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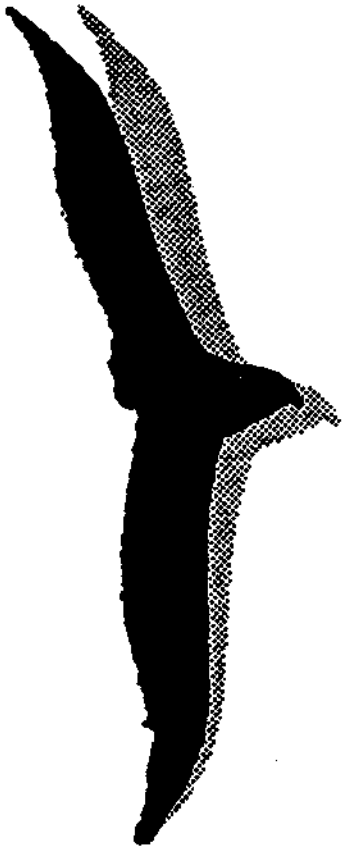
A consistent set of Time series data on Labourmarket flows for The Netherlands

Lourens Broersma
Frank A.G. den Butter

Research Memorandum 1994-43 November 1994



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ERRATUM

Unfortunately, tables 3 and 4 in this research meorandum have not been updated from a preliminary version of this paper. The correct figures in these tables are presented here.

Table 3. Employment flows: inflow rate, outflow rate, labour reallocation rate and job creation rate job destruction rate and job reallocation rate (in percentages)

Variable	Mean	Standard deviation	Maximum	Minimum	Correlation with cyclical indicator
EI_t/E_{t-1}	7.8	1.7	10.9	5.6	-0.04
EO_t/E_{t-1}	7.2	1.1	8.9	4.7	-0.32
reallocation rate	15.0	2.6	19.5	10.5	-0.17
JC_t/E_{t-1}	8.5	1.5	11.1	5.3	0.35
JD_t/E_{t-1}	8.8	1.1	11.1	7.0	-0.18
reallocation rate	17.3	2.1	21.7	14.4	0.15
$(EI_t+F_{ee,t})/E_{t-1}$	16.8	3.0	23.2	11.3	0.18
$(EO_t+F_{ee,t})/E_{t-1}$	16.2	2.2	20.5	12.5	0.11
reallocation rate	33.0	2.8	43.5	23.8	0.15

Table 4. Characteristics of our measures of job creation and job destruction at the macro level as compared to data obtained from a panel for The Netherlands (in percentages)

	Hamermesh *et al.* (1994)			Our measures		
	job creation	job destruction	sum	JC_t/E_{t-1}	JD_t/E_{t-1}	sum
1990	4.4	2.6	7.0	10.8	10.3	21.1

A CONSISTENT SET OF TIME SERIES DATA ON LABOUR MARKET FLOWS FOR THE NETHERLANDS

by

Lourens Broersma

and

Frank A.G. den Butter*

ABSTRACT

This paper develops a consistent set of worker flow data for The Netherlands, based on the availability of actual time series and a number of additional assumptions, between all essential states in the labour market: employed, unemployed and out of the labour market. Furthermore, we also construct, based on the same principle, series of job flows, where job creation, job destruction and job reallocation are most important. We find these data to correspond to evidence found in surrounding countries and evidence derived from panel data sets. Sensitivity analysis applied to our main assumptions gives an indication of their importance.

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1. Introduction

The empirical analysis of the flow approach of the labour market at the macro level is hampered by a lack of consistent time series data. The collation of such data now becomes feasible as recently much progress has been made in establishing proper operational definitions for the flows of workers and the flows of jobs which play a major role in the theoretical models of the flow approach. However, up to now empirical analysis of labour market dynamics, especially in relation with the cyclical situation, has been conducted mainly on the basis of panel data sets (see e.g. Davis and Haltiwanger, 1990; and Gautier and Broersma, 1994).

The flow approach distinguishes various types of worker and job flows (see Hamermesh *et al.*, 1994, for a taxonomy at the micro level). Worker flows can be associated with demographic change and with job mobility. Workers may leave the labour force (flow from employment to non-participation) because they reach the age of retirement or because for some other reason, e.g. marriage, they prefer to stop working. Workers may also leave their job because they found another more suitable job. Finally, there is the possibility that workers are laid-off, which determines the flow of workers from employment to unemployment.

Most worker flows are associated with structural change and hence with the processes of job destruction and job creation. But worker flows and job flows are by no means identical. Vacant jobs of those who have quit may be taken by others without changing the character of the job. On the other hand, some job leavers may also have left their jobs because they became obsolete. In that case leaving the job coincides with job destruction. Then there is not only a worker flow but also a job flow. In general outflow from employment to involuntary unemployment will be the result of job destruction (lay-offs = fires). But it can also be true that the person who is fired, was unfit for the job, but that the job remains the same and will be taken by someone else with adequate capabilities. Anyhow, this short outline of various types of job and worker flows shows that in general labour turnover - the sum of job mobility and the flows of persons into and out of employment - is larger than job turnover - the sum of job creation and job destruction. Yet it may happen that within a firm, due to technological progress, someone changes his or her job and this change does not involve a quit and a hire. In that case we have simultaneous job destruction and job creation (job flows), and hence job turnover without labour turnover[2].

The above distinction between various types of labour market flows is relevant from an analytical point of view because the adjustment costs involved in the process of reallocation are dependent upon the type of flow. For instance, for a contractor the adjustment costs may differ when 5 carpenters are to be replaced by 5 other carpenters or when, by the start of a new project, 5 carpenters are to be fired and replaced by 5 bricklayers. Therefore it is

[2] This type of flow will not be considered in the macro data of this paper.

essential that data on labour market flows consistently describe these relationships between flows of persons and flows of jobs. Job creation takes place either when a new vacancy is created or when someone takes a new job for which no vacancy existed. When someone leaves a job either a vacancy will originate or it involves job destruction. Therefore, flows into and out of the stock of vacancies form an important part of a consistent data set on labour market flows.

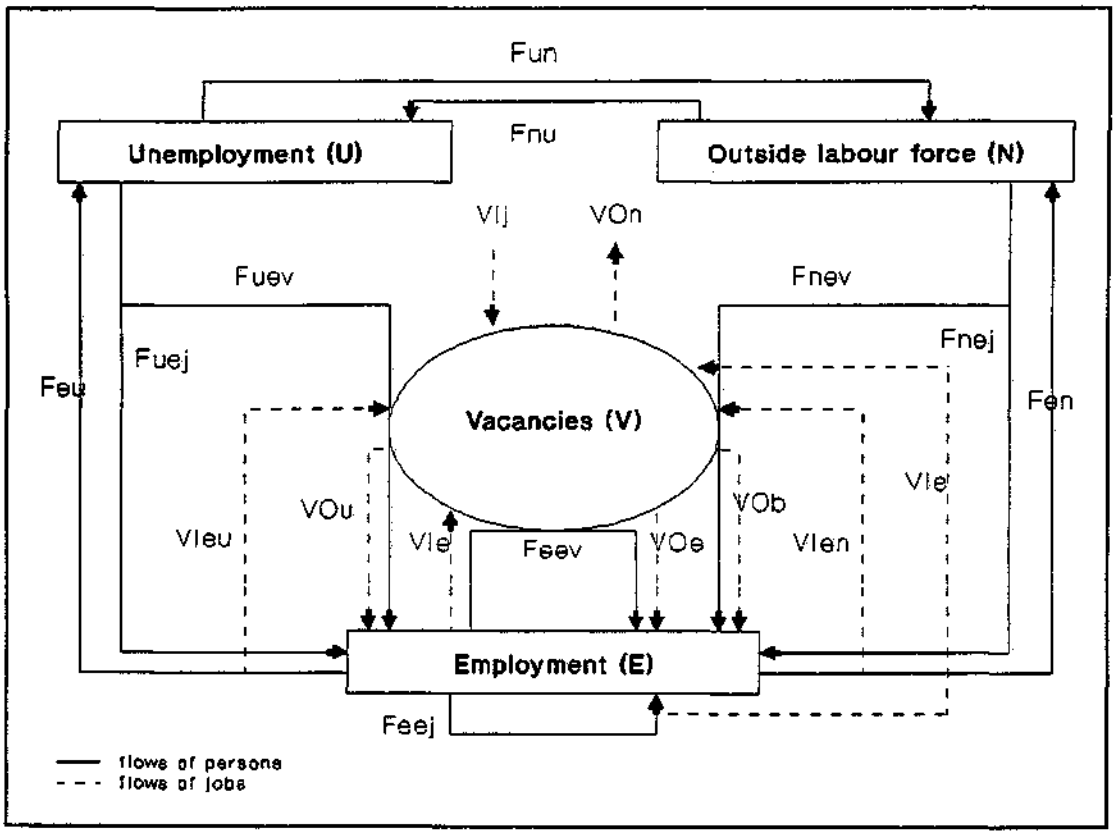
This paper shows how such consistent data set of annual time series for labour market flows at the macro level in The Netherlands can be constructed. For the construction of the data we use all available information - to our knowledge - on these flows from various sources. From published data we firstly derive a number of additional time series using the definition equations which are implied by the system. However, for The Netherlands there are not sufficient data available from published sources for the construction of the full data set. For that reason we need a number of additional assumptions in order to set up the remaining time series. These assumptions are based on (scanty) information at the micro level, but are also selected on the basis of restrictions on the flow data, e.g. that flows do not become negative. We note that in order to come to a consistent set of data we need time series for all variables in the system and cannot leave one series out. That is because the data set uses a closed accounting framework like in the national accounts.

The contents of the paper is as follows. The next section gives an overview of all relevant flows and stocks at the macro level for which time series data are to be constructed. Section 3 discusses the construction method of the data and indicates what assumptions are needed in order to complete the data set. The data which are constructed for the reference period 1970-1991 are presented in section 4. It discusses stylized facts on labour market flows, exposed by the data. Section 5 gives an sensitivity analysis which respect to the major assumptions made for the construction of the additional data. It shows how changes in the assumptions may affect the contents of the stylized facts which are derived from the data. Finally section 6 concludes.

2. Stocks and flows at the macro level

Figure 1 shows all stocks and flows to be included into a comprehensive data set on labour market flows at the macro level. The figure displays 18 relevant flows and 3 relevant stocks. The 3 relevant stocks are unemployment (U), employment (E) (stocks of persons) and vacancies (V, stock of jobs). The other stock of persons of the figure, the non-participants outside the labour force (N), is the residual stock; for the consistency of the system there is no need to have data on it. Yet it can be set equal to WP - U - E, where WP is the working age population. The flows are indicated by the general symbol F_{xyz}, which denotes the flow from x to y (x,y = e,u,n) with, when relevant, z=j in case of newly created jobs and z=v in case of jobs for which vacancies existed.

Figure 1 **Stocks and flows in the labour market**



In contrast to some previous work on labour market flows, the data set assumes that not all new jobs are taken by filling a vacancy, but that persons may also take a job for which no 'official' vacancy existed. In this case one can think of a worker who quits and starts his or her own business (included in F_{eej}) or of a firm who creates a new job just to employ a highly productive non-participant (e.g. someone who left school) (included in F_{nej}). More in general, all flows indicated by index j include jobs of employers, who successfully searched using informal channels and/or who did not register their vacancies.

Figure 1 also pictures the connection between flows of persons and flows of jobs which are relevant to the construction of the data. When an unemployed person finds a job by filling a vacancy, it leads both to an outflow from unemployment to employment (F_{uev}) and to an outflow of vacancies ($F_{uev} = VO_u$). On the other hand, when someone leaves employment and the labour force, it does not necessarily imply that a new vacancy emerges.

The individual flows pictured in figure 1 can be combined to some keynote variables which play a major role in the theory and empirics of the flow approach. The total number of jobs (J) is equal to

$$J = E + V$$

and for the labour supply or the size of the labour force (L) holds that

$$L = E + U$$

Job creation does not only include inflow of new vacancies but also the newly filled jobs for which no vacancy existed are part of job creation (JC):

$$JC = VI_j + F_{eej} + F_{uej} + F_{nej}$$

Job destruction involves all jobs of persons who left their jobs and were not replaced so that no new vacancy resulted. Moreover, vacancies that are scrapped before being filled are part of job destruction (JD):

$$JD = (F_{eu} - VI_{eu}) + (F_{en} - VI_{en}) + (F_{eej} + F_{eev} - VI_e) + VO_n$$

With respect to this definition it is noted that

$$\Delta J = JC - JD$$

We assume that persons who changed jobs and persons who left the labour force do so on a voluntary basis and hence can be labelled as quits (Q):

$$Q = F_{en} + F_{eej} + F_{eev}$$

On the other hand, workers who become unemployed are assumed to be laid-off (LO), although some of them may have become involuntarily unemployed:

$$LO = F_{eu}$$

Job turnover (JT) is equal to the sum of job creation and job destruction

$$JT = JC + JD,$$

whereas labour turnover (LT) is defined as the sum of the inflows into employment and the outflows from employment:

$$LT = F_{uev} + F_{uej} + F_{eej} + F_{eev} + F_{nev} + F_{nej} + F_{eu} + F_{en} + F_{eej} + F_{eev}$$

In labour market analysis average durations are often used as key indicators of the functioning of the labour market. These average durations can also be derived from the consistent set of flow and stock data pictured in figure 1. Average job duration (Edu) is equal to

$$Edu = E / \tfrac{1}{2}LT$$

and average unemployment duration (Udu) can be calculated as:

$$Udu = U / \tfrac{1}{2}(UI + UO)$$

where $UI = F_{eu} + F_{nu}$
$UO = F_{un} + F_{uev} + F_{uej}$

For average vacancy duration (Vdu) it holds that

$$Vdu = V / \tfrac{1}{2}(VI + VO)$$

where $VI = VI_j + VI_{eu} + VI_e + VI_{en}$
$VO = VO_u + VO_b + VO_e + VO_n$

Finally, the data contain information about the extent to which the filling of one vacancy leads to the opening of another vacancy, because the vacancy is taken by a person who leaves a job which is not to be destroyed. This length of the vacancy chain may vary considerably with the cyclical situation (see Schettkat, 1993), and can induce an upward shift of the UV-curve, which in that case should not be associated with the deterioration of the working of the labour market. In the data set of this paper the average length of the vacancy chain (Vch) can be defined as

$$Vch = \{1 + VI_e / (VI-VI_e)\}$$

Here the average length is equal to unity when all jobs of those who find another job are destroyed and the length is equal to infinity when none of these jobs is destroyed, and all new vacancies emerge because of job quitting. In Section 4 we discuss the characteristics and the time profile of the indicators of labour market dynamics defined above.

3. Construction method

For the construction of the consistent data set of all stocks and flows of figure 1 we start with the stocks and (composite) flows for which time series data are available from published sources. This is the case for the following variables

(1) E: Employment in 1000 persons;
(2) U: Unemployment in 1000 persons;
(3) V: Vacancies in 1000 jobs;
(4) VI: Total flow of new vacancies in 1000 jobs;
(5) F_{eu}: Workers who become unemployed by loosing their jobs (in 1000 persons);
(6) F_{en}: Workers leaving their job and the labour force (in 1000 persons);
(7) F_{ee}: Job movers (in 1000 persons).

The stock variables are readily available from the Central Bureau of Statistics (CBS) and the Central Planning Bureau. The flows are obtained from publications of the Social Insurance Council and the CBS and are partly based on own data collection and calculation. The Appendix provides more information on the sources of these data.

With these data it is easy to construct the total flow of workers out of employment, EO, which is composed of the flow of workers into unemployment and non-participation

(8) $EO = F_{eu} + F_{en}$.

Together with the net change in employment, ΔE, we get the total inflow of new workers into employment EI, since, by definition, the change in the stock equals the aggregate inflow into the stock minus the aggregate outflow, or

(9) $EI = \Delta E + EO$,

where these new workers were previously either unemployed or out of the labour force,

(10) $EI = F_{ue} + F_{ne}$.

Furthermore, we can also state that the inflow of person moving into unemployment, UI, consists of workers being laid-off and non-participants searching for a job by registering as unemployed job searchers, or

(11) $UI = F_{eu} + F_{nu}$.

The first assumption we make is that the inflow into unemployment from non-participation, F_{nu}, equals 50% of the total number of school leavers. Only for some scattered years in the 1980's some information on the flow of non-participants into unemployment is available, which amount to some 60 to 70 percent of the school-leavers. Because in the 1980's, when chances of a job were unfavourable, we assume that the average of this percentage over the entire sample is lower, which is why we have taken 50% of the school-leavers

Assumption 1
(12) $F_{nu} = 0.50\ F_{school\text{-}out}$

Since F_{eu} is known, we can now determine the flow of persons entering unemployment, UI, and hence, using the net change in unemployment ΔU, the outflow out of unemployment is

(13) $UO = UI - \Delta U$.

The outflow UO, in its turn, is composed of the flow of persons moving from unemployment to employment, F_{ue}, and the flow of unemployed leaving the labour force, F_{un},

(14) $UO = F_{ue} + F_{un}$.

Our second assumption concerns the latter flow F_{un} which consists of unemployed becoming non-participant due to retirement or disability. We also explicitly include the number of (long-term) unemployed, who give up hope of finding a job, become discouraged and hence stop searching for a job. This group of discouraged unemployed is then no longer part of the group of unemployed, i.e., job searchers without a job. We assume that each year 5% of the total number of unemployed become non-participant and that 50% of the long-term unemployed (U_L) is discouraged and hence effectively non-participant, based on recent survey evidence of employment agencies in The Netherlands.

Assumption 2
(15) $F_{un} = 0.05\ U + 0.50\ U_L$.

Assumption 2 in combination with definition (14) yields F_{ue} and once F_{ue} is determined, F_{ne} follows from definition (11).

As mentioned before, a number of other variables pictured in figure 1 are linked by definition equations as well, which are also used in the construction of the data. The following three definition equations relate to the fact that the outflows of vacancies with respect to non-participants, unemployed and employed are equal to the respective flows of persons who become employed by filling these vacancies.

(16) $VO_b = F_{nev}$
(17) $VO_u = F_{uev}$
(18) $VO_e = F_{eev}$
(19) $VO_f = F_{eev} + F_{uev} + F_{nev}$, denotes, by definition, of the total flow of filled vacancies. The total outflow of vacancies VO, equals by definition $VO = VI - \Delta V$.

The next three definitions extend definitions (10) en (14), where we allow the flows into employment to be decomposed in a flow of persons filling a vacancy and a flow of persons filling a job by other means. The third is the 'law of motion' for the change in vacancies.

(10') $\Delta E = F_{uej} + F_{uev} + F_{nej} + F_{nev} - F_{eu} - F_{en}$
(14') $\Delta U = F_{eu} + F_{nu} - F_{un} - F_{uev} - F_{uej}$
(20) $\Delta V = VI_j + VI_{eu} + VI_e + VI_{en} - VO_u - VO_b - VO_e - VO_n$

Moreover, we use a number of additional definition equations for composite variables, namely for the total inflows into jobs

$F_{ee} = F_{eej} + F_{eev}$
$F_{ue} = F_{uej} + F_{uev}$
$F_{ne} = F_{nej} + F_{nev}$,

and for the total number of new hires

$$H = F_{ee} + EI.$$

Using the 7 time series from published sources (1)-(7), the 6 definition equations (15)-(17), (10'), (14') and (20) and the two assumptions (12) and (15), we are able to construct 15 time series of the full set of 21 flow and stock data. Hence, in order to construct the remaining 6 time series, we need to make 6 additional assumptions on the data. Apparently each time series that would become additionally available from a published source, would make one of these assumptions superfluous. In this respect the construction method can be readily adapted when more direct information on labour market flows becomes available for The Netherlands. In the same manner the construction method can be adapted for the collation of consistent sets of labour market flow data in other countries.

The next set of assumptions determines the flows to employment with respect to jobs for which no vacancy existed. They are taken to be a fixed fraction of the total respective flows into employment. This fraction (ξ) is set equal to the share of total hires which do not lead to an outflow of vacancies.

$$(21)\ \xi = (H\text{-}VO_f)/H = (F_{eej} + F_{uej} + F_{nej})/(F_{ee} + F_{ue} + F_{ne})$$

As the data on total hires and on the outflow of vacancies are already determined, this enables us to construct the following flows that count as two additional assumptions.

Assumption 3

$$(22)\ F_{eej} = \xi F_{ee}$$

Assumption 4

$$(23)\ F_{uej} = \xi F_{ue}$$

$$(res)\ F_{nej} = \xi F_{ne}$$

According to scattered information obtained from surveys it appears that some 40% of the vacancies in The Netherlands are difficult to fill. We assume that each year 75% of these vacancies are scrapped.

Assumption 5

$$(24)\ VO_n = 0.30\ V$$

Equations (24) and (19) yield the total outflow of vacancies VO. We note that the CBS recently started collecting these flow data. For the period 1989 to 1991 these direct observations appear to be very similar to the data constructed by us.

Our last set of assumptions relates to the vacancy chain mentioned above. However, hardly any information is available for The Netherlands on the share of jobs which become vacant

again after a worker has, for some reason, left his or her job. Apparently this share, and therefore the length of the vacancy chain, will depend upon the cyclical situation, but as we have no information on this aspect, we have in our assumptions taken fixed shares with respect to the various categories of persons who left their jobs. It is assumed that 75% of the jobs which are left as result of job mobility give rise to a new vacancy, that this occurs to only 1% of the jobs of those who become unemployed (so that almost all of these jobs are subject to job destruction) and that this share amounts to 25% for those who leave the job for non-participation:

Assumption 6
(25) $VI_e = 0.75\ F_{ee}$
Assumption 7
(26) $VI_{eu} = 0.01\ F_{eu}$
Assumption 8
(27) $VI_{en} = 0.25\ F_{en}$

The 9 assumptions mentioned above, equations (12), (15) and (21)-(27) enable us to construct a full and consistent set of time series data on all variables pictured in figure 1.

4. Characteristics of flow data for The Netherlands

Table 1 gives the main characteristics of the time series on the flow data constructed by us using the basic set of assumptions. The table also shows the cyclical nature of these data and of the indicators of labour market dynamics derived from these data by calculating the correlation with the growth rate of the volume of industrial production - the major cyclical indicator for The Netherlands. All variables are in thousands of persons or thousands of jobs, which ever is relevant. The indicators of duration are in years or weeks.

When considering the characteristics of the worker flows, table 1 shows that especially the flows of employment to unemployment and *vice versa* and the flow of job movers are particularly large. Also the flow of new and filled vacancies is quite large. From its correlation with the cyclical indicator it appears that the flow of lay-offs, F_{eu}, is obviously counter-cyclical. Its counterpart F_{ue} is split in two part, one where the new employee is filling a vacancy, F_{uev}, and one where he or she is not, F_{uej}. Note that the determination of ξ in (21) implies such that especially in the 1980's a large proportion of jobs were filled by other means than a vacancy, whereas before that this fraction was only small. F_{uev} is clearly pro-cyclical, whereas F_{uej} is slightly counter-cyclical (or maybe a-cyclical). This implies that in an economic upsurge unemployed obtain a job by filling a vacancy, whereas soliciting without a vacancy my yield a job any time.

The observation that the flow of workers out of the labour force, F_{en}, is counter-cyclical, may be attributed to the fact that a large part of this flow consists of workers becoming

disabled and this disability act may have been used as a device to get rid of workers in bad times, so that they did not have to be fired. Its counterpart, F_{nev} and F_{nej}, are both also counter-cyclical. Clearly in bad times, the employers have their few free jobs preferably filled with new entrants rather than with unemployed. The latter may be stigmatized and moreover the employers can be choosy, in the sense that labour supply is abundant. The flow of job movers filling a vacancy is clearly pro-cyclical. However, when a worker moves from one job to another for which previously no vacancy existed, we find a slight counter-cyclical pattern. The rationale may be that in bad times workers may search for another job, because they fear loosing their current job and instead of waiting for this to happen, they start searching for another job, even when no vacancy is posted. In that way the few jobs that are created in a downturn are mostly filled with job movers and non-participants. The flow of non-participants to unemployment is also counter-cyclical. In bad times non-participants prefer to search by becoming unemployed, since a job will be hard to find and they receive an unemployment benefit, whereas in good times it is easier to get a job directly and they do not need to register as unemployed first. The flow of unemployed becoming non-participant is also slightly counter-cyclical, because in an economic downturn, the prospects for the unemployed to find a job are grim. Hence more (long-term) unemployed become discouraged and stop searching.

The job flows have similar cyclical characteristics. The number of new vacancies, due to a lay-off, is rather small and counter-cyclical. This is, however, the immediate consequence of the assumption that most jobs that become vacant due to a lay-off are being destroyed. In bad times, even less of the jobs from which a worker is being laid-off are being refilled by means of a vacancy. The same applies to the inflow of new vacancies due to a quit into non-participation. The flow of new vacancies due to job mobility is pro-cyclical. In good times more of the jobs left by a job mover are being posted as a vacancy. The flow of vacancies filled by an unemployed is clearly pro-cyclical and the same applies to the flow of vacancies filled by a job mover. The flow of filled vacancies by a worker who was previous out of the labour market is counter-cyclical. As mentioned earlier, in bad times non-participants may have better opportunities of finding a job, as unemployed may be stigmatized and less workers move from one job to another. Finally, also by assumption, the flow of newly created vacancies VI_j is pro-cyclical.

The last part of table 1 shows the main characteristics of labour market dynamics and their cyclical movement in The Netherlands. The number of total hires, H, is slightly pro-cyclical, but the flow of new hires into employment is slightly counter-cyclical. This flow, EI, is composed of workers previously unemployed or out of the labour force. The first component is pro-cyclical, as far as filling a vacancy is concerned, and the latter counter-cyclical. This implies that the flow of non-participants to employment dominates. The outflow out of employment and the inflow into unemployment both show the expected counter-cyclical pattern, whereas the outflow out of unemployment is only slightly procyclical. Both inflow and outflow of vacancies are pro-cyclical, which implies that more vacancies are posted in an economic upsurge, and also the fact that more vacancies are being

filled during that period.

Table 1. Characteristics of the data on labour market dynamics in The Netherlands, 1970-1991.

Variable	Mean	Standard deviation	Maximum	Minimum	Correlation with cyclical indicator
Worker flows (x1000)					
F_{eu}	281	69	383	143	-0.30
F_{uej}	78	62	203	1	-0.10
F_{uev}	192	74	308	42	0.24
F_{en}	132	10	151	116	-0.16
F_{nej}	70	68	191	1	-0.14
F_{nev}	106	46	178	25	-0.17
F_{eej}	154	128	447	1	-0.10
F_{eev}	363	136	571	103	0.35
F_{nu}	119	13	139	95	-0.27
F_{un}	105	87	245	8	-0.07
Job flows (x1000)					
VI_{eu}	3	1	4	1	-0.30
VO_u	192	74	308	42	0.24
VI_{en}	33	2	38	29	-0.16
VO_b	106	46	178	25	-0.17
VI_e	388	99	566	177	0.25
VO_e	363	136	571	103	0.35
VI_j	260	166	547	3	0.30
VO_n	27	16	71	6	0.55
Indicators of labour market dynamics (x1000)					
H	964	199	1417	634	0.14
EI	447	109	662	318	-0.05
EO	413	75	533	259	-0.30
UI	400	78	521	245	-0.31
UO	376	93	541	249	0.05
VI	684	193	964	286	0.39
VO	688	196	974	284	0.33
J	5836	234	6398	5576	0.11
L	6140	385	6885	5682	-0.15
JC	562	135	870	398	0.16
JD	533	78	673	447	-0.06
Q	650	133	904	372	0.24
LO	281	69	383	143	-0.30
JT	1095	200	1533	910	0.09
LT	1895	348	2653	1340	0.11
Edu (years)	6.2	0.9	8.3	4.7	-0.14
Udu (weeks)	50	26	101	12	-0.31
Vdu (weeks)	6	3	13	3	0.54
Vch (index)	3.4	2.9	13.7	1.6	-0.15

Next, we turn to the keynote variables in the debate on the flow approach: job creation and job destruction. Both flows do not have a strong cyclical pattern. Job creation is pro-cyclical and job destruction is slightly counter-cyclical. However, if we take the first difference of both flow variables, these cyclical effects are much more pronounced. Job turnover is also slightly pro-cyclical. When we consider the first difference of this series this is even more evident. On the other hand, labour turnover LT is also pro-cyclical. The quits, Q, with job movers as major component are pro-cyclical, as well and the lay-offs are counter-cyclical. Finally, the employment, unemployment and vacancy duration all show the expected cyclicality. In recessions workers generally tend to stick to their job, hence job duration increases. It is obvious that unemployment duration increases in a downturn, whereas the vacancy duration decreases. The vacancy chain is also negatively linked to the business cycle. However, this is due to our assumptions (7), (8) and (9) of constant job destruction rates with respect to job leavers, and because the creation of new vacancies VI_j is procyclical. More information on the cyclical nature of the extent to which vacancies are opened when workers leave their job, may amend our observation on the negative cyclicality of the length of the vacancy chain.

Apart from plausibility a major selection criterium for our assumptions is that the construction method does not yield negative values for one of the variables. The table shows that the minimum is almost zero for the data on F_{uej}, F_{nej}, F_{eej}, which is due to the fact that in the 1970's very few jobs were filled by other means than a vacancy. Also VI_j has some low values. It indicates that our set of assumptions forms a corner solution with respect to the restriction that all flows are positive. We learned from the sensitivity analysis of the next section that especially the series on inflow of new vacancies (VI_j), which has its data constructed in a rather residual manner, needs some attention in the calibration procedure in order to meet this restriction. The table also illustrates that gross labour flows are substantial as compared to net changes in employment and unemployment. Moreover, the difference between the minimum and the maximum indicates that in most cases the range of these flows is also rather large: there is much variation. It appears that labour turnover is some 70% larger on average than job turnover. Hence, the creation and destruction of workplaces can only account for some 60% of worker flows. This is in agreement with evidence from other countries. Cf. Burda and Wyplosz (1994).

Figure 2 depicts the time path of some of the major indicators of labour market dynamics. The shaded area in the figures is the period of an economic downturn according to the business cycle indicator of the Dutch Central Planning Bureau and the central bank. In diagram A, the job creation rate is confronted with the job destruction rate. The rates are calculated by dividing total job creation and job destruction by the number of jobs at the beginning of the period. Notice that both flows move fairly coherent until 1980. After that job creation fell dramatically, whereas job destruction that was already rising from 1979 onwards, rose even further. Only after 1984, both series started moving in coherent manner again, although at a somewhat higher level.

Diagram B shows the development of job turnover and labour turnover during the observation period. Of course labour turnover is higher than job turnover, since jobs of workers moving to another job, are generally not being destroyed. There was an increase in job turnover in the period 1972-74 and 1978-80, just before the recessions of 1975 and the early 1980's. However, the most remarkable increase was after 1984, when the Dutch economy faced major restructuring. Labour turnover associated with job turnover is less then 50 percent, apart from the recession of the early 1980's. This clearly shows the importance of mobility of workers between jobs in total worker turnover.

Diagram C of figure 2 presents the time series on the inflow rate into employment of workers from both unemployment and non-participation and the outflow rate of workers into these two pools. For these series the rates were calculated by dividing the inflow and outflow of workers, apart from job movers, by the total labour force. The series show a slight upward trend with cyclical variations. Moreover, the series move in a rather coherent way, just as the unemployment in- and outflow rates, which are reported in diagram D. Also for these series, the rates were calculated by dividing the gross flows by the total labour force. Notice that the huge increase in unemployment in the early 1980's, was due to a large increase in the inflow rate of unemployed, which rose some 40% from 1979 to 1982, and a fall in the outflow rate. Hence, unemployment duration increased. See also chart F.

Diagram E and F show that not only unemployment duration, in weeks, increased, but also employment duration, in years, rose in the early 1980's to 8 years, as job-to-job movement fell dramatically during the recession. The large increase in job mobility in the second half of the 1980's meant a fall in employment duration. As noted, unemployment duration increased in the early 1980's from some 35 weeks to more than 100 weeks in 1983. In that period, vacancy duration was at a low, averaging some three weeks.

Another way of looking at the data is to consider the dynamics on labour markets is to compare inflow and outflow rates with other studies on labour market flows. Let us consider the employment inflow and outflow rates, because these are the most reliable series, since no assumptions were necessary. Instead of dividing by the total labour force, we now calculate the inflow and outflow rate by dividing the gross in- and outflow by total employment, lagged one period E_{t-1}. Hence, the employment inflow rate is now EI_t/E_{t-1} and the corresponding outflow rate is EO_t/E_{t-1}. These rates, which follow from this construction method of the macro data appear to be in accordance with the inflow and outflow rates as measures by Hamermesh *et al.* (1994) for The Netherlands at the micro-level, using a panel with firm data for the year 1990. In table 2 the findings of Hamermesh *et al.* (1994) are compared with our inflow and outflow rates and with the sum of both rates, which serves as a measure of labour turnover. It appears that these values are quite similar. Table 3 gives some further characteristics of these rates computed from our data set. First, we find that not only the outflow rate is counter-cyclical, as expected, but also the inflow rate and hence also the labour turnover rate. Cf. Gautier and Broersma (1994). This implies that not only most of the lay-offs take place in economic downturns, but also that a significant part of the

new hiring are made in that downturn as well. This is in agreement with the studies of Blanchard and Diamond (1990) and Davis and Haltiwanger (1990, 1993). It means that recessions are typical periods in which firms reorganize by scrapping unproductive workers (and jobs) and hiring new and more productive ones. See also Caballero and Hammour (1993). Table 1 reveals that these new workers are former non-participants. Second, the job creation rate is pro-cyclical, opposed to the inflow rate of new workers. Job destruction is slightly counter-cyclical. Note however that workers moving from one job to another are not included in the inflow and outflow rates of table 2 and 3. When these are included we end up with rather similar characteristics for the inflow and outflow rates of workers as the ones we find for the job creation and job destruction rates, as can be seen from the bottom part of table 3. All flows presented in table 3 are of the same order as the ones that were found for other European countries by the OECD (1987) and by Burda and Wyplosz (1994).

Table 2. Characteristics of worker inflow and outflow rates at the macro level as compared to data obtained from a panel for The Netherlands (in percentages)

	Hamermesh *et al.* (1994)			Our measures		
	inflow rate	outflow rate	sum	EI_t/E_{t-1}	EO_t/E_{t-1}	sum
1990	11.9	10.1	22.0	10.8	7.9	17.8

Table 3. Employment flows: inflow rate, outflow rate, labour reallocation rate and job creation rate job destruction rate and job reallocation rate (in percentages)

Variable	Mean	Standard deviation	Maximum	Minimum	Correlation with cyclical indicator
EI_t/E_{t-1}	10.6	2.0	15.7	7.7	-0.22
EO_t/E_{t-1}	9.5	1.2	11.4	6.5	-0.38
reallocation rate	20.1	3.0	26.4	14.1	-0.30
JC_t/J_{t-1}	9.6	2.1	14.0	6.8	0.18
JD_t/J_{t-1}	9.2	1.1	11.3	7.8	-0.08
reallocation rate	18.8	2.9	24.8	15.6	0.10
$(EI_t+F_{ee,t})/E_{t-1}$	16.8	3.0	23.2	11.3	0.18
$(EO_t+F_{ee,t})/E_{t-1}$	16.2	2.2	20.5	12.5	0.11
reallocation rate	33.0	2.8	43.5	23.8	0.15

In table 4, we present a comparison between the job creation, job destruction and job turnover, as found by Hamermesh *et al.* (1994) and the measures that we find. Clearly our measures are much larger than the ones found by Hamermesh *et al.* (1994). This is due to a number of characteristics of the data set used. First, the panel of firm data considers only continuing firms. Hence, entry and exit, which are major sources of job creation and destruction are not included, whereas they are implicitly included in our analysis. Second, their analysis is at the firm-level and therefore excludes job reallocation between different establishments of the same firm, e.g., due to an employment reshuffling. Third, their sample excludes firms with less then 10 employees.

Table 4. Characteristics of our measures of job creation and job destruction at the macro level as compared to data obtained from a panel for The Netherlands (in percentages)

	Hamermesh *et al.* (1994)			Our measures		
	job creation	job destruction	sum	JC_t/J_{t-1}	JD_t/J_{t-1}	sum
1990	4.4	2.6	7.0	14.0	10.7	24.7

5. Sensitivity analysis

This section presents a sensitivity analysis with respect to the 8 assumptions described in section 3, needed for the construction of our consistent data set. By changing the assumptions one by one, the sensitivity analysis shows to what extent the time series of the flow data depend upon these assumptions. Thus, the analysis may reveal which assumptions are crucial and would have priority when collecting more direct empirical evidence on labour market flows. We already mentioned that for each additional series of flow data that can be observed directly, we can dispense with one assumption.

The results of the sensitivity analysis are summarized in table 5. The table gives the mean of some crucial flow data and the keynote indicators of labour market dynamics over the reference period for the basic set of assumptions and for 6 alternatives, listed as I through VI in table 5. The results of the alternatives are discussed below. In general the differences with the basic version of our labour market flows are minor compared to these alternatives.

I. Under assumption I, (12) changes into: $F_{nu} = F_{school\text{-}out}$, i.e. all school-leavers become unemployed (and not only 65% as in the basic assumption). This assumption implies higher unemployment flows and hence also lower unemployment duration. The other flows listed in table 5 are not affected. Of course individual flows, not listed in the table, may change, but the keynote variables that are built-up out of such series, like job creation and job destruc-

tion do not. Clearly a positive change in such an underlying series is being compensated by an equally sized negative change in another.

Table 5. Sensitivity of the major indicators of labour dynamics for the assumptions of the construction method

Indicator (mean in 1000 units)	basic version	I	II	III	IV	V	VI
UI	400	519	400	400	400	400	400
UO	376	495	376	376	376	376	376
F_{uev}	192	274	135	241	230	190	192
F_{uej}	78	116	135	27	109	81	78
EI	447	447	447	447	447	447	447
EO	413	413	413	413	413	413	413
VI_j	260	260	62	432	260	260	253
JC	562	562	544	527	562	571	555
JC-VI_j	302	302	482	95	302	311	295
JD	533	533	533	533	533	542	508
JT	1095	1095	1077	1046	1095	1113	1063
LT	1895	1895	1895	1895	1895	1895	1895
Edu	6.2	6.2	6.2	6.2	6.2	6.2	6.2
Udu	50	38	50	50	50	50	50
Vdu	6	6	9	7	6	6	6
Vch	3.4	3.4	3.4	3.4	3.4	3.4	2.7

I: $F_{su} = F_{school\text{-}out}$; II: $\xi = 0.5$ (constant); III: $\xi = 0.1$ (constant); IV: $F_{us} = 0.05\ U + 0.10\ U_L$; V: $VO_u = 0.40\ V$; VI: $VI_{su} = 0.01\ F_{su}$, $VI_{en} = 0.50\ F_{en}$, $VI_e = 0.70\ F_{ee}$.

II. In (21) we now assume a fixed value $\xi = 0.5$ (which is approximately the average value of ξ from (21)). This new assumption poses a problem in the sense that not only the fraction of persons moving into employment via a vacancy and via other means changes, but also the flow of filled vacancies VO_f. This implies, since VO_n is determined by (24) that VO changes and VI and VO no longer yield ΔV. In the figures presented in table 5, we ignore this flaw and go on with the new VO_f. We find a substantial reduction in VI_j, which now even contains negative values. Hence this assumption is not valid. If we stick to the original VO and ignore the change in the number of persons filling a vacancy, all variables, apart from JC, which is affected by the change in $F_{xy,j}$, remain unchanged. The same problem applies to the next assumption.

III. $\xi = 0.1$, hence most jobs are filled via a vacancy. Now the inflow into employment via vacancies increases dramatically, as could be expected. Also the inflow of new vacancies increases, whereas JC decreases due the fall in $F_{xy,j}$.

IV. Here we change (15) to $F_{um} = 0.05\,U + 0.10\,U_L$, hence one tenth of the number long-term unemployed is discouraged (and not 50% as in the basic projection). In table 5, we find that this only affects the flows F_{uev} and F_{usj}.

V. Assumption (24) is changed into $VO_n = 0.40\,V$, i.e., all vacancies that are difficult to fill are scrapped instead of 75% in the basic projection. This change immediately affects JD. A change in VO_n implies a change in VO_f as well, hence also ξ of (21) changes and with that the fraction of persons filling a job via a vacancy or by other means changes. This affects JC.

VI. With respect to the assumptions on the extent to vacancies are opened in case of job movers and job leavers we now set $VI_e = 0.70\,F_{ee}$, so 70 instead of 75 percent of the jobs of people moving from one job to another are refilled. Furthermore, we now assume that half (instead of 25%) of the jobs that are left by workers moving into non-participation are being refilled, or $VI_{en} = 0.5\,F_{en}$. VI_{eu} remains unchanged. Under these alternative assumptions, we find a slightly lower value for VI_j and hence JC. Also JD is slightly lower.

Although the latter change in assumptions seems realistic, larger changes yield negative values for the flow of new vacancies VI_j, which is one of the crucial series for job creation and job destruction. Hence, the margins for changing these latter assumptions are small, given the restriction that flows (and stocks) should always be positive.

The results of table 5 show that, on average, the keynote indicators of labour market dynamics are not very sensitive to alterations in the assumptions needed for construction of the data set. However, in some cases these averages hide quite large shifts in the time profile of the indicators. Yet the table shows that the number of keynote indicators, namely inflow into employment, outflow of employment, job creation exclusive of new vacancies and labour turnover do not depend at all on the assumptions. This is because these time series can be directly derived from published sources using the definition equations of the construction method. The most crucial assumptions are those on the extent to which a job becomes vacant when the person that held the job moves to another job, becomes unemployed or leaves the labour force. More direct information on the time series basis on this induce job destruction is deemed essential for a proper analysis of labour market dynamics.

6. Conclusions

Nowadays we witness an outburst of theoretical and empirical studies on structural change and its consequences for labour market dynamics. Most empirical studies concentrate on the

cyclical nature of labour market dynamics and use micro data on labour market flows. These data provide stylized facts on the cyclicality of labour market flows. In contrast, this paper considers data at the macro level and discusses the construction method of a consistent set of time series data on all relevant flows of persons and jobs, which play a role in the flow approach to labour markets. Hence, these data may be used for building a comprehensive model of labour market flows, which can be an empirical counterpart of the theoretical models. The construction method of the time series data is based on a coherent accounting system, just like the national accounts. It uses both data on stocks and flows of persons, and on stocks and flows of jobs (vacancies). Hence, the construction method combines the information contents of both types of data as it takes account of the relationship between these types of data in a consistent manner. Primary data from published sources are as much as possible used for the construction of the data set. Yet these primary data, and the definitions implicit in the accounting system, do not suffice for the construction of the whole data set. Therefore a number of additional assumptions are needed. These assumptions are based on scattered information from micro studies or on global information at the macro level. We performed a sensitivity analysis in order to investigate to what extent changes in the assumptions would alter the average values and the time profile of the data. This sensitivity analysis showed that especially more direct information on job destruction associated with job movers would enhance the quality of the data.

We note that our construction method, like in the case of national accounting, is applicable to each country. The more information is available from published sources, the less additional assumptions are needed. And the sensitivity analysis may tell what data should have priority to be collected from direct sources by statistical agencies.

Our framework includes flows of persons who take a job for which no vacancy existed. Although these flows are usually neglected in models of the flows approach, our calculation shows that these flows, which form part of the job creation process, can be quite substantial. Moreover, we investigated the cyclical nature of all flows and composite indicators of labour market dynamics. In conformity with results for other countries (based on micro data) we found that both inflow, outflow and turnover rates are negatively correlated with the cyclical indicator. It implies that labour reallocation mainly takes place during recessions.

Obviously, when we are to build a fully fledged macroeconomic policy model of labour market dynamics using the data set of this paper, we would need more directly observed time series on labour market flows and/or more information on the additional assumptions. A further scope for future research is the disaggregation of the data set with respect to the various social security provisions (temporary illness, disability, early retirement, public assistance) and with respect to the flows through the duration classes. In the latter case the system takes account of heterogeneity in the stock variables, e.g. heterogeneous unemployment (short term unemployed versus long term unemployed).

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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_{ncj}	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	Inflow of vacancies
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	Outflow of vacancies
VO_f	Flow of filled vacancies
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

Indicators of labour market dynamics

J	Total number of jobs

JC	Gross job creation
JD	Job destruction
JT	Job turnover
L	Labour supply
LO	Lay-offs
LT	Labour turnover
Q	Quits
Edu	Average employment duration
Vch	Average length of vacancy chain
Vdu	Average vacancy duration
Udu	Average unemployment duration

Sources of data

E — total employment in 1000 persons
source: CPB, Lange Reeksen.

U — number of job searchers without a job (x1000)
source: Central Planning Bureau, Lange reeksen.

V — number of vacancies (x1000)
source: CBS, Sociaal-economische maandstatistiek and Muysken *et al.* (1991)

VI — inflow of new vacancies (x1000)
source: CBS, Sociaal-economische maandstatistiek and van Ours (1991).

F_{eu} — inflow of persons receiving an unemployment insurance benefit (WW) (x1000)
source: Social Insurance Council, Kroniek van de sociale zekerheid.

F_{en} — inflow of workers into non-participation, where $F_{en} = F_{ed} + F_{er} + F_{eer} + F_{em}$.

F_{ed} — inflow of persons receiving a disability insurance benefit (WAO/AWW) (x1000)
source: Social Insurance Council, Kroniek van de sociale zekerheid.

F_{er} — inflow of workers into retirement (x1000)
This flow is calculated as the change in the number of old-age benefit receivers plus the number of deaths in the cohort with age over 65 (which serves as outflow out of retirement), multiplied by the participation rate of persons of 60-64 years old.

F_{eer} inflow of workers into early retirement (x1000)
source: CBS, Statistical yearbook and author's own calculations.

F_{em} number of workers who die
This flow is calculated as 0.5 percent of the total number of employees, based on Hartog *et al.* (1980).

F_{ee} flow of persons moving from one job to another
source: Hartog *et al.* (1980) and Hassink and Broersma (1993).

Figure 2. **Various characteristic flow and duration series for the Dutch labour market, 1970-1991.**

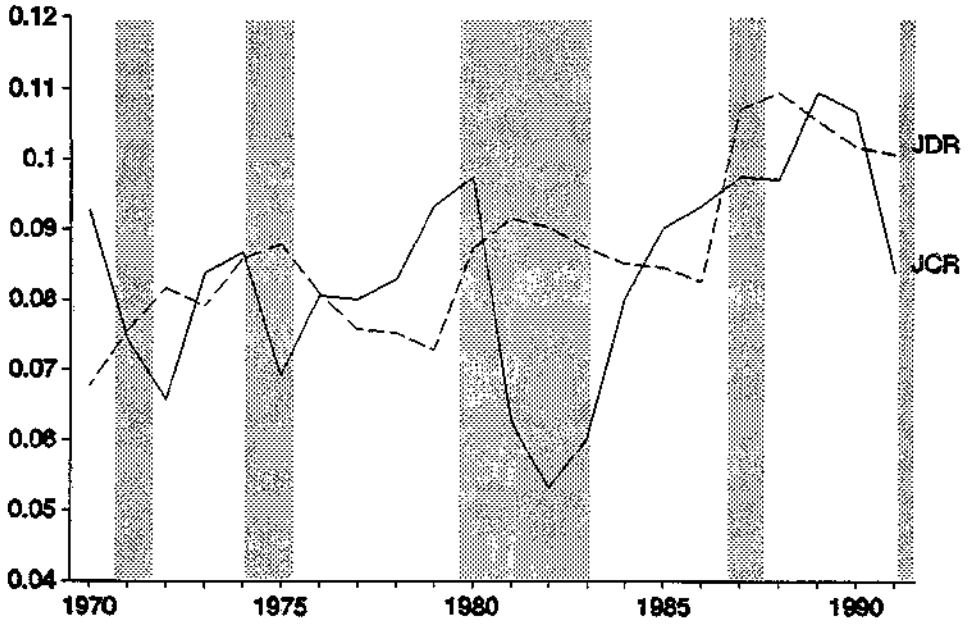

Chart 2A. Rates of job creation and job destruction, as percentage of total jobs.

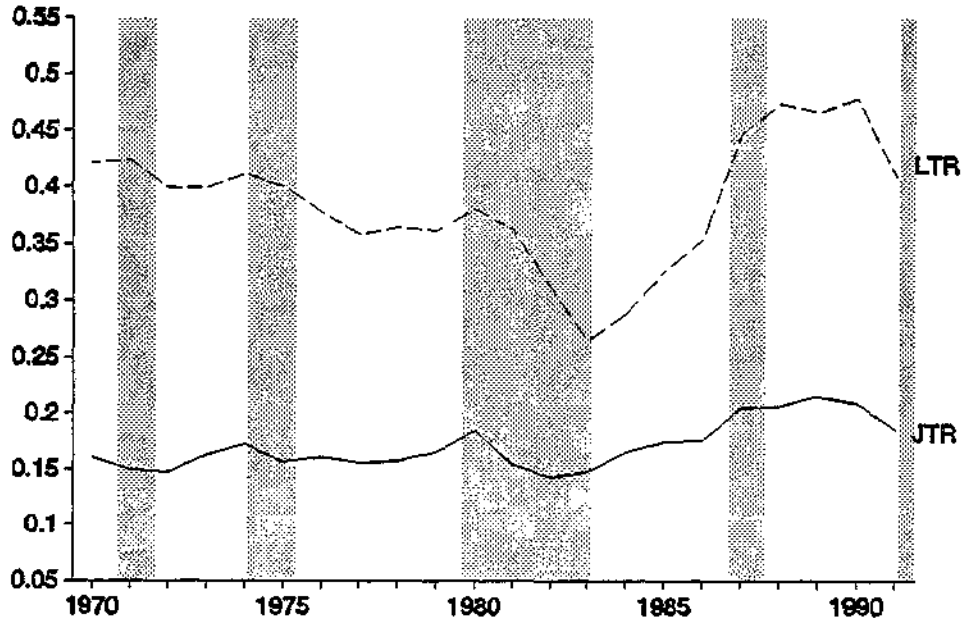

Chart 2B. Labour turnover and job turnover.

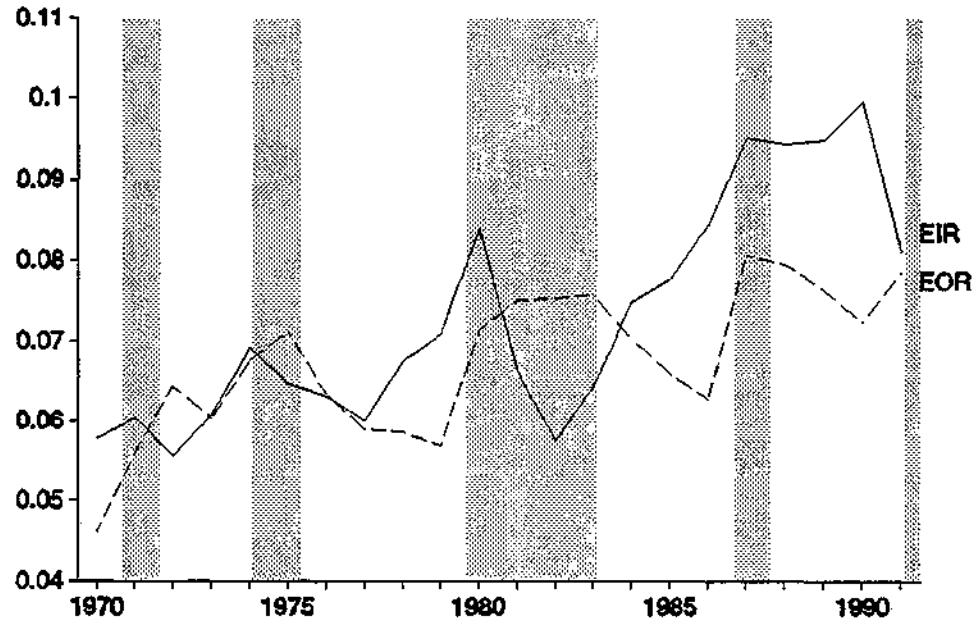

Chart 2C. Employment inflow and outflow rates, as percentage of the labour force.

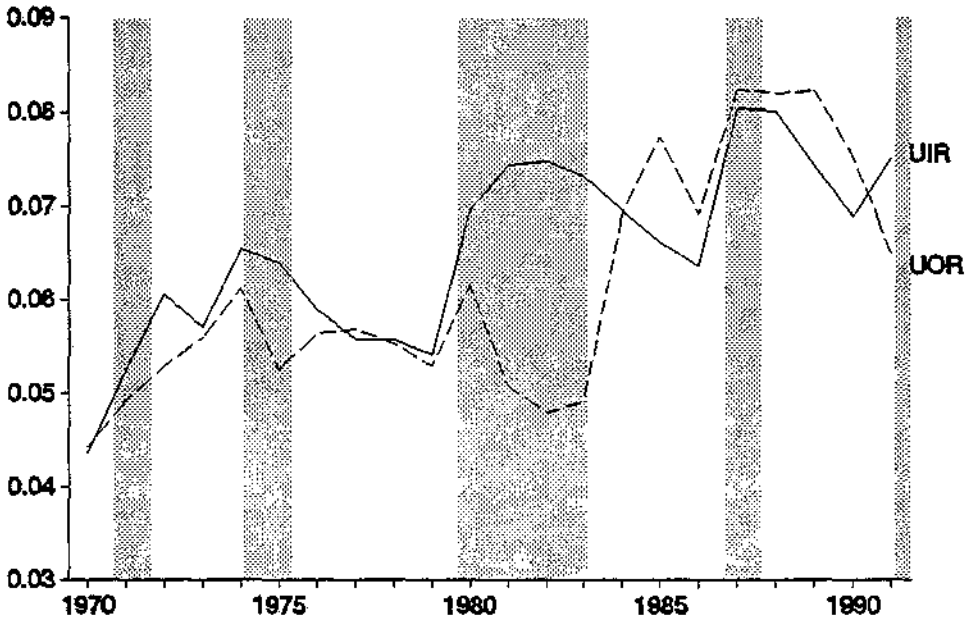

Chart 2D. Unemployment inflow and outflow rates, as percentage of the labour force.

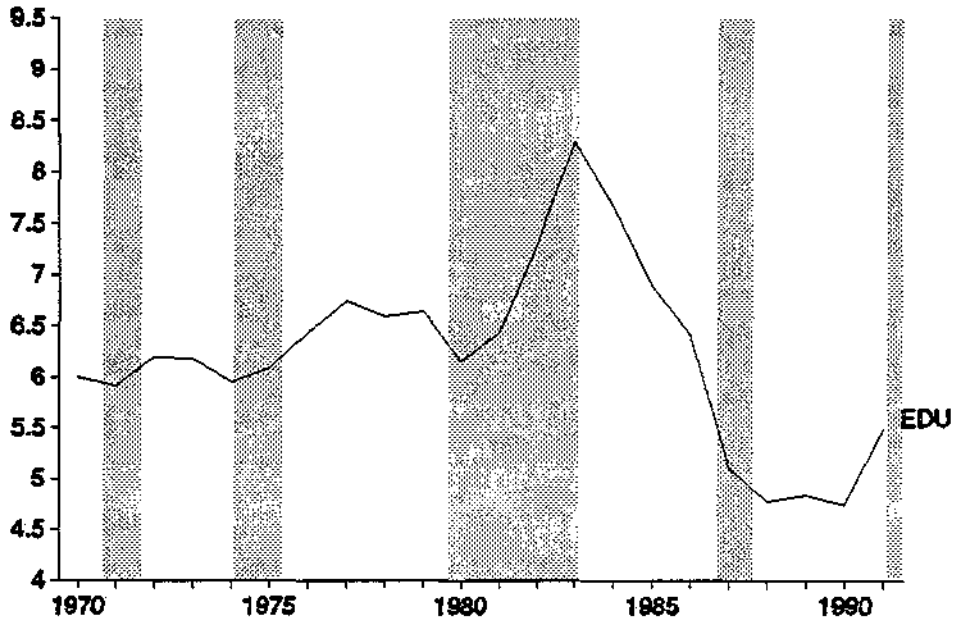

Chart 2E. Employment duration (in years).

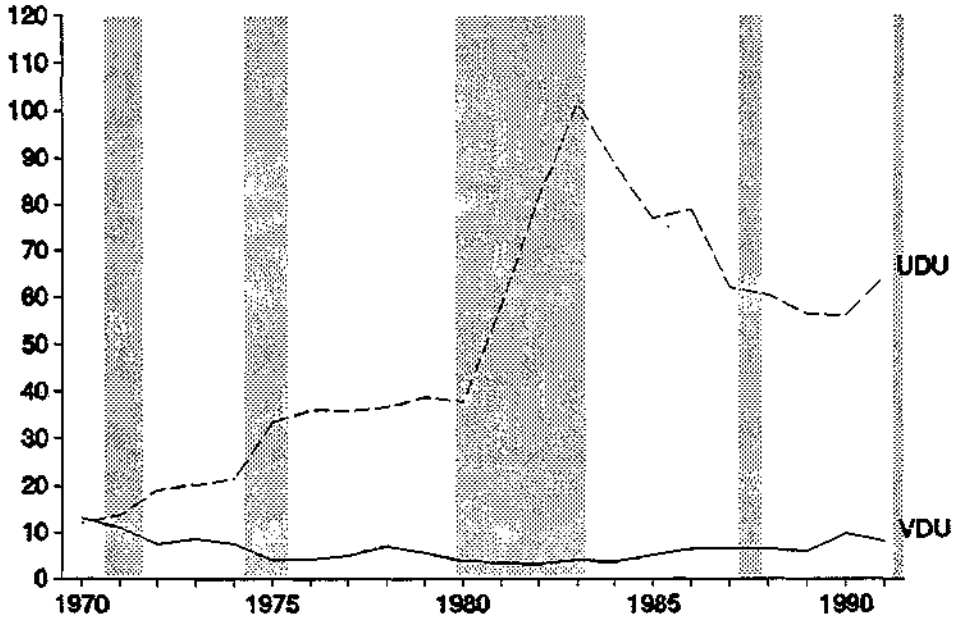

Chart 2F. Unemployment and vacancy duration (in weeks).

1992-1	R.J. Boucherie N.M. van Dijk	Local Balance in Queueing Networks with Positive and Negative Customers
1992-2	R. van Zijp H. Visser	Mathematical Formalization and the Analysis of Cantillon Effects
1992-3	H.L.M. Kox	Towards International Instruments for Sustainable Development
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1992-6	R.J. Veldwijk M. Boogaard E.R.K. Spoor	Assessing the Software Crisis: Why Information Systems are Beyond Control
1992-7	R.L.M. Peeters	Identification on a Manifold of Systems
1992-8	M. Miyazawa H.C. Tijms	Comparison of Two Approximations for the Loss Probability in Finite-Buffer Queues
1992-9	H. Houba	Non-Cooperative Bargaining in Infinitely Repeated Games with Binding Contracts
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1992-11	L. Broersma P.H. Franses	A model for quarterly unemployment in Canada
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