Direct Measurement of Continuous Job Flows

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Explanation of symbols

.	= data not available
*	= provisional figure
x	= publication prohibited (confidential figure)
–	= nil or less than half of unit concerned
–	= (between two figures) inclusive
0 (0,0)	= less than half of unit concerned
blank	= not applicable
2003–2004	= 2003 to 2004 inclusive
2003/2004	= average of 2003 up to and including 2004
2003/'04	= crop year, financial year, school year etc. beginning in 2003 and ending in 2004

Due to rounding, some totals may not correspond with the sum of the separate figures.

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DIRECT MEASUREMENT OF CONTINUOUS JOB FLOWS

Summary: We measure continuous employee job flow dynamics directly from the Social Statistical Database (SSD). We suggest some job dynamics indicators for the comparison over time and between classifications. We show how the job flows are related to the quantity and the average number of jobs. We observe for the years 2000 to 2002 that the job dynamics decrease in the Netherlands. There is a great difference in job flow dynamics between industries. The employment agencies are the most dynamic industry, and the government the least dynamic, in 2001. Jobs of younger employees have more flow dynamics than jobs of older people. Jobs of women have somewhat more dynamics than jobs of men.

Keywords: Job flow dynamics, Labour market, Social Statistical Database, Labour Accounts.

1. Introduction

The Dutch Labour Accounts (LA) present average numbers of jobs per reference period. The net change on the average number of jobs over time gives insight in the development of the labour market. However, it does not show the underlying dynamics of job creation and job destruction. In the near future we like to extend the Labour Accounts with information about the labour market dynamics.

In this paper we present how we can measure directly continuous creation and destruction flows for ***employee*** *jobs* from the Social Statistical Database (SSD), and how the flows are related with the quantity of jobs and average number of jobs in a year.[1] Furthermore we suggest some indicators for the study of continuous job flow dynamics between years and subpopulations.

An employee job is defined in ESA (1995) as a contract between an employee and an employer. As Statistics Netherlands has to comply with ESA definitions, we follow this job definition, which means that a job is an occupied labour position. We do not measure therefore internal dynamics within enterprises, because it does not result in destruction or creation of the contract. However, we should be very careful with the job definition. The academic world of economics uses the term 'jobs' for the sum of the occupied labour positions and the vacancies. We do *not* include the vacancies in the population of jobs.

As far as we know this is the first time that the continuous employee job flows are measured directly from integral micro data sources. Kock (1998) constructed

[1] The continuous dynamics of employees into and out of employment can also be meaured with the SSD. We will describe this in a seperate *Discussion Paper*.

indirectly the continuous (academic) 'job' (including vacancies) flows with some assumptions based on the continuous inflow and outflow of social security provisions in the Netherlands. The work of Kock is an extension of the macro data approach of Broersma and Den Butter (1994). Other studies on (academic) 'job' and worker flow are based on panel data [Davis, Haltiwanger and Schuh (1996); Broersma and Gautier (1997)].

The rest of this paper is organized as follows. We start with the concepts and methods in Section 2. Subsection 2.1 describes the ESA job definition, the SSD with all employee jobs in the Netherlands, and how the quantity and average number of jobs can be calculated from the SSD. Subsection 2.2 describes how the jobs can be classified by its inflow and outflow. We define in subsection 2.3 some indicators for the job dynamics. These indicators are shown in Section 3 as an example for the years 2000 to 2002. We will not discuss the results about labour market dynamics of the Netherlands in full detail here. We will do that in forthcoming publications. The goal of this paper is to suggest possible indicators, show the potential of the indicators, and get some idea about the values of an indicator in relation to the others. Section 4 ends this paper with some conclusions about the indicators and the employee job flow dynamics in the Netherlands for the years 2000 to 2002.

2. Concepts and methods

We will now explain what we define as a job and a job flow, and how we can measure them. We also suggest some indicators for the comparison of job dynamics.

2.1 Jobs

2.1.1 Definition

The European System of Accounts (ESA 1995, 11.22) gives the following definition of a job: *'A job is defined as an explicit or implicit contract between a person and a resident institutional unit to perform work in return for compensation for a defined period or until further notice.'* In this definition, both employee jobs and self-employment jobs are covered.

In this paper we will only study the **employee jobs**. A job is an employee job if the person holding it belongs to another institutional unit than the employer. Persons can have more jobs during a reference period. These jobs can either successively follow one another or run in parallel. The economic territory in which the producer (employer) is resident defines the residence of the job, because resident producers alone contribute to the production of a country. So the employee may be resident in another country.

2.1.2 Social Statistical Database

An employee job file in the Social Statistical Database (SSD) contains the total volume of employee jobs for a reference year. Every labour contract, which exists during (a part of) the reference year, is included in the SSD employee job micro data file. The SSD micro data file is constructed by combining administrative micro data sources from the tax and social security authorities, and micro data of our Survey on Employment and Earnings (SEE). The editing rules for the construction of the employee job files of the SSD are described by Arts and Hoogteijling (2002).

Although the editing rules are sufficient for the current statistical program, they are not sufficient for a consistent time series of job flows. Therefore, we developed new *forward* and *backward* longitudinal micro data editing rules for the current employee job files of the SSD. *Forward* longitudinal micro data editing sets the final date of a job in year *T* from unknown to December 31 year *T*, if the job cannot be found back in the file of year *T+1*. Forward longitudinal micro data editing can never be implementation in the first version of an SSD file, because the next year is not available yet. *Backward* longitudinal micro data editing sets the start date of a job in year *T* to January 1 year *T*, if the job had a starting date before year *T* and the job cannot be found back in the file of year *T-1*. For more information about the method, see Milot and Kee (2005).

2.1.3 Measurement of quantity and average

There is a difference between the quantity and average number of jobs. The quantity of jobs *J* is the sum of all jobs which exist during (a part of) the reference period. The average number of jobs <*J*> can be calculated by

$$< J >= \frac{\sum_{j=1}^{J} d_j}{d_{\max}},$$

where d_j is the number of days job *j* exists during the reference period, and d_{max} is the maximum number of days for the reference period. The number of days d_j is calculated with use of the starting and final date of the job.

2.2 Job flow classifications

We can construct different kinds of job flows with the starting and final date of the total population of employee jobs in the SSD. We distinguish first and second order job flows.

2.2.1 First order job flow classifications: creation or destruction of jobs

The first order job flow classifications are classified either by the creation or destruction of jobs:

- The **gross inflow (GI)** of jobs into the population of jobs during the reference period is caused by jobs **created** during the reference period, which are the jobs with a starting date within the reference period.
- The **gross outflow (GO)** of jobs out of the populations of jobs during the reference period is caused by jobs **destructed** during the reference period, which are the jobs with a final date within the reference period.

2.2.2 Second order job flow classifications: combining creation and destruction

For the second order job flow classifications we combine the creation and destruction classifications. This gives a quadruple cross classification of flows during the reference period:

1. **Without flow (WF)**: No creation and no destruction of the job.
2. **Single inflow (SI)**: *Creation*, but no destruction of the job.
3. **Single outflow (SO)**: *Destruction*, but no creation of the job.
4. **Double flow (DF)**: Both *creation and destruction* of the job.

The jobs without flow are jobs with a starting date before the reference period, and a final date after the reference period. Many jobs in the data set do have an unknown final date, because they still exist at the moment. Although we do not know the final date, we know for sure that the final date of these jobs will be after the reference period. The single inflow jobs all start within the reference period, and have a final date after the reference period. The single outflow jobs have a starting date before the reference period, and a final date within the reference period. The double flow jobs start and end within the reference period. This means that the double flow jobs are part of the population of jobs in the reference period only, and do not participate in the population of jobs in other periods, like the single flow and without flow jobs do. Most of the double flow jobs are probably seasonal or temporary jobs.

2.3 Indicators of labour market dynamics

We will now introduce four types of dynamics indicators: quantity indicators, average indicators, average duration within a reference period, and short duration jobs.

2.3.1 Quantity indicators

The simplest indicators are the magnitudes of the specified flows: F_{GI}, F_{GO}, F_{SI}, F_{SO}, and F_{DF}. The following identities are valid for these quantity indicators. The gross inflow is equal to the single inflow plus the double flow:

$F_{GI} = F_{SI} + F_{DF}$.

A comparable relation applies to the gross outflow:

$F_{GO} = F_{SO} + F_{DF}$.

The quantity of all jobs J is equal to the sum of all the jobs classified by the second order job flows:

$$J = J_{WF} + J_{SI} + J_{SO} + J_{DF} ,$$

which can be written in terms of flows as:

$$J = J_{WF} + F_{SI} + F_{SO} + F_{DF} .$$

An often used indicator is job turnover (JT), which is defined as the sum of gross inflow into and gross outflow out of the population of jobs:

$$JT = F_{GI} + F_{GO} = F_{SI} + F_{SO} + 2F_{DF} .$$

The quantity of the **net flow** (ΔF) can be calculated from the gross flows or the single flows by

$$\Delta F = F_{GI} - F_{GO} = F_{SI} - F_{SO} ,$$

therefore a positive ΔF means a net inflow and a negative ΔF a net outflow. It is now obvious that the jobs with a double flow do not influence the net flow within a reference period.

For comparison of the dynamics for different classifications or time series, it can be useful to represent the quantity of the jobs classified by the type of the underlying flows as a fraction p of the total quantity of jobs:

$$p(J_{WF}) = \frac{J_{WF}}{J},$$

$$p(J_{SI}) = \frac{J_{SI}}{J} = \frac{F_{SI}}{J},$$

$$p(J_{SO}) = \frac{J_{SO}}{J} = \frac{F_{SO}}{J},$$

$$p(J_{DF}) = \frac{J_{DF}}{J} = \frac{F_{DF}}{J}.$$

The fraction of the jobs without flow $p(J_{WF})$ is an indicator of the non dynamic part of the labour market. As an indicator for the *long duration* job reallocation can be taken the sum of the single flow jobs $p(J_{SI}) + p(J_{SO})$, and as an indicator for the *short duration* job reallocation can be taken the fraction of the double flow jobs $p(J_{DF})$.[2]

2.3.2 Average indicators

The average number of jobs per type of flow ($<J_{WF}>$, $<J_{SI}>$, $<J_{SO}>$, and $<J_{DF}>$) can be used as alternative indicators. Again the sum of the average number of jobs per type of flow must be equal to the average number of jobs:

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[2] We have no information about the type of contract yet. Therefore we call the jobs here *short* and *long duration* jobs. We can assume however that most of the short duration jobs are related with *temporary* labour contracts, and long duration jobs with *permanent* labour contracts. It is however possible that a permanent contract has been ended by a new employee within the same year as the job started.

$<J> = <J_{WF}> + <J_{SI}> + <J_{SO}> + <J_{DF}>$.

We can also calculate the contribution of each type of job to the average number of jobs within the year by the following fractions:

$$p(<J_{WF}>) = \frac{<J_{WF}>}{<J>},$$

$$p(<J_{SI}>) = \frac{<J_{SI}>}{<J>},$$

$$p(<J_{SO}>) = \frac{<J_{SO}>}{<J>},$$

$$p(<J_{DF}>) = \frac{<J_{DF}>}{<J>}.$$

The average fraction of the jobs without flows $p(<J_{WF}>)$ is again an indicator of the non dynamic part of the labour market. As an indicator for the long duration job reallocation can be taken the sum of the single flow jobs $p(<J_{SI}>) + p(<J_{SO}>)$, and as an indicator for the short duration job reallocation can be taken the fraction of the double flow jobs $p(<J_{DF}>)$.

The average fraction can be seen as the quantity fraction with the jobs weighted by the job duration within the reference years. The SSD does not contain information about the labour time of the jobs yet. When the labour time becomes available within the SSD in the near, then the flows can also be weighted by the labour input.

2.3.3 Average duration within the reference period

The average duration of a (sub)population of jobs within a reference period can be calculated by the average number of jobs divided by the quantity of jobs. So the average duration of the total population of jobs L_J is given by

$$L_J = \frac{<J>}{J}.$$

The duration within the reference period for the job without flow is one by definition ($L_{WF} = 1$), because the jobs without flow exist during the whole reference period. This means that the relation between the average number of jobs <J> and the job flows can be written as:

$<J> = J_{WF} + L_{SI} F_{SI} + L_{SO} F_{SO} + L_{DF} F_{DF}$.

The average durations of the single inflow jobs L_{SI} and single outflow jobs L_{SO} are interesting indicators for inflow and outflow profile over the reference period. If the single inflow and single outflow are equally distributed over the reference period, then the durations are half the reference period ($L_{SI} = L_{SO} = 0.5$). If the duration of the single inflow jobs are lower than half ($L_{SI} < 0.5$), then the single inflow takes place on average more at the end of the reference period. The opposite applies for the duration of the single outflow jobs.

The sum of single inflow and outflow jobs is an indication for the gains ($L_{SI} + L_{SO} > 1$) and losses ($L_{SI} + L_{SO} < 1$) of "permanent" job reallocation in the reference period. A reallocation gain means a higher average number of jobs within the reference period, and a loss a lower average number of jobs. The gains or losses, however, do not influence the number of jobs in the next period.

The average duration of the double flow jobs L_{DF} is the real duration of these jobs, because the double flow jobs only exist during the reference period.

2.3.4 Short duration jobs

In the previous subsections we have assumed that the double flow jobs within the reference period are all short duration jobs which existed during this period. If we take for a reference period a calendar year, then all double flow jobs exist less than one year. This does not mean that the double flow jobs are the only outflow jobs with a real duration less than one year during the calendar year, because some outflow jobs with a duration of less than one year started in the previous year. If we want a better insight in the number of temporary jobs, then we have to count the gross outflow jobs SDJ_{GO} with a duration less than a year separately and compare them with the number of double flow jobs. We will do this here only for the jobs which ended within the reference period. We can calculate F_{DF}/SDJ_{GO} for checking the relevance of F_{DF} as a short duration job indicator, and SDJ_{SO}/F_{SO} for checking the relevance of F_{SO} as a reallocation indicator for long duration jobs.

3. Results and discussion

We will give as an example the number of jobs, the job flows, and the indicators of the job dynamics, which are obtained with the employee job files of the Social Statistical Database for the years 1999 to 2003. We have only job flows for the years 2000 to 2002, because we needed the first and last data file for the forward and backward longitudinal micro data editing. The Netherlands were in a slowing economy during these years.

3.1 Quantity and average number of jobs

Table 1 shows the quantity J and average number $\langle J \rangle$ of jobs for the total population of the years 1999 to 2003.

Table 1: The quantity J and average number $\langle J \rangle$ of jobs per year for the total population of jobs.

	J	$\langle J \rangle$
1999	10,589,641	7,183,308
2000	10,850,046	7,373,871
2001	10,832,159	7,553,387
2002	10,679,772	7,614,811
2003	10,334,628	7,587,178

The highest quantity of jobs J is observed in the year 2000. After this year the quantity of jobs decreases. The average number of jobs $<J>$ increases from 1999 to 2002, and decreases in 2003. So during the years 2001 and 2002 the average increases, while the quantity decreases.

3.2 Quantity indicators

We show in Table 2 the second order job flows and the net flow for the years 2000 to 2002.

Table 2: The quantity of the second order job flows per year for the total population of jobs.

	J_{WF}	F_{SI}	F_{SO}	F_{DF}	ΔF
2000	5,070,505	1,675,297	1,549,554	2,554,690	125,743
2001	5,273,267	1,658,244	1,485,873	2,414,775	172,371
2002	5,522,472	1,585,858	1,431,938	2,139,504	153,920

The net flow ΔF is, with a net inflow of 172 thousand, the highest in the year 2001. The net flow is for all years positive, so there is a net creation of permanent jobs. This is in agreement with the increase of the quantity of the jobs without flow F_{WF}. The single inflow F_{SI}, single outflow F_{SO}, and double flow F_{DF} decrease. This means that the job flow dynamics also decrease during this period.

The decrease of the job flow dynamics can be observed also directly by the increase of the quantity fraction of the jobs without flow $p(J_{WF})$ in Table 3. We also observe a decrease of the quantity fractions of the single inflow $p(J_{SI})$, single outflow $p(J_{SO})$, and double flow $p(J_{DF})$.

Table 3: The quantity fractions of the second order job flows per year for the total population of jobs.

	$p(J_{WF})$	$p(J_{SI})$	$p(J_{SO})$	$p(J_{DF})$
2000	0.46733	0.15440	0.14282	0.23545
2001	0.48682	0.15309	0.13717	0.22293
2002	0.51710	0.14849	0.13408	0.20033

3.3 Average indicators

The average number of jobs for the second order job flow classifications is given in Table 4. The average number of jobs without flow $<J_{WF}>$ is equal to the quantity of jobs without flow J_{WF} (see Table 2), because these jobs exist during the whole reference year. The average number of jobs with single outflow $<J_{SO}>$ and double flow $<J_{DF}>$ decreases for this period, while the average number of jobs with single inflow $<J_{SI}>$ has a maximum in 2001. This means that the inflow should be more balanced to the begin of 2001 in comparison to 2000, because the single inflow F_{SI} decreases from 2000 to 2001.

Table 4: The average number of jobs for the second order job flow classifications per year for the total population of jobs.

	$<J_{WF}>$	$<J_{SI}>$	$<J_{SO}>$	$<J_{DF}>$
2000	5,070,505	875,449	826,213	601,704
2001	5,273,267	908,655	783,228	588,237
2002	5,522,472	877,416	728,823	486,100

Table 5 shows the average job fractions for the second order job flow classification. The denominator for the average job fractions is lower than the denominator of the quantity fractions, so the value of $p(<J_{WF}>)$ must be higher than $p(J_{WF})$. We know now that the jobs without flow contribute around 50 percent of the quantity of jobs and 70 percent of the average number of jobs.

Table 5: The average job fractions for the second order job flow classifications by year.

	$p(<J_{WF}>)$	$p(<J_{SI}>)$	$p(<J_{SO}>)$	$p(<J_{DF}>)$
2000	0.68763	0.11872	0.11205	0.08160
2001	0.69813	0.12030	0.10369	0.07788
2002	0.72523	0.11522	0.09571	0.06384

The average number of jobs and the average job fractions show the same trends for the total population for this period of time. The average job fractions become very useful if we compare the job dynamics for groups of jobs with different denominators. We will give an example of the dynamics per industry and by crossing of gender and age of the employee. In forthcoming publications we will discuss these results in more detail.

3.3.1 Industries

We present in Table 6 the industries in increasing order of the fraction for the average number of no-flow jobs $p(<J_{WF}>)$ for the year 2001. We observe that the employment agencies have the highest dynamics (lowest $p(<J_{WF}>)$) and the government the lowest dynamics (highest $p(<J_{WF}>)$). The dynamics of the employment agencies is based primarily on double flow jobs, because the double flow jobs are responsible for 40 percent of the average number of jobs in this industry. This is in agreement with our expectation of a lot of temporary jobs for employment agencies.

Hotels and restaurants *and* Agriculture are also relatively dynamic industries, because the non flowing (no-flow) jobs are responsible for around 50 percent of the average number of jobs. The dynamics of hotels en restaurants are relatively more concentrated on the single inflow and outflow jobs, and less on the temporary double flow jobs.

The dynamics of the health care is primarily caused by the average job fraction of single inflow jobs. This means that dynamics is primarily caused by the growth of

the health care industry. If we compare the fractions of the single outflow and the double flow jobs, then the health care is not more dynamic than education or manufacturing.

Table 6: The average number of job fractions for the second order job flow classifications by industries for the year 2001.

	$p(<J_{WF}>)$	$p(<J_{SI}>)$	$p(<J_{SO}>)$	$p(<J_{DF}>)$
Employment agencies	0.222	0.185	0.192	0.401
Hotels and restaurants	0.467	0.193	0.174	0.165
Agriculture	0.557	0.130	0.122	0.190
Transport, storage and communication	0.750	0.106	0.097	0.046
Financial Activities	0.754	0.098	0.082	0.066
Construction	0.772	0.095	0.087	0.046
Health care	0.775	0.114	0.077	0.035
Education	0.802	0.089	0.075	0.034
Manufacturing	0.812	0.076	0.079	0.033
Government	0.856	0.071	0.053	0.020

3.3.2 Gender and age of the employee

Table 7 shows the average fraction of the no-flow jobs on the average number of jobs $p(<J_{WF}>)$ by gender and age group for the year 2001. We observe increasing dynamics for decreasing age, for both men and women (higher dynamics (lower $p(<J_{WF}>)$) towards the younger age groups.) The dynamics of men and women are almost the same for the age group 25 to 35, but for all other age groups jobs of women behave more dynamic than jobs of men.

Table 7: The fraction of the no-flow jobs on the average number of jobs $p(<J_{WF}>)$ by gender and age group for the year 2001.

	Men	Women	*Total*
15-<25	0.408	0.387	*0.397*
25-<35	0.687	0.684	*0.684*
35-<45	0.800	0.745	*0.775*
45-<55	0.866	0.795	*0.836*
55-<65	0.827	0.796	*0.816*
Total	*0.723*	*0.668*	0.698

3.4 Average durations within the reference period

Table 8 shows the average duration for the total population of jobs and for the second order classifications. The average duration of the total population L_J increases in the period 2000 to 2002. We know from Table 1 that this is caused by the increase of the average number of jobs $<J>$ and by the decrease of the quantity of jobs J. An increase of L_J is also an indication for a decrease in the job dynamics.

Table 8: The average durations of jobs for the second order job flows in years.

	L_J	L_{WF}	L_{SI}	L_{SO}	L_{DF}
2000	0.6796	1	0.5226	0.5332	0.2355
2001	0.6973	1	0.5480	0.5271	0.2436
2002	0.7130	1	0.5533	0.5090	0.2272

The average duration of the no-flow jobs L_{WF} is always one, because these jobs exist during the whole reference period. The average duration of the single inflow L_{SI} and single outflow jobs L_{SO} are higher than half a year. This means that the single inflow is more balanced towards the beginning of the year and the single outflow more towards the end of the year. We can also observe from Table 8 that the average duration of the single inflow jobs is increasing and the average duration of the outflow jobs is decreasing, which means that both the balance of the inflow and outflow is moving towards the beginning of the year. The sum of the average durations of the single inflow and single outflow jobs is for these years always above 1.05, which means that there is a reallocation gain. A reallocation gain will give a higher average number of jobs within the reference period.

The average duration of double flow jobs is somewhat less than 3 months.

3.5 Short duration jobs

All double flow jobs exist shorter than a year. Some of the single outflow jobs exist also shorter than a year, for example when a job begins in December 2000 and ends in January 2001. Table 9 shows the short duration jobs of the gross outflow SDJ_{GO} and the single outflow SDJ_{SO}. Both short duration job flows decrease during the year 2000 to 2002. We can observe from the fraction F_{DF}/SDJ_{GO} in Table 9 that the double flow jobs are responsible for around 85 percent by the gross outflow of the short duration jobs. From the fraction SDJ_{SO}/F_{SO} we know that 27 percent of the single outflow is caused by the single outflow of short duration jobs. So the double flow jobs are a reasonable indicator for the temporary job dynamics and the single flow jobs for the reallocation of long duration jobs.

Table 9: The short duration jobs of the gross outflow SDJ_{GO} and the single outflow SDJ_{SO}, and related to the total double flow jobs F_{DF} and total single outflow jobs F_{SO}.

	SDJ_{GO}	SDJ_{SO}	F_{DF}/SDJ_{GO}	SDJ_{SO}/F_{SO}
2000	2,967,977	413,287	0.8608	0.2667
2001	2,818,969	404,194	0.8566	0.2720
2002	2,530,239	390,735	0.8456	0.2729

4. Conclusions

We can measure continuous employee job flow dynamics directly from the Social Statistical Database (SSD). We suggested some job dynamics indicators for the

comparison over time and between subpopulations. We showed how the job flows are related to the quantity and the average number of jobs. We observed for the years 2000 to 2002 that the job dynamics decreases, while the Netherlands were in a slowing economy. The fraction indicator of the average number of jobs for the second order job flows showed that there is a great difference in job flow dynamics between industries. The employment agencies are with a fraction of 0.22 for the non flowing jobs the most dynamic industry, and the government with 0.86 is the least dynamic industry, in 2001. We also observed that jobs of younger employees have more flow dynamics than jobs of older people. Jobs of women have somewhat more dynamics than jobs of men.

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