Do Austria And Germany Form An Optimum Currency Area ?

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Abstract. The paper focuses on consequences that a Common Currency Area imposes on the wage and price formation in a small open economy. Optimum Currency Areas (OCA) can be defined in many ways but the concept can be simplified to a high degree of labor mobility and real wage flexibility. Assuming an OCA consists of several regions this implies that shifts in relative prices among those regions should not induce movements in regional unemployment or inflation but either migration or real wage adjustment. The presence of an OCA between Austria and Germany is of special interest because the Austrian schilling can be regarded as pegged to the deutsche mark since the 1950's and the European Monetary Union forces not only small open economies to adjust their price and wage formation in accordance with stable member countries. Using a structural VAR approach, shocks to the nominal effective exchange rate are interpreted as shifts in relative prices. A test for an OCA between both countries looks on effects that exchange rate shocks have on unemployment and real wages in the tradables and nontradables sectors of a small open economy.

Zusammenfassung. In einer Gemeinsamen Währungszone ergeben sich für eine kleine offene Wirtschaft Auswirkungen auf die Lohn- und Preisgestaltung. Eine Optimale Währungszone (OWZ) kann in unterschiedlich definiert werden. In einer Vereinfachung kann das Konzept jedoch auf die ausreichende Mobilität der Faktoren und die Flexibilität der Reallöhne reduziert werden. Unter der Annahme, daß eine Währungszone aus mehreren Regionen besteht, ergibt sich aus diesen Bedingungen, daß Verschiebungen der relativen Preise zwischen den Regionen keine regionale Arbeitslosigkeit oder Inflation erzeugen, sondern entweder Migration oder eine Anpassung der Reallöhne bewirken. Das Bestehen einer OWZ zwischen Österreich und Deutschland ist von speziellem Interesse, weil der Österreichische Schilling seit 1950 mehr oder weniger stark an die Deutsche Mark angebunden ist. Die Europäische Währungsunion zwingt nicht nur kleine offene Wirtschaften zu einer Anpassung der Lohn- und Preisgestaltung an die Verhältnisse in den stabilen Mitgliedsländern. In einer Strukturellen Vektorautoregression werden Schocks auf den nominellen effektiven Wechselkurs als eine Verschiebung der relativen Preise interpretiert. Der Test auf eine OWZ zwischen beiden Ländern betrachtet die Auswirkungen von Wechselkursschocks auf die Arbeitslosenrate und die Reallöhne im Sektor handelbarer und nicht handelbarer Güter.

INTRODUCTION

The efforts to introduce a European Monetary Union result in an ever growing literature on prerequisites and disadvantages of a common currency in Europe. An illustration can be given in a Keynesian model of a small open economy with fixed exchange rates and sticky prices. Within this model class the government should use fiscal policy in order to maintain internal equilibrium or full employment, whereas a balanced trade surplus is established automatically by adjusting real money balances to the desired level of demand. One representative example of this model class is given in Frenkel/Mussa (1985). If an unexpected shock hits a region within such a common currency area, one would expect divergent fiscal and monetary policy paths that correct for temporary deviations from the long run equilibrium income. On the other side, an unexpected shock, for example due to a shift in preferences from goods of one region to that of another, will change the relative price among regions that insures external balance. If furthermore, short term wage contracts and sticky prices prevail, a corresponding change in the exchange rate would dodge temporary income losses and therefore, minimize adjustment costs at the initial relative price. The costs of fixed exchange rates in terms of deviations from equilibrium employment or a higher inflation rate will be bigger, the more slowly nominal wages and prices adjust to their new equilibrium values. Since in a common currency area an adjustment of exchange rates is not at the government's disposal, several prerequisites must hold in order to avoid or minimize more or less persistent output deviations.

In case of sluggish price and wage adjustments shocks can be balanced by movements of factors of production among regions and industries. This notion was used by Mundell (1961) to define an Optimum Currency Area (OCA) as comprising several regions with a single currency or fixed exchange rates that are linked by high mobility of labor among regions and among industries. Correspondingly, a high mobility of capital can serve as a mean of adjustment. Several other conditions were emphasized in the literature. For example the degree of openness by McKinnon (1963), the extent of product diversification by Kenen (1969), or the homogeneity of policy makers preferences by Tower/Willet (1976). The similarity of the agent's preferences towards seignorage over regular tax payments proposed in Canzoneri/Rogers (1990) as well as supra-regional fiscal compensations that have been stressed in Sala-i-Martin/Sachs (1991) may provide a basis for an accelerated adjustment process.

Given the preconditions for a quick adjustment are met, fixing exchange rates or even introducing a common currency among regions enhances the quality of money by increasing its liquidity and enlarging the area of a common unit of account. On the other hand, whether more or less costs in terms of income losses or additional inflation will occur depends on the direction of the shock and the degree by which the prerequisites for an OCA are violated.

Previous studies by Bayoumi/Eichengreen (1992a, 1992b), Eichengreen (1991), Inman/Rubinfeld (1992) and Sala-i-Martin/Sachs (1991) revealed several deviations of European countries from the ideal of an OCA as compared to the U.S. For example, real exchange rates between member countries of the European Community (EC) are more variable and hence, region specific shocks seem to be comparatively dominant. Furthermore, the EC lacks a mechanism of fiscal transfers from prospering to suffering regions. Last but not least Eichengreen (1991) showed that labor mobility, as measured by the speed of adjustment between Europe's regions, is about 20 % lower than within the U.S. Due to different cultural habits and languages in member countries, labor mobility is unlikely to grow substantially with the removal of legal restrictions to factor movements inside the European Economic Area in 1993.

The significance of the question wether Austria and Germany form an OCA can be seen in Figure 1, where the exchange rate between Austrian schilling (ATS) and deutsche mark (DM) is given. The exchange rate has been fixed for almost the entire period after World War II. As one can see in Figure 1 just three major devaluations happened from 1952 to 1992. During the most volatile period between 1970 and 1980, average deviations from a mean of 718.58 ATS per 100 DM were just 1.4 %, thus lying conveniently inside the narrow band established in the European Monetary System (EMS) nowadays. Without participating in the exchange rate mechanism of the EMS the Austrian National Bank managed to keep the relation to the DM almost constant since 1981.

The Austrian experience with a Common Currency Area vis a vis Germany is of particular interest as it allows to assess the impact of shocks to relative prices on wage and price formation and on the unemployment rate in a small open economy. Several of the preconditions for an OCA between both countries are met:

(1) Austria is a small open economy with high and diversified foreign trade volume.
(2) Policy makers in Austria seem to pursue similar targets for economic policy like those in Germany.
(3) Neither the Austrian central bank nor the population prefers seignorage over income tax payments.
(4) Austria and Germany do not suffer from cultural barriers to labor mobility to the same extend as other members of the European Community.

However, there is no system of fiscal transfers between Austria and Germany and regional labor mobility is still subject to legal restrictions. The validity of an OCA can thus be summarized to the question, whether real wages in Austria are flexible enough and labor mobility between Austria and Germany and among Austrian industries is sufficiently high to balance relative price shocks and minimize adjustment costs in terms of lost output or high inflation.

Shocks to relative prices can be modelled as unexpected changes in the nominal effective exchange rate of the ATS. This formulation has two advantages. First, it is easy to incorporate this variable into a theoretical model for the transmission of foreign shocks into a small open economy. Second, the effective exchange rate comprises an import and export weighted average of exchange rates with all trading partners. In the presence of constant world prices of tradable goods, it reflects movements in relative prices between Austria and the rest of the world directly. Although the nominal exchange rate to the DM is fixed. This interpretation is corroborated by a strong correlation between nominal and real effective exchange rates as presented in Table 1. The strongest linear relation between these variables occurs contemporaneously. Lagged correlations are significant at lags -1 and 1 but small. Therefore, movements in the nominal effective exchange rate reflect shifts in relative prices quite good.

TABLE 1. Crosscorrelation of nominal and real effective exchange rate *)

Lag	-2	-1	0	1	2
$\rho(t, t + Lag)$	0.0038	0.1911	0.7248	0.2046	0.0445

*) monthly changes from 1967:8 to 1992:2
S: GEN database of the Austrian Institute of Economic Research, own calculations

In section two a short term version of the Scandinavian model is presented to illustrate the transmission of shocks in a small open economy. Based on theoretical results, restrictions for a Structural Vector Autoregression (SVAR) are derived. The SVAR includes the following variables: the nominal effective exchange rate, nominal wages and prices in tradables and nontradables sectors, respectively, and the economy wide unemployment rate. Empirical results are presented in the third section and the last part contains a short summary and conclusions.

THE MODEL

At the end of the sixties the Scandinavian model was developed to model the specific process of wage and price formation in a corporate environment, where centralized trade unions and employer organizations bargain over these variables[1]. This setting reflects the Austrian situation quite well. The model explains the transmission of international price changes into a small open economy and divides the economy into two sectors, one exposed to foreign competition (tradables) and the other sheltered (nontradables). The analysis starts with the

[1] See Lindbeck (1979) for citations and a comprehensive exposition of the model

assumption of a small open economy where prices of tradables are fixed at the prevailing world market prices. Firms inside the country face, therefore, completely elastic foreign supply and demand and are not able to influence the world market price. As equation (1) shows, percentage changes in the world price $\hat{p}_W$ are immediately transmitted into the small open economy through a fixed exchange rate ($\hat{e} = 0$)

$$\hat{p}_T = \hat{e} + \hat{p}_W \quad , \tag{1}$$

where $\hat{p}_T$ represents percentage changes in the price of tradables in home country currency.

The Scandinavian model was originally designed for a long run analysis and missed any demand side reactions. Because in the short run fluctuations in demand do have some effects on wages and prices, the original wage setting has been slightly modified in Lindbeck (1979). The struggle between employers and employees about wage and profit shares in income is reflected in the expectation term of the Phillips curve in equation (2)

$$\begin{aligned} \hat{w}_T &= a + b \cdot \hat{ur} + c(\hat{w}_T^e) \\ &= a + b \cdot \hat{ur} + c(\hat{p}_T + \hat{\lambda}_T) \quad , \end{aligned} \tag{2}$$

where the growth rate of wages in the tradables sector $\hat{w}_T$ depends on a constant a, the deviation of the unemployment rate from full employment $\hat{ur}$, and the expected wage movement in the tradable sector $\hat{w}_T^e$. The expected wage growth is determined by the assumption, that over the long run wages grow in line with changes in the price of tradable goods $\hat{p}_T$ and productivity growth in this sector $\hat{\lambda}_T$. This formulation leaves the long run income distribution between employers and employees constant. In the short run wage contracts hold the nominal wage constant and changes in the price of traded goods lead to corresponding changes in real producer wages. That may cause short run fluctuations in employment. Excess demand factors are covered by the deviations of unemployment from its natural level. The variable $\hat{ur}$ is assumed to have an unconditional expected mean of zero and the long run Phillips curve is assumed to be vertical $c = 1$. In this case the long run development of nominal wages in the tradables sector is determined by the deterministic term a, price changes $\hat{p}_T$ and productivity growth $\hat{\lambda}_T$.

An important assumption in the context of this paper is perfect mobility of labor between the tradables and nontradables sector. The wage equation for the nontradables sector (3) may be interpreted either as a consequence of a perfect labor market or as the result from a centralized wage policy of trade unions

$$\hat{w}_N = \hat{w}_T \quad . \tag{3}$$

Nevertheless, the nominal wage growth in the nontradables sector $\hat{w}_N$ reflects price and productivity developments in the tradables sector despite the fact, that there may be different paths of productivity growth among sectors. To keep the income distribution in the nontradables sector constant, mark up pricing is assumed

$$\hat{p}_N = \hat{w}_N - \hat{\lambda}_N \quad . \tag{4}$$

Percentage changes in prices of nontradables $\hat{p}_N$ correspond to changes in wages minus the productivity growth in the nontradables sector $\hat{\lambda}_N$. Following these equations the development of real producer wages in both sectors can be written in the following way

$$\hat{w}_T - \hat{p}_T = b \cdot \hat{ur} + c \cdot \hat{\lambda}_T + (c-1)\hat{p}_W + (c-1)\hat{e} \tag{5}$$

$$\hat{w}_N - \hat{p}_N = \hat{\lambda}_N \quad . \tag{4'}$$

In the short run c may differ from 1. Then unanticipated movements in the exchange rate or world market price will affect real producer wages in the tradables sector. Over the long term both sectors follow a trend given by the development of productivity.

To illustrate the implications for an OCA in this model, assume a one percent decrease in world market prices for tradables. In the short run a system of flexible exchange rates can improve the competitive situation of domestic firms simply by a devaluation. By that, lay offs in the tradables sector are prevented. On the other side, a fixed exchange rate or a common currency will generate unemployment through rising real producer wages in the production of tradables. The more the adjustment parameter c differs from 1, the more pronounced will be the deviation in employment and output. Additionally, the more sticky wages and prices are, the more time will be needed for the adjustment towards the new equilibrium values.

A test for the presence of an OCA between Austria and Germany can analyze the effects of unexpected changes in relative prices on unemployment and on real producer wages in both sectors of the economy. If there is no or just a minor reaction of the unemployment rate to exchange rate shocks, evidence for the existence of an OCA in this area can be provided. In this case the lack of an international system of fiscal transfer and the existence of legal barriers to labor mobility between Austria and Germany are compensated by changes in other economic variables.

IDENTIFICATION

The structural relations derived from the Scandinavian model can be used to define a set of restrictions for a Structural Vector Autoregression (SVAR). SVAR systems are a useful tool if one believes that an economy can be modelled as a system of linear stochastic difference equations. The system of equations reflects the economic structure and dynamics. It shows the way in which a shock to one of the variables is transmitted throughout the entire system. A series of stochastic shocks perturbs the system unswervingly and keeps a more or less irregular motion alive. This type of modelling is well known in economics. Frisch (1933) and Slutzky (1937) explained business cycle fluctuations by a stable propagation mechanism interfered with a flow of independent disturbances. For these model class the VAR method allows an empirical approximation to the reduced form of the propagation mechanism and it gives the best linear predictor for variables in the system. In order to arrive at an economic interpretation of a VAR system, restrictions on the simultaneous relations must be imposed from economic theory. To be concrete, consider the following reduced form VAR

$$\begin{aligned} y_t &= v + \Theta_1 y_{t-1} + \cdots + \Theta_p y_{t-p} + u_t \\ &= v + \sum_{i=1}^{p} \Theta_i y_{t-i} + u_t \quad , \end{aligned} \tag{7}$$

where y_t denotes a vector of endogenous variables at time t, Θ_i are coefficient matrices belonging to the corresponding lagged vector y_{t-i} and u_t is a vector of regression residuals. The number of variables in y_t determines the dimension m of the system. The vector of residuals u_t is assumed to be White Noise with mean zero and a time invariant $(m \times m)$ covariance matrix $\Sigma_u = E(u_t u_t')$ in general not diagonal. The dynamic response of the system to various shocks is depicted by the Wold decomposition or moving average representation of y_t

$$\begin{aligned} y_t &= v^* + u_t + M_1 u_{t-1} + M_2 u_{t-2} + \ldots \\ &= v^* + \sum_{i=0}^{\infty} M_i u_{t-i} \quad , \end{aligned} \tag{8}$$

where

$$\begin{aligned} v^* &= (I - \Theta_1 - \Theta_2 - \cdots - \Theta_p)^{-1} \cdot v \\ M_0 &= I \\ M_i &= \sum_{j=1}^{min(p,i)} \Theta_j \cdot M_{i-j} \quad . \end{aligned}$$

The kj-th element in M_i gives the reaction of the k-th variable to a shock in variable j, i periods ago. Obviously a problem arises if a shock is related to other shocks in the system at the same point in time. This exactly happens if Σ_u is not diagonal. In this case an independent structural shock, call it ϵ_t, is not identical to the residual u_t from the estimated VAR. Furthermore, contemporaneous relations are ignored when applying this method without regard to simultaneity. A solution to this problem is provided by orthogonalizing the variables in u_t by means of a decomposition of the covariance matrix $PP' = \Sigma_u$. Using this decomposition it is possible to rewrite the moving average representation in the following way

$$\begin{aligned} y_t &= v^* + \sum_{i=0}^{\infty} M_i P P^{-1} u_{t-i} \\ &= v^* + \sum_{i=0}^{\infty} \Psi_i \epsilon_{t-i} \quad , \end{aligned} \tag{9}$$

where $\epsilon_t = P^{-1} u_t$ is a vector of orthogonal disturbances and Ψ_i are corresponding coefficient matrices. The kj-th element shows now the effect of a structural shock to the j-th variable on variable k after i periods. To arrive at an economically sensible and unique decomposition of the original covariance matrix, one has to apply economic theory. Since there are just $m(m+1)/2$ distinct elements in Σ_u for estimating the elements of P and Σ_ϵ, the diagonal covariance matrix of structural shocks, there are just $m(m-1)/2$ free parameters left in P. Remaining elements must be either set to zero or subjected to other restrictions. For example, long run impacts of certain shocks may be imposed. Taking notice of these limitations one can use a General Method of Moments[2] estimator for P. The Scandinavian model suggests to include 6 variables in a VAR, $y_t = (e, p_T, w_T, w_N, p_N, ur)'_t$. In correspondence to the theoretical model, all variables are in log differences. In matrix notation the structural form of the VAR system may be written as

$$A y_t = v + \sum_{i=1}^{p} \Theta_i y_{t-i} + \epsilon_t \quad . \tag{10}$$

where A corresponds to P^{-1} mentioned above and the reduced form looks like

$$y_t = Pv + P \cdot \sum_{i=1}^{p} \Theta_i y_{t-i} + P\epsilon_t \quad . \tag{11}$$

[2] See Bernanke (1986) for a short description.

From equation (11) it is obvious that the observed residuals from the VAR can be interpreted in a economically meaningful way by premultiplying u_t with P^{-1}. Given the restrictions derived from the Scandinavian model, the following relations between the (6×1) vector of residuals u_t from the VAR and the vector of structural shocks ϵ_t can be imposed:

$$u_e = \epsilon_e \tag{13}$$

$$u_{pT} = a_{21}u_e + \epsilon_{pw} \tag{14}$$

$$u_{wT} = a_{32}u_{pT} + \epsilon_{\lambda T} \tag{15}$$

$$u_{wN} = a_{42}u_{pT} + a_{43}u_{wT} + \epsilon_{\lambda N} \qquad (16)$$

$$u_{pN} = a_{52}u_{pT} + a_{54}u_{wN} + \epsilon_{pN} \qquad (16)$$

$$u_{ur} = a_{62}u_{pT} + a_{63}u_{wT} + a_{64}u_{wN} + a_{65}u_{pN} + \epsilon_{ur} \tag{17}$$

or in the respective matrix notation $P^{-1}u_t = \epsilon_t$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ -a_{21} & 1 & 0 & 0 & 0 & 0 \\ 0 & -a_{32} & 1 & 0 & 0 & 0 \\ 0 & -a_{42} & -a_{43} & 1 & 0 & 0 \\ 0 & -a_{52} & 0 & -a_{54} & 1 & 0 \\ 0 & -a_{62} & -a_{63} & -a_{64} & -a_{65} & 1 \end{bmatrix} \cdot \begin{bmatrix} u_e \\ u_{pT} \\ u_{wT} \\ u_{wN} \\ u_{pN} \\ u_u \end{bmatrix} = \begin{bmatrix} \epsilon_e \\ \epsilon_{pw} \\ \epsilon_{\lambda T} \\ \epsilon_{\lambda N} \\ \epsilon_{pN} \\ \epsilon_u \end{bmatrix}$$

Equation (13) states that innovations in the effective exchange rate ϵ_e are exogenous to the system and therefore equal to the residual from the VAR u_e. Pegging the ATS to the DM allows no influence of Austrian variables on the stochastic part of the nominal effective exchange rate. As Schulmeister (1988) proved, most of the transactions on foreign exchange markets are purely financial in the sense that there are no underlying real transactions. In the short and medium run exchange rate markets are determined by expectations of international financial markets. One further argument is that in contrast to the ATS, the DM is an international reserve currency. Market clearing on DM exchange markets does not necessarily imply market clearing for the ATS versus other currencies, since these are determined automatically by cross rates and central bank interventions.

Concerning the tradables sector price equation (14) a strict forward formulation is suggested by equation (1). Price movements for tradables are directly associated to movements in the exchange rate and own shocks ϵ_{pT}, which represent unexpected shifts in world market prices for tradables.

The tradables sector wage equation (15) needs some more motivation. Wage contracts do not allow for an immediate reaction of nominal wages to any shock in the system. However, in the empirical part, wages are measured as nominal wages per employee. Thus, immediate reactions of this variable are associated with quantity adjustments in response to changes in real producer wages. Equation (15) excludes a direct influence of the exchange rate on wages and allows just for indirect effects on nominal wages through prices. The incorporation of the unemployment rate into the wage equation is suggested by equation (3). On the other hand, quantity adjustments reflect reactions of firms to different levels of real wages and not the other way round. Furthermore, including unemployment in both wage equations resulted in convergence problems in the minimization problem of the estimator. The Scandinavian model suggests to interpret the disturbance term $\epsilon_{\lambda N}$ in (15) as a productivity shock to the tradables sector. The above arguments carry directly over to equation (16), where wages in the nontradables sector are modelled. Prices and wages in the production of tradables and the own productivity shock $\epsilon_{\lambda N}$ are simultaneously related to u_{wN}.

Residuals in the price equation for nontradable goods u_{pN} are related to unexpected changes in prices of tradables. This allows only indirect effects of the exchange rate on prices in the nontradables sector. According to the mark up assumption in (4) prices of non tradable are also determined by the actual value of nominal wages in this sector. The structural shock ϵ_{pN} in (16) corresponds to a mark up shock to the nontradables sector.

The last equation (17) ties innovations in the unemployment rate u_{ur} with prices and wages in both sectors. A motivation for this cannot be directly derived from the Scandinavian model. Nevertheless, standard economic theory suggests a relation of demand for labor to real wages. The structural shock ϵ_{ur} in (17) reflects demand and supply shocks on the labor market like a shift in the natural rate.

The Data

Due to the availability of data there are problems to separate economies into a tradables and nontradables sector and this is even reinforced if quarterly data are used. One possibility is to take industrial production as a proxy for the tradables and to regard the remaining output as production of the nontradables sector. Despite the fact that contributions of tourism to the remaining output may be regarded as being exposed to international competition, exactly this has been done. The variables follow closely definitions from the Scandinavian model and are available from the GEN data base of the Austrian Institute for Economic Research. The nominal effective exchange rate (excluding Yugoslavia), wages per employee in both sectors and the unemployment rate are directly available. Both prices have to be constructed as deflators of nominal and real variables. All variables are transformed to logs and seasonally adjusted by seasonal differencing[3]. The unemployment rate is logit transformed to allow for values between plus and minus infinity.

[3]See the appendix for further details. Raw data are available from the author on request.

Since all variables in y_t are in log differences, it is entirely possible that a misspecification of the VAR arises from cointegration among variables. That means although all variables follow a stochastic trend, there is an economic relation among them keeping a linear combination of y_t stationary, i.e. in equilibrium. A classic example for cointegration is provided in Davidson/Hendry/Srba/Yeo (1978). They showed that a stable ratio of savings to income implies an error correcting or cointegrating relation between income and consumption. Specifying a cointegrated system in differences leads to an omitted variable bias, since long run relations are disregarded. Results from a Likelihood Ratio test for cointegration developed by Johansen (1988) over the period 1964:2 to 1991:4 are provided in Table 2. Cointegration between analyzed variables is rejected at the 5 % significance level, thus a specification in differences does not result in lost information with regard to the long run behavior of the time series[4].

TABLE 2 Likelihood Ratio tests for Cointegration *

statistic	null hypothesis	90.0%	95.0%	97.5%
1.59	$r \leq 5$	2.8	4.0	6.9
9.63	$r \leq 4$	12.1	14.0	17.9
14.73	$r \leq 3$	18.7	20.8	25.5
24.64	$r \leq 2$	24.7	27.2	31.9
29.76	$r \leq 1$	30.8	33.2	38.3
37.36	$r \leq 0$	34.8	37.4	43.2

*) Critical values from Johansen/Juselius (1990) Table A1

The VAR is estimated in first differences with a constant and 4 lags of each variable. The estimation period runs from 1964:2 to 1991:4. It includes a period of relative stability of the nominal effective exchange rate and another one of appreciation starting in the early seventies (see Figure 2). The overidentifying assumptions suggested above are tested by a Likelihood Ratio test and cannot be rejected. The significance value of the $\chi^2(4)$ distributed statistic is 0.24.

DYNAMIC EFFECTS OF EXCHANGE RATE SHOCKS

The best way to achieve some insight into the dynamic structure of economic systems is to analyze dynamic effects of structural shocks by means of impulse responses and variance decompositions. In general impulse response functions show the dynamic response of an element in the vector of endogenous variables y_t to a once and for all structural shock, given all other shocks set to zero. Because this paper concentrates on effects of unexpected changes in relative prices, just

[4]A variation in numbers of observation leads to stronger evidence in favor of rejecting the null.

results of an one percent exchange rate shock are presented. Figures 3 to 8 and Table 3 show accumulated responses of the analyzed variables and are already adjusted for effects from the seasonal difference filter.

Not very surprisingly, exchange rate shocks do have a persistent effect on itself. This confirms results in Meese/Rogoff (1983). Compared to a situation where no shock hit the system the nominal effective exchange rate overshoots in the first two years and remains even after 40 quarters 0.9 % above the reference solution.

TABLE 3 Impulse responses to an exchange rate shock: 1964 - 1991

quarters ahead	e	pt	wt	wn	pn	u	wtpt	wnpn
1	1.00	-0.01	0.00	0.00	0.00	0.00	0.01	0.00
4	1.15	-0.07	-0.03	-0.04	-0.04	0.26	0.03	0.00
8	1.23	-0.14	-0.14	-0.09	-0.06	0.45	-0.01	-0.03
12	1.14	-0.18	-0.20	-0.16	-0.09	0.36	-0.01	-0.05
20	1.00	-0.25	-0.29	-0.24	-0.12	0.31	-0.04	-0.12
40	0.89	-0.29	-0.35	-0.30	-0.15	0.24	-0.06	-0.15

The upward movement in the exchange rate is mirrored by a smooth negative reaction in prices for tradables. This direction would be expected from the Scandinavian model. However, there is no one to one relationship due to a sluggish and incomplete price adjustment. Apparently, the law of one price for tradables is not completely fulfilled in the Austrian case. The first few quarters show a statistically significant but small response of about -0.07 % and after 40 quarters just a decline by 0.3 % remains.

According to the theoretical model, one would expect nominal wages in the tradables sector to follow prices closely. And exactly this is suggested by the impulse response function. Wages per employee are quite stable until the fourth quarter, but subsequently they react slightly stronger than prices. This results in an almost constant real wage (wtpt) as shown in Figure 9. Nominal wages in the production of non tradables follow this pattern almost identically. The long run decrease in tradables sector nominal wages of 0.35 % is accompanied by a decline of 0.30 % in nontradables sector wages.

Prices for nontradables do not react strongly. The impulse response function is given in Figure 7. It is characterized by a very small short run decline and a modest one of 0.15 % after 40 quarters have passed. In the long run, this results in falling real producer wages in the nontradables sector twice as big as in the tradables sector.

Most interestingly the unemployment rate reacts rather strong after three quarters. An unexpected one percent increase in exchange rates affects an upward adjustment of the unemployment rate by 0.25 %. In the medium run this results in a peak of 0.45 % and after 40 quarters the unemployment rate is still 0.25 %

higher.

The results from impulse response functions give strong evidence for small but significant and persistent labor market effects of shocks to the nominal effective exchange rate. Through repercussions of wages in both sectors this seems to be the reason for a prolonged but small decline in real producer wages in both sectors.

Because the period between 1964 and 1991 contains two different exchange rate regimes, Bretton Woods and the period of the so called hard currency policy, it is interesting to see whether private agents adjusted their wage and price bargaining behavior. For this purpose the same analysis was done for a shorter time period between 1973 and 1991. Table 4 and Figures 9 to 11 show the results. The main difference to the full sample are the smaller and vanishing deviation of the unemployment rate and a slightly positive reaction of real wages in the tradables sector. As a summary the result suggests that real variables do not react in the long run and the adjustment process is faster over this period.

TABLE 4 Impulse responses to an exchange rate shock: 1973 - 1991

quarters ahead	e	u	wtpt	wnpn
1	1.00	-0.01	-0.04	0.00
4	1.06	0.35	0.09	0.01
8	1.04	0.36	0.15	0.01
12	0.99	-0.15	0.12	0.00
20	0.86	-0.07	0.11	-0.02
40	0.84	-0.04	0.10	-0.03

The next step in the analysis is to estimate the relative contribution of exchange rate shocks to other variables. For this purpose variance decompositions are a popular means. This method shows that part of the conditional variance that is explained by a variation in each structural shock. Thus it characterizes the contribution of each source of fluctuations to the variance of an i-quarter ahead forecast error for each endogenous variable. Table 5 gives the percentage of variance of the i-quarter ahead forecast error due to exchange rate shocks. With the exception of the exchange rate itself, these shocks contribute only a small part to forecast errors at all horizons.

The variance decomposition in Table 5 indicates that exchange rate shocks are on average of little importance to fluctuations in other endogenous variables of the system. The central source of fluctuations are structural shocks of the same equation. For example, as can be seen in Figures 13 and 14 the second largest source of fluctuations in nominal wages are shocks to the labor market. Approximately 20 % of unexpected long run variations in wages are caused by these shocks.

TABLE 5 Variance explained by unexpected fluctuations in the exchange rate

quarters ahead	e	pt	wt	wn	pn	u
1	1.00	0.00	0.00	0.00	0.00	0.00
4	0.85	0.04	0.03	0.07	0.05	0.04
8	0.83	0.06	0.12	0.08	0.06	0.05
12	0.81	0.06	0.13	0.11	0.06	0.05
20	0.80	0.07	0.13	0.13	0.07	0.05
40	0.80	0.07	0.13	0.13	0.07	0.05

Despite the relatively low part of fluctuations explained by exchange rate shocks it is interesting to show the impact of exchange rate shocks on the variables of the system. From estimation of the joint process and by setting all other disturbances to zero one can calculate simulated time series for each variable by adding only structural exchange rate shocks. A comparison of these simulated series with realized series shows the direction in which exchange rate shocks would have forced the system in case that other shocks were absent. Figures 15 to 20 give the realized series as solid lines and its simulated counterparts marked by an $'f'$ as dotted lines. The exchange rate series is matched quite good by the simulated equivalent. Whereas for prices and wages a downward deviation of the realized series during the late sixties and early seventies can be revealed, implying that due to exchange rate shocks prices and wages should have been at higher levels. This period is characterized by a sharp devaluation in 1969 and subsequent weakening of the ATS until 1973. The Scandinavian model predicts inflationary pressure on the economy in such a scenario which apparently was corrected by other factors. On the other hand, the period of revaluation starting in 1973 had a dampening effect on the price development until the end of the sample. The downward pressure on nominal wages in both sectors disappears since 1986 and corroborates results from impulse response functions for the shorter sample period 1973 to 1991.

Of special interest is the movement of the artificial unemployment rate. For this series exactly the opposite happened. The period of devaluation at the beginning of the sample had a negative impact on the unemployment rate. Apart from the deterministic part which may capture strong hysteresis effects in Austria's unemployment rate[5], there obviously has been an upward pressure from positive exchange rate shocks between 1973 and 1981. Since 1982 other factors, like the inflow of foreign labor force, are responsible for the upward shift in unemployment.

[5] See for example Neudorfer/Pichelmann (1989) and Pichelmann (1990)

CONCLUSIONS

For the period after World War II Austria and Germany formed a common currency area where legal restrictions to factor movements across borders were binding. Furthermore, a system of fiscal transfers between both countries remains to be established. Therefore, prerequisites for an Optimal Currency Area (OCA) were not met. Starting from this failure one should find effects of shocks to relative prices of tradables on real variables in the Austrian economy. The Scandinavian model was used to show the transmission of shocks to the nominal effective exchange rate on prices and wages in the tradables and nontradables sector. In an OCA with perfect factor mobility the model suggests no real short run effects of changes in relative prices. When sticky prices or wages and sluggish labor and capital movements prevail, shocks to relative prices should result in regional unemployment over the short and medium term.

The hypothesis of an OCA between Austria and Germany is tested by applying a Structural Vector Autoregression to the variables suggested in the Scandinavian model. Shocks to relative prices were approximated by shocks to the nominal effective exchange rate. The empirical results suggests even long run real effects of exchange rate shocks in the period between 1964 and 1991. Impulse response functions show that real producer wages in the tradables and nontradables sector fall in response to a 1 % shock by approximately 0.06 and 0.15 % respectively and the unemployment rate rises by 0.24 %.

These findings lead to several interpretations. First of all, it appears that frictions on mobility in the Austrian labor market cause unemployment if shocks to relative prices occur. Over the whole sample period pegging the exchange rate to the deutsche mark (DM) resulted in permanent deviations of the unemployment rate from equilibrium and brought about economic costs. By the time labor mobility and flexibility increased as well as both, employers and employees organizations got more familiar with consequences from this exchange rate policy. A restriction of the estimation period to 1973-1991 puts more weight on current observations and reflects this reasoning. Real producer wages remain constant over all horizons and the unemployment rate shows only short run effects. The lack of complete in regional labor mobility and of a system of fiscal transfers were compensated by a very high degree of nominal wage flexibility and intersectoral factor mobility.

Nevertheless, variance decompositions show that on average shocks to the nominal effective exchange rate did not play a central role for fluctuations in Austria's price and wage system. Unexpected shocks to productivity and the natural rate of unemployment are responsible for most of the short and long run fluctuations in nominal wages. Despite the minor impact of exchange rate shocks to fluctuations in wages there was a downward pressure on nominal wages during the period of revaluation starting with 1973 and lasting until the end of the eighties.

The most striking finding is related to the fact that the policy of pegging the Austrian schilling to the DM leads to a more or less steady revaluation of the nominal effective exchange rate. This implies that Austria's relative prices versus other trading partners should increase or profits decrease. Apparently, most of the short run deterioration in competitiveness is compensated directly in the deterministic part of the wage and price formation process. The centralized wage bargaining in Austria guaranteed a relatively quick incorporation of external effects from unexpected revaluations into both sectors. Even though short run costs of a fixed exchange rate occur in terms of higher temporary unemployment, the effect of exchange rate shocks on this variable are only of minor importance. This result confirms also previous studies on a DM oriented OCA within Europe for example by Bayoumi/Eichengreen (1991b) and Menkhoff/Sell (1992), where Austria was proofed to be one of the prime candidates for an European Monetary Union.

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APPENDIX: DATA AND FIGURES

With the exception of the exchange rate all variables show a seasonal pattern which is removed in the analysis by the well known $(1-L^4)$ seasonal difference filter proposed by Box/Jenkins (1976). The advantages of this filter are equal treatment of all variables, its linearity and the small amount of data lost at the beginning of the series. Furthermore, changes in the seasonal pattern of each variable are allowed. A prerequisite for the application of this filter is the existence of seasonal unit roots. To test for this assumptions I run a series of tests developed by Hylleberg/Engle/Granger/Yoo (1990). Table 2 presents just the strongest evidence. For each individual series the largest available number of observations T were used to obtain the maximum amount of information. All reported statistics are calculated from regressions including a constant, a linear trend and seasonal dummies. It is already obvious from Figure 2 that the nominal effective exchange rate does not show a seasonal pattern. Accordingly, all unit roots at seasonal frequencies are rejected. Concerning the remaining series the null of seasonal unit roots cannot be rejected at the 5 % level. Therefore, both price and wage series and the unemployment rate are filtered by fourth differences. Experiments with other seasonal adjustment procedures like Census-X11 and spectral filtering methods did not alter the results of section 3.

TABLE A.1 Test for seasonal unit roots [1)]

			(-3.53)	(-2.94)	(-3.48)	(-2.32)	(6.60) [2)]
series	T	$k^{3)}$	$t(\pi_1)$	$t(\pi_2)$	$t(\pi_3)$	$t(\pi_4)$	$F(\pi_3, \pi_4)$
e	124	1	1.30	-6.77*	-4.61*	-5.89*	27.53*
p_T	112	6	-1.39	-1.07	-1.31	-1.36	2.53
w_T	144	3	-1.53	-0.66	-2.85	-0.37	4.33
w_N	144	14	-1.34	-2.56	-1.86	-0.80	2.22
p_N	112	5	-1.29	-1.66	-3.38	-0.74	6.56
ur	168	3	-0.97	-1.19	-1.88	-0.57	1.92

1) regression includes constant, trend and seasonal Dummies
2) 5 % critical values from Hylleberg et al. (1990) Table 1a and 1b
3) k = number of autoregressive corrections, T = number of obs.
*) significant at the 5 % value

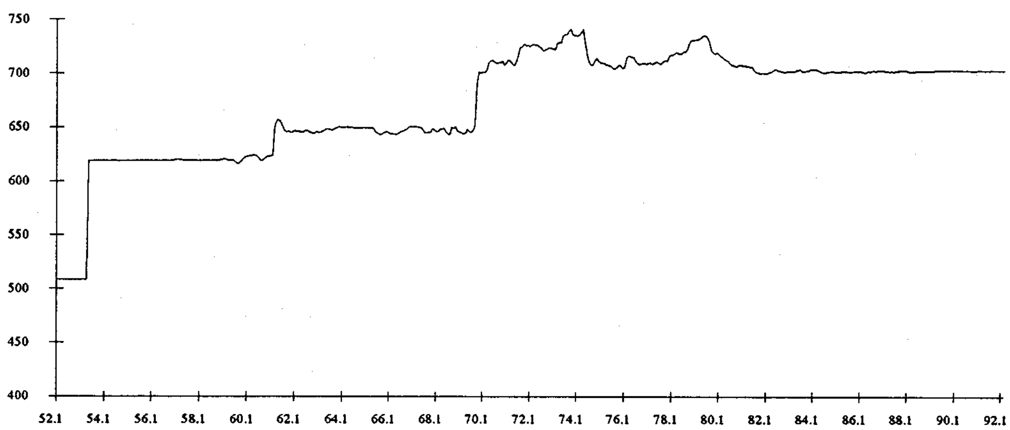

Fig. 1. Exchange rate ATS per 100 DM

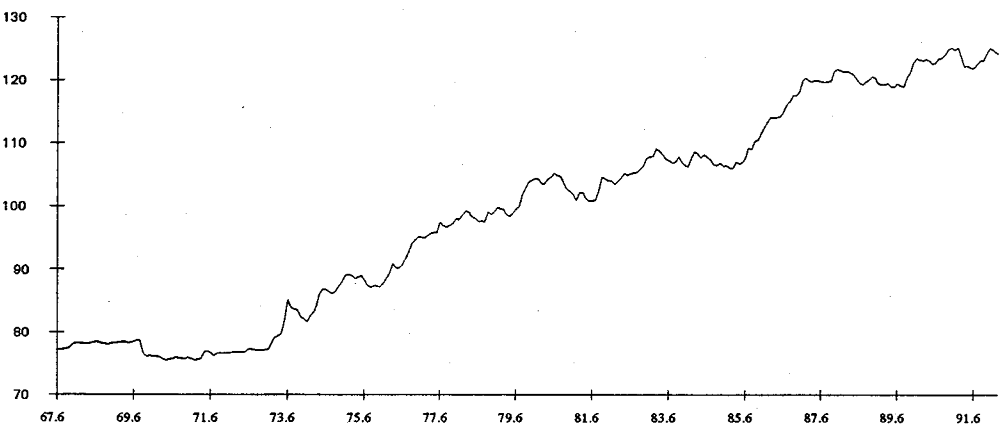

Fig. 2. Nominal effective exchange rate ATS (import and export weighted index)

Results for estimation period 1965-1991

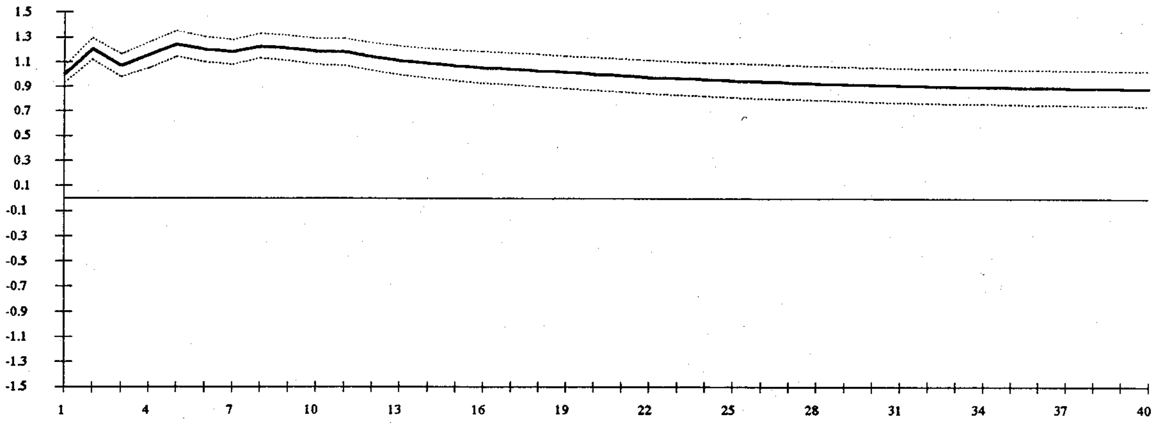

Fig. 3. Accumulated impulse response of the exchange rate to a 1 % exchange rate shock 1)

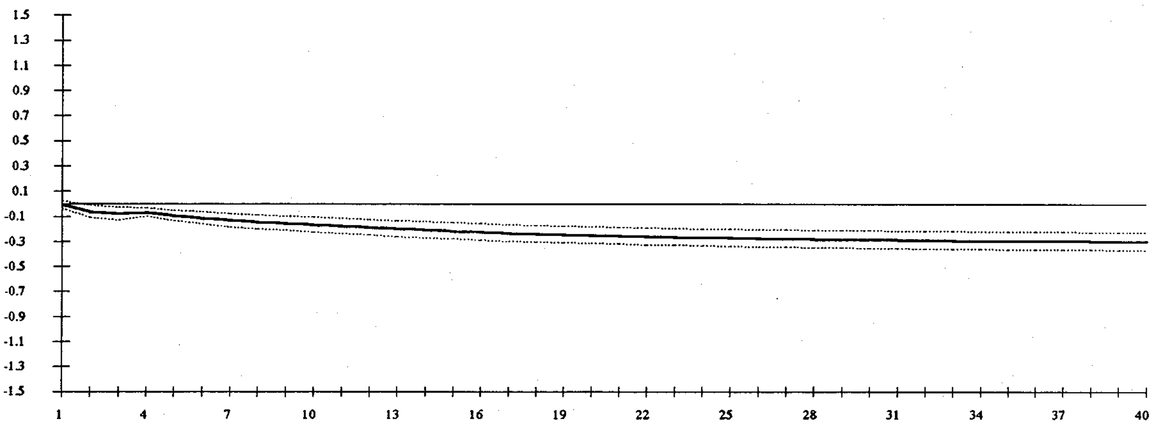

Fig. 4. Accumulated impulse response of tradables prices to a 1 % exchange rate shock 1)

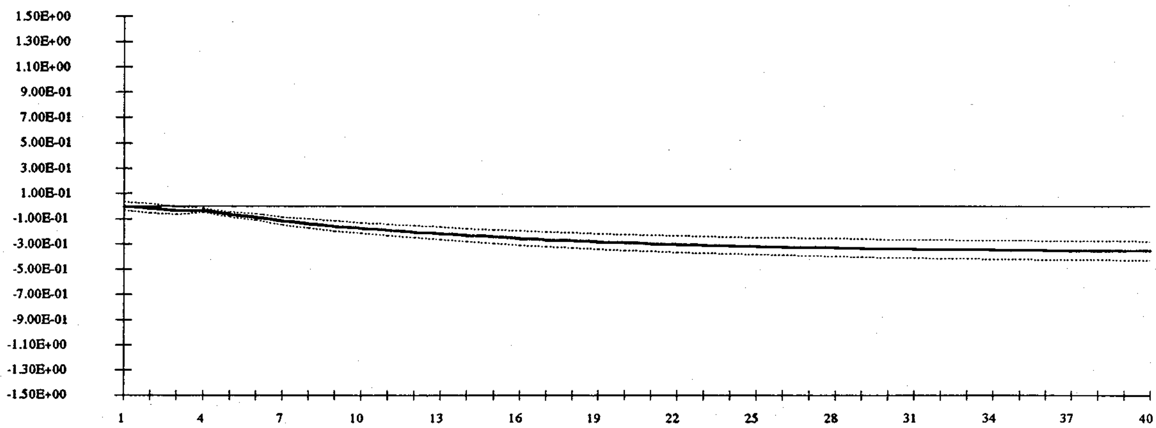

Fig. 5. Accumulated impulse response of wages in tradables sector to a 1 % exchange rate shock 1)

1) Dotted lines represent plus/minus 2 standard errors confidence intervalls

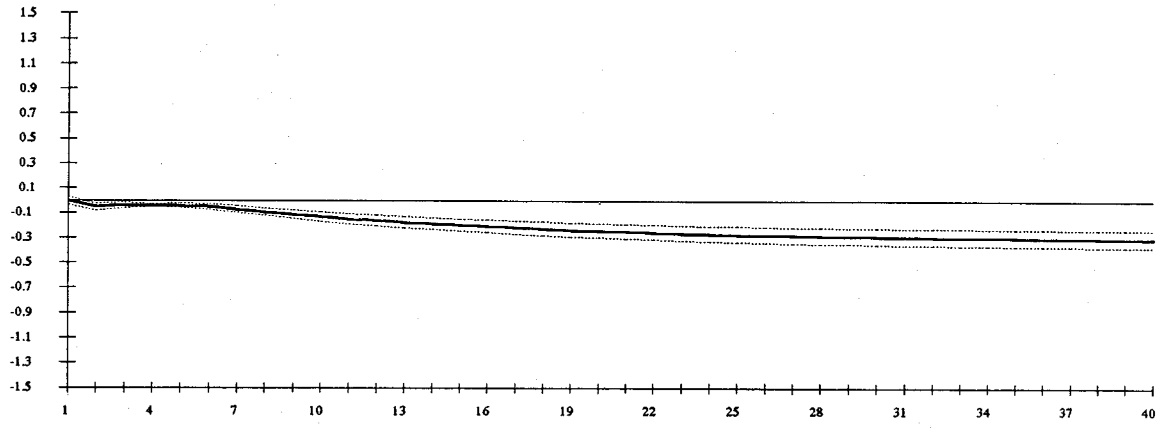

Fig. 6. Accumulated impulse response of wages in nontradables sector to a 1 % exchange rate shock 1)

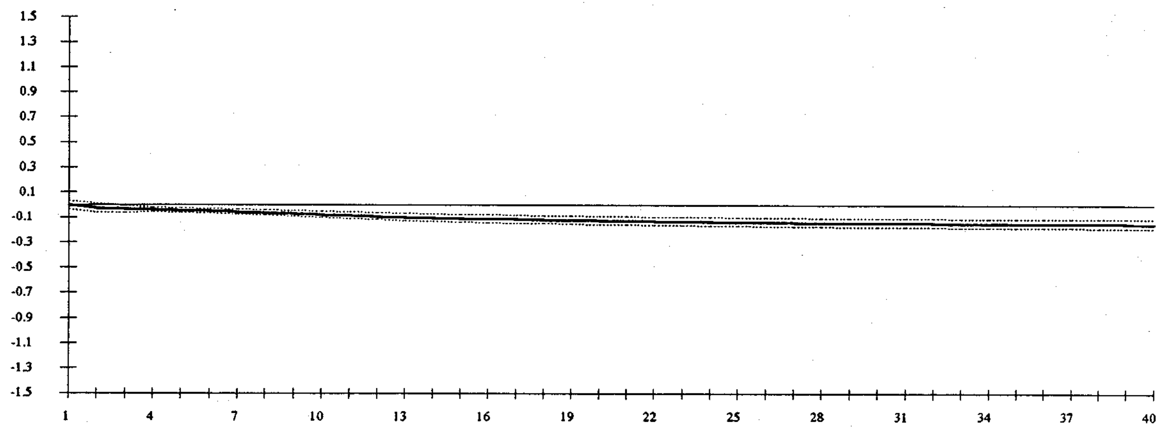

Fig. 7. Accumulated impulse response of nontradables prices to a 1 % exchange rate shock 1)

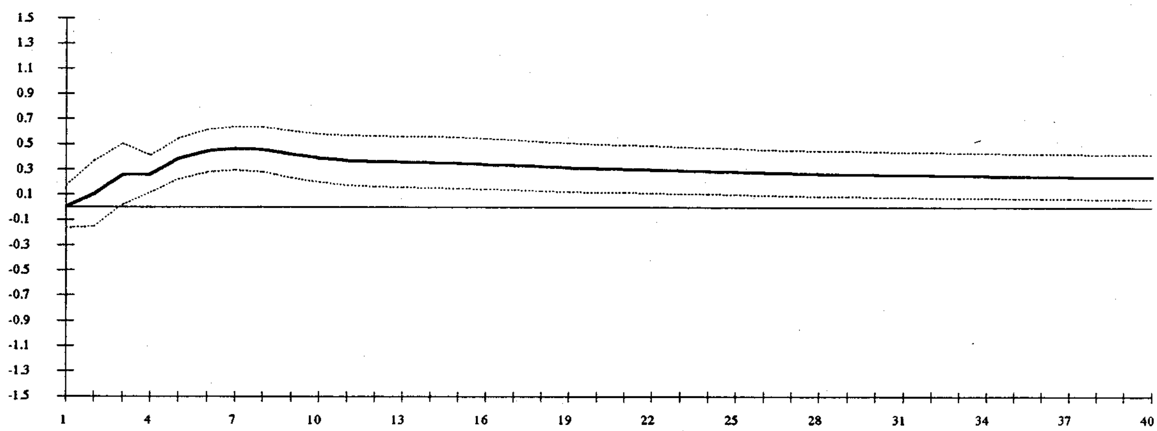

Fig. 8. Accumulated impulse response of the unemployment rate to a 1 % exchange rate shock 1)

1) Dotted lines represent plus/minus 2 standard errors confidence intervalls

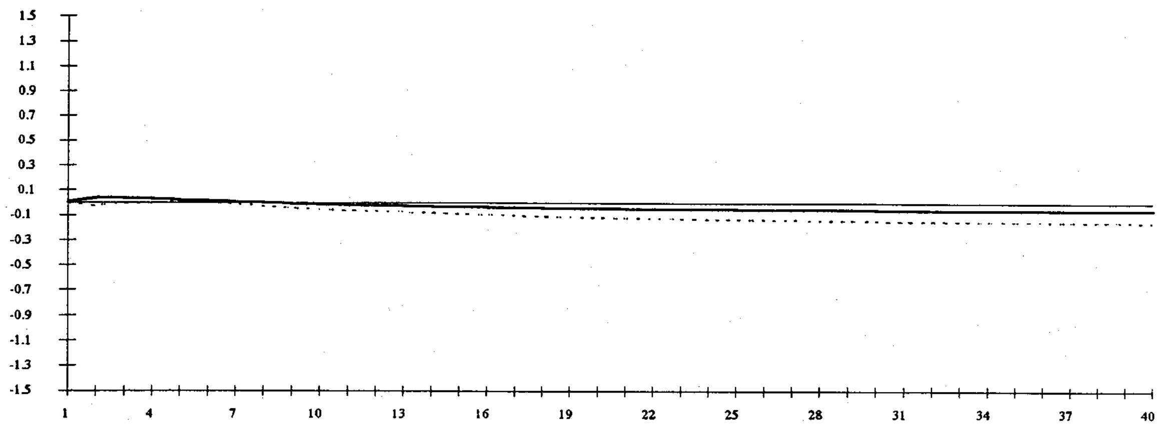

Fig. 9. Accumulated impulse response of real wages in both sectors to a 1 % exchange rate shock 1)

1) Dotted line represents real wages in nontradables sector and the solid line represents real wages in tradables sector

Results for estimation period 1973 - 1991

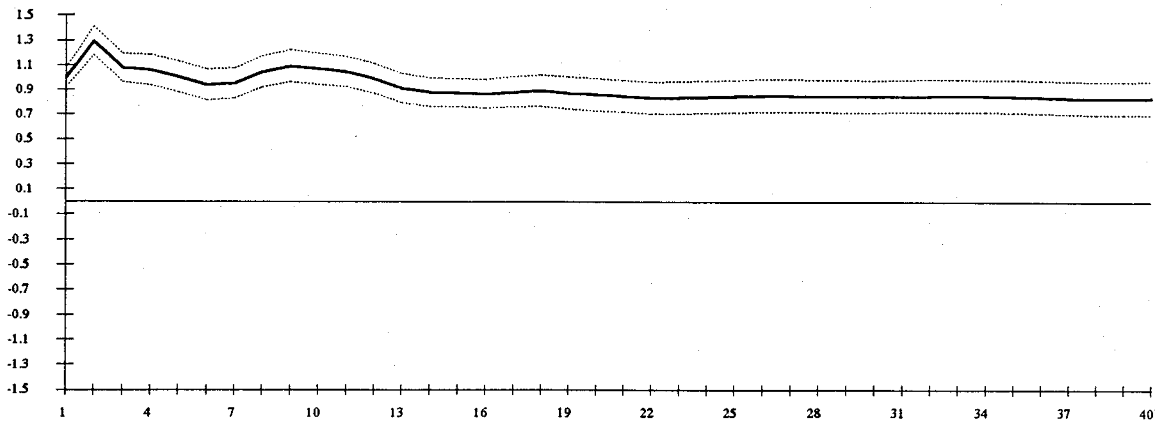

Fig. 10. Accumulated impulse response of the exchange rate to a 1 % exchange rate shock 1)

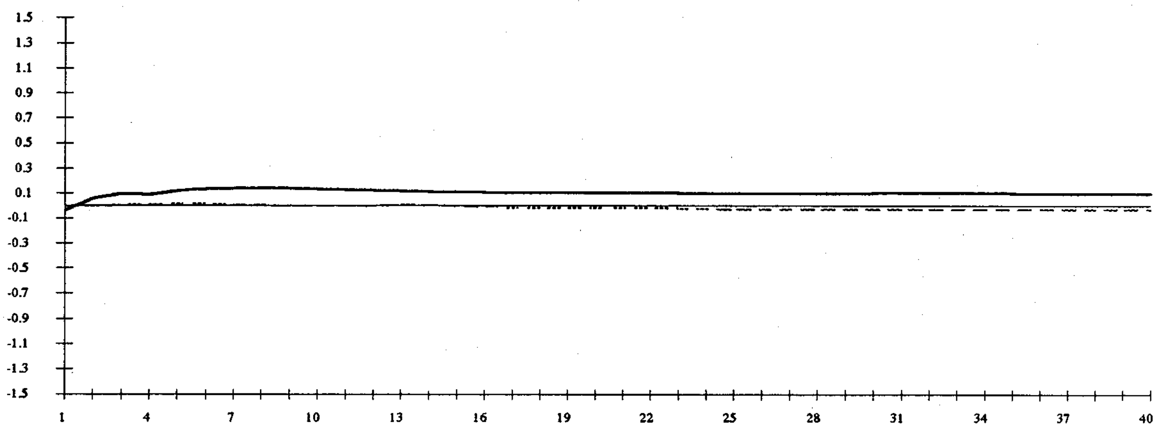

Fig. 11. Accumulated impulse response of ral wages to a 1 % exchange rate shock 2)

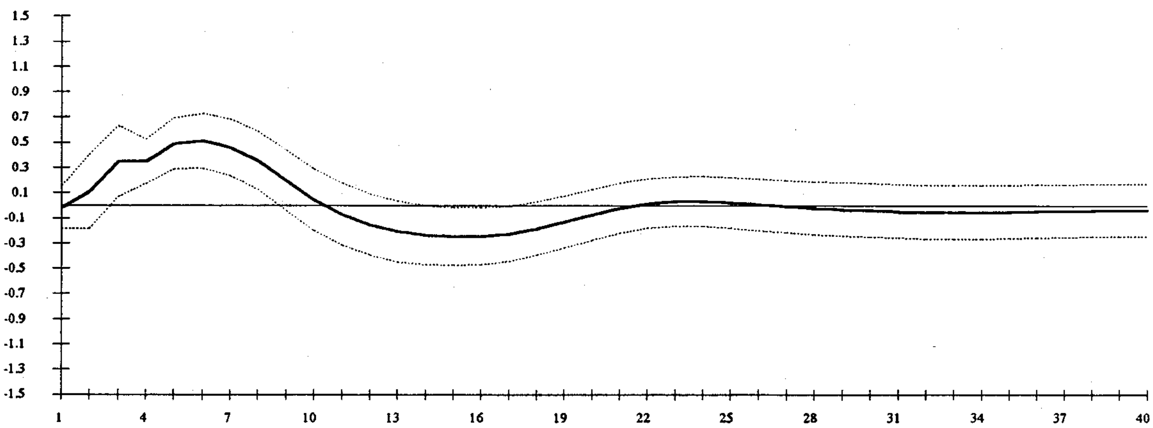

Fig. 12. Accumulated impulse response of the unemployment rate to a 1 % exchange rate shock 1)

1) Dotted lines represent plus/minus 2 standard errors confidence intervalls
2) Dotted line represents real wages in nontradables sector and the solid line represents real wages in tradables sector

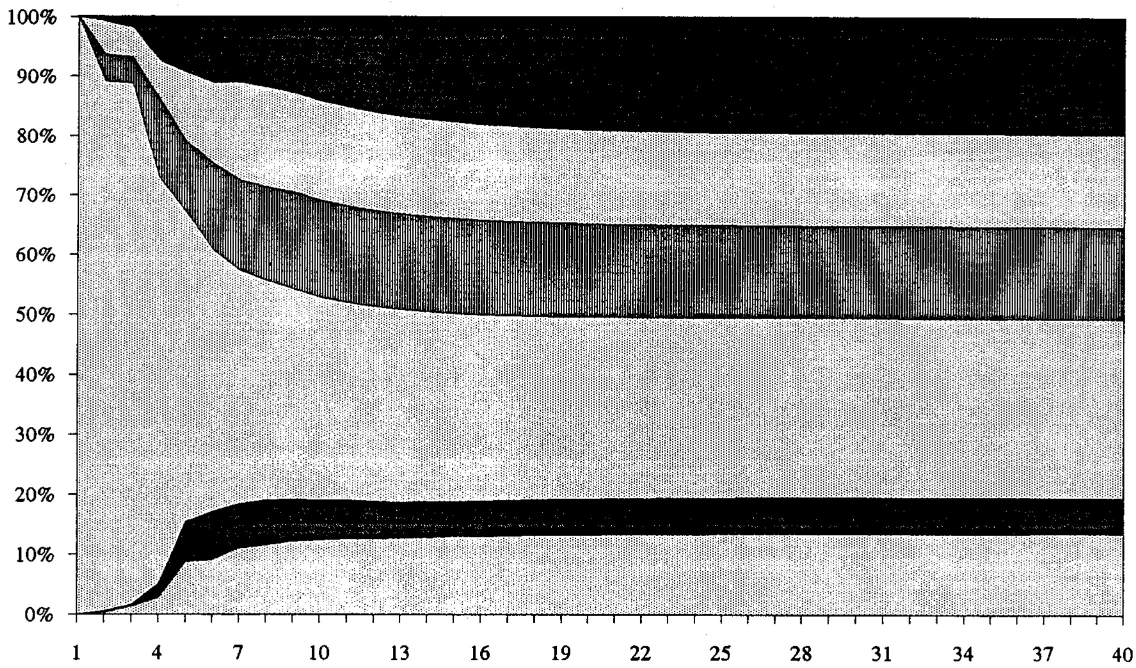

Fig. 13. Results of a variance decomposition for tradables sector wages (estimat. period 1965-91) [1)]

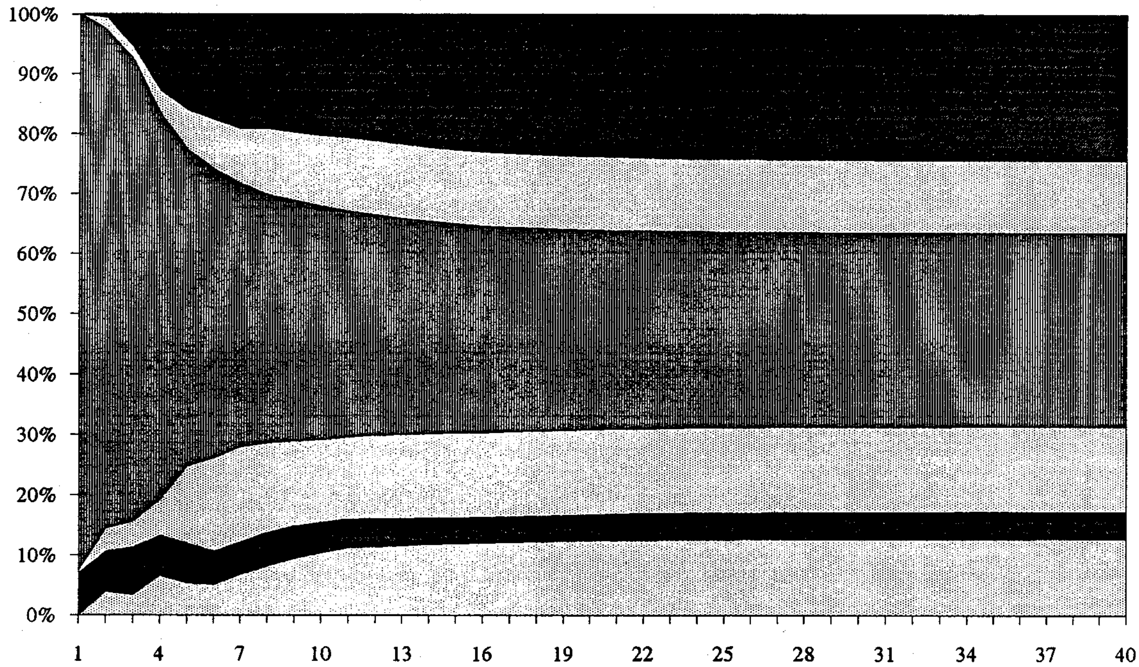

Fig. 14. Results of a variance decomposition for nontradables sector wages (estim. period 1965-91) [1)]

1) Areas represent that part of variance explained by the following shocks: exchange rate shock, world price shock, productivity shock to tradables sector, productivity shock to nontradables sheltered sector, mark up shock in the sheltered sector and demand side as well as supply side labor market shocks. The shares are ordered in this sequence starting with the share of the exchange rate shock at the bottom.

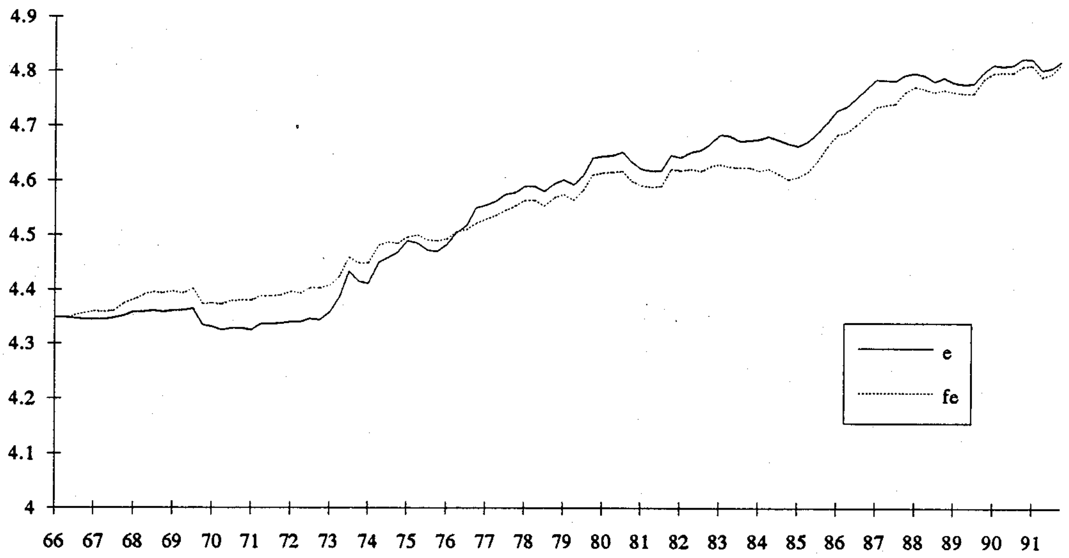

Fig. 15. Realized and simulated exchange rate

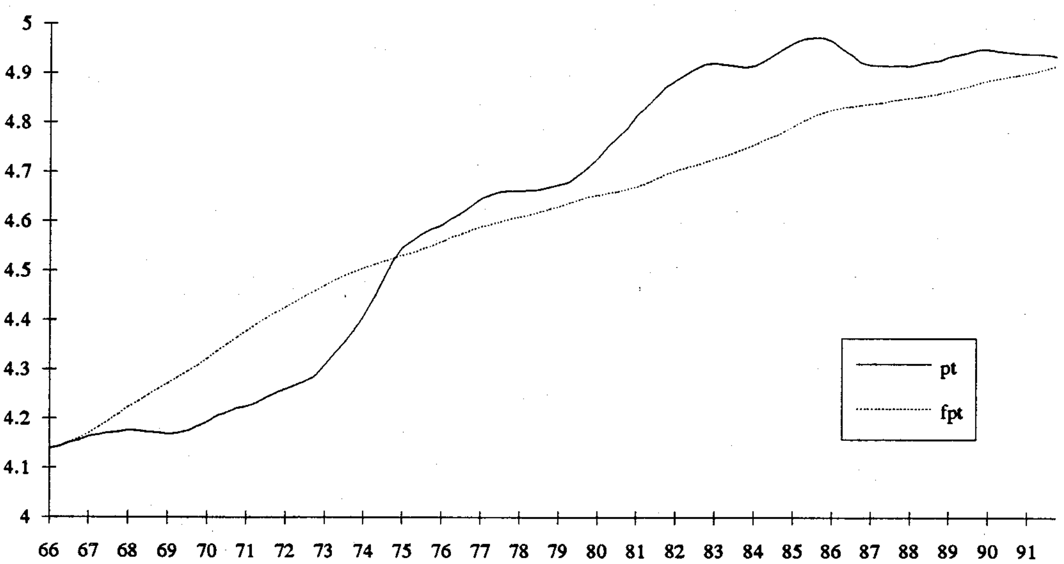

Fig. 16. Realized and simulated prices of tradables

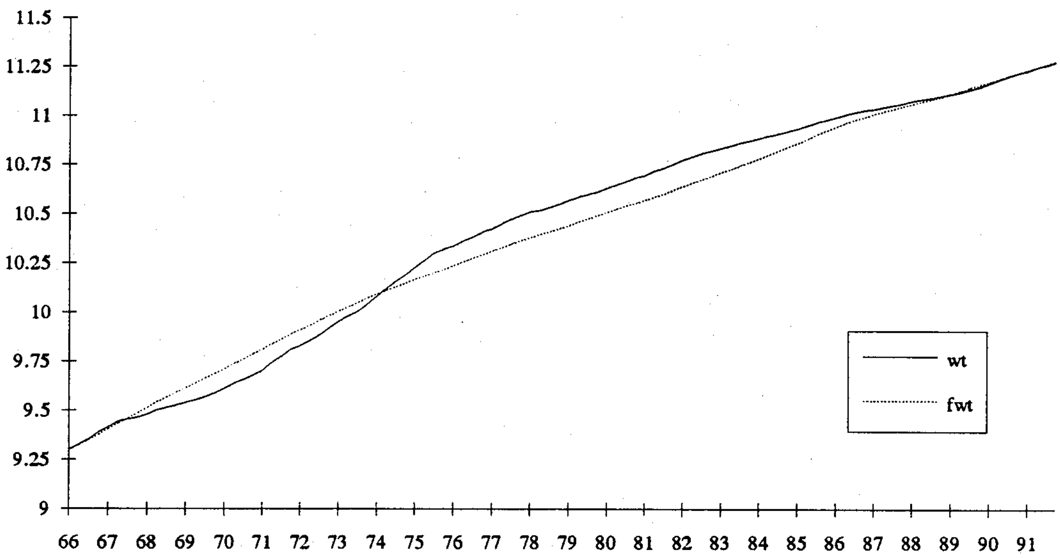

Fig. 17. Realized and simulated wages in tradables sector

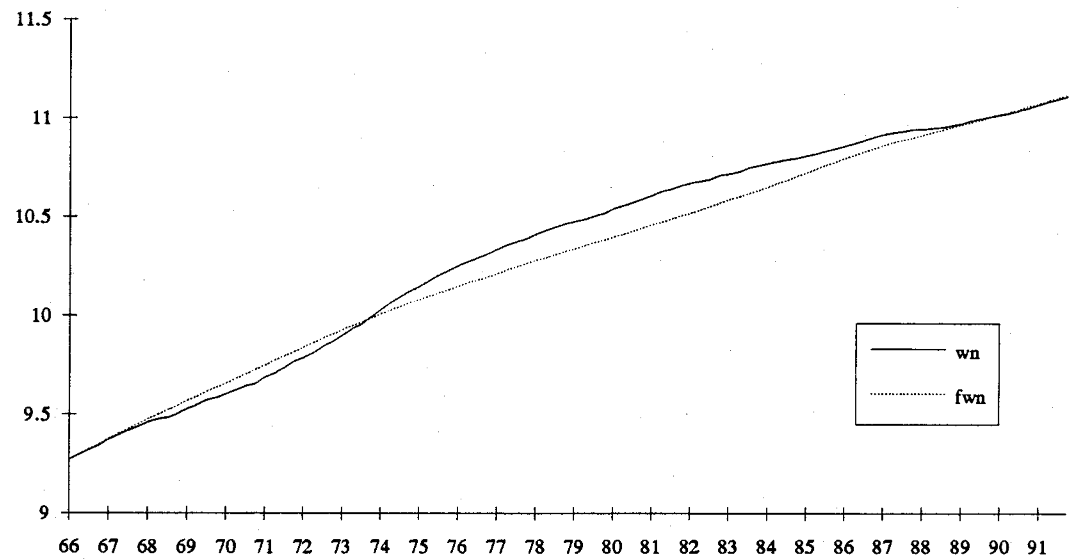

Fig. 18. Realized and simulated wages in nantradables sector

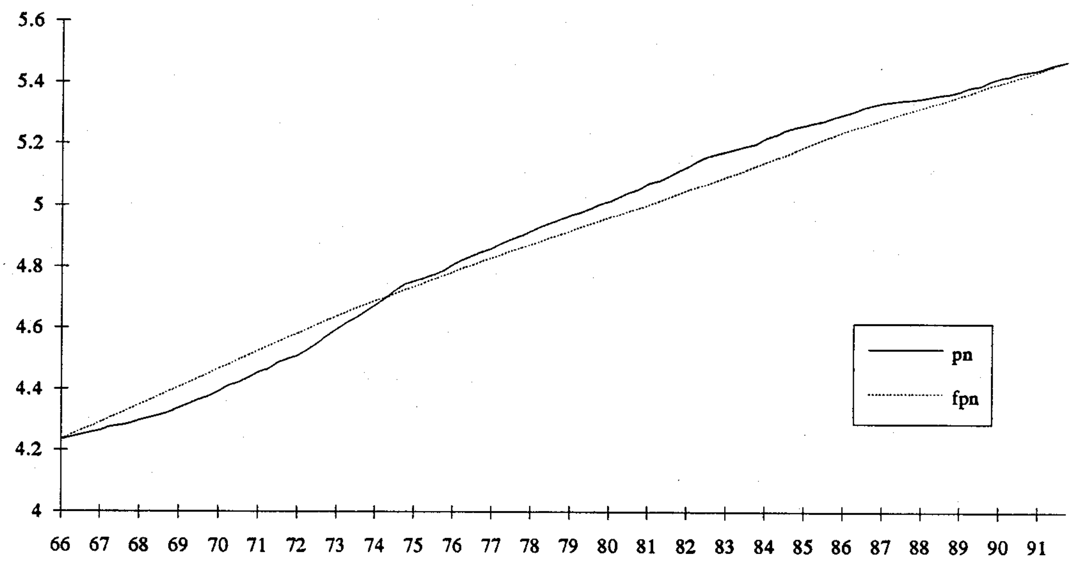

Fig. 19. Realized and simulated prices for nontradables

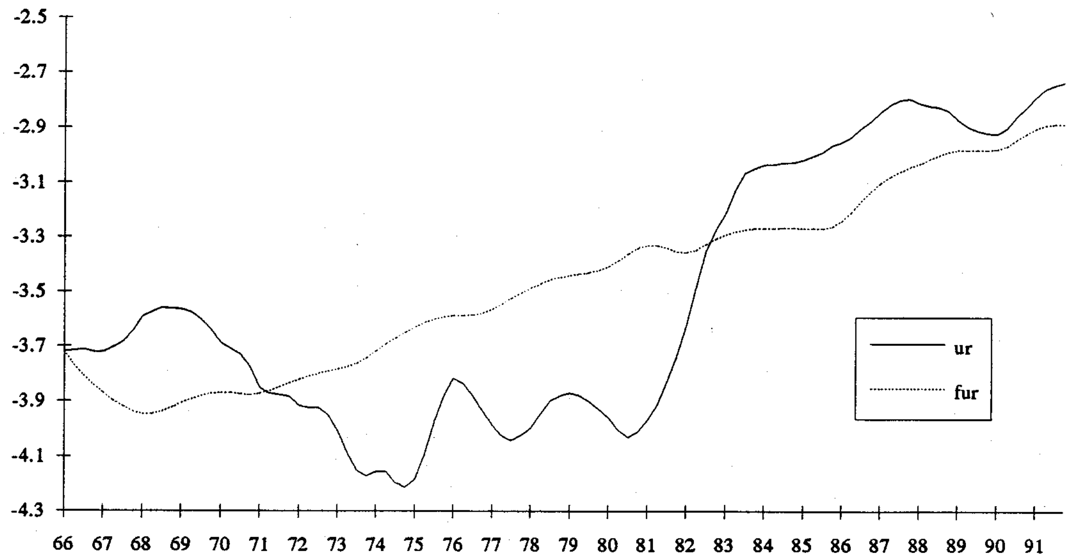

Fig. 20. Realized and simulated unemployment rate