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A MODEL OF COMPETITION BETWEEN UNEMPLOYED AND EMPLOYED JOB SEARCHERS: A Replication of Burgess for the Netherlands 1965–1991.

by

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ABSTRACT

This paper replicates the analysis of Burgess, concerning a model of job competition between employed and unemployed job search. Using an annual data set of Dutch flows into and out of unemployment, we find results remarkably similar to those found by Burgess for the U.K. So also for The Netherlands, this competition is of crucial importance for the determination of the unemployment outflow rate.

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AUTHOR'S NOTE

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1. INTRODUCTION

Since the flow approach to labour markets recently gained momentum, see for example Blanchard and Diamond (1992), matching models have been the most popular models to analyze the unemployment outflow. Van Ours (1991) was the first to estimate a matching model for the Netherlands. A common feature of all matching models so far is that only unemployed persons are assumed to engage in search for a new job. Burgess (1993) is the first to highlight the role of employed persons in job search and to *endogenise* employed job search within the search and matching approach.

This paper replicates Burgess (1993) in analyzing the outflow out of unemployment, in the context of competition between employed and unemployed job searchers, using flow data for The Netherlands of 1965-1991. We find that also in The Netherlands, competition for jobs between employed and unemployed search is an important determinant of the outflow rate. This paper is organized as follows. In section 2 the flows into and out of unemployment are identified. Section 3 briefly sums up the theoretical background of the model of job competition and section 4 presents empirical results. Finally, section 5 concludes.

2. UNEMPLOYMENT FLOWS ON THE DUTCH LABOUR MARKET

First, we have to identify the unemployment flows for the Netherlands. We use the flow of unemployment benefit recipients. See Appendix. Since the inflows of persons with an unemployment insurance benefit (WW) and on unemployment support (RWW) are available, it is easy to calculate the gross outflow, using the net change in unemployment, for which we taken the total number of persons with an unemployment benefit (WW and RWW). In figure 1, the in- and outflow are presented and their main statistical characteristics are given in table 1.

The size of these flows appears to be very large, compared to the net change in unemployment. In fact, the flows are of the same magnitude as the level of unemployment. The actual flows may even be much larger, since we cannot take account of persons moving in and out of unemployment within one year. Furthermore, in the period 1965–1979, inflow and outflow moved close together, with a possible exception for 1975. From the early 1980's however, it looked as if the outflow was lagging the inflow, with one or two years. After 1985 the flows started moving more in line with each other again.

Table 1. Characteristics of stock and flow series, 1965–1991.

	Mean	Standard deviation	Maximum	Minimum
Unemployment	331 150	249 000	741 000	35 000
Inflow	322 000	127 000	508 600	111 000
Outflow	301 500	130 000	522 700	108 000

The standard way of analyzing the outflow rate is based on search and matching models. See e.g., Layard *et al.* (1991). Standard matching models relate the number of matches to the active searches on each side of the market. It has the basic form

$$X = H(U,V), \tag{1}$$

where X is the number leaving unemployment, $H(.)$ is the matching function, U is the number of unemployed and V is the number of vacancies. H can be identified with the total number of hires within the economy. Dividing (1) by U yields $X/U = H/U$ or $X/U = (H/L)/(U/L)$ and taking logs gives

$$\log x = \log h - \log u, \tag{2}$$

where x is (X/U), the outflow rate, h is the hiring rate, normalized by the labour force L and u is the unemployment rate.

Equation (2) implies that there is a unit elasticity between the outflow rate and the hiring rate. Taking data on the Dutch labour market, (2) does not even roughly fit that fact. The coefficient on $\log h$ is 0.072 and a standard F-test on the validity of that coefficient being equal to unity, yields $F(1,24) = 7.804$. Hence, this hypothesis is rejected at any reasonable significance level.

The reason for the difference between $\log x$ and $\log h$, becomes clear if we plot the total outflow from unemployment and the total number of hires in figure 2. The lack of correlation between the two series is confirmed. In fact the vertical distance between the two lines represents the hiring of persons other than the unemployed, which is overwhelmingly made up of employed persons moving from one job to another. Hiring of this group forms a high proportion of total hiring.

Figure 3 expresses this phenomenon in yet another way. Here X is normalized by L and split in two components: $(X/L)=(X/H)(H/L)$. The first is the share of new jobs won by the unemployed, the second is the hiring rate. It is evident that when the hiring rate falls, the unemployed's share of new jobs rises and *vice versa*. This is especially true in the period 1981-1988.

Thus, also in The Netherlands, we find that the standard matching models do not provide an adequate explanation of the unemployment outflow. In fact, in estimating a matching model for The Netherlands, van Ours (1991) took account of this phenomenon by using the flow of filled vacancies as the number of matches and not the unemployment outflow. In this paper, we will follow Burgess (1993) and take the number of matches equal to the sum of the new hires and the number of employed job movers. Later, we will compare this measure with that flow of filled vacancies.

3. A MODEL OF COMPETITION BETWEEN EMPLOYED AND UNEMPLOYED JOB SEARCHERS

This section briefly summarizes the competition model that Burgess (1993) has developed. This model is based on search theory. Central elements in this analysis are the proportion of the employed engaged in search, ϕ, the arrival rate of job offers, θ, and the rate of acceptance of a job offer, ρ. The outflow rate out of unemployment, x, is the product of θ and ρ. It is assumed that ϕ depends on the reservation wage. Workers earning less than this wage rate, engage in search,

$$\phi = \phi(\theta, \boldsymbol{Z}), \tag{3}$$

where ϕ is increasing in θ and $\boldsymbol{Z}$ is a vector representing other variables influencing the reservation wage. On the other hand, θ is given by

$$\theta = M/J, \tag{4}$$

where M is the number of matches and J is the total number of job seekers. In fact $J=U+\phi N$, where N is the number of employed, or dividing by the labour force L

$$j = u + (1-u)\phi(\theta), \tag{5}$$

where $j=J/L$. Hence, ϕ is important in the determination of θ and hence in the determination of x. Equations (3), (4) and (5) jointly determine ϕ and θ. In equilibrium, we can derive that

$$\theta = \theta(m,u,\boldsymbol{Z}), \qquad \phi = \phi(m,u,\boldsymbol{Z}), \tag{6}$$

where $m=M/L$. Clearly from (5), the properties of $\theta(.)$ are important for the composition of the number of job seekers J. The elasticities of θ with respect to m and u are

$$\eta_{\theta,m} = \frac{1}{1+\beta\ \eta_{\phi,\theta}} < 1, \tag{7}$$

$$\eta_{\theta,u} = \frac{-(1-\phi)(1-\beta)}{1+\beta\ \eta_{\phi\ ,\ \theta}} > -1, \tag{8}$$

where β is the proportion of employed job searchers, $\beta=(1-u)\phi/j$. The elasticity of θ with respect to ϕ is crucial in this context; it measures the responsiveness of employed job seekers to changes in the offer rate and in that way endogenises employed job search in the search and matching theory.

Finally, it is assumed that employed and unemployed face a different offer arrival rate function. The share of offers to the unemployed is given by

$$X/M = \lambda(U/J). \tag{9}$$

So the unemployed receive more (less) than their 'fair' share of offers if $\lambda>1$ ($\lambda<1$). The outflow rate then is

$$x = \lambda\theta(m,u,Z)\rho. \tag{10}$$

In essence, this completes the specification of the outflow model.

4. EMPIRICAL RESULTS

The actual number of matches differs from its expected (equilibrium) value by a mean zero random shock, ε, hence $\log\bar{m} = \log m + \varepsilon$. So the actual offer arrival rate then becomes $\log\theta(m,u,Z)+\varepsilon$. The equation to estimated in this section is a dynamic log-linearized version of (10), including this random element

$$\log x = \log\lambda(.) + \log\theta(m,u,Z) + \log\rho(.) + \varepsilon. \tag{11}$$

λ represents movements in the relative shares of offers and so will depend on the relative search intensity between employed and unemployed and on the suitability of applicants. Relative search intensity is related to income, the replacement rate (rr), and motivation, the proportion of long term unemployed (ltu). Suitability of applicants is related to mismatch, in case unemployed are in the wrong place ($mm1$) or offering the wrong skills ($mm2$). It may also depend on demographic variables, like the proportion of employed aged 16-24 (ξ_{1624}) and those aged over 55 (ξ_{5564}). Young workers are assumed to engage in a job switch more than old workers.

These two demographical variables are also present in the vector Z of the arrival rate θ. Z also contains the replacement rate. We allow for non-linearities in $\theta(.)$ by including the terms $(\log u)^2$ and $(\log m \log u)$. Finally, the offer acceptance rate ρ depends on the replacement rate.

Application of the augmented Dickey-Fuller test on the presence of unit roots in these series, imply that most are I(1). A static cointegration regression based on these variables, yields a Durbin-Watson of 2.20. This high value suggests first of all that indeed there is a long-run equilibrium relation, and second that only limited additional dynamics is required to obtain a statistically adequate model.

Equation (11) can easily be rewritten in error-correction form and is then estimated with annual data of 1965 to 1991 for The Netherlands. The general model includes only contemporaneous dynamic variables, due to the limited number of observations. This general model is then sequentially simplified and subjected to a number of misspecification tests. We report the preferred specifications in Table 2.

The model of column 1 of table 2 is a simplification of the general model. As the cointegration test suggested, the adjustment parameter is close to minus one, so this model can be restricted to the one in table 2 column 2, with $\log x_t$ as dependent variable. Also, $\Delta \log m_t$ and $\log m_{t-1}$, $\Delta \log ltu_t$ and $\log ltu_{t-1}$ and $\Delta(\log m \cdot \log u)_t$ and $(\log m \cdot \log u)_{t-1}$ can be combined to $\log m_t$, $\log ltu_t$ and $(\log m \cdot \log u)_t$. None of the diagnostic tests applied to these two models indicates any severe misspecification.

The parameter estimates we find for the preferred model of column 2 are of the same size as those of Burgess (1993). We do not find a significant impact of any of the demographic variables on the outflow. Note that we do find a slightly significant positive parameter for the replacement rate rr. A higher replacement rate means the possibility of job loss is less bad for an employed worker and so there is little incentive to search. Thus, competition for the unemployed is reduced, raising the outflow. There is no unanimity on the sign of this coefficient. Nickell (1982) reports a significant negative effect and Layard *et al.* (1991) find no significant effect.

We next consider the two primary variables, m and u. The elasticity of x with respect to these two variables is non-constant and cannot straightforwardly be read from table 2, due to the two non-linear terms, $(\log u)^2_{t-1}$ and $(\log m \cdot \log u)_t$, in the model. These elasticities are graphed in figures 4 and 5. The figures are similar to those found by Burgess (1993). For most of the period the hiring rate elasticity is insignificantly different from zero. However, in 1981 it started rising, averaging around 0.5. The rationale for this rise is straightforward, as the rise in unemployment around 1980-82 much reduced employed job search, so the effect of an increase in hiring is now greater on outflow. The shape of the unemployment elasticity is also similar to that of Burgess (1993). It starts with a value of around -1 and increases to a value insignificantly different from zero.

The two non-linear terms are highly significant in the model of column 2. The theoretical explanation for the importance of these interaction terms is that if ϕ is convex in m/j, then $\eta_{x,m}$ will rise as u rises. However, the result that $\eta_{x,m}<1$, does not depend on their inclusion. Columns 3 and 4 of table 2 present equations excluding these terms. Clearly, the fit worsens dramatically, but the hiring elasticity is still around 0.4 to 0.6.

We have thus established the same main result for The Netherlands as Burgess (1993) found for the U.K., namely that competition for jobs between employed and unemployed search is a crucial determinant of the outflow rate. Also the model specifications and elasticities for the two countries, are of a striking resemblance.

Finally, we compare the model of table 2 column 2 with a model where the number of hires is taken to be the flow of filled vacancies, as was used in the matching model of van Ours (1991) for The Netherlands. We also compare the model of column 2 with a specification of the outflow rate, based on the standard matching approach, as in equation (1).

A similar analysis as the one presented above can be carried out for a model with the flow of filled vacancies as a measure of hiring. This model is presented below in the first column of table 3. It is also not rejected by any of the misspecification test we apply. In this model $\log fv$ is the log of the flow of filled vacancies, taken from van Ours (1991). Only $(\log u)^2_{t-1}$ is included as non-linear term. Since $(\log m \cdot \log u)$ is not significant, the hiring elasticity is of a constant value of some 0.2, which is still of the same order as we found for the model of table 2, column 2. The unemployment elasticity is non-constant and has a similar pattern as the one presented in figure 3.

Next, we want to know if our preferred model encompasses the one with this alternative hiring rate. However, because of the limited number of observations, the encompassing tests cannot adequately be conducted. We therefore apply a number of model selection criteria, as a way of comparison, as set out by Franses (1989). Both the $\bar{R}^2$, the Akaike and the Schwarz criteria have a slight preference for the model of table 2, column 2.

The standard model specification of the outflow rate, which does not take account of competition between employed and unemployed job searchers, based on the approach of Pissarides (1986) and Layard *et al.* (1991), depends solely on unemployment and vacancies, as also argued by Burgess (1993). The estimation and test results for this model are given in the second column of table 3. This model specification only suffers from first order RESET, indicating that important explanatory variables are omitted from this model. A glance at table 2 might indicate what these variables are. It is possible to compare this model and the preferred model of table 2 with the usual encompassing tests. Cf. Hendry (1989). All encompassing tests, given in table 4, indicate that the specification in the spirit of Pissarides and Layard *et al.* is rejected in favour of the model of table 2, column 2.

5. CONCLUDING REMARKS

This paper presents a replication of the study of Burgess (1993), into a model of competition between employed and unemployed job search, applied to annual unemployment flow data for The Netherlands. We confirm all major findings and conclusions of Burgess with our limited data set. Therefore, also in The Netherlands this competition is of crucial importance for the determination of the unemployment outflow rate.

Figure 1. Unemployment, stock and flows, in The Netherlands, 1965–1991 (stock: left scale, flows: right scale).

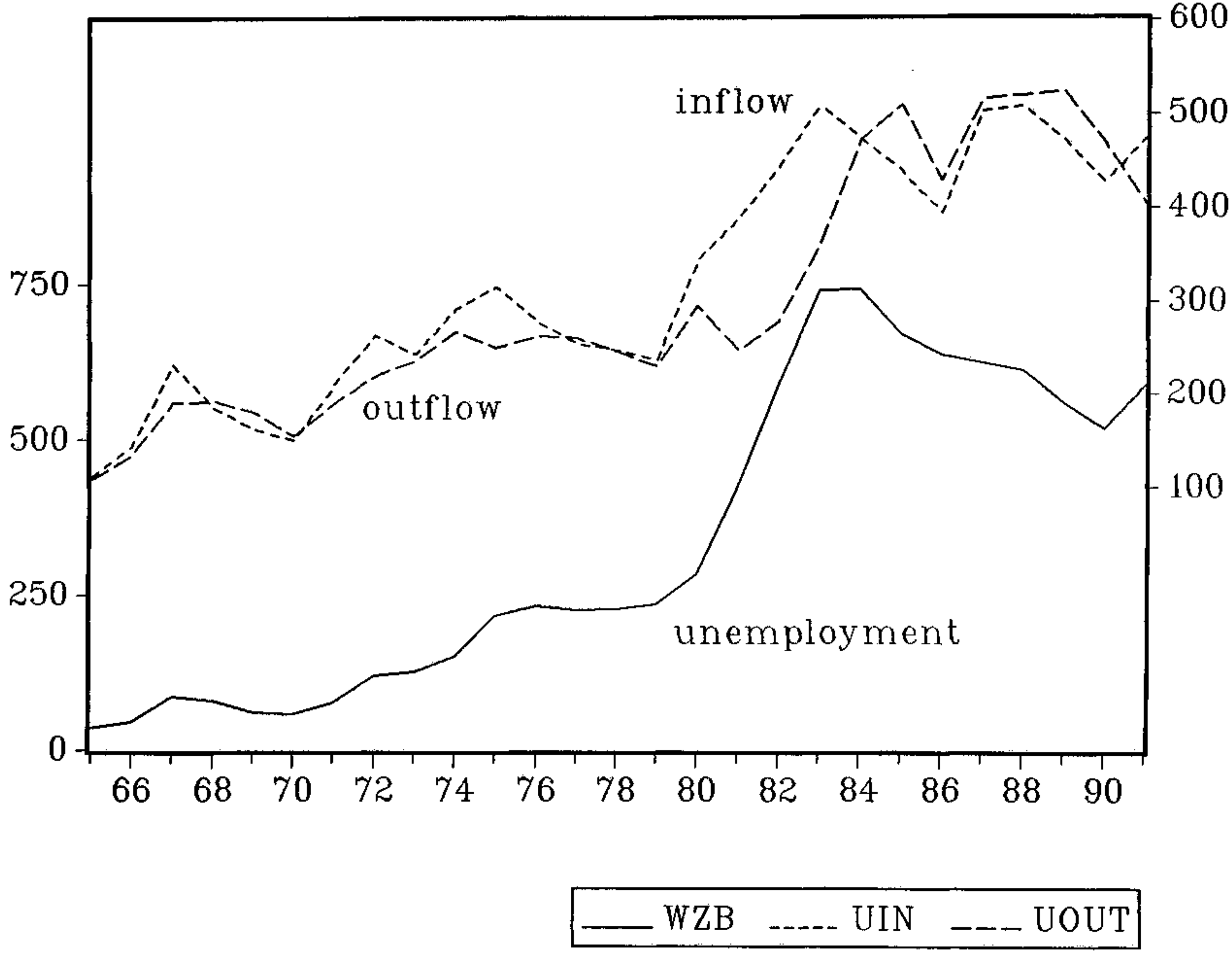

Figure 2. Engagements and unemployment outflow in The Netherlands, 1965–1991.

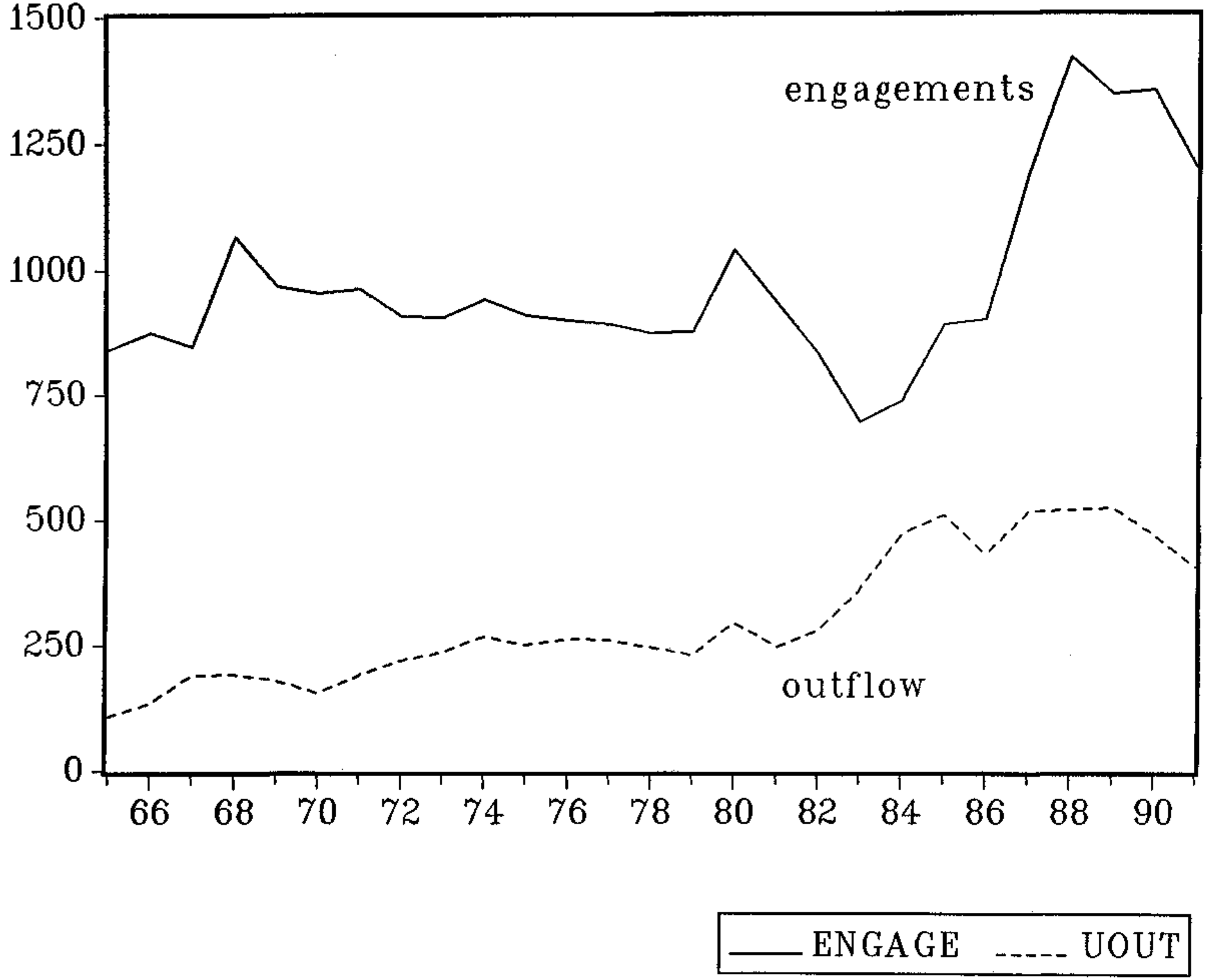

Figure 3. The share of jobs won by the unemployed and the hiring rate in The Netherlands, 1965–1991.

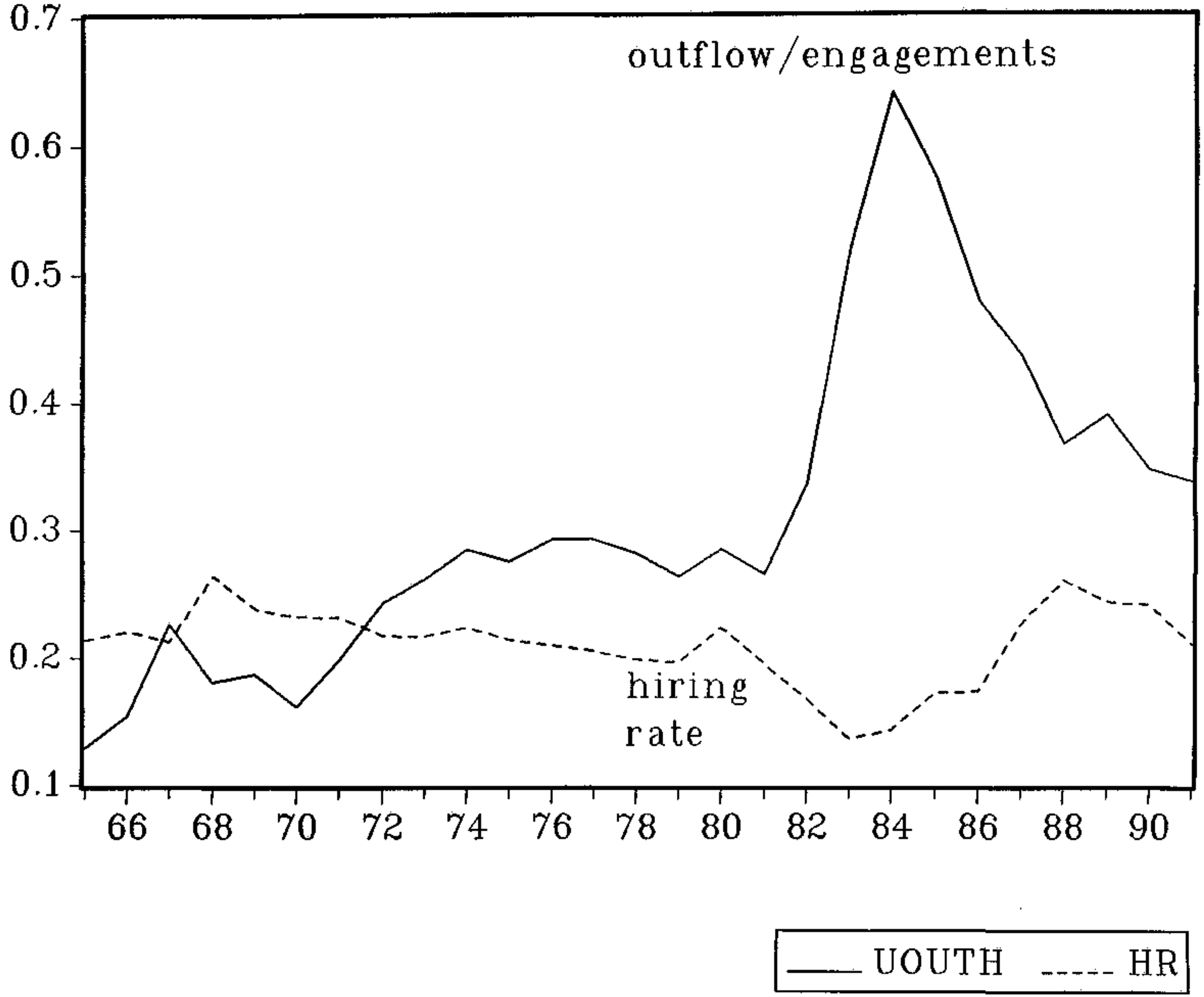

Figure 4. Hiring rate elasticity, with 2 standard error boundaries.

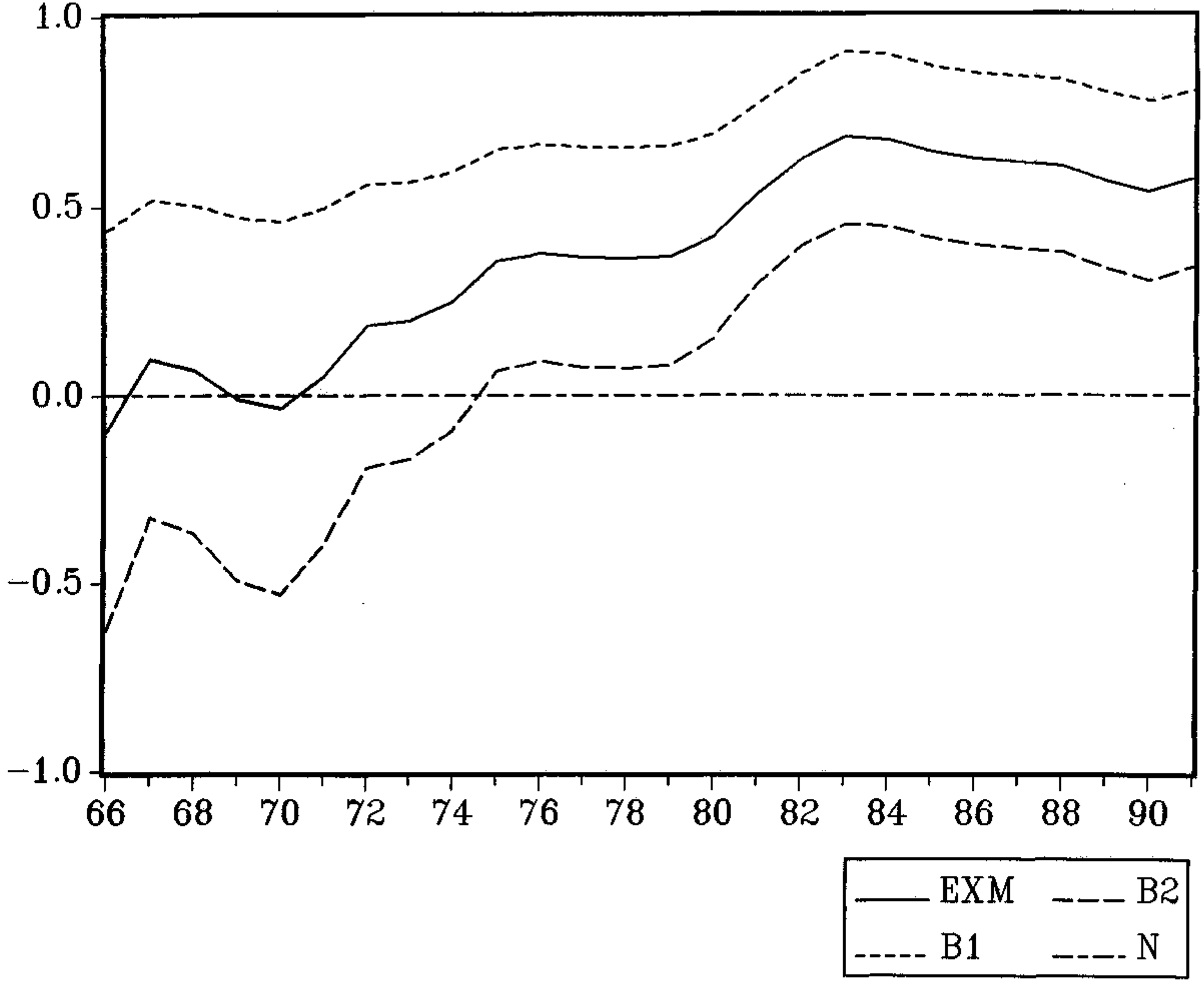

Figure 5. Unemployment rate elasticity, with 2 standard error boundaries.

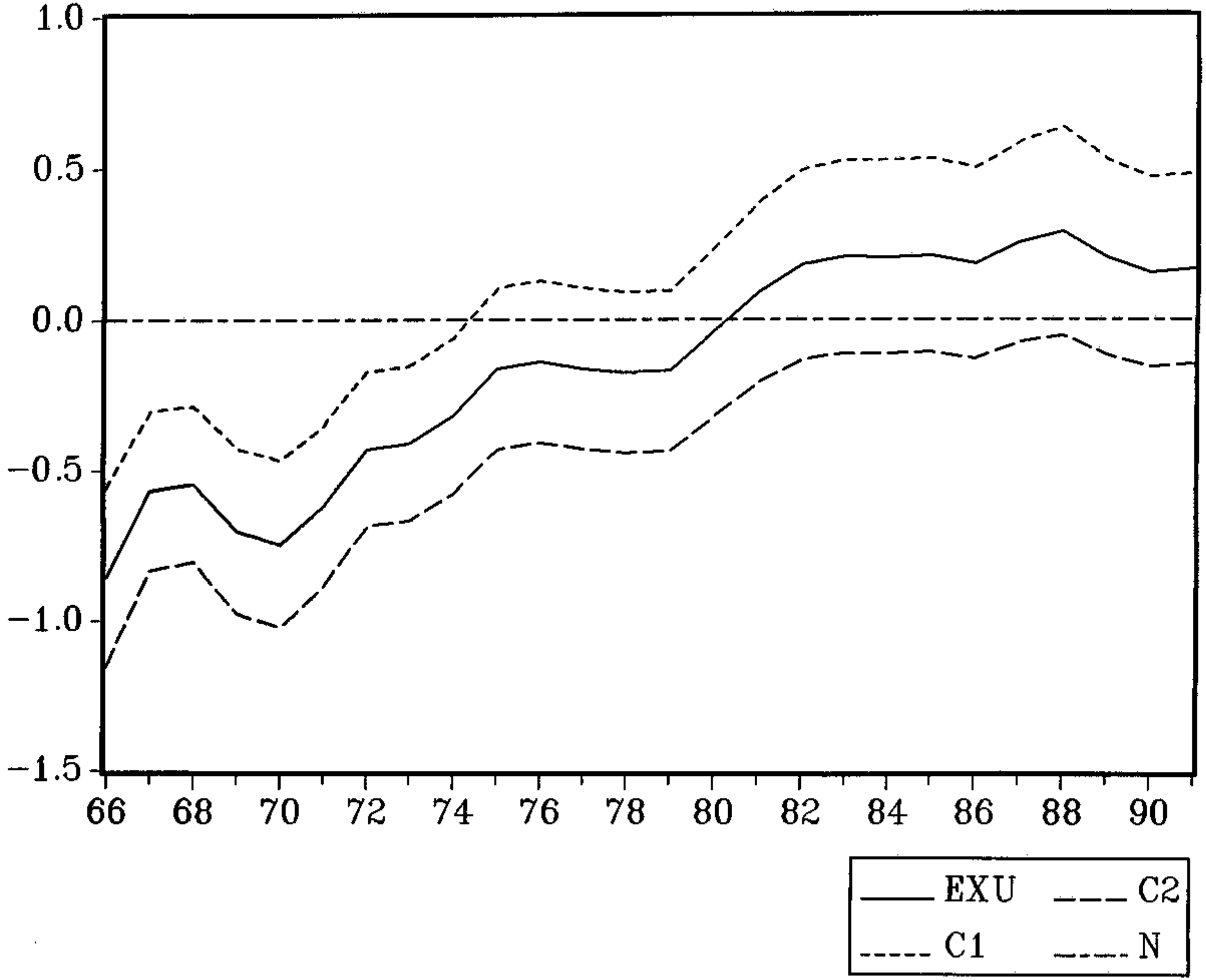

Table 2. Regressions for the outflow rate, 1965–1991.

Dependent variable:	$\Delta \log x_t$		$\log x_t$		$\log x_t$		$\log x_t$
constant	1.313 (1.130)		2.851 (4.084)		1.206 (2.255)		−1.020 (−2.820)
$\Delta \log rr_t$	1.187 (2.501)		0.820 (1.823)		0.154 (0.328)		0.160 (0.239)
$\Delta \log m_t$	1.422 (5.148)						
$\Delta \log ltu_t$	−0.604 (−4.754)						
$\Delta(\log m \cdot \log u)_t$	0.257 (2.515)						
$\log x_{t-1}$	−1.055 (−6.693)						
$\log u_{t-1}$	0.975 (1.603)		1.698 (4.256)		0.698 (2.533)		−0.579 (−7.383)
$\log m_{t-1}$	0.492 (0.877)						
$\log ltu_{t-1}$	−0.601 (−3.615)						
$(\log u)^2_{t-1}$	0.202 (3.824)		0.235 (6.390)		0.170 (4.734)		
$(\log m \cdot \log u)_{t-1}$	−0.015 (−0.060)						
$\log m_t$			1.254 (5.497)		0.646 (4.758)		0.391 (2.207)
$\log ltu_t$			−0.621 (−5.514)		−0.373 (−3.977)		−0.108 (−1.009)
$(\log m \cdot \log u)_t$			0.302 (3.074)				
R^2	0.930		0.989		0.983		0.964
σ	0.073		0.075		0.089		0.127
AR $F(1,14)$	0.984	$F(1,18)$	0.151	$F(1,19)$	1.542	$F(1,20)$	5.872*
AR $\chi^2(5)$	4.13		4.13		5.20		7.13
Normality $\chi^2(2)$	0.873		1.607		10.43*		0.607
ARCH $F(1,25)$	0.037		1.676		3.625**		0.021
RESET $F(1,14)$	0.001	$F(1,18)$	0.477	$F(1,19)$	0.124	$F(1,20)$	12.83*
CHOW $F(4,11)$	2.159	$F(4,15)$	1.004	$F(4,16)$	0.228	$F(4,17)$	0.390

* means significant at 5 percent and ** means significant at 10 percent.

Table 3. Regressions of alternative outflow models, 1965–1991.

Dependent variable:	$\log x_t$		$\log x_t$
constant	0.454 (0.694)		0.411 (4.592)
$\Delta \log u_t$	-0.308 (-2.077)		
$\log u_{t-1}$	0.864 (2.776)		
$\log fv_{t-1}$	0.227 (2.291)		
$(\log u)^2_{t-1}$	0.168 (4.241)		
$\log rr_{t-1}$	-0.687 (-3.474)		
$\log ltu_t$	-0.633 (-4.825)		
$\log mm2_t$	-0.124 (-2.177)		
$\log x_{t-1}$			0.368 (3.245)
$\log(v/u)_{t-1}$			0.259 (5.262)
R^2	0.988		0.949
σ	0.080		0.145
AR $F(1,17)$	0.269	$F(1,22)$	0.283
AR $\chi^2(5)$	2.87		0.500
Normality $\chi^2(2)$	0.319		0.550
ARCH $F(1,25)$	1.043		0.018
RESET $F(1,17)$	0.754	$F(1,22)$	10.11^*
CHOW $F(4,15)$	0.284	$F(4,19)$	0.620

Table 4. Encompassing tests

The model of table 2, column 2 is called model 1

The model of table 3, column 2 is called model 2

model 1 vs model 2	Form	Test	Form	model 2 vs model 1
0.507	N(0,1)	Cox	N(0,1)	-12.06*
-0.443	N(0,1)	Ericsson IV	N(0,1)	5.487*
0.339	$\chi^2(2)$	Sargan	$\chi^2(2)$	18.01*
0.155	$F(2,17)$	Joint Model	$F(6,17)$	10.23*

Note: Tests performed with PC Give. Cf. Hendry (1989).

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APPENDIX. DATA

Abbreviations

CBS: Netherlands Central Bureau of Statistics

CPB: Netherlands Central Planning Bureau

OECD: Organization of Economic Cooperation and Development

Definitions and sources

x: outflow rate out of unemployment: $X/(E(-1)+U(-1))$.

The outflow X is calculated as

$$X = U_{in} - \Delta U,$$

where U_{in} is the inflow into unemployment, which consists of inflow in the number of persons receiving unemployment insurance benefit (WW) and the inflow of persons on unemployment support (RWW).

source: Sociale Verzekeringsraad, *Kroniek van de sociale verzekeringen*, 1992.

CBS, *Statistisch Zakboek.*

CBS, *Statistiek van de algemene bijstand*

CBS, unpublished RWW-inflow data

and author's own calculations

U: number of unemployed job searchers, (this amounts to number of unemployment benefit recipients).

source: CPB, *Lange reeksen.*

E: number of employed persons (wage and salary earners)

source: OECD, *Labour Force Statistics.*

u: unemployment rate: $u = U/(E(-1)+U(-1))$

m: hiring rate: $(H+JJ)/(E(-1)+U(-1))$,

H: the gross inflow into employment, calculated as $H=\Delta E+F_{out}$.

F_{out}: persons moving from employment to unemployment and non-participation

source: Broersma (1993)

JJ: the number of employed persons moving from one job to another.

source: Hartog *et al.* (1988)

CBS, *Arbeidskrachtentelling*

Ministry of Social Affairs, *Kwartaalbericht Arbeidsmarkt* and author's own calculations.

ltu: proportion of unemployed persons with duration of more than 1 year.

source: Ministry of Social Affairs, *Kwartaalbericht Arbeidsmarkt.*

rr: replacement ratio, defined as the daily unemployment insurance benefit, times seven, divided by the average weekly net pay in industry.

source: Sociale Verzekeringsraad, *Kroniek van de sociale verzekeringen*, 1992.

CBS, *Statistisch Zakboek.*

*mm*1: regional mismatch index of the eleven Dutch provinces.

It is calculated as the absolute value of the forecast error of the individual *UV*-curves, hence

$$U_{it} = \alpha_0 + \alpha_1 V_{it} + \varepsilon_{it},$$

and $mm1 = \Sigma_{i=1}^{11} |\varepsilon_{it}|$.

source: CBS, *Sociaal economische maandstatistiek*
CBS, *Statistisch Zakboek.*

mm2: sectoral mismatch index for six Dutch sectors, due to Lilien (1982).

It is calculated as

$$mm2 = \{\Sigma_{i=1}^{6}(E_{it}/E_t)[\Delta\log E_{it} - \Delta\log E_t]^2\}^{½}.$$

source: CBS, *Statistisch Zakboek.*

ξ_{1624}: fraction of employed persons between 16 and 24 years old.

source: CBS, *Statistisch Zakboek.*

ξ_{5564}: fraction of employed persons between 55 and 64 years old.

source: CBS, *Statistisch Zakboek.*

ψ_{25}: ratio of unemployed below 25 and employed below 25.

source: CBS, *Statistisch Zakboek.*

FV: flow of filled vacancies.

source: van Ours (1991)
supplemented from CBS, *sociaal economische maandstatistiek.*

fv: flow rate of filled vacancies: $fv = FV/(E(-1)+U(-1))$

V: the number of vacancies.

source: OECD, *Main Economic Indicators.*