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Explanation of symbols

.	= data not available
*	= provisional figure
**	= revised 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
2008–2009	= 2008 to 2009 inclusive
2008/2009	= average of 2008 up to and including 2009
2008/'09	= crop year, financial year, school year etc. beginning in 2008 and ending in 2009
2006/'07–2008/'09	= crop year, financial year, etc. 2006/'07 to 2008/'09 inclusive

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

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The definition of a job and the flow approach to the labour market; a sensitivity analysis for the Netherlands

Arjan Bruil, Frank A.G. den Butter and Peter Kee[1]

Summary: Statistical measurement of labour market flows depends on three major aspects of the definition of a job, namely (i) the minimum size of the job (e.g. 12 hours per week); (ii) the minimum length of the job (e.g. three months), and (iii) whether in accordance to national accounting rules, jobs are identified with labour contracts, or whether in accordance to labour demand theory, unfilled vacancies are also counted as jobs. This paper looks at the sensitivity of measuring job flows and worker flows with respect to these alternatives for the definition of a job using a unique data set that combines a job register for all industries in the Netherlands and a register of persons which covers the entire Dutch population. Moreover, data from the vacancy survey are linked to this data set. It appears that measurement of labour market dynamics is especially sensitive for the dynamic dimension of the definition of a job, namely that of (minimum) job length. This is true for our preferred continuous measurement of labour market flows, but seems less relevant when flows data are derived from observations at discrete times, e.g. end of year data.

Keywords: Job flows, labour market dynamics, definition of a job

JEL-codes: C82, J21, J63

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1. Introduction

The seminal work of Davis, Haltiwanger and others (Davis and Haltiwanger 1990, 1992, 1998, 1999; Davis *et al*. 1996) provides a measurement method for gross job and worker flows. These data on job creation and destruction in relation to hires and separations have been widely used for the analysis of labour market dynamics. The method of Davis and Haltiwanger measures job creation as net employment changes in expanding firms and job destruction as net employment changes in contracting firms. These data on job creation and destruction of individual firms are aggregated so that at the macro level net employment growth is equal to hires minus separations, which represents worker flows, and to job creation minus job destruction which represents job flows.

In accordance with the rules of national accounting, these worker and job flows use data on labour contracts. Worker flows can be considerably higher than job flows when a major part of hires and separations relates to jobs that continue to exist when workers quit or are fired. In that case, new hires will fill these jobs. Whereas the literature on job flows focuses on labour demand, the analysis of worker flows, or more broadly, of flows of persons, considers the supply side of the labour market and relates to all transitions between the various states of the labour market and the reallocation of work. There is only a limited number of studies which provides an integrated analysis of job and worker flows (see, e.g., Anderson and Meyer 1994; Burda and Wyplosz 1994; Burgess *et al*. 2000; Davis and Haltiwanger 1998, 1999; Davis *et al.* 2006).

The definition of a job according to the measurement method of Davis and Haltiwanger means that jobs are filled by a worker with a labour contract. This is somewhat at variance with the concept of labour demand where total labour demand is equal to employment – filled labour contracts – plus vacant jobs. Therefore, in this paper we also consider an alternative definition of jobs where posting of new vacancies is accounted as job creation as well. Moreover, the unique data set of this study, which combines registers of jobs and persons for the entire Dutch industry and working population, allows us to compile job flows and worker flows in continuous time. It is in contrast to the measurement methodology of Davis and Haltiwanger, and of many other studies on labour market dynamics (see, e.g., Albæk and Sørensen 1998; Bassanini and Marianna 2009; Haltiwanger and Vodopivec 2002a, 2002b; Haltiwanger *et al.* 2008; Hijzen *et al.* 2007; Ilmakunnas and Maliranta 2003, 2005) which are based on discrete-time observations, e.g. the number of labour contracts at the start and the end of the year (or quarter). A further advantage of our method in comparison with that of Davis and Haltiwanger is that the resulting data on job creation and job destruction also take account of simultaneous job creation and destruction within a firm. Our method is inspired by the national accounting framework of Den Butter (1993), Broersma and Den Butter (1994) and Broersma *et al*. (2000), which aims at making data on job flows and worker flows consistent at the macro level in the sense that the flow of persons that find a job by filling a vacancy is equal to the flow of filled vacancies.[2] However this method uses data on vacancies which are not readily available from statistical data sources so that additional assumptions are needed, for instance on the number of jobs that continue to exist when workers quit or are fired, and on the number of new hires without filling a (registered) vacancy. In this paper, we simplify this framework but also need additional information on the origin of vacancies in order to be able to link the data from the vacancy survey with our main data set.

The calculation using our data set shows that other assumptions prove crucial for the observed sizes of worker and job flows. These are the two dimensions of the definition of a job at the micro level, namely (i) the size of a job and (ii) the length of a job. When labour market flows are measured by means of labour contracts, these two dimensions relate to the size of the contract and to the length of the contract. The first dimension, the size of the labour contract, is also implicit in the definition of

[2] A pilot version of the method is included in Den Butter and Van Ours (1990).

employment. In the Netherlands, labour contracts are only considered as part of employment when the job is for 12 hours per week or more. The second dimension, the length of the labour contract, is especially relevant when considering labour market dynamics. In most measurement methods of labour market flows, such as the Davis and Haltiwanger method, this latter dimension of the definition of a job is implicitly determined. A labour contract is counted as a job when it exists at the date of observation. In that case, it is not relevant whether it is a job for say one week, or for several years. Indeed, lengthy labour contracts will have a larger probability to be measured as job than a short contract, but a sequence of short contracts may also be measured as one job.

This paper conducts a sensitivity analysis on the measurement of job and worker flows for the Netherlands with respect to these two dimensions of the definition of a job. We also address the role of the type of labour relation, i.e. whether there is a fixed or flexible relationship. It appears that measured sizes of job and worker flows become much larger when short labour contracts are included in the definition of a job than when only labour contracts are taken into account that take 3 months or longer or one year or longer. Such short length jobs relate for a considerable part to holiday jobs, student jobs and other forms of occasional work, which are of no big relevance to an assessment of labour market flexibility using data on labour market dynamics. Yet the sensitivity analysis shows that one should be very cautious to draw policy conclusions in comparative studies on labour market dynamics in various countries, when the implicit definition of a job depends on the measurement method.

At the macro level, there are also some ambiguities in the definition of a job, namely whether to include jobs of foreigners in the home country, or jobs of residents abroad. Here we take the perspective of labour demand and define total employment as all jobs in the home country. Moreover, jobs taken by persons over the age of 65 (and if relevant, under the age of 15) are also accounted as employment.

The content of the remainder of the paper is as follows. Section 2 shortly discusses the various concepts, which are relevant in the analysis of labour market flows. Section 3 discusses the data sources of our analysis. Section 4 demonstrates the relationship between worker flows, job flows and the definition of a job in the measurement method of Davis and Haltiwanger when different assumptions are made on the minimum size and length of a job. Section 5 shows how inclusion of data on vacant jobs yields a consistent data system at the macro level where job flows are associated with labour demand and worker flows with labour supply. Section 6 summarizes and concludes.

2. Flows of jobs and persons in labour market dynamics

Figure 1 depicts the confrontation of supply and demand at the labour market. In this static set up labour demand comprise filled and vacant jobs, whereas labour supply consists of paid workers and the unemployed who are seeking paid work. Since a person may work in several jobs, e.g. as moonlighter in a day and evening job, or in different jobs during the week, the employed population is lower than the number of filled jobs. The number of job seekers, on the other hand, generally exceeds the number of vacant jobs. The relationship between these two variables is given by the Beveridge curve (see, e.g., Blanchard and Diamond 1989). The position of the economy on this curve can be regarded as indicator of the cyclical situation on the labour market, but shifts of the curve can be associated with changes in the dynamics of the labour market and in the efficiency of the working of the labour market (see, e.g., Den Butter and Abbring 1994).

For an analysis of the dynamics of the labour market, we need observations on the time pattern of the data of figure 1. These data provide information on transitions on the labour market: in the dynamic

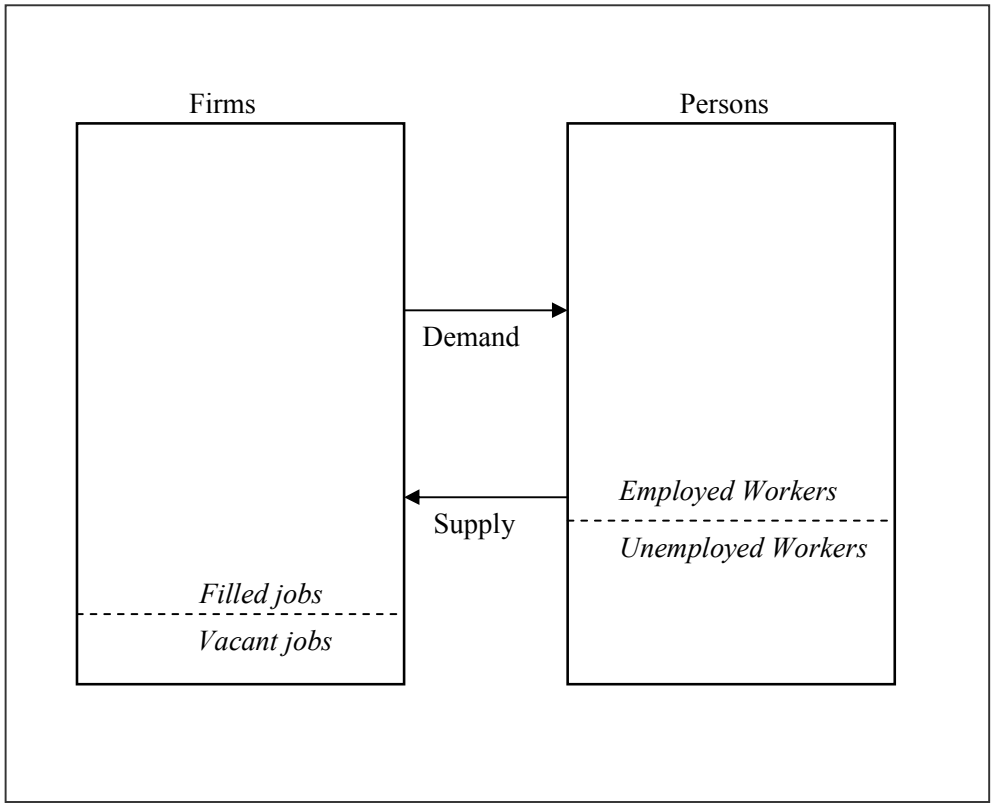

Figure 1. Labour demand and supply.

version of figure 1 these are only transitions between employment and unemployment, but in a more elaborated version (see the appendix) with various states it also enables analysis of transitions which are analysed in the framework of transitional labour markets from a more sociologic orientation (see, e.g., Schmid 2002, p. 188, figure 5.3). From the perspective of the definition of a job, the most relevant data in labour market dynamics are job flows and worker flows. Job flows, i.e. the creation or destruction of jobs, reflect demand-side developments. They indicate the growth or contraction of firms due to business cycle shocks or factors like changes in technology and tastes. In contrast, worker flows mainly reflect supply-side phenomena. They are not necessarily associated with job creation or destruction. Worker flows typically exceed job flows. As our empirical analysis shows, there is indeed a significant amount of churning: the reallocation of heterogeneous workers across heterogeneous existing jobs (Burda and Wyplosz 1994, p. 1301). Churning is related to job mobility, and can be the consequence of job-to-job movements. When a worker quits because he or she has found a new job, the old job may remain and be filled by another worker. In that case, there is a worker flow with a new contract, but no job destruction and creation. Burgess *et al*. (2000) suggest that churning flows arise as a correlate of an equilibrium personnel policy, rather than as a response to an unfortunate mismatch.

The functioning of the labour market can be described by the process of matching of jobs and workers, which can be represented by a matching function. This function gives the number of new employment relationships as a function of the number of job seekers, the number of vacant jobs, and possibly some other variables describing special aspects of the matching technology (for an overview, see Petrongolo and Pissarides 2001). Thus also from an analytical point of view, it is important to clearly distinguish between job and worker flows. Furthermore, a consistent description

of the connection between these two kinds of labour market flows is required. The precise relationship depends on how a job is defined. The above arguments on the confrontation of labour demand and labour supply also show that, from this theoretical perspective, it is relevant to have unfilled vacancies included in the definition of a job.

Yet, Davis *et al*. (1996, p. 9) define a job as an employment position filled by a worker and therefore exclude vacancies from their definition. This corresponds to the definition in the national accounts: a job is the agreement between an employee and the employer (SNA 2008, p. 408). However, job-match creation and destruction should not be confused with job creation and destruction. A significant number of job-worker pairs are formed or destroyed despite the fact that the jobs themselves already existed or continue. As Burda and Wyplosz (1994, p. 1299) point out, the notion of a job captures aspects of employment which are independent of worker or worker-firm match attributes. According to Davis *et al*. (1996) job reallocation (job creation or job destruction) occurs if the level of desired employment changes. In their view, these desired changes are revealed by yearly or quarterly plant-level employment changes. They define job creation at time t as employment gains summed over all plants that expand or start up between t-1 and t. Job destruction at time t is defined as employment losses summed over all plants that contract or shut down between t–1 and t. Hence, job flows are measured by comparing quarterly or yearly employment data at discrete times. Sometimes even a shorter sampling frequency of one month is used (see, e.g., Davis *et al*. 2006). The method of Davis *et al*. (1996) is the now standard calculation of job reallocation. As the authors themselves point out, however, their job reallocation measure understates the true magnitude. The point-in-time nature of the calculation means that job flows, which are reversed within the period, are not counted. Furthermore, job shifts within a firm are not captured. Davis *et al*. (1996) find that in the U.S., quarterly job flow figures show much smaller persistence than the annual figures: most of the job flows captured by quarterly figures reflects changes that are reversed within a year. A shorter sampling interval captures a larger fraction of transitory employment changes (see also Anderson and Meyer 1994, pp. 219-23). This is less so in Portugal, as Blanchard and Portugal (2001) have shown. Persistence rates are higher and quarterly job flow rates substantially lower in Portugal than in the U.S.

As mentioned before, the definition of a job of Davis *et al*. (1996) implies that changes in unfilled positions are disregarded in the calculation of job creation and destruction. Their measurement of changes in desired employment levels by means of actual quarterly or yearly plant-level employment changes assumes that vacancies are filled within the quarter or year. Davis *et al*. (1996, p. 10) give the following example. If a vacancy arises because of a quit, the position can likely be refilled within three or twelve months, if desired. They thereby neglect the fact that firms may not be able to find workers to fill newly created jobs or that the position happened to be still open at the time point of observation. Blanchard and Diamond (1990) therefore add the change in vacancies to the standard job creation measure. In this way, they try to measure the creation of new employment positions, whether filled or not. Job creation then also takes place if a vacancy is opened for a new position and no job-employee match is realized. Thus, workplaces may be created without the location of workers. In contrast, in the model of Burda and Wyplosz (1994) there is no incentive to create the workplace until a worker has been located to the vacancy (planned position). Put differently, job matching is necessary for job creation in their model. This is in conformity to the model in Pissarides (2000), where for job creation to take place, a vacant job has to become filled, i.e. a firm and a worker have to agree to an employment contract.

The inclusion of vacancies is only a rough adjustment, because not for all vacant jobs a vacancy is posted. It is obvious that accounting for vacant jobs implies that a job no longer is defined in terms of a worker-employer match. Rather, a job then relates to a task, a particular set of skills (Burgess *et al*. 2000, p. 478). In this case, the job definition of Hamermesh *et al*. (1996, p. 24) is more

appropriate. They define a job as a distinct set of duties and responsibilities that the employer recognizes as being attached to a position of employment. Hence, the employers themselves identify a job. This information is used by the authors to adjust the standard measures of job creation and destruction for the fact that a firm may replace specific jobs with an equal number of different jobs, i.e. without an effect on employment. Worker flows are adjusted for internal movements to existing or newly created jobs. Both simultaneous creation and destruction of jobs at firms and internal mobility, however, are found to be low. Information on these issues is of course very difficult to obtain. Indeed, the data set used by Hamermesh *et al*. (1996) combines two unique surveys.

An important purpose for calculating job flows is to compare them with worker flows. Linking these different concepts, the fraction of worker flows attributable to job flows can be calculated. As Davis *et al*. (1996, p. 35) point out a meaningful comparison requires a consistent measure of both kinds of flows. Davis and Haltiwanger (1998, pp. 82-3) distinguish two different concepts of worker flows. Gross worker reallocation at time t is defined as the number of persons whose place of employment or employment status differs between t–1 and t. This measure counts changes between two discrete points in time, i.e. the total number of persons who currently have a different job or employment status (employed or not employed) than they had for instance twelve months earlier. Hence, gross worker reallocation measures the number of persons who participate in transitions. Their second measure, total turnover, on the other hand measures the gross number of labour market transitions. Total turnover at time t is defined as the number of accessions plus the number of separations that occur during the interval from t–1 to t. This measure may incorporate one person several times, for example, when a job-to-job movement takes place (one hire and one separation). But also, when someone experiences several job changes or movements between employment and no employment during a period. Total turnover thus incorporates multiple transitions of a person. It follows that total turnover minus separations and accessions that are reversed within the sampling interval minus job-to-job transitions equals worker reallocation (Davis and Haltiwanger 1998, p. 86).

In order to be meaningful, the standard measure of job reallocation thus has to be compared with gross worker reallocation. The relationship between these two kinds of flows should be expressed in terms of upper and lower bounds on worker reallocation, if double counting of persons in the measure of job reallocation cannot be ruled out with the available data (see Davis and Haltiwanger 1998, pp. 84-5). Double counting occurs when workers move from shrinking firms to expanding firms or vice versa. Davis *et al*. (1996) estimate that job reallocation accounts for between one-third and one-half of annual worker reallocation in U.S. manufacturing. A comparison with total turnover would be less appropriate, because job reallocation is calculated with observations taken at discrete times and total turnover is a continuous-time measure (see Davis and Haltiwanger 1998, p. 85).

In addressing labour market flexibility, however, the focus often is on all movements of workers into and out of jobs, i.e. on all hires and separations that occur during a period. This raises the question of how this total turnover should be decomposed into job and churning flows. Obviously, such analysis requires a continuous-time measure of job flows, i.e. a measure of job turnover. Continuous-time job flows can be calculated by removing from the flow of separated workers those that have to be replaced and by removing from the flow of hired workers those who are replacements of separated workers. Blanchard and Diamond (1990) compute job flows that occur during the interval from t-1 to t by using an estimate of the fraction x of the number of separations that are not replaced. Job destruction then equals $(x/100) \times S$, and job creation equals $H - [(1 - (x/100)) \times S]$, where S denotes separations and H denotes hires. Blanchard and Diamond (1990) use a rough estimate for nonreplaced separations of 15%. Their quarterly figures, however, are not really continuous-time measures, because they are based on monthly point-in-time changes. This paper applies an alternative approach to consistently derive continuous-time job and worker flows, which is based on a method proposed by Den Butter (1993) and Broersma and Den Butter (1994). In this continuous-

time measurement the two dimensions of the definition of a job, the size and the length, become particularly relevant. With respect to size, a limit of 12 hours or more per week could be chosen, which is the minimum job size required for inclusion in official Dutch employment statistics. However, for the minimum length of the job no standards have been set. It just depends on the purpose of the analysis whether short-term jobs should be included or not.

3. Data

Our calculations are based on two data sets from Statistics Netherlands. The first is the Social Statistical Database (SSD), which links several large (volume) administrative registrations to each other and to data from sample surveys. It contains two subsets of data, which are particularly useful for studying labour market dynamics: the jobs register and the register for persons. All labour contracts in the Netherlands are included in the jobs register, which is constructed by Statistics Netherlands by combining various data sources from e.g. tax offices and employee insurance registrations.[3] This means that all industries in the economy are included. The primary source of the register for persons is data from the population administrations from municipalities. The register for persons covers the entire Dutch population, as well as persons living abroad but working in the Netherlands. For detailed information on how the SSD is constructed, see Houbiers (2004). Reliable and consistent information on persons and their labour contracts can be obtained by matching the jobs register and the register for persons. The direct connection between workers and their employers can be established for several consecutive years. Hence, longitudinal links allow following worker-employer pairs over time.

We also use data from the Vacancy Survey (VS), which is a quarterly survey conducted by Statistics Netherlands among private companies and government institutions. For this survey, about 21 thousand companies and 900 institutions are approached on a sample basis. In this survey, a vacancy is considered as a working position open for internal or external employees, who can start immediately or as soon as possible. The VS includes vacancies for which applicants already applied, vacancies for which recruitment procedures take so long that an actual appointment cannot be expected in the short term, vacancies for apprentices and trainees (on the condition that they are employed with a contract, i.e. excluding unpaid traineeships), and vacancies for workers from employment agencies or other temporary workers. On the other hand, vacancies for working positions at private households, at international governmental organisations, at the army, and at sheltered workplaces are excluded. Also excluded in the VS are vacancies for positions at companies and institutions, which do not employ workers according to the general register of businesses from Statistics Netherlands. At employment agencies, only vacancies for their own staff are counted: vacancies for their customers are not included to avoid double counting. Finally, vacancies exclusively for internal employees who lose their positions due to a reorganisation or downsizing are not counted in the VS. Unfortunately, only the total number of new vacancies can be obtained from the VS. No distinction is being made between vacancies opened for new working positions and vacancies opened to replace separated workers.

4. Worker and job flows with jobs as labour contracts

In this first part of the sensitivity analysis, we mimic the calculation method for job flows of Davis *et al*. (1996), where a job is viewed as a relationship between a worker and an employer, i.e. as a worker-employer match. Denoting the employment gain at an expanding or starting employer i at time t as $\Delta J_{it}^{+} = J_{it}^{+} - J_{it-1}^{+}$, gross job creation (JC) in the economy at time t equals $JC_t = \Sigma_i \Delta J_{it}^{+}$. Similarly, denoting the employment loss at a contracting or stopping employer i at time t as $\Delta J_{it}^{-} = J_{it}^{-} - J_{it-1}^{-}$, gross job destruction (JD) in the economy at time t equals $JD_t = \Sigma_i |\Delta J_{it}^{-}|$. Note that $\Delta J_{it}^{+} =$

[3] The beginning and ending dates of the contracts are derived from the periods during which employees receive a salary.

$H_{it} - S_{it}$ if $H_{it} - S_{it} > 0$, where H and S denote hires and separations, respectively. Similarly, $\Delta J_{it}^{-} = H_{it} - S_{it}$ if $H_{it} - S_{it} < 0$. Gross job reallocation (JR) equals the sum of job creation and job destruction: JR = JC + JD.
In order to be consistent with the measures of job flows above, worker flows have to be calculated between the same two points in time. Because persons may have more than one labour contract at these dates, they may be counted more than once in worker flows. For example, consider a moonlighter who works during the day, but also in the evening at the start of the year. This person is counted twice in worker outflow if both labour contracts do not show up in the data at the end of the year. Thus, here we compute worker flows by looking at individual labour contracts at the beginning and at the end of the year. Obviously, when someone has an agreement with the same employer at both points in time, no flows are counted. However, if the contract is no longer present at the end of the year, a worker outflow is counted. Worker inflow, on the other hand, occurs if a contract exists at the end of the year, but not at the start. Our measure of worker reallocation (WR) is the sum of these two kinds of worker flows: WR = WI + WO, where WI and WO denote worker inflow and outflow, respectively. Following Anderson and Meyer (1994, p. 178), worker reallocation is thus defined as the formation and dissolution of employee-employer job matches. Worker reallocation double counts persons whose place of employment differs at the end of the year. Hence, when this measure is compared to job reallocation, no correction is needed for job reallocation's double counting persons who move from growing to shrinking employers or vice versa.

Churning flows (CF) are defined as worker flows in excess of job flows: CF = WR – JR. This means that churning flows are by definition replaced separations. Hence, churning inflows (CI) equal churning outflows (CO). More formally, this can be shown as follows. CI = WI – JC and CO = WO – JD. Thus, CI – CO = (WI –JC) – (WO – JD) = (WI – WO) – (JC – JD). Also, ΔJ = JC –JD = WI – WO, with ΔJ the change in the number of jobs. Hence, CI – CO = (JC – JD) – (JC – JD) = 0. Churning flows arise from the re-evaluation of job matches by employers, employees, or both. For example, employers may decide to replace personnel by better-qualified workers. On the other hand, employees may quit (and being replaced) due to better prospects elsewhere.

Labour market flows, calculated according to the above procedures, are provided in table 1, with flow rates in parentheses. Rates are calculated by dividing by the average number of jobs in t–1 and t: $0.5(J_t + J_{t-1})$; this has become the standard approach for flows derived from data observations at discrete times (see Davis *et al*. 1996, pp. 189-90). The first row in table 1 reports outcomes for the all-inclusive concept of all jobs. It demonstrates the well-known fact that job reallocation and especially worker reallocation are much larger than would be inferred from the net change in the number of jobs, which equals –49 thousand or –0.7%. The method of point-in-time comparisons generates an amount of worker reallocation of 2.5 million: 1.2 million job-match formations and 1.3 million job-match dissolutions. That is, nearly 1 in 5 job matches were formed and another 1 in 5 job matches were broken up in 2004. Job reallocation equals 906 thousand: 428 thousand created jobs and 477 thousand destroyed jobs. This means that 1 in 16 jobs were created and another 1 in 14 jobs were destroyed in 2004. Job reallocation accounts for only 36% of worker reallocation. Or, put differently, nearly two-thirds of worker reallocation relates to churning.

Table 1 compares the outcomes for all jobs with the results when a job is defined as a labour contract that lasts at least 3 months. In this case of discrete-time measurement the stricter definition of job length only slightly reduces the measured magnitudes of flows and rates. That is because most of the very short employment spells start and end during the year, and thus do not show up in flows measured by the method of point-in-time comparisons. Therefore, also only .3% of the average number of 6.9 million jobs endures less than a quarter. This compares to 4.2% for spells of less than 1 year. Excluding these latter 285 thousand jobs lowers the worker and job reallocation rates by 7.0

Table 1. Worker flows, job flows and churning flows, main job characteristics, 2004.*

	Worker flows			Job flows			
	Worker inflow	Worker outflow	Worker re-allocation	Job creation	Job des-truction	Job re-allocation	Churning flows
	× 1000						
All jobs	1,219	1,268	2,487	428	477	906	1,581
	(17.8)	(18.5)	(36.2)	(6.2)	(7.0)	(13.2)	(23.0)
More strict job definition							
Job duration							
≥ 3 months	1,194	1,247	2,440	421	474	895	1,545
	(17.5)	(18.2)	(35.7)	(6.2)	(6.9)	(13.1)	(22.6)
≥ 12 months	922	994	1,917	361	433	793	1,123
	(14.0)	(15.1)	(29.2)	(5.5)	(6.6)	(12.1)	(17.1)
Working time							
≥ 12 hours per week	902	968	1,870	340	406	746	1,124
	(14.9)	(16.0)	(30.8)	(5.6)	(6.7)	(12.3)	(18.5)
Labour relation							
fixed	958	1,072	2,030	359	473	832	1,198
	(15.1)	(16.9)	(32.0)	(5.7)	(7.4)	(13.1)	(18.9)

*Flow rates as percentages of the average number of jobs are in parentheses.

percentage points and 1.1 percentage points, respectively. Not including ephemeral jobs thus gives rise to lower churning.

Table 1 also presents a sensitivity analysis with respect to the working time according to the contract. Here the alternative definition sets a limit of 12 hours per week, which, as mentioned before, is the minimum amount of time required for being included into the employed labour force according to the Dutch definition. Eighty-eight percent of the total number of jobs is jobs with a working time of at least 12 hours per week. Of these non-peripheral jobs, 97% relates to jobs which last 1 year or more. Therefore, imposing the restriction of a working time of at least 12 hours per week yields quite similar outcomes as the restriction of job duration of at least 1 year. Both duration and working hours are indicators of the significance of a contract. This also holds for the type of contract, i.e. whether labour relations are fixed or flexible. Workers with variable hours and workers employed via employment agencies are considered to have flexible contracts. This holds for only 7% of the number of jobs. Ninety-seven percent of fixed labour contracts have a duration ≥ 1 year and 91% has working hours of ≥ 12 per week. When we leave flexible labour relations out of the calculations, reallocation and churning decrease more than when we exclude jobs which last < 3 months. Compared to the other two cases with jobs with duration less than one year or with working time less than 12 hours left out of the calculations, however, the effect is small.

The sizes of job and worker flows are not only influenced by job characteristics, but also by employer characteristics. This is illustrated in table 2. The table confirms the findings from other studies: sizes of worker and job flows decrease with the size of the employer and they vary greatly across industries (see, e.g., Davis *et al.* 1996; Davis and Haltiwanger 1999).[4] Labour market dynamics tend to be lower in manufacturing than in non-manufacturing and dynamics generally are

[4] For employers with 5 or more workers we find annual worker inflow, worker outflow, job creation, job destruction and churning rates of 0.163, 0.177, 0.045, 0.059 and 0.235, respectively.

Table 2. Worker flows, job flows and churning flows, firm characteristics, 2004.*

	Worker flows			Job flows			
	Worker inflow	Worker outflow	Worker re-allocation	Job creation	Job des-truction	Job re-allocation	Churning flows
	× 1000						
All jobs	1,219	1,268	2,487	428	477	906	1,581
	(17.8)	(18.5)	(36.2)	(6.2)	(7.0)	(13.2)	(23.0)
Firm characteristics							
Employer size**							
≥ 10 workers	912	988	1,900	237	314	552	1,349
	(15.8)	(17.2)	(33.0)	(4.1)	(5.5)	(9.6)	(23.4)
≥ 100 workers	594	630	1,224	124	160	284	940
	(14.4)	(15.3)	(29.7)	(3.0)	(3.9)	(6.9)	(22.8)
Economic activity**							
agriculture, forestry and fishing	22	26	47	12	15	27	21
	(21.7)	(25.3)	(47.0)	(11.4)	(15.1)	(26.5)	(20.5)
mining and quarrying	1	1	2	0	0	1	1
	(8.7)	(10.4)	(19.1)	(2.1)	(3.8)	(5.9)	(13.1)
manufacturing	91	116	207	34	59	93	114
	(10.5)	(13.3)	(23.8)	(3.9)	(6.7)	(10.7)	(13.1)
electricity, gas and water supply	2	3	5	1	1	2	3
	(7.6)	(9.7)	(17.3)	(2.2)	(4.4)	(6.6)	(10.7)
construction	47	60	107	22	35	57	50
	(12.9)	(16.7)	(29.5)	(6.0)	(9.8)	(15.8)	(13.8)
trade, hotels, restaurants and repair	324	338	662	108	123	231	431
	(23.4)	(24.4)	(47.7)	(7.8)	(8.8)	(16.7)	(31.1)
transport, storage and communication	65	79	144	21	35	56	88
	(15.1)	(18.2)	(33.3)	(4.9)	(8.0)	(12.9)	(20.3)
financial and business activities	366	335	701	134	103	237	464
	(28.0)	(25.7)	(53.7)	(10.2)	(7.9)	(18.1)	(35.5)
general government	87	103	189	21	37	58	131
	(9.0)	(10.6)	(19.7)	(2.2)	(3.8)	(6.0)	(13.6)
care and other service activities	198	200	398	60	62	122	276
	(14.8)	(14.9)	(29.7)	(4.5)	(4.6)	(9.1)	(20.6)

*Flow rates as percentages of the average number of jobs are in parentheses.
** Exclusive of a category "unknown".

smaller in the public sector as compared to the private sector. Indeed, the least dynamic areas of economic activity are, according to our calculations, general government and manufacturing. These sectors cover 14.0% and 12.7% of the average number of jobs, respectively. The sector financial and business activities, the sector trade, hotels, restaurants and repair, and the agricultural sector appear most dynamic. These industries account for 19.0%, 20.2% and 1.5% respectively of the average number of jobs. For employers with 10 workers or more and with 100 workers or more these percentages are 84.0 and 60.0, respectively.

How do these findings compare with results from other studies? Hamermesh *et al*. (1996) estimate lower worker and job reallocation rates for the Netherlands than those shown in table 1. Their worker reallocation rate of 25.4% (including internal flows) and job reallocation rate of 7.0% (including intrafirm gross job flows) are based on unweighted data for 1158 firms from 1990 (see also Hassink 1995). These data exclude employers with fewer than ten employees, deaths of firms, and employees with a temporary contract for a period shorter than one year. Our estimates of worker flows for all sectors and of job flows for the manufacturing sector, however, are reasonably comparable to those found by Gautier (1997). For the entire Dutch economy, he finds average worker accession and separation rates of 16.3% and 15.7% respectively for the period 1971-91. For Dutch manufacturing, he reports average job creation and destruction rates of 7.3% and 8.3% respectively over the years 1979-93.

According to this measurement method, based on discrete-time observations, labour market dynamics appear to be lower in the Netherlands than in the United States. For the entire U.S. economy, Anderson and Meyer (1994) report an average annual job reallocation rate of 21.3% for the years 1979 through 1983. Davis *et al*. (1996) consider employers with five or more employees in the U.S. manufacturing sector and estimate that on average, 9.1% jobs were created and 10.3% jobs were destroyed over a twelve-month interval during the 1973-88 period. They report an average annual worker reallocation rate of 36.8% in U.S. manufacturing over the 1968-87 period. Both Dutch and U.S. dynamics, however, are low compared to Portugal. Annual job creation and destruction rates estimated by Blanchard and Portugal (2001) for the Portuguese economy (manufacturing sector) over the 1983-95 period equal 14.9% (11.4%) and 13.7% (11.8%) respectively for all employers [12.9% (10.6%) and 13.4% (11.6%) respectively for employers with 5 employees or more]. However, if adjusted for the different sectoral composition and the overall low employer size in Portugal as compared to the United States, Portuguese rates too are lower than U.S. rates.

5. Worker and job flows with jobs as labour demand

In contrast to the calculation of the previous section, the compilation of data for labour market dynamics of this section clearly and consistently distinguishes between flows of persons and flows of jobs, i.e. between labour supply and labour demand, respectively. In addition, by calculating cumulative flows it accounts for the fact that labour market dynamics are taking place continually. Worker flows are constructed by counting all hires and separations that occur during a year.[5] Thus worker turnover (WT) is calculated as $WT = H + S$, where $H = \Sigma_i H_i$ denotes all hires and $S = \Sigma_i S_i$ denotes all separations.

Job creation and destruction as measures of changes in labour demand should ideally relate to employment positions whether filled or not. We assume that more than one person may not fill a single position. Our estimates of continuous-time job flows that include vacant jobs are based upon the framework shown in figure 2. Due to limited availability of data on vacancies, it is a simplified version of the flow model of Den Butter c.s., presented in the appendix. Flows of persons are represented by hires and separations, irrespective of where these persons go to or come from. The

[5] Persons separating from their employer and returning within the same year, however, are not counted.

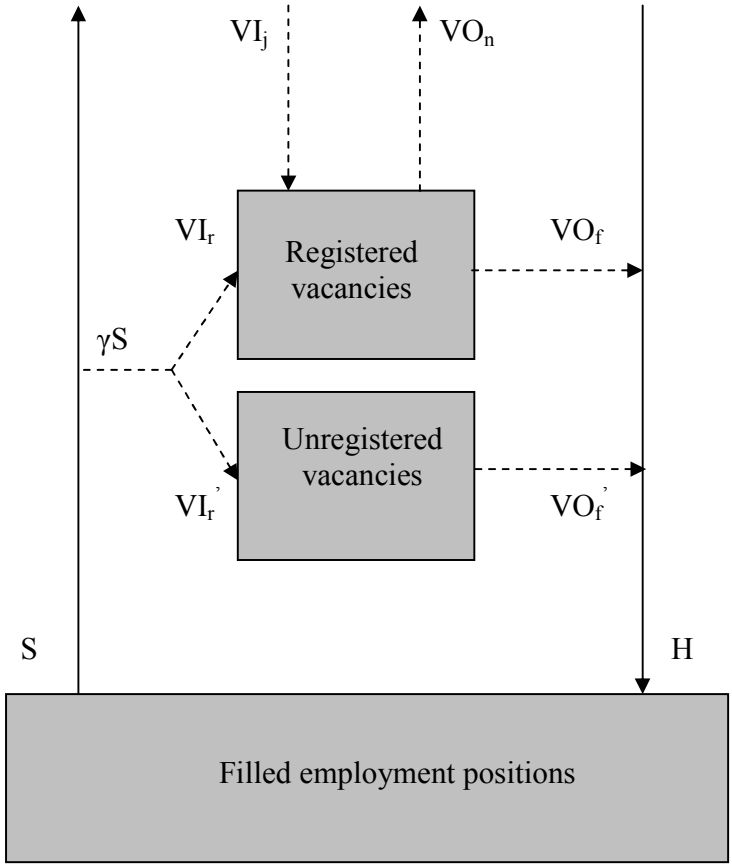

Figure 2. The vacancy flow model of the labour market.

dashed lines depict flows into and out of the stock of vacancies. Because not for all vacant jobs a vacancy will be registered, we decompose the stock of vacancies into those registered and those unregistered. Registered vacancies are vacancies, which are reported by employers in the VS of Statistics Netherlands. Information on how the VS is conducted teaches us that reported vacancies exclude vacancies for short temporary employment positions, for example for working on a one-day event. We assume that registered vacancies relate to employment positions lasting at least one year. Inflow into the stock of registered vacancies (VI) is given by $VI = VI_j + VI_r$, where VI_j denotes newly created vacancies and VI_r stands for new vacancies arising from the separation of workers. The VS gives data on VI, but the decomposition into its component parts is unknown. We assume that a fraction $\gamma = 0.53$ of separated workers is being replaced. This replacement rate for 2004 is given in OSA (2007) and derived from the OSA labour market panel, a sample survey among all labour market organisations with at least 5 workers in the Netherlands. Hence, $VI_r = \gamma S_{\geq 1}$ and $VI_j = VI - \gamma S_{\geq 1}$, with $S_{\geq 1}$ equal to the number of separations from jobs lasting ≥ 1 year. Outflows out of the stock of registered vacancies are split into cancelled and filled vacancies, i.e. into VO_n and VO_f, respectively. The VS provides data on both these outflow components. The inflow of unregistered vacancies (VI_r') is computed as $VI_r' = \gamma S_{<1}$, with $S_{<1}$ equal to the number of separations from jobs enduring < 1 year. We assume that $VI_r' = VO_f'$, where VO_f' is the outflow of unregistered vacancies. This assumption implies that the stock of unregistered vacancies remains unchanged.

Table 3 presents the estimated vacancy flows for the various job definitions. VI, VI_r, VI_j, VO_n and VO_f relate to registered flows, and hence to vacancies for jobs enduring at least 12 months. Therefore, these vacancy flows are identical across job definitions encompassing all jobs, jobs

Table 3. Vacancy flows in the model of figure 2.

	All jobs	≥ 3 months	≥ 12 months	≥ 12 hours per week	Fixed relation
	×1000				
γS	1,760	1,020	527	1,196	1,154
VI	725	725	725	634	670
VI_r	527	527	527	407	459
VI_r'	1,233	493	0	789	695
VI_j	198	198	198	227	211
VO_n	66	66	66	58	61
VO_f	633	633	633	554	585
VO_f'	1,233	493	0	789	695

enduring ≥ 3 months and jobs enduring ≥ 1 year. The table shows that 88% of the variables that are directly observed in the VS (VI, VOn and VOf) relate to jobs for ≥ 12 hours per week and 92% to jobs with a fixed labour relation. These percentages relate to the filled employment positions for these kinds of jobs in the total number of filled employment positions which last ≥ 1 year.[6,7] Note, that, due to our observation that all vacancies for jobs which last ≥ 1 year are registered, VI_r' and VO_f' are equal to 0 for a job definition including only jobs ≥ 1 year. The change in the number of vacancies (ΔV_t) is calculated as $\Delta V_t = V_t - V_{t-1} = (VI_j + VI_r + VI_r') - (VO_n + VO_f + VO_f')$.

In the model of figure 2, job flows are calculated as follows. Job creation equals hires that are not accompanied with an outflow of either registered or unregistered vacancies, plus the newly created vacancies: $JC = H - VO_f - VO_f' + VI_j$. Job destruction equals separations that are not replaced, plus the cancelled vacancies: $JD = S - VI_r - VI_r' + VO_n$. Job turnover (JT) is equal to the sum of both kinds of job flows: $JT = JC + JD$.

The results for labour market flows using this calculation method are presented in table 4. In the table, $WI - WO = JC - JD - \Delta V$. Hence, churning outflows differ from churning inflows by the change in the number of vacancies: $WO - JD = WI - JC + \Delta V \rightarrow CO - CI = \Delta V$. Note, that $CO \neq \gamma S$. The reason is that vacancies may be scrapped before becoming filled: $CO = \gamma S - VO_n$. Rates are again calculated by dividing by the average number of jobs. However, the calculation of this average number significantly differs from the computation in section 4.[8] First, we use a continuous-time measure of the average number of filled employment positions. This measure is a weighted mean with each filled position that exists during (part of) the year counting only for its duration within the year. This yields an average number of 7.5 million filled employment positions.[9] The average duration of these positions within 2004 was 269 days.[10] Next, added to this average number of filled

[6] By the number of filled employment positions we mean the amount of filled positions which exists during (part of) the year.
[7] These percentages could also be used to compute VI_r by means of γS. This alternative calculation would increase VI_r and lower VI_r', VI_j and VO_f', all by the same amount (54 thousand and 28 thousand, respectively). The sizes of job flows, however, would not be affected.
[8] Information on the precise calculation is available upon request.
[9] The number of filled employment positions which existed during (part of) 2004 was 10.2 million.
[10] This compares to an average employment spell within 2004 of 301 days.

Table 4. Worker flows, job flows and churning flows, main job characteristics, 2004.*

	Worker flows			Job flows			
	Worker inflow	Worker outflow	Worker turnover	Job creation	Job des-truction	Job turnover	Churning flows
	× 1000						
All jobs	3,271	3,320	6,591	1,603	1,626	3,229	3,362
	(42.9)	(43.5)	(86.4)	(21.0)	(21.3)	(42.3)	(44.1)
More strict job definition							
Job duration							
≥ 3 months	1,871	1,924	3,795	943	970	1,913	1,881
	(25.0)	(25.7)	(50.7)	(12.6)	(13.0)	(25.6)	(25.1)
≥ 12 months	922	994	1,917	487	533	1,021	896
	(13.3)	(14.4)	(27.7)	(7.1)	(7.7)	(14.8)	(13.0)
Working time							
≥ 12 hours per week	2,192	2,257	4,449	1,076	1,119	2,194	2,254
	(33.4)	(34.3)	(67.7)	(16.4)	(17.0)	(33.4)	(34.3)
Labour relation							
fixed	2,065	2,178	4,243	995	1,085	2,080	2,163
	(29.9)	(31.5)	(61.4)	(14.4)	(15.7)	(30.1)	(31.3)

*Flow rates as percentages of the average number of jobs are in parentheses.

employment positions are the average numbers of registered vacancies (118 thousand) and unregistered vacancies (41 thousand).

Now that we use continuous-time measurement and include vacancy flows, calculated flows are much larger. Worker, job and churning flows in the first row of table 4 exceed those in table 1 by a factor of about 2.5, 3.5 and 2.0, respectively. The gross number of worker transitions is particularly large: 3.271 million entries and 3.320 million exits. Job turnover equals 3.229 million: 1.603 million created jobs and 1.626 million destroyed jobs. This means that 1 in 5 jobs were created and another 1 in 5 jobs were destroyed in 2004. Job turnover accounts for 49% of worker turnover. Or, in other words, about half of worker turnover relates to churning. In section 4, we estimated that job reallocation accounts for 36% of worker reallocation. Thus, the calculations according to the continuous-time method yield a lower fraction of worker flows attributable to churning. The effect of deleting short-term jobs from the job definition is huge. Turnover is cut by about 40% and 70% respectively if jobs lasting < 3 months and < 12 months are excluded. Churning is reduced to nearly a half and a quarter, respectively. Short-duration jobs clearly are responsible for much of the observed dynamics, despite the fact that 98.1% of the average number of jobs represents jobs with duration of 3 months or more and 90.7% represents jobs with duration of 1 year or more. Though less drastic, deleting jobs with working times < 12 hours per week and jobs with flexible labour relations also significantly reduces the sizes of measured flows. Jobs with working hours of 12 hours or more per week and jobs with a fixed labour relation represent 86.2% and 90.6% respectively of the average number of jobs.

The results by employer size and economic activity are given in table 5. Qualitatively, the findings are in conformity with those in table 2. Again, the sizes of the flows decrease with employer size. Employers with 10 workers or more and with 100 workers or more provide 82.6% and 58.5%

Table 5. Worker flows, job flows and churning flows, firm characteristics, 2004.*

	Worker flows			Job flows			
	Worker inflow	Worker outflow	Worker turnover	Job creation	Job des-truction	Job turnover	Churning flows
	× 1000						
All jobs	3,271	3,320	6,591	1,603	1,626	3,229	3,362
	(42.9)	(43.5)	(86.4)	(21.0)	(21.3)	(42.3)	(44.1)
Firm characteristics							
Employer size**							
≥ 10 workers	2,439	2,516	4,955	1,163	1,221	2,384	2,571
	(38.7)	(39.9)	(78.6)	(18.5)	(19.4)	(37.8)	(40.8)
≥ 100 workers	1,643	1,680	3,323	781	809	1,590	1,733
	(36.8)	(37.7)	(74.5)	(17.5)	(18.1)	(35.6)	(38.8)
Economic activity**							
agriculture, forestry and fishing	147	150	297	70	72	142	155
	(107.8)	(110.5)	(218.2)	(51.3)	(53.3)	(104.5)	(113.7)
mining and quarrying	1	1	2	1	1	1	1
	(12.5)	(14.0)	(26.5)	(6.1)	(7.7)	(13.7)	(12.7)
manufacturing	164	188	352	70	94	164	188
	(17.9)	(20.6)	(38.4)	(7.6)	(10.3)	(17.9)	(20.5)
electricity, gas and water supply	3	4	7	1	2	3	3
	(10.3)	(12.4)	(22.7)	(4.4)	(6.5)	(10.9)	(11.8)
construction	87	101	188	40	52	92	96
	(22.3)	(25.8)	(48.1)	(10.3)	(13.3)	(23.6)	(24.6)
trade, hotels, restaurants and repair	679	694	1,373	335	343	678	695
	(44.2)	(45.1)	(89.3)	(21.8)	(22.3)	(44.1)	(45.2)
transport, storage and communication	142	155	298	63	76	140	158
	(30.2)	(33.0)	(63.2)	(13.4)	(16.2)	(29.6)	(33.5)
financial and business activities	1,388	1,357	2,744	698	655	1,353	1,392
	(87.4)	(85.4)	(172.8)	(44.0)	(41.2)	(85.2)	(87.6)
general government	172	187	359	83	92	175	184
	(16.8)	(18.3)	(35.1)	(8.1)	(9.0)	(17.1)	(18.0)
care and other service activities	462	464	926	229	230	459	467
	(31.8)	(`31.9)	(63.7)	(15.8)	(15.8)	(31.6)	(32.1)

* Flow rates as percentages of the average number of jobs are in parentheses.
** Exclusive of a category "unknown".

respectively of the average number of jobs. Also, worker and job flows are relatively high for the industries agriculture, forestry and fishing, financial and business activities, and trade, hotels, restaurants and repair. These three industries account for 1.8%, 20.8% and 20.2% respectively of the average number of jobs. Dynamics are relatively low for general government and manufacturing. These economic activities enclose 13.5% and 12.0% respectively of the average number of jobs. From a comparison of tables 5 and 2 it appears that the increase in labour market dynamics now that all short jobs are fully counted, is especially sharp in agriculture, forestry and fishing, and in the financial and business activities. Apparently, these sectors are not only relatively dynamic when flows are measured at discrete times, but even more so when all short jobs are taken into account.

It is difficult to compare our findings from the continuous-time measurement method with other studies. The reason is that nearly all other studies calculate gross flows from changes that occur from one point in time to another one year or one quarter later. In addition, the definition of a job generally does not include vacancies. Noteworthy is a study by Abowd *et al*. (1999), which uses a representative sample of French establishments with at least fifty employees from 1987 to 1990 to compare job creation and destruction rates on a year-to-year basis with worker flow rates excluding within-year entry and exit. Analogously, job flow rates on a year-aggregated monthly basis are compared with worker flow rates including within-year entry and exit. In their analyses, the average year-to-year job creation rate of 7.6% compares to an average year-aggregated monthly creation rate of 17.4% for establishments with increasing employment. The average year-to-year job destruction rate of 6.9% compares to an average year-aggregated monthly destruction rate of 15.0% for establishments with decreasing employment. Hence, job flow rates more than double by measuring in a way that approximates our continuous-time measurement. Comparing tables 1 and 4, our results point to job creation and destruction rates, which are about three times higher. Also, their result that inclusion of within-year entry and exit approximately doubles calculated worker entry and exit rates is in line with our findings.

6 Summary and conclusions

This paper investigates the sensitivity of the measurement of labour market flows for three major aspects of the definition of a job, namely (i) the size of a job (all jobs including small ones, or only jobs for more than 12 hours a week); (ii) the length of a job (all jobs including very short ones or only jobs which last for more than 3 months or one year); and (iii) the inclusion of vacancies in the definition of a job. We take the calendar year 2004 as our reference period and use a unique data set of Statistics Netherlands, which combines a job register for all industries in the Netherlands and a register of persons, which covers the entire Dutch population. The sensitivity analysis is conducted by comparing two alternative methods for the construction of the flow data, namely (a) the standard method of Davis and Haltiwanger where flows are measured as changes between discrete times, and (b) a method of measuring all flows that occur during the interval where all short-term jobs and job dynamics within employment units are fully taken into account. Moreover, as job flows should provide comprehensive information about the demand side of the labour market, our continuous-time measurement of labour market flows includes vacant jobs. In order to take inflow and outflow of vacancies into account we have linked our data set of combined registers of persons and jobs to the data from the Vacancy Survey of Statistics Netherlands. Finally, our data set allows us to make a consistent comparison of worker flows and job flows so that we are able to calculate churning rates, i.e. the rates of separations of workers from jobs, which are not destroyed and therefore are to be filled by other workers. These churning rates are closely related to the so-called vacancy chains, which indicate how many times on average the same job is filled by a different worker.

Now that our data set allows us to measure labour market flows over an interval, we prefer this method to the kind of measurement based on point-in-time changes. In fact, job creation and

destruction are continuous-time phenomena, i.e. jobs are being created and destroyed at any point in time. Counting every change in the number of jobs highlights the true extent of dynamics at the demand side of the labour market. It means that job flows within employment units are included as well. In addition, job creation and job destruction are not restricted to growing and shrinking employers, respectively. Continuous-time measurement allows users of the data to analyse labour market dynamics by choosing their own definition with respect to length and size of jobs to be included in the analysis. Moreover, it implies that the choice of the length of the reference period is not crucial. For example, data calculated on an annual basis for one year simply equal the sum of the outcomes derived on a quarterly basis for the same year. This does not hold for job flows computed from point-in-time levels. A 12-months sampling interval excludes all within-year flows of jobs with duration of less than 1 year. By contrast, a 3 months interval would exclude all within-quarter flows of jobs with duration of less than 1 quarter.

With respect to job creation and destruction our continuous-time method yields 1.603 million created jobs in 2004 (1 in 5) and 1.626 million destroyed jobs (1 in 5). By contrast, according to the discrete-time measurement, which mimics the Davis and Haltiwanger method, 428 thousand jobs are created (1 in 16) and 477 thousand jobs are destroyed (1 in 14). In comparing job flows and worker flows, both kinds of flows should of course be measured conceptually the same. Therefore, we compare the job flows measured between discrete points in time with worker flows measured in the same way. Alternatively, we compare continuous-time job flows with worker flows measured similarly. These latter flows include multiple changes of employer or of labour market status within the reference period. We estimate worker turnover to be 6.591 million and worker reallocation to be 2.487 million. Hence, job turnover accounts for 49% of worker turnover and job reallocation accounts for 36% of worker reallocation. In other words, approximately half of worker turnover and two-thirds of worker reallocation relates to churning.

Our sensitivity analysis shows that in the preferred continuous-time measurement the choice with respect to the length (duration) of a job is by far the most important one in the definition of a job. As table 4 clearly shows, labour market dynamics are dominated by short-duration jobs. A job definition including only jobs that last at least 3 months implies a reduction of measured turnover with respect to both jobs and workers by about 40%. Imposing a restriction on job duration of 12 months or more yields approximately a 70% lower turnover. The important role of short-term jobs is not revealed, however, by the numbers in table 1. Annual flows based upon the discrete-time methodology of Davis and Haltiwanger exclude, *a priori*, a vast amount of dynamics, i.e. the within-year flows relating to jobs that last shorter than 1 year. In other words, this method has an implicit definition of job length where the shorter the jobs are, the less weight they carry in the measurement of labour market dynamics.

We also investigate the sensitivity of our results to the assumptions about working time per week and type of labour relation in the definition of a job. Both worker and job turnover are reduced by 32% if jobs are defined exclusive of work for less than 12 hours per week. Turnover declines with 36% if the definition of jobs is restricted to jobs with a fixed labour relation. These exclusions also significantly lower annual worker and job reallocation. The impact, however, is considerably smaller on reallocation than on turnover.

Finally, we show that, in conformity with studies on labour market dynamics for other countries, labour market flows vary considerably across employers in the Netherlands. Small employers have higher annual reallocation and turnover than larger employers. Also, employers in the sector financial and business activities, in the sector trade, hotels, restaurants and repair, and in the agricultural sector have a relatively high annual reallocation and turnover. These indicators of labour market dynamics are relatively low for employers in the government and manufacturing sector.

The analysis of this paper indicates the importance of making explicit all aspects of the definition of a job when constructing data for the measurement of labour market dynamics. Differences in job definition, especially when the length of a job is implicit in the methodology, may hamper international comparisons with respect to labour market dynamics and flexibility. The data set with combined individual job and person registers we use, allows investigating many more characteristics of jobs and persons than this paper does. In that sense the paper provides a starting point for a fully-fledged analysis of determinants of labour market flows. On the other hand, in order to obtain more insight into the dynamics of vacancy chains, internal job mobility and the dynamics of matching vacancies with workers, more information should become available on how to link vacancy data with the data set of the combined registers. Another extension of the data set would be to distinguish between the various states of the labour market – employed, unemployed, recipient of other social security benefits, non-participant, at school, retired – so that a more complete analysis of various labour market transitions and the resulting hazards and durations can be made. The continuous-time measurement of job flows and worker flows of this paper is a first step in that direction.

Appendix
The model of job and worker flows with more transitions

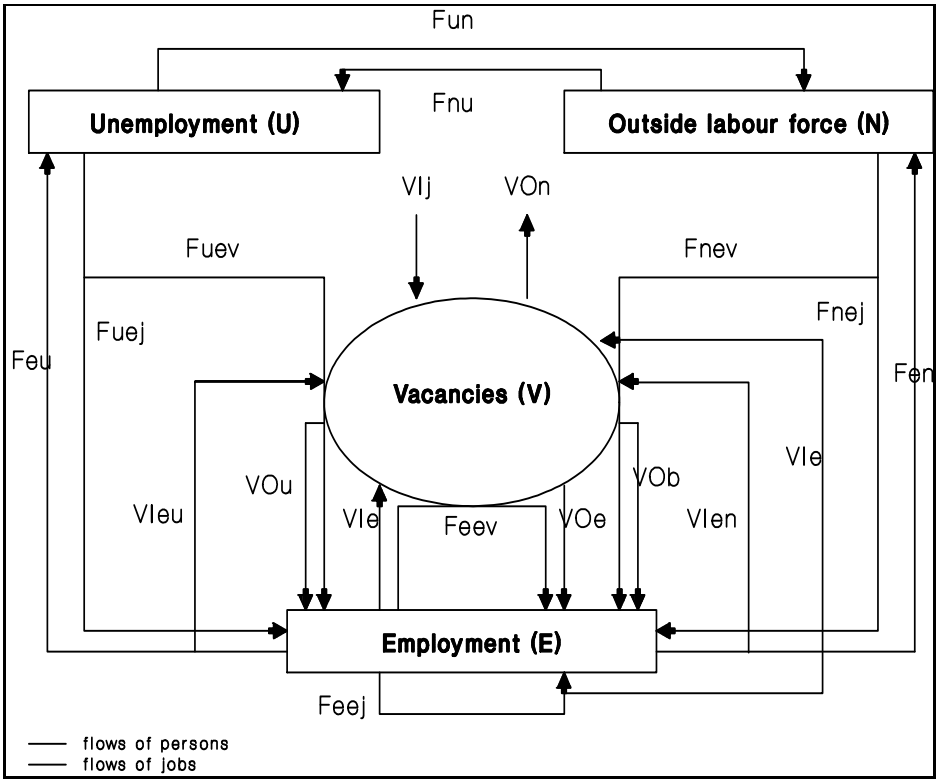

Figure A1. The relation between job flows and worker flows in case of transitions between employment, unemployment and non-participation.

The procedure of the main text calculates data for job flows and worker flows where the state out of employment is not further specified. Figure A1 shows all stocks and flows to be included into a comprehensive national accounting system of labour market flows at the macro level, which distinguishes between unemployment and non-participation as states of being out of employment (based on Den Butter, 1993). Vacancy flows are indicated by the notation VO for the flow out and VI for the flow into the stock of vacancies. Flows of persons 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. Hence, not all new jobs are taken by filling a vacancy, but persons may also take a job for which no 'official' vacancy existed. In this case, one can think 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 post their vacancies. Figure A1 also pictures the connection between flows of persons and flows of vacancies. For example, 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 ($F_{uev} = VO_u$).

Job creation (JC) does not only include inflow of new vacancies, but also the newly filled jobs for which no vacancy existed: $JC = VI_j + F_{eej} + F_{uej} + F_{nej}$. Job destruction (JD) involves all jobs of persons

who left their jobs and were not replaced so that no new vacancies resulted. Moreover, vacancies that are scrapped before being filled are also part of job destruction: JD = $(F_{eu} - VI_{eu}) + (F_{en} - VI_{en}) + (F_{eej} + F_{eev} - VI_e) + VO_n$.

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 z = v in case of vacancies)
F_{eu}	Workers who become unemployed by losing 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 persons who find a new job by filling a vacancy
F_{uej}	Unemployed persons who find a new job for which no (registered) vacancy exists
F_{nej}	Non-participants (outside the labour force) who find a new job for which no (registered) vacancy exists
F_{nev}	Non-participants who find a job by filling a vacancy
F_{un}	Unemployed persons leaving the labour force
F_{nu}	Non-participants who register as unemployed

Flows 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 another job
VI_{en}	New vacancies because of quits and lay-offs of workers who leave the labour force
VO_u	Vacancies filled by unemployed persons
VO_b	Vacancies filled by non-participants
VO_e	Vacancies filled by job movers
VO_n	Removed vacancies

Stocks

E	Employment
N	Non-participants
U	Unemployment
V	Vacancies

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