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STOCKS AND FLOWS IN THE DUTCH LABOUR MARKET:
A quarterly simulation model.

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Abstract

Traditional labour market models do not distinguish between stocks and flows. This article specifies a quarterly stock-flow model of the Dutch labour market with a matching function and system of unemployment dynamics as its two main characteristics. The model is calibrated to simulate developments during the 1970s and 1980s and to analyze the relationship between the matching function and unemployment dynamics by simulating labour supply and demand shocks. An increase in labour demand leads to a strong reduction of unemployment whereas very few of the additional vacancies remain unfilled. A labour supply shock creates very little additional employment.

1. Introduction

Labour demand and supply equations are at the core of the usual macroeconomic models of the labour market. In an equilibrium model wage formation follows implicitly from the equality of labour supply and demand. In that case labour supply is identified as effective labour supply; there is no involuntary unemployment. In disequilibrium modelling unemployment marks the difference between registered labour supply and labour demand, whereas wage formation is described explicitly by a wage equation, in which a Phillips-curve term acts as equilibrating mechanism. In such disequilibrium model actual labour demand may be somewhat below notional labour demand in case of supply constraints on the labour market (see Malinvaud, 1977). Moreover, according to new Keynesian macroeconomics, hysteresis may lead to persistence in unemployment, and hence to a partial fallacy of the equilibrating Phillips-curve mechanism (see Cross, 1988).

A common feature of both equilibrium and disequilibrium models is their focus on labour market stocks. Yet, the same levels of labour demand, supply and unemployment may be the result of quite different flows on the labour market. Hence, a considerable part of labour market dynamics - e.g. variations in persistence of unemployment - is not captured by the usual stock models of the labour market. In models which concentrate on the search process on the labour market the focus is on flows. At the core of these models is a so called matching function which describes labour market search behaviour by the relation between the flow of filled vacancies and the stock of unemployed and vacancies in a kind of production function (see Holmlund, 1980, 1984, for a Swedish example, Jackman, Layard and Pissarides, 1989, for a UK study and Blanchard and Diamond, 1989, for a US labour market model). The well-known UV-curve can be regarded as the iso-product curve defined by such matching function (see Van Ours, 1991). Whereas historical simulations with empirical disequilibrium models can provide an estimate of classical and Keynesian unemployment, the UV-curve analysis allows us to estimate the size of a third type of unemployment, viz. frictional unemployment. In case of a search process in disequilibrium shifts in the UV-curve can also be used to calculate the unemployment due to the malfunctioning of the labour market (Muysken, 1989).

The present article seeks to combine both approaches mentioned above into a consistent stock-flow model of the Dutch labour market. In our model a matching function plays the central role as a description of labour market behaviour. Labour demand and supply are represented in the model in a very simple way by new vacancies and inflow into unemployment respectively. Unemployment dynamics are specified using duration dependent escape and retention probabilities. By specifying a matching function in which long term unemployed workers have a smaller job match probability than short term unemployed workers, the model endogenizes the persistence of unemployment, so that we get insight into the degree of hysteresis implicit in the model (See Budd, Levine and Smith, 1988, and Möller, 1990, for analogous studies combining

UV-analysis and long term unemployment relationships). As we concentrate on the central role of the matching function in the working of the model, we have, until now, kept the rest of the model as simple as possible. Therefore, wage formation and the determinants of the duration dependency of the escape probabilities are not yet included into the model.
The model is used to simulate developments on the labour market in the Netherlands during the seventies and the eighties. The focus is on changes in unemployment and more specifically on the explanation of the explosive growth of long term unemployment in connection with low labour participation, which has become a major problem for economic policy in the Netherlands. To that end we investigate whether the model describes asymmetry between negative and positive demand and supply shocks, and to what extent a positive supply shock enhances employment.

This article is set up as follows. The next section discusses time series data on unemployment and on the duration of unemployment in the Netherlands and briefly informs on the construction of the data needed for our model, which were not readily available from statistical sources. Section 3 specifies the model with special emphasis on the interaction of in- and outflow of vacancies and unemployment, and on the consistency of overall escape probability implied by the model. This imposes a restriction on the transition probabilities between the various duration classes of unemployment. Section 4 reports on the parameter values of the model which are calibrated in such a way that a historical simulation with the model reproduces the actual data of the reference period. Section 5 analyses the working of the model by means of an impulse analysis simulating labour supply and demand shocks. This section also contains a sensitivity analysis on the major parameter values of the model. Finally section 6 gives conclusions and suggestions for extension of the model.

2. The Dutch labour market

There is discussion in the Netherlands about the actual number of unemployed. Unemployment is registered at public employment offices. According to recent estimates due to registration problems actual unemployment is some 40% lower than registered unemployment. The main problem is that the public employment offices are not notified in time that unemployed workers have found jobs. Estimates of actual unemployment corrected for these registration inaccuracies are however available for recent years only. Therefore we use data on registered unemployment (See Appendix 1 for more details on our data).

There are also registrations problems with job vacancies. If employers have vacancies they can use various recruitment methods in order to fill their vacancies: advertise, notify the vacancy to the public employment office, internal or informal recruiting, etc.. The basis of the regular information about the stock of job vacancies in the Netherlands consists of vacancies notified to the public employment service. As in most EC-countries the employer has in the Netherlands no obligation to notify the public employment service, so that notified vacancies are only a part of the actual number of vacancies. There is a vacancy survey of the Central Bureau of Statistics (CBS), but it only was started in 1980. From this vacancy survey it appears that in 1988 36% of the job vacancies were reported to public employment offices. Using the information from the CBS vacancy survey we corrected the vacancy data from the employment offices for changes in notification rate.

The developments in the Dutch unemployment and vacancy rates in the seventies and eighties are shown in figure 1. Until the end of the sixties the Netherlands experienced a situation of near full employment characterized by a low and stable rate of unemployment, fluctuating around 1% of the labour force (35,000 unemployed), and a high vacancy rate of about 3.5% (120,000 vacancies). In the beginning of the seventies the small open economy of the Netherlands met with the consequences of the first oil crisis and declined profitability of enterprises due to increased real labour costs: unemployment rate reached 6%, while the vacancy rate declined to 1.5%. In the beginning of the eighties unemployment grew explosively. The unemployment rate increased to 16% in 1984 (800,000 unemployed), while the vacancy decreased to less than 0.5% (10,000 vacancies). The sharp increase of unemployment in the Netherlands in the beginning of the eighties was caused by the combination of the stagnation in employment growth, which was in line with developments in other West-European countries, and an increase of labour supply, which was rather high as compared to other European countries. Since 1984 employment started to grow quite rapidly again.

Figure 1.Unemployment, vacancy stocks and flows; 1971-1987
(in % of the labour force)

- Unemployment (% of the labour force)

☐ Stock of vacancies (% of the labour force)
+ Yearly flow of vacancies (% of the labour force)

Source: see Appendix 1

As stated before, an important aspect of the labour market is the search of employers on the one hand and both employed and unemployed workers on the other hand. This simultaneous process results in a flow of filled job vacancies. There are almost no published data on total vacancy flow or vacancy durations in the Netherlands. The flow of vacancies reported to the public employment offices is available until 1978 (Hartog, 1980). From the CBS vacancy survey we have information about elapsed vacancy durations over the period 1980-1987. Applying the method as described in Van Ours en Ridder (1991) we calculated completed vacancy durations over this period. Using this information and the information on the vacancy flows towards the public employment office we constructed a 1961-1987 series of vacancy durations and flows of filled job vacancies[1]. Figure 1 also shows that the yearly flow of filled job vacancies in the seventies fluctuated around 10% of the labour force. In the beginning of the eighties there was a sharp decline to 5%. Since 1984 the flow of filled job vacancies increased substantially to about 17% in 1987. Figure 1 illustrates that the discrepancy between the stock and flow of vacancies becomes larger in the eighties as compared to the beginning of the reference period. It indicates a decline in the duration of job vacancies. In other words, job vacancies are filled much quicker in the eighties than in the early seventies.

Figure 2 shows that the share of long term unemployed in total unemployment varied from 10% in the beginning of the seventies to 25% in the late seventies. In the beginning of the eighties the share increased within a few years till almost 60%. The rapid employment growth did not lead to a substantial reduction of the share of long term unemployed, indicating the importance of the problem of persistent unemployment in

[1] The average duration of job vacancies notified to the public employment office is approximately equal to the average vacancy duration (Van Ours, 1990). See Appendix 1 for details of the data.

the Netherlands.

Figure 2. Share of long term unemployed; 1971-1987
(in % of total unemployment)

Source: Ministry of Social Affairs and Employment

Information on labour mobility on the Dutch labour market is scarce. There is some information derived from labour force surveys, which were held two-yearly in the period 1975-1985. From these surveys it appears that in this period on average 6.3% of the employed workers moved from job to job every year, while 7.2% left there job, either because they were dismissed or because they left there job voluntarily (Van Ours, 1990).

3. Stock-flow dynamics

3.1 **The matching function**

Search theory describes how employers and (unemployed) job seekers are searching for each other. For the moment we will ignore employed job seekers and assume that only unemployed workers are searching for a job. Employers are searching for new workers by means of job vacancies. The mutual search eventually leads to unemployed workers finding jobs and to vacancies being filled. We assume that this process can be described by a matching function in which the flow of unemployed workers filling job vacancies is a function of the number of unemployed workers and the number of job vacancies:

$$F^{ue} = f(U,V) \qquad [1]$$

in which: F^{ue} = flow of unemployed workers filling job vacancies
U = the number of unemployed workers
V = the number of job vacancies

Equation [1] is the matching function which often has a constant returns to scale Cobb-Douglas specification. Matching functions are not necessarily constant returns to scale Cobb-Douglas functions, but may also be specified more generally as for example constant elasticity of substitution functions. Empirical research indicates however that a constant returns to scale Cobb-Douglas matching function gives an adequate description of labour market developments. Both Blanchard and Diamond (1989) and Van Ours (1991) estimate a Cobb-Douglas matching function and find constant returns to scale with an α of about 0.4. Pissarides (1990) justifies a constant returns to scale matching function, because it is the only specification which can ensure a constant unemployment rate along the balanced-growth path of a growing economy.

We assume a constant returns to scale Cobb-Douglas matching function on a quarterly basis. In addition to that we make a distinction between short term and long term unemployed workers, by specifying our matching function as follows:

$$F_t^{ue} = k\,(U_{t-1}^S + \Theta.U_{t-1}^L)^{\alpha}\, V_{t-1}^{1-\alpha} \qquad [2]$$

in which: U^S = number of short term unemployed (less than 1 year)
U^L = number of long term unemployed (more than 1 year)
k = efficiency parameter of the labour market
α = parameter; $0<\alpha<1$
Θ = duration dependency parameter; $0\leq\Theta\leq1$

In equation [2] the flow out of unemployment in quarter t, F_t^{ue}, depends on the stocks of unemployed and vacancies in quarter t-1. The parameter k gives an indication of the efficiency of the labour market: with given numbers of unemployed and vacancies, the larger k the more filled vacancies per period of time and thus the more efficient the labour is in matching unemployed workers and vacancies. The parameter α stresses the importance of the 'production factor' unemployment in producing matches. A large α indicates a large influence of the number of unemployed, a small α indicates a large influence of the number of job vacancies. The parameter Θ indicates whether or not long term unemployed workers have the same escape probability from unemployment as short term unemployed workers. The flows out of unemployment for short and long term unemployed workers can be derived from the matching function specified in [2]:

$$F_t^{ue,S} = F_t^{ue} . U_t^S / \{U_{t-1}^S + \Theta.U_{t-1}^L\}$$

$$F_t^{ue,L} = F_t^{ue} . \Theta.U_t^L / \{U_{t-1}^S + \Theta.U_{t-1}^L\} \qquad [3]$$

Therefore the escape probabilities are specified as:

$$P_t^S = F_t^{ue} / (U_{t-1}^S + \Theta.U_{t-1}^L)$$

$$P_t^L = \Theta.F_t^{ue} / (U_{t-1}^S + \Theta.U_{t-1}^L) \qquad [4]$$

So:

$$P_t^L = \Theta . P_t^S \qquad [5]$$

The equations above show that in our model a one to one relationship exists between the matching function and the escape probabilities. In this way our model gives a behaviourial explanation of the outflow from unemployment. Therefore we do not need to specify a hazard function for the escape probabilities, which would only give a sheer probabilistic explanation of the outflow from unemployment.
If Θ=1 the escape probability from unemployment is equal for long and short term unemployed workers. If

Θ<1, the escape probability for long term unemployed workers is smaller than the escape probability for short term unemployed workers. In theory this may be the case due to either individual duration dependency or to workers' heterogeneity. Empirical evidence on individual duration dependency is not conclusive. Empirical studies usually investigate whether the hazard rate, i.e. the conditional escape probability from unemployment, is duration dependent (See Kiefer (1988) for a survey of hazard functions). Van Opstal and Theeuwes (1986) using micro data on youth unemployment spells are inconclusive. Depending on the specification of the hazard rate they found negative duration dependency or a duration dependency which could not be distinguished from the so-called heterogeneity effect. This effect is caused by omitted variables or misspecification of the base-line hazard rate and may lead to fallacious duration dependency if it is not counted for. Ridder (1987) finds no significant negative or positive duration dependency. The second explanation for duration dependency at an aggregate level is heterogeneity, the 'best' unemployed workers leaving unemployment first. As Van Ours (1992) discusses one may distinguish both explanations by studying the ratio of escape probabilities from different duration classes. If labour market conditions change and this ratio is constant over time, there is a pure duration dependency effect. If the ratio fluctuates as well, there is a pure heterogeneity effect or a combination of pure duration dependency and heterogeneity. Since our model specifies a constant ratio of escape probabilities from short term and long term unemployment, it is consistent with duration dependency on a micro-level.

Thusfar, we ignored employed job seekers. The behaviour of employed job seekers can, of course, also be analyzed in a job matching context. The number of employed job seekers will influence the flow of job vacancies filled by employed job seekers. However, lacking information on the number of employed job seekers, we considered the flow of workers from job to job S^e to be autonomous in the model. The total flow of filled job vacancies F_t^{xv} is equal to the sum of the flow of unemployed workers finding jobs and the flow of the employed workers finding new jobs:

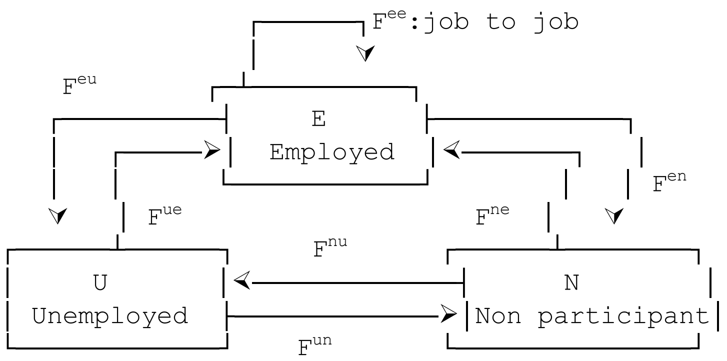
$$F_t^{xv} = F_t^{ue} + S_t^e \qquad [6]$$

in which: S_t^e = flow from job to job

3.2 **Employment, unemployment and vacancies**

Figure 3 shows the seven flows and three related stocks of workers which are relevant from a labour market point of view. The stocks are of unemployed workers, employed workers and persons outside the labour market. There are flows from unemployment to a job and vice versa (F^{ue} and F^{eu}), flows from non-participation to a job and vice versa (F^{ne} and F^{en}), flows between unemployment and non-participation (F^{un} and F^{nu}) and there is the flow from job to job (F^{ee}).

Figure 3 **Stocks and flows of workers on the labour market**



Thusfar, we described two of the flows: F^{ue} and $F^{ee} = S^{e}$, both flows into employment. The third flow of workers into employment is the flow originating from outside the labour force. We assume that this flow is negligibly small. The reason for this is that for persons outside the labour force to find a job, they have to seek for it first. However, if they start looking for a job they are no longer outside the labour force but have to be considered as unemployed job seekers.

Apart form the flow from job to job there are two flows out of employment. Firstly, the flow of workers loosing their job due to dismissals: F^{eu}. The number of dismissals as a fraction of employment will be high in periods of recession and low in cyclical upswings. Secondly, the flow to a position outside the labour force: F^{en}. This flow, consisting of retirements and (temporary) withdrawals depends for example on the age structure of the working population, the number of female workers, and economic conditions. There are obviously arguments in favour of fluctuating proportions of employed workers flowing out of employment. However, since there are hardly any data available on these flows, we assume fixed proportions μ_1 for the dismissals and μ_2 for the voluntary withdrawals. So, the number of employed workers in quarter t becomes:

$$E_t = E_{t-1} + F_t^{ue} - \mu_1 E_{t-1} - \mu_2 E_{t-1}$$

$$= F_t^{ue} + (1-\mu_1-\mu_2)\, E_{t-1} \qquad [7]$$

in which: E = employment
μ_1 = fraction of workers losing their job
μ_2 = fraction of workers leaving their job and the labour force

The remaining two flows of workers are the flow of discouraged workers or unemployed workers retiring from the labour force: F^{un} and the flow of new job seekers entering the labour market: F^{nu}. The latter flow represents the labour supply behaviour. In the last decades the Dutch labour force has almost continuously been growing, therefore usually: $F^{un} > F^{nu}$. We take the surplus $S^{u} = F^{un} - F^{nu}$ as an autonomous flow in our model.

The flow into unemployment F_t^{iu} is equal to the sum of the inflow of workers from outside the labour market and the flow of workers losing their job due to dismissals:

$$F_t^{iu} = \mu_1 E_{t-1} + S_t^{u} \qquad [8]$$

in which: S^{u} = net inflow from outside the labour market

Then, of course, the stock of unemployed depends on inflow into, and outflow from unemployment:

$$U_t = U_{t-1} + F_t^{iu} - F_t^{ue} \qquad [9]$$

Apart from flows of workers, we distinguish flows of jobs, and consequently describe the inflow and outflow with respect to job vacancies.
The inflow of vacancies F_t^{iv} is equal to the sum of vacancies originating frome job leavers and the flow of new vacancies because of employment growth:

$$F_t^{iv} = \mu_3\mu_2 E_{t-1} + S_t^v + \mu_3 S_t^e \qquad [10]$$

in which: μ_3 = the share of unfilled jobs becoming vacancies

S^v = new vacancies because of employment growth

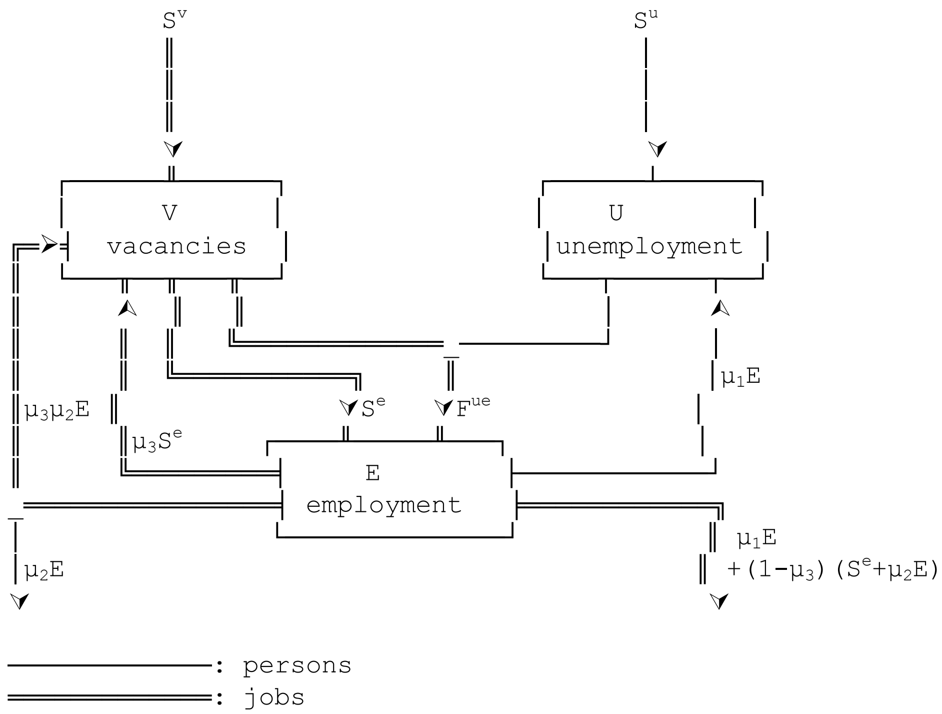
The new vacancies variable S^v represents labour demand behaviour in the model and is, as yet, like the flow from job to job, considered autonomous. The formula above assumes that not every job left turns into a new vacancy. Some jobs left unfilled by workers moving to another job or retiring do not become vacant but obsolete.

The stock of vacancies depends on inflow and outflow of vacancies:

$$V_t = V_{t-1} + F_t^{iv} - F_t^{xv} \qquad [11]$$

The system of relationships between stocks and flows, outlined in our model, is illustrated in figure 4.

Figure 4 Stocks and flows in the model of the labour market



3.3 **Unemployment dynamics**

Finally we built unemployment dynamics into our model by distinguishing n duration classes of unemployment where $U_{i,t}$ (i=1,...n) represents the unemployed over a period of {i-1,i} quarters with i=∞ for i=n. By definition it holds that

$$U_t = U_{1,t} + U_{2,t} + U_{3,t} + ... + U_{n,t} \qquad [12]$$

The number of unemployed in the first duration class is equal to the inflow into unemployment:

$$U_{1,t} = F_t^{iu} \qquad [13]$$

The numbers of unemployed in the next duration classes depend on the escape probabilities:

$$U_{j,t} = (1 - P^S_t) \quad U_{j-1,t-1} \quad \text{for } j=2\text{-}5$$

$$U_{j,t} = (1 - P^L_t) \quad U_{j-1,t-1} \quad \text{for } j=6,...,n-1 \qquad [14]$$

As the highest class n is an open class the number of unemployed in this class is equal to:

$$U_{n,t} = (1 - P^L_t) \quad (U_{n,t-1} + \quad U_{n-1,t-1}) \qquad [15]$$

4. Model calibration

Now our dynamic labour market model consists of equations [2] and [6]-[15] with S_t^e ,S_t^u and S_t^v as exogenous variables and α, μ_1, μ_2, μ_3 and Θ as parameters which should be determined empirically and which represent labour market behaviour incorporated in the model[2].

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 note that the matching function could have been directly estimated using our data base. However, we decided not to replicate the estimations of Van Ours (1991) (and of others), but we have set parameters of the matching function equal to those values found in the literature. Some crucial parameters are used as instruments to calibrate the model so that it gives good ex post predictions of labour market developments in the 1970s and 1980s. Such calibration would also be necessary in case of direct estimation (of part) of our model. The model, which is recurrent, is solved numerically. For the exogenous variables S_t^e, S_t^u and S_t^v, 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 (see also appendix 1). Some crucial parameters are used as instruments to calibrate the model so that it gives good ex post predictions of labour market developments in the 1970s and 1980s. In theory matching functions are specified in continuous time. One of the problems involved in the empirical application of a matching function is that data on flows of filled vacancies are specified in discrete time (Blanchard and Diamond, p. 25). If the discrete time intervals

[2] The efficiency parameter of the labour market k is determined by the values of both α and Θ.

are not very short then the flow of filled vacancies may be larger than the stock of vacancies at the beginning of the interval. In our model this happens to be the case in the eighties, where the average vacancy duration is shorter than the length of the discrete time interval (a quarter). In the calculation procedures we therefore specified the model - except for the unemployment dynamics part - in weekly intervals.

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 ($LU=U^L/U$).

Table 1. Model calibration with selected parameter values.

parameter values					fit of dependent variables							
					V		U		E		LU	
α	Θ	μ_1	μ_2	μ_3	RMSE	INEQ	RMSE	INEQ	RMSE	INEQ	RMSE	INEQ
0.5	0.5	0.010	0.010	0.9	27	0.15	22	0.02	22	0.002	0.06	0.10
0.4	0.5	0.010	0.010	0.9	26	0.15	23	0.02	24	0.002	0.07	0.10
0.6	0.5	0.010	0.010	0.9	30	0.17	24	0.02	23	0.003	0.06	0.09
0.5	0.5	0.005	0.010	0.9	27	0.15	22	0.02	20	0.002	0.10	0.14
0.5	0.5	0.020	0.010	0.9	30	0.17	50	0.05	46	0.005	0.10	0.17
0.5	0.5	0.010	0.005	0.9	27	0.15	22	0.02	20	0.002	0.10	0.14
0.5	0.5	0.010	0.020	0.9	25	0.17	62	0.06	49	0.006	0.10	0.16
0.5	0.5	0.010	0.010	0.8	27	0.15	24	0.02	23	0.003	0.07	0.10
0.5	0.5	0.010	0.010	1.0	27	0.15	22	0.02	21	0.002	0.06	0.10
0.5	0.9	0.010	0.010	0.9	28	0.15	27	0.03	26	0.003	0.11	0.14
0.5	0.1	0.010	0.010	0.9	28	0.16	22	0.02	22	0.002	0.07	0.11

Explanatory note: RMSE: Root mean square error
INEQ: Theil's inequality coefficient

The table shows that the various parameter values selected by us do, in general, not influence the fit of the model very much. The fit on the number of vacancies does not depend very much on the parameter values. The fit on the number of unemployed and employed is best of the parameters μ_1 and μ_2 are in the range 0.005-0.01. The fit on the share of long term unemployed depends on the parameters μ_1, μ_2 and Θ, which should not be too high or too low. We therefore selected the model of the first line of table 1 as our basic model for the simulation experiments, because this model gives a reasonable fit for all variables involved. In the basic model we have a Cobb-Douglas matching function in which the number of unemployed have the same influence on the flow of job vacancies as the number of job vacancies (α=0.5). The duration dependency parameter Θ is equal to 0.5, which means that the probability a long term unemployed worker escapes from unemployment is half of that of a short term unemployed worker. The value of μ_1 indicates that on a yearly basis 4% of the workers are dismissed, while the value of μ_2 indicates that on a yearly basis also 4% of the workers leave their job and the labour force. The total of 8% of the workers leaving their job annually is almost equal to the actual value of 7.2% which we mentioned in section 2. Finally the value of μ_3 of 0.9 indicates that of the jobs that are left voluntarily (due to job mobility or retirements) 90% turns into a job vacancy, while 10% is lost.

Figure 4.Realisations and model projections over the reference period 1971-1987.

employment
(x 1,000,000)

unemployment
(x 1000)

vacancies
(x 1000)

long term unemployment
(share of total unemployment)

☐ realisation
\+ projection

Figure 5 pictures the fit of the four main endogenous variables in the basic model in the reference period. The model appears to describe the stocks of vacancies and unemployment very well, albeit that some computational problems occurred because of the low level of vacancies in the period 1981-1985. In this period the calculated stock of vacancies sometimes assumes negative values, which we have corrected to a small positive value. The good fit for these two variables is, however, rather obvious because they are largely determined by the autonomous inflow variables S^u and S^v, which represent labour supply and demand behaviour. The time profile of employment is also reproduced quite well by our model. Finally, the share of long term unemployment in total unemployment is described with somewhat less accuracy by our model. Here, an overestimation of the flow into long term employment in the beginning of the 1980s leads to a projected long term unemployment, which lies above actual long term unemployment after that period.

5. Model simulation

We use the model to illustrate labour market dynamics by means of an impulse analysis, viz. by simulating labour supply and employment demand shocks (autonomous impulses in S^u and S^v). Moreover a sensitivity analysis shows how the working of the model depends on major parameter values.

The baseline for each simulation run is a projection over 6 years, starting in 1988:I, in which the exogenous variables are given realistic values. As impulses we consider autonomous increases or decreases in the inflow of vacancies or inflow into unemployment by 50,000 in each quarter of the first year of the simulation period. Hence, after the first year the total autonomous change is 200,000. The impulse effect is measured as the difference between the impulse projection and the baseline.

Table 2.The effects of an autonomous change of the inflow of vacancies by 50,000 in each quarter of the first year of the simulation period.

Effects on	Increase of vacancies after			Decrease of vacancies after		
	1 yr	3 yrs	6 yrs	1 yr	3 yrs	6 yrs
(numbers x 1000)						
employment	117	164	137	-137	-169	-145
vacancies	80	19	26	-60	-12	-15
unemployment	-119	-179	-170	140	186	181
(% points of baseline projection)						
% unempl. > 12 months	-3.3	-15.0	-19.7	3.1	9.8	12.6

The left hand side of table 2 shows that after a few years an increase in the number of vacancies leads to a considerable growth of employment and a decrease of unemployment. About 13% of the newly created vacancies can, according to our model, not be filled. This employment shock also results in a decrease of long term unemployment. Apparently these new jobs are taken by those people who, according to our baseline projection, would become long term unemployed.
The right hand side of table 2 gives the results of an opposite demand shock: now the number of vacancies decreases by 200,000 in the first year of the simulation period. It appears that the model is not completely symmetrical. On the other hand, our model does not generate obvious asymmetries or ratchet effects, in this simulation experiment.

Table 3.The effects of an autonomous change of the inflow of unemployed by 50,000 in each quarter of

the first year of the simulation period.

Effects on	Increase of unemployed after			Decrease of unemployed after		
	1 yr	3 yrs	6 yrs	1 yr	3 yrs	6 yrs
(numbers x 1000)						
employment	10	10	12	-13	-16	-21
vacancies	-10	-11	-14	13	17	25
unemployment	190	189	186	-187	-183	-175
(% points of baseline projection)						
% unempl. > 12 months	-10.0	9.3	12.2	16.1	-14.4	-19.5

Table 3 summarizes the effects of a labour supply shock simulated by an increase and a decrease in the number of unemployed. We see that, according to our model, a supply shock, as compared with a demand shock, hardly enhances employment. It illustrates that the model with a high number of unemployed and a relatively low number of vacancies describes a labour market regime which is to a major extent demand determined. This different impact of autonomous increases of unemployment and vacancies is, of course, a direct consequence for the specification of our matching function, where dF/dU is small as compared to dF/dV in the present situation with a high number of unemployed and a relatively low number of vacancies. According to this simulation, due to the inflow of the new unemployed, the share of short term unemployment in total unemployment increases in the first year of a simulation period. Consequently the share of long term unemployment decreases, but obviously not the number of long term unemployed. In the medium term most of the generation of unemployed due to the supply shock have become long term unemployed, so that the share of the long term unemployed increases as compared to the baseline. The results of table 3 again show that the model is symmetrical with respect to such shock, albeit that the long run employment effect of the negative supply shock is somewhat larger (in absolute value) as that of the positive supply shock.

Table 4 The effects of an autonomous increase of the inflow of unemployed and vacancies by 50,000 in each quarter of the first year of the simulation period, using a different Cobb-Douglas function (α=0.6).

Effects on	Increase of vacancies after			Increase of unemployed after		
	1 yr	3 yrs	6 yrs	1 yr	3 yrs	6 yrs
(numbers x 1000)						
employment	112	160	130	12	12	15
vacancies	85	24	35	-12	-13	-17
unemployment	-115	-175	-162	188	187	183
(% points of baseline projection)						
% unempl. > 12 months	-3.4	-14.8	-18.9	-10.0	9.4	12.2

Another way to investigate how the working of the model is affected by the modelling of labour market efficiency is to perform a sensitivity analysis on the parameter value in the matching function. Table 4 gives the results of that analysis. When unemployment obtains a somewhat higher weight in the matching function and vacancies a somewhat lower weight, it appears that a demand shock leads to less employment than in the basic model (compare table 2). In case of a supply shock, more employment results than in the basic model (compare table 3). Yet, the differences are very small.

Finally we investigated the influence of duration dependency on the working of the model. Table 5 presents the results of supply and demand shocks, if we assume that there is no duration dependency in the probability that unemployed find jobs. It appears that a demand shock leads to less employment growth and a smaller decline in unemployment than according to a model with duration dependency. The difference, however, is again very small. A supply shock in a model with no unemployment duration dependency leads to almost the same effects as in a model with duration dependency as well.

Table 5 The effects of an autonomous increase of the inflow of unemployed and vacancies by 50,000 in each quarter of the first year of the simulation period, using a model with no duration dependency.

Effects on	Increase of vacancies after			Increase of unemployed after		
	1 yr	3 yrs	6 yrs	1 yr	3 yrs	6 yrs
(numbers x 1000)						
employment	122	161	132	7	11	14
vacancies	75	22	32	-7	-12	-16
unemployment	-124	-177	-165	193	188	184
(% points of baseline projection)						
% unempl. > 12 months	-5.8	-16.3	-19.9	-9.7	10.4	13.4

6. <u>Conclusion</u>

This article presents a stock-flow model of the Dutch labour market, which describes the relationships between labour market efficiency and the duration of unemployment and vacancies in a consistent way. The model in which the matching function plays a central role, is calibrated to reflect labour market developments in the Netherlands in the last two decades. From impulse simulations with the model we infer the following conclusions:

-With a relatively high number of unemployed and a low number of vacancies which is the actual situation in the Netherlands, the model mirrors a demand determined labour market regime. An increase in labour demand leads to a strong reduction of unemployment whereas very few of the additional vacancies remain unfilled. On the other hand, a labour supply shock creates less additional employment.

- Persistence of unemployment is built into the model to the extent that long term unemployed have smaller escape probabilities from unemployment than short term unemployed. However, this persistence appears not to be of major quantitative importance in the present simulations.

-The endogenous distinction between unemployment duration classes enables us to make labour market efficiency dependent upon the distribution of unemployment over the various duration classes in our model. As yet, the working of our model appears not to be affected very much by the influence of these unemployment characteristics on labour market efficiency.

As mentioned before, we have deliberately kept the specification of our model as simple as possible in order to highlight the central role of the matching function in the working of the model. Therefore, apart from the matching function the model does not contain behaviourial relationships.It is remarkable that in a regime of high unemployment the simulation results resemble those of the traditional macro-economic disequilibrium models, with the usual behaviourial equations for the stocks of labour demand and supply: employment can only be increased by a demand shock, whereas a supply shock results in an about equal increase in unemployment. As in our model demand and supply have been modelled by the matching function in a fully symmetrical way, we would have expected the effect of a supply shock on employment to be more substantial. Such effect of an increased participation to the labour force would be relevant from a policy point of view in the Netherlands, where high unemployment nowadays coincides with supply constraints on some sectors of the labour market.

Our model can, however, very well be extended into various directions. Firstly, the model parameters, especially those parameters representing the duration dependency of the escape probabilities from unemployment and of labour market efficiency, could be estimated instead of being determined by calibration. However, the highly non-linear character of the model and the many unobserved variables contained in it, will complicate such estimation. Secondly an extension of the model with behaviourial equations for e.g. the inflow of vacancies (labour demand), the inflow into unemployment (labour supply) and a wage equation with endogenous hysteresis effects (insider-outsider effects) is an option for future research. Moreover, in line with modern theories of equilibrium wage formation, the effects of a changing wage distribution can be modelled in the matching function. Outflow from unemployment and the resulting creation of new vacancies can be made dependent upon the cyclical situation. An other direction for extending the model is to add more flows in the labour market, such as the flow of entrants to the labour market who obtain a job without filling an existing (registered) vacancy. A further extension is to include employed job seekers into the matching process.Such extensions may lead to a fully fledged model of the labour market, which incorporates several modern labour market theories that, up to now, have only be modelled separately. Our first experiments with the model indicate that it is a promising line of research.

References

Blanchard, J.O. and P. Diamond, 1989, The Beveridge curve, Brookings Papers on Economic Activity, nr 1, pp. 1-76.

Budd, A., P. Levine and P. Smith, 1988, Unemployment, Vacancies and the Long-term Unemployed, The Economic Journal, 98, pp. 1071-1091.

Cross, R. (ed.), 1988, Unemployment, Hysteresis and the Natural Rate Hypothesis (Basil Blackwell, Oxford).

Hartog J., 1980, Tussen Vraag en Aanbod (Stenfert Kroese, Leiden).

Holmlund, B., 1980, A Simulation Model of Employment, Unemployment and Labor Turnover, Scandinavian Journal of Economics, pp. 273-290.

Holmlund, B., 1984, Labor Mobility, Stockholm, Industrial Institute for Economic and Social Research.

Jackman, R, R. Layard and C. Pissarides, 1989, On Vacancies, Oxford Bulletin of Economics and Statistics, 51, 4, pp. 377-394.

Kiefer, N.M., 1988, Economic Duration Data and Hazard Functions, Journal of Economic Literature, 26, pp. 646-679.

Malinvaud, E., 1977, The Theory of Unemployment Reconsidered (Basil Blackwell, Oxford).

Möller, J., 1990, Unemployment and Deterioration of Human Capital, Empirical Economics, 15, pp. 199-215.

Muysken, J., 1989, Classification of Unemployment: Analytical and Policy Relevance, De Economist, 137, pp. 397-424.

OECD, 1988, Labour Force Statistics; 1967-1987 (OECD, Paris).

OECD, 1989, Main Economic Indicators; 1969-1988 (OECD, Paris).

Opstal, R. van and J. Theeuwes, 1986, Duration of Unemployment in the Dutch Youth Labour Market, De Economist, 134, pp. 351-367.

Ours, J.C. van, 1989, Durations of Dutch Job Vacancies, De Economist, 137, pp. 309-327.

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, en G. Ridder, 1991, Cyclical Variation in Vacancy Duration and Vacancy Flows: An Empirical Analysis, European Economic Review, 35, pp. 1143-1155.

Ours, J.C. van, 1992, Duration Dependency and Unobserved Heterogeneity in Unemployment Time Series: An Empirical Analysis for the Netherlands, Economics Letters, forthcoming.

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

Ridder, G., 1987, Life Cycle Patterns in Labor Market Experience, Doctoral Dissertation, University of Amsterdam.

List of symbols

c_1	relative search efficiency of long term unemployed
c_2	relative employers' acceptance probability of long term unemployed
E	employment
F^{iu}	flow into unemployment
F^{ue}	flow of unemployed workers finding jobs
F^{eu}	flow of employed workers to unemployment
F^{ee}	flow from job to job
F^{ne}	flow of non participants to a job
F^{en}	flow of employed workers to non-participation
F^{nu}	flow of non participants to unemployment
F^{un}	flow of unemployed workers to non-participation
F^{iv}	inflow of vacancies
F^{xv}	flow of filled vacancies
k	indicator for labour market efficiency
LU	share of long term unemployed in total unemployment
N	non participants
P^S	probability a long term unemployed worker find a job
P^L	probability a short term unemployed worker find a job
$P_{j,t}$	escape probability from duration class j in period t, j=1,..n
S^e	flow from job to job (=F^{ee})
S^u	net inflow from outside the labour market (=F^{nu}-F^{un})
S^v	new vacancies because of employment growth
U	number of unemployed
U^S	number of short term unemployed (less than 1 year)
U^L	number of long term unemployed (1 year or more)
$U_{i,t}$	unemployed over a period of {i-1,i} quarters where (i=1,...n) and with $i=\infty$ for i=n
V	number of job vacancies
α	scale parameter in matching function; $0<\alpha<1$
Θ	duration dependency parameter; $0\leq\Theta\leq1$
μ_1	fraction of workers loosing their job
μ_2	fraction of workers leaving their job and the labour force
μ_3	fraction of unfilled jobs due to job mobility which become vacancies

Appendix 1. Source of the data

Unemployment
Quarterly data on unemployment (in persons) in the period 1976-1987 are directly from OECD (1989). For the period 1970-1975 we used yearly data from the Dutch Central Planning Bureau to correct quarterly data from OECD (1989).

Employment
Yearly data on employment of wage earners and salaried employees (in persons) in the period 1971-87 are from OECD (1988). We used quarterly employment data from the Dutch Central Bureau of Statistics of the period 1984-1987 to determine quarterly fluctuations in employment. We then imposed this quarterly pattern on the yearly OECD data.

Vacancy stock
We used quarterly data on the number of notified vacancies from OECD (1989).
To correct for the decline of the share of vacancies notified to the public employment office we used corrected vacancy data for the 1980s. These data are corrected using information from the CBS vacancy surveys. The CBS vacancy surveys are from October 1980, 1981, 1982, 1983, September 1984, January 1986, 1987, 1988. By interpolating we calculated the average share of notified vacancies for the years 1980-1987. We assumed that for the period 1961-1979 this share was equal to the share of 1980.

Vacancy flow
We used yearly data on vacancy flows to the public employment office of the period 1971-1978 from Hartog (1980) to calculate average vacancy durations (duration = stock/flow).
1980-1987: calculated using CBS vacancy survey data and applying the method described in: Van Ours/Ridder (1990). The average vacancy duration of 1979 was calculated by interpolating the durations of 1978 and 1980. By interpoling the yearly data we calculated quarterly duration data. Finally we calculated quarterly vacancy flows as the quotient of vacancy stocks and vacancy durations.

Duration of unemployment
Quarterly information on the elapsed duration of unemployment in classes 0-1 month, 1-3 months, 3-6 months, 6-12 months, more than 12 months, is from the Ministry of Social Affairs and Employment.

Exogenous variables S^e, S^u and S^v
The exogenous variables have been constructed as three quarterly moving averages of calculated quarterly values, based on information about unemployment, employment, vacancies, and the flow of filled vacancies.