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An empirical analysis for The Netherlands

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LABOUR PARTICIPATION AND THE FLOW APPROACH:
An empirical analysis for The Netherlands.

by F.A.G. den Butter*

Summary

An empirical flow model of the Dutch labour market is used to simulate the effects of autonomous labour demand and supply shocks on employment and unemployment. A positive labour supply shock, representing a policy which aims at enhancing labour participation, appears to lead to more employment indeed, but the effect is rather small. A sensitivity analysis using the model shows that a string of positive and negative labour supply shocks generates unemployment persistence, which depends upon the degree of unemployment duration dependence and upon the level of labour market dynamics. This corroborates the theoretical predictions, but the sensitivity for specification changes appears to be small.

key words:
matching of unemployed and vacancies, job mobility, persistence of unemployment, duration dependence, simulation model, impulse response effects

1. Introduction

Today, low labour participation is a major economic problem in The Netherlands. The extent of the problem is illustrated by the dramatic rise of the ratio between the number of workers and those receiving government benefits in the past twenty years. In 1970 this ratio was less than 0.5 so that more than two workers earned the benefit of each person receiving such benefit. However, in 1990 the ratio has risen to over 0.8 so that each worker has to earn almost a full benefit of another person. Both politicians and academics have proposed a number of practical policy measures in order to curb this development (see e.g. WRR, 1990). Most proposals aim at enhancing labour participation by a reduction of the eligibility for social security, or by stimulating labour supply in an other way. However, the main policy problem with respect to these proposals is whether or not they stimulate employment indeed.

This paper gives a model based analysis of this policy problem, by using the flow approach of modelling the labour market. According to a traditional model of the labour market with fixed prices, with employment determined by labour demand, a positive labour supply shock will not result in more employment, but will only lead to more involuntary unemployment. Hence, according to this model labour supply incentives do not lead to more labour participation (defined as total employment divided by total working age population). However, traditional models of the labour market disregard

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labour market dynamics, i.e. the size of the flows into and out of employment and unemployment. From a policy point of view it can make much difference whether each year 20% of the employed lose their jobs and the same number of new jobs is created so that employment remains constant or that, under constant employment, there is job destruction and job creation at a pace of only, say, 5% of the total number of jobs. Thus the main academic (or technical problem) of the paper is the construction of an empirical model of labour market dynamics for The Netherlands, which describes all flows relevant for the policy analysis of a labour supply shock. The model is an extended version of the model of Den Butter and Van Ours (1992). It is strongly inspired by the flow approach to labour markets as portrayed by Blanchard and Diamond (1992). At the core of the model is a matching function of unemployed and vacancies, which determines the flow out of unemployment and specifies the search process of employers and employees.

The next section gives a graphical illustration of the consequences of a labour supply shock according to different models of the labour market and illustrates the importance of considering the position and determinants of the UV-curve when such (policy induced) shock occurs. A UV-curve can be derived from the aggregate transaction curve in case of a heterogeneous labour market, but alternatively as the result of the search and matching processes at the labour market, even is if this market is homogeneous. The flow approach and hence the remainder of the paper has the latter theoretical background. Section 3 presents a full model of labour market flows and shows how the model is calibrated for The Netherlands. Section 4 presents the results of impulse simulations using the model. A sensitivity analysis reveals to what extent, according to alternative model specifications, a labour supply shock indeed enhances employment. This section also considers asymmetric effects of negative and positive labour demand shocks, in order to investigate whether the model generates persistence of unemployment if the escape probability from unemployment is duration dependent. Finally, section 5 concludes.

2. Demand effects of enhanced labour supply

Figure 1 shows the effects of a policy directed at enhancing labour supply in case of a homogeneous labour market in a simple demand and supply diagram. The effects depend on whether the labour market is in equilibrium or not. In equilibrium with market clearing wages we start with labour demand equal to the labour supply so that total employment is *Le* with equilibrium wage *we*. Now policy incentives lead to a supply shock, represented by a shift of the labour supply curve to the right. (*Ls* -> *Ls*'). A new equilibrium is reached at a higher level of employment and at lower wages. Hence, in case of labour market equilibrium a policy directed at enhancing labour supply leads to more employment indeed. However, when wages are fixed and are above the equilibrium level (*wf*) we have in the initial situation employment determined by labour demand (*Ldf*) and unemployment equal to

$$Uf = Lsf - Ldf$$

Now a shift of the labour supply curve to the right does not lead to more employment, but only to more unemployment:

$$Uf' = Lsf' - Ldf > Uf$$

The figure illustrates two extreme situations. In The Netherlands the labour market is characterized by disequilibrium with sticky (not fixed) wages where the Phillips-curve effect of a labour supply shock will induce a small reduction of wages, so that employment slightly rises.

Yet, the assumption of a homogeneous labour market may not be not realistic. Therefore figure 2 shows the effects of a labour supply shock in a heterogeneous market under the extreme assumption of labour market disequilibrium with fixed wages. Now total employment is determined by the ***aggregate transaction curve***, which is the sum of employment at the micro markets in disequilibrium. When wages are above equilibrium at the macro level, the majority of these markets will suffer a demand constraint, but some of these markets will have a supply constraint. Therefore, total employment is always smaller according to the aggregate transaction curve than according to the short side of the aggregated labour market (i.e. employment equal to labour demand when wages are above equilibrium and equal to labour supply when wages are below equilibrium).

Figure 1 Labour supply shock in a homogeneous labour market

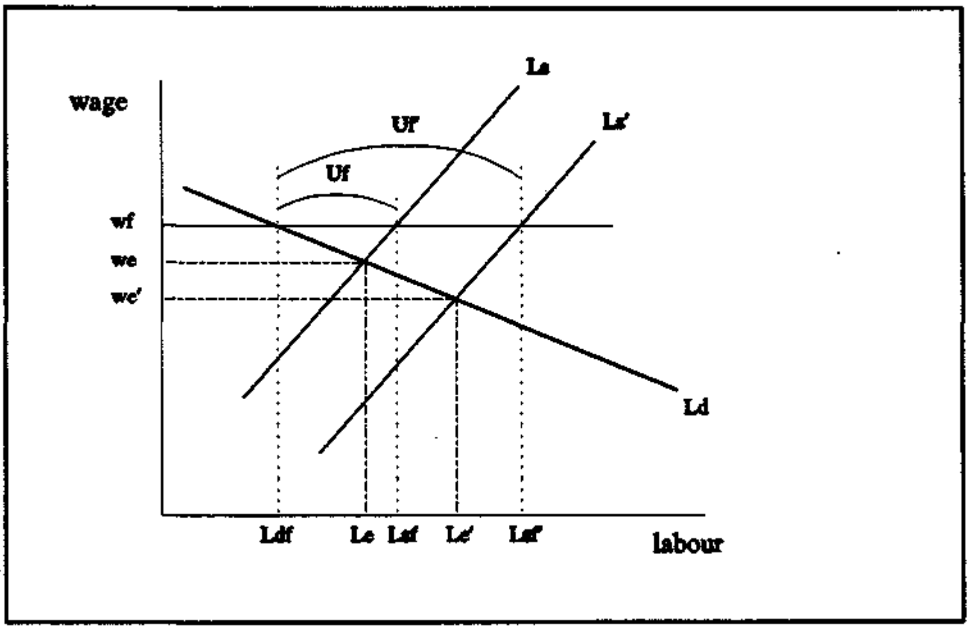


Figure 2 starts with wages above equilibrium. Total employment is equal to *Ldf* whereas for unemployment holds

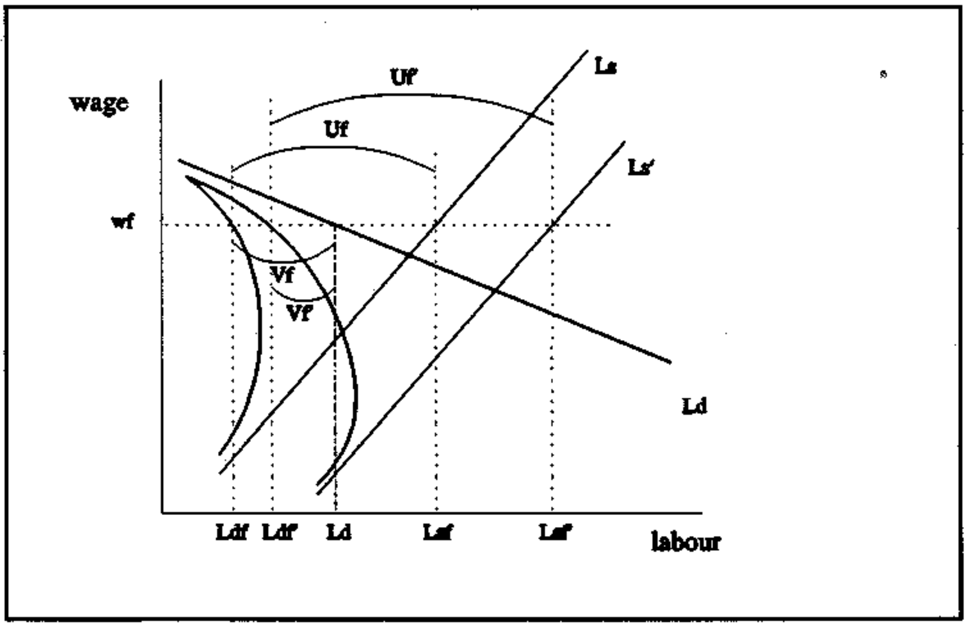
Uf = Lsf - Ldf

Figure 2 shows how in case of a heterogeneous labour market vacancies and unemployment co-exist. With labour supply curve *Ls* and fixed wages *wf*, vacancies are equal to

Vf = Ld - Ldf

The graph shows that when wages are at their equilibrium level the number of vacancies is equal to the number of unemployed. This is frictional unemployment. When wages rise above equilibrium level the number of vacancies decreases and the number of unemployed increases. Hence the ratio of unemployed and vacancies can be regarded as an indicator of how much the labour market is out of equilibrium.

Figure 2 Labour supply shock in a heterogeneous labour market



When the policy to enhance labour participation leads to a shift of the labour supply curve from *Ls* to *Ls'* the aggregate transaction curve will also shift to the right. Now, with wages still fixed at *wf*, employment rises from *Ldf* to *Ldf'*. Because of this labour supply shock unemployment becomes much larger:

Uf' = Lsf' - Ldf',

whereas the number of vacancies declines:

Vf' = Ld - Ldf'

So we see that, unlike in the case of a homogeneous labour market, in a heterogenous labour market a labour supply shock induces some additional employment, when wages are fixed and above equilibrium level. A major lesson from this graph is that the employment effects of a policy directed at enhancing labour supply depends on the shape and the position of the aggregate transaction curve. At first sight it seems that this position can easily be determined empirically, when data on total unemployment and on the number of vacancies are available and when the aggregate transaction curve is identified as the well-known UV-curve.

However, modern search theory provides quite another theoretical underpinning of the UV-curve. Here the UV-curve is determined by the matching process at the labour market, where job seekers and employers meet. This matching process is described by a matching function or hiring function according to which the flow of new jobs depends on the stock of unemployed and the stock of vacancies. Yet, in this matching function not all unemployed necessarily have the same weight: the probability for a long-term unemployed to escape from unemployment may be much lower than that for a short-term unemployed. In this case of duration dependence with respect to unemployment, the position of the UV-curve does not only depend on the number of vacancies and of unemployed, but also on the composition of the unemployed.[2] Moreover, a search equilibrium does not neccesarily imply that the number of vacancies be equal to the number of unemployed (corrected for heterogeneity) but may also occur with unequal numbers of unemployed and vacancies (see Pissarides, 1990).

From this viewpoint we need to analyze labour market flows and labour market dynamics in order to assess the success of a policy of enhancing labour supply. The traditional modelling of the labour market in macroeconomic policy models which only consider stocks, does not provide adequate information for such assessment. This traditional (disequilibrium) modelling of the labour market can be summarized in an archetypical way as follows:

Labour demand (stock):	$L_d = L_d(......)$
Labour supply (stock):	$L_s = L_s(......)$
Unemployment:	$U = L_s - L_d$

where total labour demand and total labour supply are determined by behaviourial equations with unemployment the difference between supply and demand.

The stylized version of the dynamic labour market model with stocks and flows, reads as follows:

Unemployment:	$U_t = U_{t-1} + F_t^{in} - F_t^{ou}$
Flow out of unemployment:	$F^{ou} = f(U,V)$ (matching function)
Flow into unemployment:	$F^{in} = f(E,...)$ (job destruction process)

[2] For the sake of simplicity we consider vacancies to be homogenous.

Here, the difference between gross inflow into unemployment and gross outflow determines the change of unemployment. The flow out of unemployment is determined by the matching function, whereas the flow into unemployment is described by a behaviourial equation in which, besides total employment, real wages and the cyclical situation may act as determinants of job destruction (see equation 1 of the bare-bones-model of Blanchard and Diamond, 1992). In the model of labour market flows of this paper we concentrate on the matching function as the main behaviourial equation and keep the specification of the job destruction process deliberately very simple. Moreover, two other processes, which play a major role in flow models of the labour market, viz. the job creation process and labour supply, are specified in a simple manner as well. Wage formation is not modelled explicitly so that the model may either describe a labour market in disequilibrium or in (unemployment) equilibrium. However, the baseline projections of the model, used for the simulation experiments, represent search equilibria with constant stocks.

3. Modelling labour market flows

Our model distinguishes three labour market positions for the working age population: the *employed*, the *unemployed* and the *(voluntary) non-participants* (= outside the labour force). Figure 3 pictures all relevant flows of persons between these stocks. The stock of non-participants is taken as the residual group. Both the inflow into this group and the outflow from it, which are demographically determined, are left out of consideration.

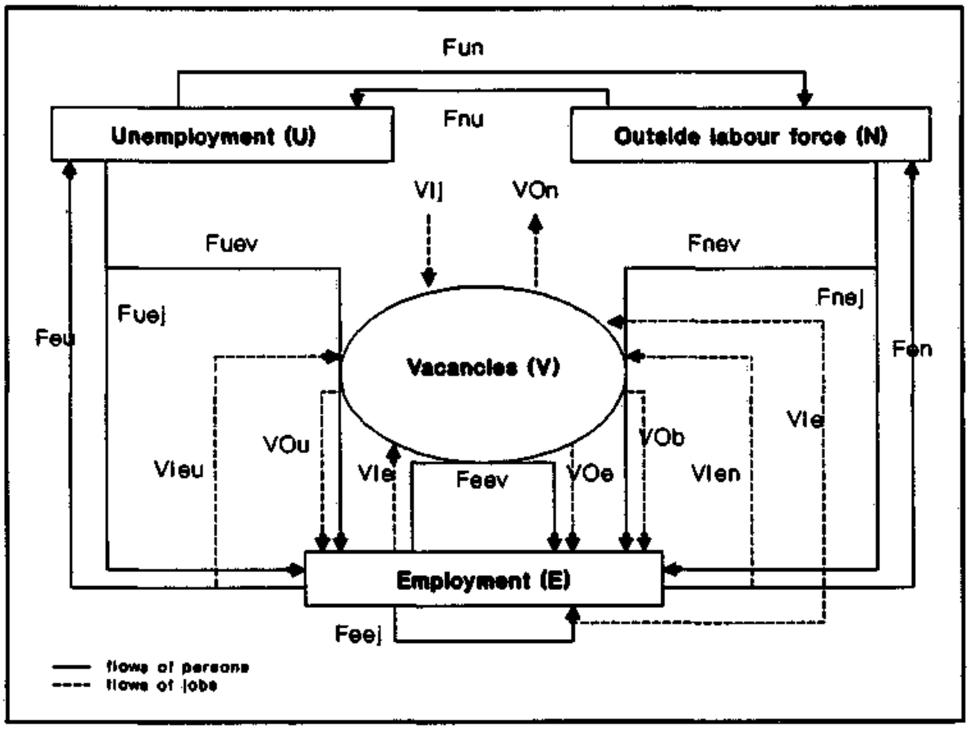
Beside the three positions for the working age population, the figure also shows the stock of vacancies and the consequent flows of jobs. These flows of jobs are linked to the flows of persons. The model describes at a macro level all labour market flows depicted in figure 3. The equations of the model are given in the Annex which also contains a list of the main symbols. Our following discussion of the separate equations of the model is to clarify its structure.

Equation (1) is the matching function of unemployed and vacancies. In the present version of the model this equation only describes the outflow from unemployment of those unemployed who find a new job for which a vacancy exists. Of course this is only part of the matching process between job seekers and employers. Vacancies are not only filled by unemployed, but also by job movers and by non-participants. These other matches can also be described by behaviourial equations which have the number of vacancies, and the number of relevant job seekers and non-participants as determinants. However, we have not yet specified matching functions for these labour market flows.

The matching function of equation (1b) is based on estimates by Van Ours (1991) for The Netherlands and was also included in a simplified previous version of the present model by Den Butter and van Ours (1992). Parameter θ in the matching function represents duration dependence. In case θ is equal to unity we have no duration dependence and all unemployed obtain the same weight in the matching function. A θ between

1 and 0 in equation (1a) assumes that the probability of unemployed finding a job reduces when unemployment duration increases. There are several possible reasons for such duration dependence. Firstly, duration dependence on the macro level may be the result of *duration dependence on the micro level.* Because of depreciation of human capital long term unemployed lose part of their productive capacity. When the depreciation of human capital outweighs the speed at which the unemployed reduce their reservation wage, the chance for a successful matching becomes smaller. Long term unemployment can also have a signalling effect, so that employers are inclined not to employ long term unemployed, irrespective of their productive capacity. On the other hand, duration dependence on the macro level may as well be caused by *heterogeneity on the micro level.* When groups of unemployed have different escape probabilities from unemployment, those groups with low escape probabilities will be overrepresented in long term unemployment. Both types of duration dependence require different policy measures. Van Ours (1992) attempts to separate both sources of duration dependence empirically at the macro level.

Figure 3 Stocks and flows in the model of the labour market



Our actual simulation model includes specification (1.b) of the matching function. Instead of a gradual decline of the escape probability from unemployment with the duration of unemployment, this specification assumes a partition between long term and short term unemployed. Here the escape probability for the long term unemployed π_L is $\theta\ \pi_S$, where π_S is the escape probability for the short term unemployed.

The specification of the matching functions is a Cobb-Douglas function with α the weight given to the composite unemployment variable in the matching process, and c a constant term representing the efficiency of the matching process. Apart from the matching function all other behaviourial equations of our model describe behaviour in a very simple manner, namely by relating the relevant flows to scaling variables only. These behaviourial equations could be extended in subsequent versions of our model, but up to now we have refrained from doing so both because of lack of data and because of lack of appropriate empirical examples from the literature[3]. An advantage of keeping the model (relatively) simple is that its working is (rather) transparent.

According to definition equation (2) the number of vacancies filled by unemployed is equal to the number of unemployed who find a new job for which a vacancy exists. Equation (3) relates the number of non-participants finding a job for which a vacancy exists to the number of vacancies. We already mentioned that this equation can also be described by a matching function. The major specification problem for such matching function is, however, that only part of the non-participants is relevant for the matching process, because the majority of them does not want a (paid) job at all.

Definition equation (4) makes the amount of vacancies filled by non-participants equal to the number of non-participants finding a job for which a vacancy exists. Equation (5) defines the gross outflow of vacancies. Besides filled vacancies these are vacancies which are scrapped because they cannot be filled. Equation (6) assumes these removed vacancies to be a fixed part of the total stock of vacancies. This is in line with the model of Blanchard and Diamond (1989) who consider the scrapping of vacancies as part of the job destruction process. Equation (7) sets the number of vacancies filled by job movers equal to the number of job movers finding a new job for which a vacancy exists.

Equation (8) relates these job movers to the number of vacancies. Again a matching function would be an alternative to the present simple specification but in that case we should have data on which part of the employed workers is actively looking for another job. Equation (9) defines this change in the stock of vacancies as the net result of gross inflow and gross outflow of vacancies. The components of gross inflow are differentiated in equation (10). Equation (11) describes the process of job creation which generates new vacancies (equation 2 of the bare-bones-model of Blanchard and Diamond, 1992). In the present version of our model we regard it as an autonomous flow, so that we can simulate a labour demand shock by an impulse to this variable. Equation (12) describes new vacancies which result from quits of job movers. The parameter μ_3 indicates the extent to which job mobility induces new vacancies, so that $(1-\mu_3)$ represents the ratio of jobs which disappear after a quit. Equation (13) assumes the same ratio for the number of new vacancies of job quitters who become non-participants, on the understanding that it makes no difference for the continuation of the job whether the

[3] Pissarides (1990) provides a theoretical specification for the processes of job creation, labour supply and wage formation, which are derived from microeconomic behaviour and which imply an unemployment equilibrium.

holder of that job quits because he or she did find a new job or because he or she wanted to become a non-participant. Equations (12) and (13) may both relate to job quitters who would otherwise have been laid off, so that in this interpretation ($1-\mu_3$) is associated with the job destruction process.

Equation (14) describes the number of vacancies which emerge when workers lose their job and become unemployed. These will mainly be lay-offs, so that the number of resulting vacancies is probably small. Therefore μ_4 will be close to zero.

Equation (15) relates the number of job movers to a newly created job to total employment. Obviously this simple way of modelling this part of the job creation process should be elaborated in a later version of the model. The same holds true for equations (16) and (17) according to which total employment determines the number of persons who become unemployed and the number of persons who leave their jobs (quits, lay-offs, retirement) and become non-participants[4].

Equation (18) defines the pool of unemployed. Its net change is equal to gross inflow minus gross outflow. Definition equation (19) equates gross inflow into unemployment to the sum of the number of workers who lose their jobs and got unemployed and the number of non-participants who register as unemployed. The latter variable represents the autonomous part of labour supply in the model. Equation (21) gives the components of gross outflow from unemployment. The flows from unemployment to employment have been described previously, but some unemployed will stop searching and become (voluntary) non-participant. Equation (22) relates the flow of these discouraged unemployed to total unemployment. As an alternative one can think of long term unemployment as a scale variable. Hence equations (20) and (22) describe the labour supply process. Equation (23) relates the number of unemployed who find a newly created job to the autonomous inflow of vacancies, so that this flow is linked with the autonomous job creation process of the model. As equations (22) and (23) describe outflow from unemployment and as we distinguish various duration classes of unemployment in the model we are bound to make assumptions about the duration classes from which the outflow originates. We assume a uniform distribution over the duration classes for the discouraged unemployed and the same distribution as implied by the matching process of equation (1b) for those unemployed who take a newly created job.

Equation (24) defines total employment as the result of gross inflow and gross outflow and the stock in the previous period. Equation (25) describes the various components of gross inflow into employment, distinguished by the model. When job movers are included in gross inflow, they are also to be included in gross outflow in equation (27). Equation (26) relates non-participants who take a newly created job to the inflow of new vacancies, which provides an other link with the autonomous job creation process. The

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[4] E.g. Blanchard and Diamond (1989) define $\mu_1 = (q+\pi_0)$ with q the quit rate and π_0 the fraction of jobs that become unproductive and involve lay-offs because of the job destruction process.

definition of gross outflow from employment in equation (27) completes the model's description of all flows of persons and jobs depicted in figure 3.

As total employment, total unemployment and the stock of vacancies, including the respective inflows into, and outflows from these stocks, are fully determined by the model, the model implicitly describes escape probabilities and average durations of persons staying in these stocks. Hence the model encompasses duration models of search theory. However, most empirical duration models using microeconomic data, focus on one stock in particular (employment duration, unemployment duration or the duration of vacancies) and do not consider the various escape probabilities or hazard functions in a consistent framework. This model does, but no simple distribution functions for the escape probability result from it. According to the model escape probabilities and average durations are time dependent in the model and vary with on all parameter values and exogenous flows. Only in very specific circumstances, when all stocks are constant (or grow at the same pace) we have time independent distribution functions as assumed by duration analysis (see Den Butter and Abbring, 1993, for an analysis of unemployment equilibria with heterogenous unemployment).

Equation (28) defines the escape probability from the first duration class. The number of unemployed in this class is equal to the inflow into unemployment (equation 29). Equation (30) gives the composition of the higher duration classes and the escape probability from these classes.

The model is specified on a quarterly basis. Rather than estimating the parameters of the model, these parameters are set to plausible values, which are partly based on empirical results from the literature. We label this procedure model calibration. In this calibration procedure we have used the parameters μ_1 .... μ_{11} of the model as instrument so that the model gives, in a dynamic simulation, good *ex post* predictions of labour market developments in the 1970's and the 1980's. In principle we use the same calibration procedure as Den Butter and Van Ours (1992) and therefore we take their parameter values for μ_1, μ_2 and μ_3 as starting point. For the autonomous inflows VI_j and F_{au}, no data are available from statistical sources so that artificial data have been constructed for the series using information on unemployment, employment, vacancies and the flow of filled vacancies. These artificial data are in accordance with the equilibrium solution of the model, given the observations mentioned above[5]. The other variables for which no data exists are endogenous and determined by the model.

[5] These equilibrium values are:

$$VI_j = \frac{[(1-\mu_4)\mu_1 + (1-\mu_3)\mu_2 - \mu_3\mu_8]\ E}{(1+\mu_{10}+\mu_{11})} + \frac{[(1-\mu_3)\mu_7 + \mu_6]\ V}{(1+\mu_{10}+\mu_{11})}$$

$$F_{au} \quad = \mu_2 E - \mu_{11} VI_j - \mu_5 V + \mu_9 U$$

We have taken four quarter moving averages in order to smoothen incidental shocks in the data.

Table 1 summarizes the results of several calibration experiments. The table presents two yardsticks for the adequacy of the model to describe past developments, namely the root mean square prediction error (RMSE), and Theil's inequality coefficient (INEQ). The latter provides a measure of the relative deviations of the ex post predictions from their realisations. These yardsticks are applied to the projections and realisations of the four main endogenous variables of the model, namely vacancies, unemployment, employment, and the share of long term unemployment ($LU=U_L/U_S$).

Table 1. **Model calibration with selected parameter values**

	LU		V		U		E	
	RMSE	INEQ	RMSE	INEQ	RMSE	INEQ	RMSE	INEQ
selected specification	0.149	0.298	31.8	0.204	95.9	0.109	151	0.0179
alternatives								
μ_4 0.01	0.149	0.297	32.0	0.206	96.4	0.109	149	0.0177
0.1	0.150	0.299	31.5	0.201	95.3	0.108	153	0.0182
μ_5 0.1	0.153	0.307	32.8	0.210	94.3	0.106	150	0.0179
0.2	0.146	0.289	31.2	0.199	97.8	0.111	152	0.0181
μ_6 0.005	0.149	0.298	32.0	0.206	95.9	0.109	152	0.0181
0.015	0.149	0.298	31.6	0.202	96.0	0.109	150	0.0178
μ_7 0.4	0.154	0.310	36.2	0.235	99.6	0.113	148	0.0176
0.6	0.144	0.285	30.0	0.180	93.3	0.105	163	0.0195
μ_8 0.01	0.154	0.311	29.1	0.174	84.1	0.094	197	0.0236
μ_9 0.15	0.127	0.241	31.3	0.198	117.1	0.136	157	0.0188
0.25	0.172	0.361	32.4	0.209	82.1	0.092	146	0.0173
μ_{10} 0.05	0.148	0.294	31.3	0.199	95.2	0.108	153	0.0182
0.15	0.151	0.302	32.5	0.209	96.8	0.110	149	0.0178
μ_{11} 0.3	0.152	0.305	30.9	0.195	94.5	0.107	155	0.0185
0.5	0.147	0.292	32.7	0.212	97.2	0.110	147	0.0175

Explanatory note: the selected specification is $\mu_1=0.01$, $\mu_2=0.01$, $\mu_3=0.9$, $\mu_4=0.05$, $\mu_5=0.15$, $\mu_6=0.01$, $\mu_7=0.5$, $\mu_8=0$, $\mu_9=0.2$, $\mu_{10}=0.1$, $\mu_{11}=0.4$, $\alpha=0.5$, $\theta=0.5$. RMSE means root mean square error; INEQ means Theil's inequality coefficient. The alternative parameter values in the left hand column are selected in order to illustrate the sensitivity of the fit of the model for parameter changes.

Besides the parameter values for μ_1, μ_2, μ_3, those for θ and α are also equal their calibrated values in the restricted model (see Den Butter and Van Ours, 1992). A major criterium in our calibration procedure is that the parameters $\mu_4,\ldots,\mu_{11}$ of the selected specification obtain plausible values. The table shows that the sensitivity of the model for changes of parameter values, as measured by the fit of a dynamic specification over the reference period, is rather small. It indicates that a wide range of parameter values would yield a fit about as good as that of the selected specification. Moreover, no set of parameter values is optimal in the sense that it yields the best fit for all observed endogenous variables at the same time. Obviously the information contents of the available macroeconomic time series data is too poor to allow a proper assessment of all parameter values of the model. Additional information using, for instance, microeconomic data is needed for such assessment. The sensitivity analysis of the next section shows how the working of the model is affected by changes of some crucial parameter values.

4. Effects of demand and supply shocks

This section shows the effects of autonomous labour demand and supply shocks by means of impulse and sensitivity analyses. The baseline projection is calculated as an extrapolation of the model using the equilibrium values of the autonomous variables VI_j and F_{nu}, so that, after an initial period, the baseline reaches a stationary equilibrium path. A labour supply shock is represented by an autonomous change of the net inflow into unemployment of non-participants. The baseline projection has this net inflow equal to the gross inflow F_{nu}, determined by the equilibrium condition, minus outflow into non-participation, F_{un}, which is according to equation (22) a fixed fraction of the stock of unemployed. The impulse projection augments the time path of net inflow of the baseline with a positive or negative shock. The reason for giving an impulse to *net* inflow instead of to the (autonomous) *gross* inflow, is that a change of gross inflow induces a change of the stock of unemployed and hence a change of outflow into non-participation. In that case the impulse projection approaches the equilibrium values of the baseline projection, so that a labour supply shock does not have a permanent effect because the cumulated change of gross inflow is matched by a cumulated change of gross outflow of equal size. A demand shock is modelled in a similar manner by an autonomous change of the net inflow of new vacancies. In order to avoid negative stocks, the simulated (temporary) impulse is distributed over the four quarters of the first year of the simulation period, whereas impulse effects are measured at the end of the year.

Table 2 gives the results of autonomous labour demand and supply shocks according to the basic version of the model, which has the parameter values of the calibrated specification, and which yields, in accordance with the actual situation in The Netherlands, a central projection with equilibrium values of 400,000 unemployed and 50,000 vacancies. However, in equilibrium the share of long term unemployment (one year or more) amounts to 24% of total unemployment, which is rather low in comparison with the actual situation.

The table shows that, according to this version of the model, a positive demand shock, which brings about an initial increase of the number of vacancies, enhances employment very much. In the long run (i.e. after 6 years) almost all additional vacancies are filled up and unemployment has decreased considerably. We note that the decrease of unemployment is smaller than the increase of employment because the positive demand shock induces non-participants to take (newly created) jobs. Long term unemployment has come down with over 1 %-point. Comparison of the results of the two blocks at the left hand side of table 2 demonstrates that there is substantial symmetry between the effects of a positive and a negative demand shock.

Table 2 The effects of an autonomous change of vacancies (demand shock), and of unemployed (supply shock), basic central projection

	Increase of vacancies after			Increase of unemployed after		
Effects on	1 yr.	3 yrs.	6 yrs.	1 yr.	3 yrs.	6 yrs.
employment	44	49	42	2.8	3.5	3.9
vacancies	14	3	2	-2.7	-2.6	-2.2
unemployment (x 1,000)	-23	-26	-20	37	32	27
% unempl. > 12 months (% points)	-0.5	-1.5	-1.1	-1.3	1.4	1.2
	Decrease of vacancies after			**Decrease of unemployed after**		
Effects on	1 yr.	3 yrs.	6 yrs.	1 yr.	3 yrs.	6 yrs.
employment	-45	-49	-43	-3.0	-3.9	-4.2
vacancies	-12	-3	-2	2.9	2.9	2.3
unemployment (x 1,000)	25	28	22	-37	-31	-26
% unempl. > 12 months (% points)	0.5	1.4	1.1	1.5	-1.6	-1.3

Explanatory note: shocks are represented by an autonomous change of 10,000 in each quarter of the first year of the simulation period.

A positive labour supply shock, which may, for instance, represent the result of a stimulative participation policy, gives a different picture. This shock has, according to the model, no substantial effect on employment: in the long run the increase of employment is only about 10% of the additional labour supply. Most new entrants on the labour market remain unemployed so that the labour participation rate is not really enhanced by such supply policy. As a result of second order effects the sum of the effects on employed and unemployed after 6 years is smaller than the initial shock of 40,000 labour years. The share of the long term unemployed decreases in the first year of the shock because at that time the unemployed new entrants are still short term unemployed, but in the long run this share exceeds that of the baseline because most new entrants remain unemployed or take jobs of others who become long term unemployed. Similar to the demand shocks, the positive and negative supply shocks appear to be almost symmetrical.

Table 3 gives the results of positive supply and demand shocks according to a version of the model, which has the same parameter values of the basic model, but which yields an equilibrium baseline projection with an equal number of vacancies and unemployed (100,000). In this situation the effect of a demand shock on employment is of about the same size as that of the previous case of a supply surplus on the labour market. On the other hand the demand shock now causes a small decrease of unemployment only, whereas this decrease is sizable in the previous case. A positive supply shock appears to enhance employment considerably when the numbers of unemployed and vacancies are in balance. Therefore this simulation pictures a situation in which a stimulative supply policy can be useful from the perspective of augmenting labour participation. As the effects of negative supply and demand shocks are again almost the mirror images of the effects of the positive shocks, these simulation results are not presented in the table.

Table 3 **The effects of an autonomous increase of vacancies (demand shock), and of unemployed (supply shock), central projection with an equal number of vacancies and unemployed**

	Increase of vacancies after			Increase of unemployed after		
Effects on	1 yr.	3 yrs.	6 yrs.	1 yr.	3 yrs.	6 yrs.
employment	34	43	40	9.7	11.0	8.1
vacancies	23	7	2	-9.4	-8.0	-3.3
unemployment (x 1,000)	-11	-7	-2	28.8	13.6	5.3
% unempl. > 12 months (% points)	-0.3	-0.5	-0.2	0.2	1.3	0.5

Explanatory note: shocks are represented by an autonomous increase of 10,000 in each quarter of the first year of the simulation period.

The next simulation considers a situation of low labour market dynamics. The baseline projection has in equilibrium the same amount of unemployed (400,000) and vacancies (50,000) as the basic central projection of table 2, so that the economy is seemingly located at the same point of the UV-curve. However, the parameters of the job destruction process (μ_1) and outflow to non-participation (μ_2 and μ_9) are given values which are one third of those in the calibrated model ($\mu_1 = \mu_2 = 0.003$ and $\mu_9 = 0.06$). The resulting shift of the UV-curve is offset by a reduction of the efficiency constant c. The low level of labour market dynamics is reflected in the share of long term unemployed which is 69% of total unemployment in the present baseline projection as compared to 24% in the basic projection. The simulation results of table 4 prove that a positive labour supply shock is less effective for the enhancement of employment in the case of low labour market dynamics than when the same stock of unemployed and vacancies concurs with relatively large labour market flows. In other words, a stimulative labour supply policy will, *ceteris paribus*, be less successful when the share of long term unemployment is high than when there are only a few long term unemployed. The effects of a negative supply shock again appear to mirror those of a positive supply shock almost completely.

Table 4 **The effects of an autonomous change of unemployed (supply shock), central projection with low labour market dynamics**

	Increase of unemployed after			Decrease of unemployed after		
Effects on	1 yr.	3 yrs.	6 yrs.	1 yr.	3 yrs.	6 yrs.
employment	1.2	2.3	2.9	-1.3	-2.5	-3.1
vacancies	-1.2	-1.7	-1.5	1.2	1.8	1.6
unemployment (x 1,000)	38.6	35.3	31.7	-38.6	-34.9	-31.1
% unempl. > 12 months (% points)	-5.5	0.8	0.8	6.5	-0.9	-0.8

Explanatory note: shocks are represented by an autonomous change of 10,000 in each quarter of the first year of the simulation period.

The following simulations investigate the incidence of persistence of unemployment in case of labour supply shocks. An autonomous change of net inflow into unemployment in the first year of the simulation period is followed by an opposite change of equal size in the fourth year of the simulation period. This string of shocks may represent a cyclical impact on labour supply, or alternatively a stimulative labour supply policy which is maintained for a short period only. The upper part of table 5 gives the simulation results for the basic central projection, and the lower part of the table reports the results for the corresponding projection with low labour market dynamics. Although this string of opposite shocks hardly affects the level of employment, indeed it causes some persistence of unemployment, which is somewhat higher in the short run than in the long run. Unemployment comes down when a positive shock is followed by a negative shock and goes up *vice versa*. It illustrates that a temporary stimulative labour supply policy which intends to enhance labour participation, may cause a reduction of the unemployment rate, without really affecting labour participation. The table shows that the persistence of unemployment is slightly larger in the basic situation with a relatively low rate of long term unemployment than in the case of a low level of labour market dynamics with a lot of long term unemployed.

Table 5 **The effects of two successive supply shocks, two alternative projections with the same UV-equilibrium (400,000 unemployed and 50,000 vacancies)**

a. basic central projection

	Increase/decrease of unemployed after			Decrease/increase of unemployed after		
Effects on	1 yr.	3 yrs.	6 yrs.	1 yr.	3 yrs.	6 yrs.
employment	0.9	0.4	0.2	-1.0	-0.4	-0.2
vacancies	0.2	0.5	0.4	-0.3	-0.5	-0.4
unemployment (x 1,000)	-6.6	-5.2	-4.3	7.2	5.8	4.8
% unempl. > 12 months (% points)	2.9	-0.3	-0.2	-2.8	0.3	0.2

b. central projection with low labour market dynamics

	Increase/decrease of unemployed after			Decrease/increase of unemployed after		
Effects on	1 yr.	3 yrs.	6 yrs.	1 yr.	3 yrs.	6 yrs.
employment	1.3	0.5	0.5	-1.4	-0.6	-0.5
vacancies	-0.4	0.2	0.2	0.5	-0.3	-0.2
unemployment (x 1,000)	-4.6	-3.5	-3.1	5.0	3.8	3.4
% unempl. > 12 months (% points)	6.9	-0.1	-0.1	-6.7	0.1	0.1

Explanatory note: the first shock is represented by an autonomous change of 10,000 in each quarter of the first year of the simulation period and the second shock by a similar change in the fourth year of the simulation period. Effects are calculated from this fourth year onwards.

All previous simulations assume duration dependent unemployment according to which the weight of the long term unemployed in the matching function is half of that of the short term unemployed. In order to investigate the relationship between the degree of duration dependence and the persistence of unemployment in case of a string of labour supply shocks, table 6 gives the results for the case of low duration dependence (long term unemployed have a weight of 0.9 in the matching function) and for the case of high duration dependence (a weight of only 0.1 for the long term unemployed). The baseline projections for both cases have their equilibrium at 400,000 unemployed and 50,000 vacancies so that they seemingly are at the same point of the UV-curve. As the largest effects of changes of the degree of duration dependence are to be expected when there are a lot of long term unemployed, these baseline projections are taken as variants on the central projection with low labour market dynamics, for which the effects of a string of supply shocks are reported in the lower part of table 5. Indeed, we see that these results for the model with $\theta = 0.5$ lie between the results for the models with $\theta = 0.9$ and with $\theta = 0.1$ of table 6.

Table 6 The effects of two successive supply shocks, two alternative projections with the same UV-equilibrium (400,000 unemployed and 50,000 vacancies)

a. central projection with low duration dependent unemployment ($\theta = 0.9$)

	Increase/decrease of unemployed after			Decrease/increase of unemployed after		
Effects on	1 yr.	3 yrs.	6 yrs.	1 yr.	3 yrs.	6 yrs.
employment	1.6	0.6	0.5	-1.7	-0.7	-0.5
vacancies	-0.8	0.2	0.2	0.9	-0.2	-0.2
unemployment (x 1,000)	-4.7	-3.8	-3.4	5.1	4.1	3.6
% unempl. > 12 months (% points)	7.1	-0.1	-0.1	-6.9	0.1	0.1

b. central projection with highly duration dependent unemployment ($\theta = 0.1$)

	Increase/decrease of unemployed after			Decrease/increase of unemployed after		
Effects on	1 yr.	3 yrs.	6 yrs.	1 yr.	3 yrs.	6 yrs.
employment	0.4	0.1	0.4	-0.6	-0.3	-0.5
vacancies	0.7	0.5	0.1	-0.6	-0.5	-0.1
unemployment (x 1,000)	-4.5	-2.6	-2.5	5.2	3.3	3.1
% unempl. > 12 months (% points)	6.6	-0.0	-0.1	-6.5	0.1	0.1

Explanatory note: the first shock is represented by an autonomous change of 10,000 in each quarter of the first year of the simulation period and the second shock by a similar change in the fourth year of the simulation period. Effects are calculated from this fourth year onwards.

However, the persistence of unemployment appears not to depend very much on the degree of duration dependence. The decrease of unemployment due to a positive labour supply shock followed by a negative supply shock is somewhat higher in the case of low duration dependence than in the case of high duration dependence. Similarly an autonomous decrease of the inflow into unemployment followed by an increase of the same size leads to a somewhat higher unemployment rate when escape probabilities for long term unemployed are high as compared to those for short term unemployed than in the case of low escape probabilities. So we find a negative, albeit rather weak, relationship between duration dependence and persistence of unemployment. This is somewhat against our intuition as it contrasts the predictions of the insider-outsider theory which associates high persistence of unemployment with high duration dependence. Yet we note that the wage formation process described by the insider-outsider theory relates to a quite different mechanism than the search process underlying the flow approach modelled here. Moreover, our simulations refer to the comparative statics of alternative situations at the same point of the UV-curve, and we do not consider the effects of autonomous changes of duration dependence on the persistence of employment. Such experiments would not fit into the comparative statics framework of our equilibrium simulations.

5. Conclusions

The analysis of this paper is inspired by the low labour participation rate in The Netherlands and by policy proposals to enhance labour participation and employment by encouraging labour supply. According to the traditional model of a homogeneous labour market an autonomous labour supply shock does not lead to more employment in the case of labour market disequilibrium with excess supply and a fixed wage. On the other hand a flow model of the labour market allows for a positive employment effect of an autonomous positive labour supply shock in that case, even when the wage formation process is left out of consideration. The effect of such supply shock depends upon the position and the shape of the reduced form UV-curve, which is determined by the specification of the flow model. Unemployment equilibrium theory has established that shifts of the UV-curve can be caused by efficiency and parameter changes of the matching process, by changes of the job destruction process (matched in equilibrium by changes of the job supply process), by changes of the steady state employment growth rate and by changes of the duration dependence of unemployment (see e.g. Pissarides, 1990 and Den Butter and Abbring, 1993).

The dynamic model for the Dutch labour market, used in this paper to simulate the effects of labour supply and demand shocks, is an empirical offspring of the theoretical models of the flow approach to labour market modelling. The model endogenises all possible flows between the stocks of unemployed, employed, vacancies and the non-participants on the labour market at the macro level, but its specification of the model is kept as simple as possible. The only fully fledged behaviourial equation is that for the matching process of unemployed and vacancies. The other relevant flows are described as fixed proportions of scale variables.

Impulse simulations show that the model reproduces a number of mechanisms implicit in theoretical models of the flow approach. According to the model a positive labour supply shock enhances employment and a string of positive and negative supply shocks of equal size is shown to cause unemployment persistence. The extent of unemployment persistence appears to depend upon the degree of unemployment duration dependence and upon the level of labour market dynamics. However, the model, which has its parameter values calibrated according to the Dutch situation in the 1970's and 1980's, shows that the effects described above are rather small when calculated empirically. Large specification changes only induce small differences in the degree of unemployment persistence. The employment effects of an autonomous increase of labour supply appear to be so modest that a stimulative labour supply policy in order to enhance labour participation can be regarded as ineffective and should be accompanied by a labour demand policy. A more extensive sensitivity analysis and an extension of the model with more sophisticated specifications for the major behaviourial relations (including the wage formation process) may amend this view on the empirical relevance of the flow approach.

Literature

Blanchard, O.J. and P. Diamond, 1989, The Beveridge curve, Brookings Papers on Economic Activity, 1, pp. 1-60.

Blanchard, O.J. en P. Diamond, 1992, The flow approach to labor markets, American Economic Review, 82, Papers and Proceedings, pp. 354-359.

Butter, F.A.G. den, and J.H. Abbring, 1993, Dynamic labour market equilibria and heterogeneous unemployment, TRACE Discussion Paper nr. 31, 23 pp.

Butter, F.A.G. den, en J.C. van Ours, 1992, Stocks and flows in the Dutch labour market: a quarterly simulation model, VU Research Memorandum, 1990-59, revised March 1992, 19 pp.

Ours, J.C. van, 1990, An International Comparative Study on Job Mobility, Labour, 4, 3, pp. 33-55.

Ours, J.C. van, 1991, The efficiency of the Dutch labour market in matching unemployment and vacancies, De Economist, 139, pp. 358-378.

Ours, J.C. van, 1992, Duration Dependency and Unobserved Heterogeneity in Unemployment Time Series, Economics Letters, 38, pp. 199-206.

Pissarides, C.A., 1990, Equilibrium Unemployment Theory (Basil Blackwell, London).

WRR (Scientific Council for Government Policy), 1990, Een werkend perspectief, Arbeidsparticipatie in de jaren '90, Rapporten aan de Regering, nr. 38 (SDU Uitgeverij, The Hague)

The model

(1) $F_{uev} = f(V,U)$ (matching function)

(1a) $= c\, V^{1-\alpha} (U')^{\alpha}$ (general specification) where $U' = \sum_{k=1}^{\infty} U_k \, g(\theta, k)$

$$0 < \theta \leq 1$$

Here the weight of each duration class $g(\theta, k)$ depends on the duration dependence parameter θ and on the length of a spell of unemployment k. In case of negative duration dependency this weight falls with the length of the unemployment spell k.

(1b) $F_{uev} = c\, V^{1-\alpha} (U_S + \theta U_L)^{\alpha}$ (model specification)

(2) $VO_u = F_{uev}$

(3) $F_{nev} = \mu_5 V$

(4) $VO_b = F_{nev}$

(5) $VO = VO_u + VO_b + VO_e + VO_n$

(6) $VO_n = \mu_6 V$

(7) $VO_e = F_{eev}$

(8) $F_{eev} = \mu_7 V$

(9) $V = V_{-1} + VI - VO$

(10) $VI = VI_j + VI_e + VI_{en} + VI_{eu}$

(11) VI_j = autonomous

(12) $VI_e = \mu_3 (F_{eej} + F_{eev})$

(13) $VI_{en} = \mu_3 F_{en}$

(14) $VI_{eu} = \mu_4 F_{eu}$

(15) $F_{eej} = \mu_8 E$

(16) $F_{en} = \mu_2 E$

(17) $F_{eu} = \mu_1 E$

(18) $U = U_{-1} + UI - UO$

(19) $UI = F_{nu} + F_{eu}$

(20) F_{nu} = autonomous

(21) $UO = F_{uej} + F_{uev} + F_{un}$

(22) $F_{un} = \mu_9 U$

where the outflow from unemployment has a uniform distribution over the duration classes.

(23) $F_{uej} = \mu_{10} VI_j$

where the outflow from unemployment has the same distribution over the duration classes as the outflow because of the matching process of equation (1b).

(24) $E = E_{-1} + EI - EO$

(25) $EI = F_{uej} + F_{uev} + F_{nej} + F_{nev} \; (+ F_{eev} + F_{eej})$

(26) $F_{nej} = \mu_{11} VI_j$

(27) $EO = F_{eu} + F_{en} \; (+ F_{eev} + F_{eej})$

(28) (general specification)

$\pi_{1,t} = UO / U'$

(28') (specification used in the model)

$\pi_S = UO / (U_S + \theta U_L)$

(29) $U_{1,t} = UI$

(30) (general specification)

$U_{k,t} = (1-\pi_{k-1,t}) \, U_{k-1,t-1}$ where

$\pi_{k,t} = \pi_{1,t} \, g(\theta, k)$

(30') (specification used in the model)

$$\pi_L = \theta \pi_S$$

List of symbols

Flows of persons

(F_{xyz}	Flow from x to y (x,y = e,u,n) with, when relevant, z=j in case of newly created jobs and k=v in case of vacancies)
F_{eu}	Workers who become unemployed by loosing their jobs.
F_{en}	Workers leaving their job and the labour force.
F_{eej}	Job movers who find a new job for which no (registered) vacancy exists.
F_{eev}	Job movers who find a new job by filling a vacancy.
F_{uev}	Unemployed who find a new job by filling a vacancy.
F_{uej}	Unemployed who find a new job for which no (registered) vacancy exists.
F_{nej}	Non-participants (outside the labour force) who find a new job for which no (registered) vacancy exists.
F_{nev}	Non-participants who find a job by filling a vacancy.
F_{un}	Unemployed leaving the labour force.
F_{nu}	Non-participants who register as unemployed.

Flows of jobs

VI_j	New vacancies.
VI_{eu}	New vacancies because of lay-offs (and quits) of workers who become unemployed.
VI_e	New vacancies because of job mobility: i.e. workers finding an other job.
VI_{en}	New vacancies because of quits (and lay-offs) of workers who leave the labour force.
VO_u	Vacancies filled by unemployed.
VO_b	Vacancies filled by non-participants.
VO_e	Vacancies filled by job movers.
VO_n	Removed vacancies

Stocks

E	Employment
U	Unemployment
V	Vacancies

Other symbols

$\pi_{1,t}$	Escape probability of unemployed from the first duration class
$\pi_{k,t}$	Escape probability of unemployed from the k-th duration class

π_S Escape probability of short term unemployed

π_L Escape probability of long term unemployed

$U_{k,t}$ Number of unemployed in the k-th duration class

θ Duration dependence parameter

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