,[(1+\alpha-a-Ø)\theta + \tau - Ød + Ø\arg(n_{-1})]$
⇔ $\boxed{\Delta u = (1+b)^{-1}\,[(1+\alpha-a-Ø)\Delta\theta + \Delta\tau - Ø\Delta d]}$

under the assumption of λ=0, the *long-run solution* is given by

$$\begin{pmatrix} \Delta(w-p) \\ \Delta y \\ \Delta u \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ \phi + a & \phi & 0 \\ (1+\alpha-\phi-a)(1+b)^{-1} & -(1+b)^{-1}\phi & (1+b)^{-1} \end{pmatrix} \begin{pmatrix} \varepsilon_s \\ \varepsilon_d \\ \varepsilon_l \end{pmatrix}$$

The model is *exactly identified.* [cf. Balmaseda, Dolado and López-Salido (2000)].

Table 1:

Results of Unit Root Tests	
H0 = Nonstationarity	**t-stat (specification)**
Unemployment Rate[1)] Differenced Unemployment Rate	-1.46 (constant, lags: 1, 2, 4, 5, 8) - 3.44 (lags: 1, 4, 5, dummy in 1992:2) **
Log of Real GDP Differenced Log of Real GDP	-2.75 (constant, trend, lags: 1 to 4, 7, 8, dummies in 1987:1, 1975:1) -5.48 (constant, lags: 1, 3, 4, 8, dummies in 1987:1, 1992:1) ***
Log of Real Wage Differenced Log of Real Wage	-3.68 (constant, trend, lags: 2 to 5, 8) * -3.36 (constant, lags: 1, 2, 4, 8)
*, **, *** = reject H0 at 10, 5, 1%-level 1) No structural break was detected in the unemployment rate when the Perron (1989) procedure was applied. Therefore the critical values of a conventional ADF test were used.	

Table 2

Forecast Error Variance Decomposition (in % of Variable Variance)			
Variable:	**Real Wage**		
Shock:	Supply Shock	Demand Shock	Labour Supply Shock
Lag:			
1	68.7	30.9	0.3
8	76.3	21.2	2.5
60	98.1	1.6	0.3
Variable:	**Output**		
Shock:	Supply Shock	Demand Shock	Labour Supply Shock
Lag:			
1	55.0	26.2	18.8
8	44.7	50.1	5.1
60	36.8	62.6	0.5
Variable:	**Unemployment**		
Shock:	Supply Shock	Demand Shock	Labour Supply Shock
Lag:			
1	23.3	42.3	34.3
8	13.9	70.3	15.8
60	2.4	75.4	22.2

Figure 1: Data used for estimation

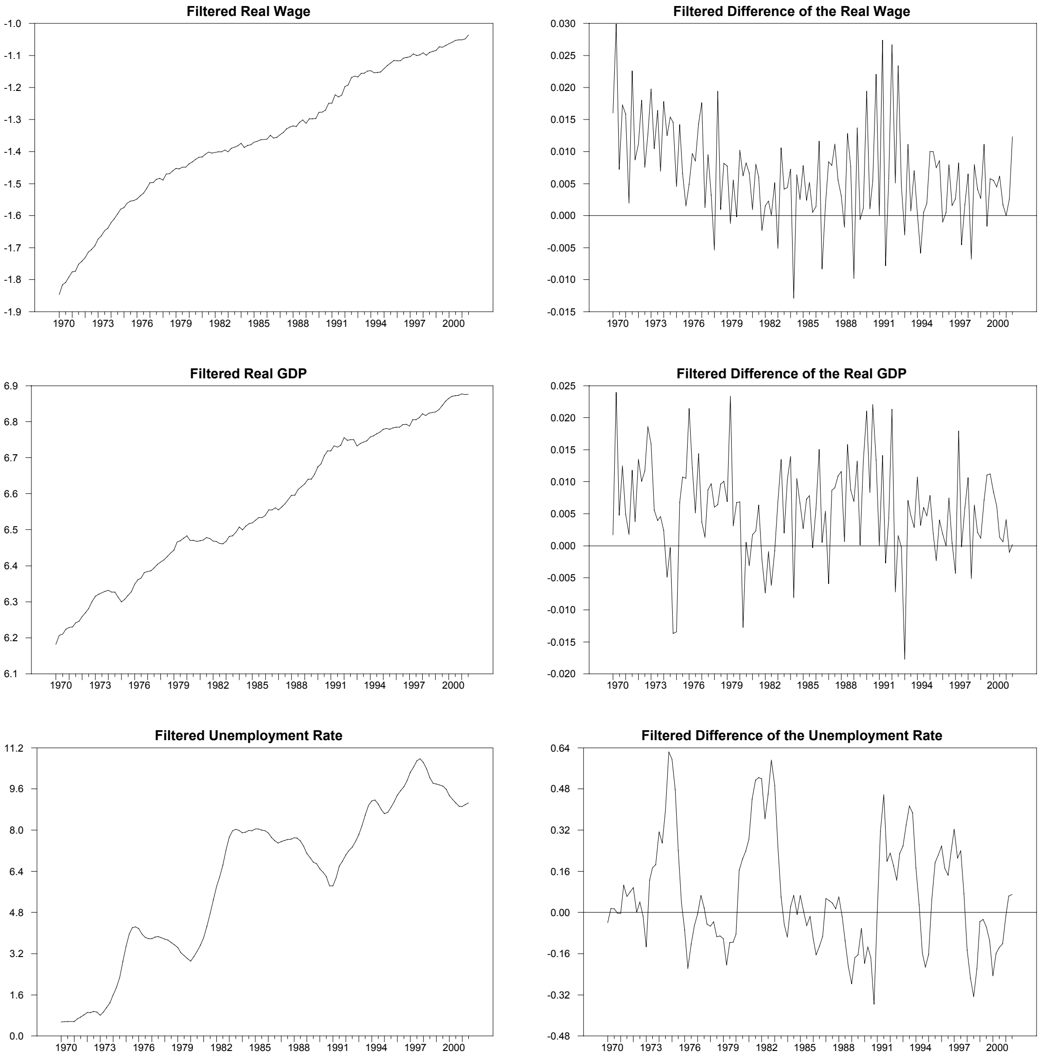


Figure 2: Impulse Responses to a S.D. Structural Innovation with 2 Standard Errors Confindence Bounds

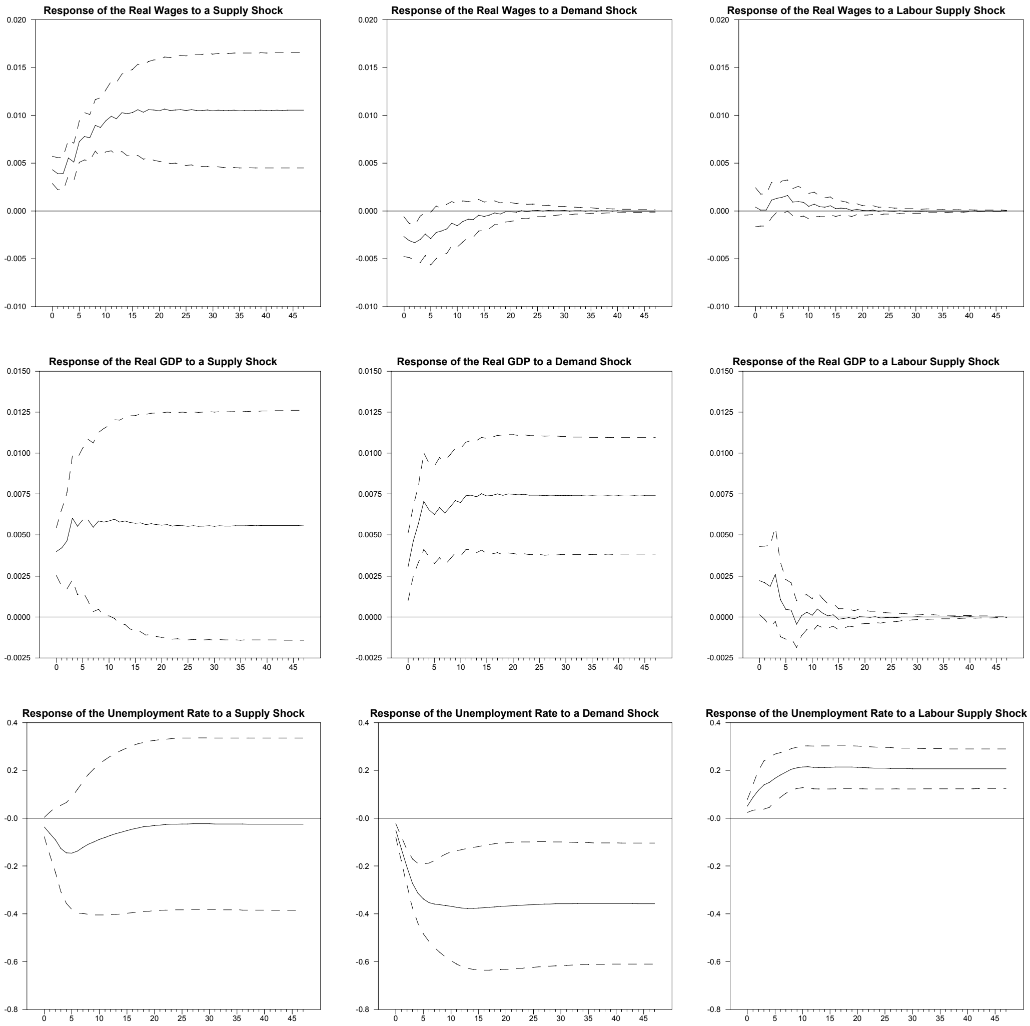


Figure 3: Decomposition of the Forecast Error (Output minus Base Projection)

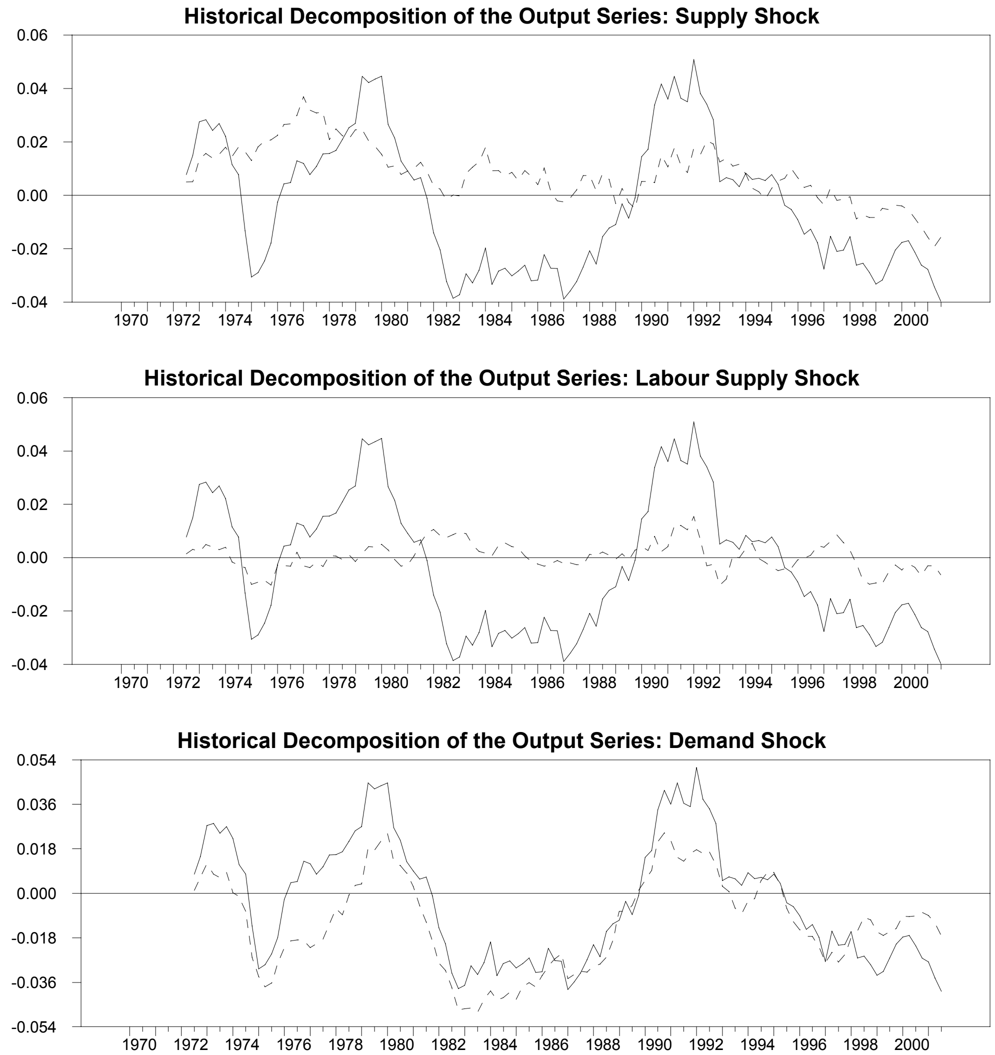


Figure 4:

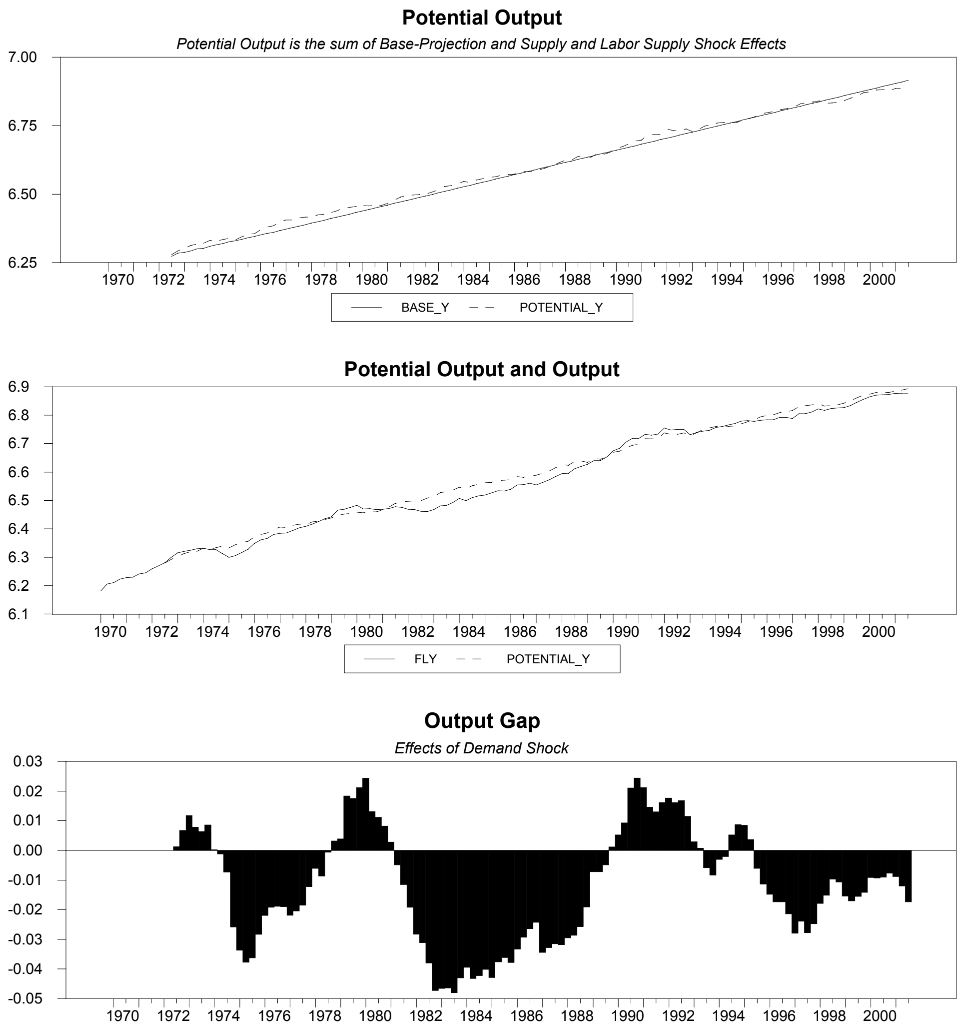

Potential Output
Potential Output is the sum of Base-Projection and Supply and Labor Supply Shock Effects
7.00
6.75
6.50
6.25
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000
BASE_Y
POTENTIAL_Y
Potential Output and Output
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000
FLY
POTENTIAL_Y
Output Gap
Effects of Demand Shock
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000

Figure 5: Decomposition of the Forecast Error (Unemployment Rate minus Base Projection)

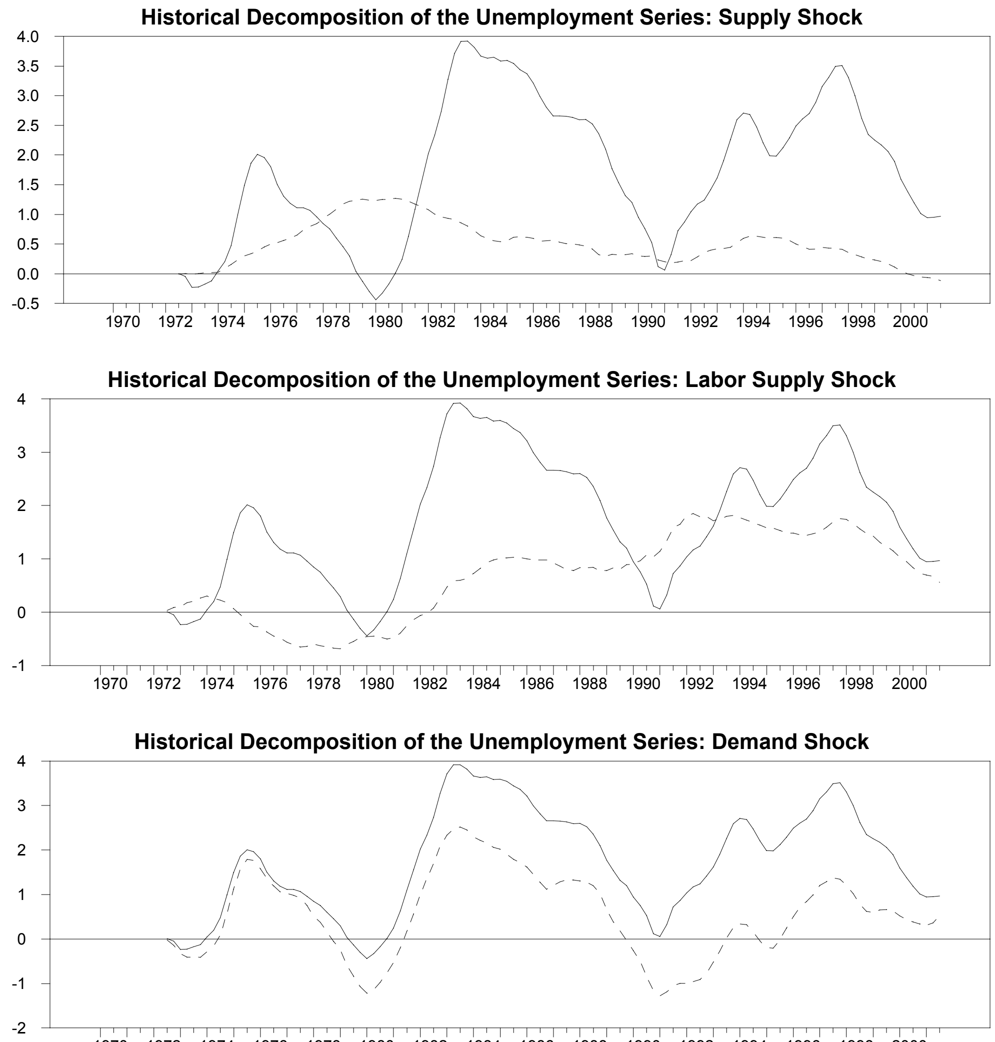
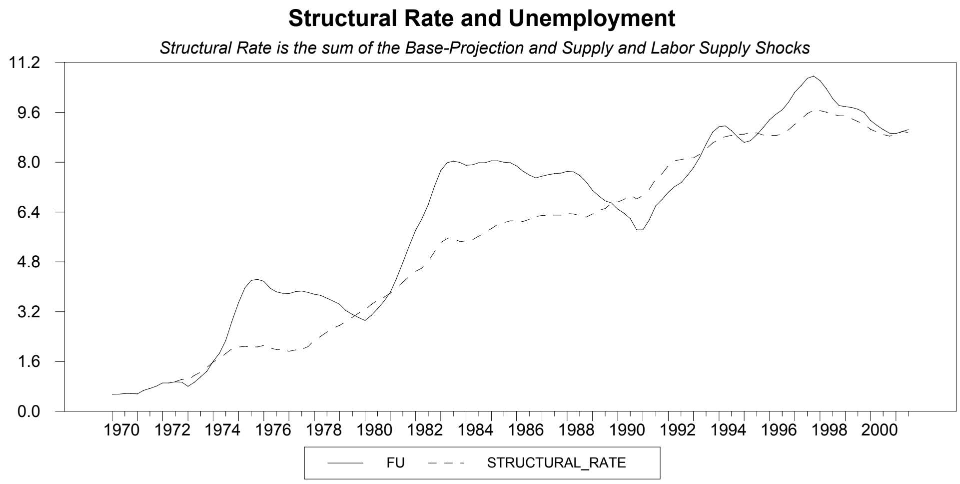
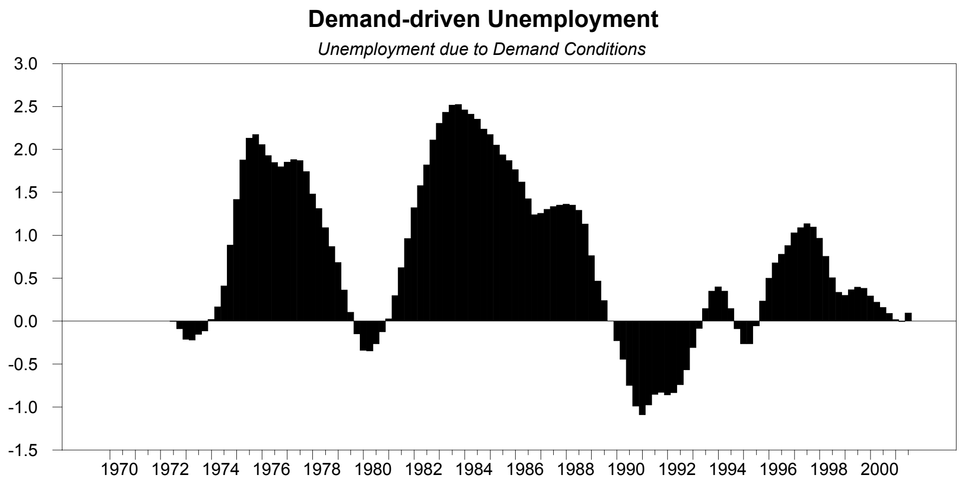


Figure 6



Structural Rate and Unemployment
Structural Rate is the sum of the Base-Projection and Supply and Labor Supply Shocks
11.2
9.6
8.0
6.4
4.8
3.2
1.6
0.0
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000
FU
STRUCTURAL_RATE



Demand-driven Unemployment
Unemployment due to Demand Conditions
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000