Employee flows to improve measures of job creation and destruction and of firm dynamics. The case of Belgium

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Abstract

This paper presents a method for improved estimation of measures of firm dynamics and job creation and destruction. We use employee flow information to re-establish broken links between records of the same firm, and to identify relationships between firms in case of mergers, take-overs, split-offs, and other forms of restructuring. The method is developed on the basis of a linked employer-employee data set covering all private employment in Belgium.

The employee flow approach results in substantial quality improvement of the measures discussed. First, it leads to significant reduction of the upward bias in statistics of firm dynamics and job reallocation. In the period of observation, we find that 35 to 50 per cent of total entries and exits of firms with at least 10 employees does not coincide with the real opening or closing of a firm. Overall job creation and destruction levels are revised downwards by 14.5 and 16.6 per cent respectively. Second, correcting for employee flows reduces annual variation in estimated measures, revealing more regular patterns of firm and employment dynamics, especially at the sectoral level.

Keywords: Firm dynamics, Job creation and destruction, Micro data

JEL-Classification: J23, J21, C81

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1 Introduction[1]

Measures of net employment growth, usually aggregated at the sectoral or national level, are still used as predominant indicators to monitor labour market trends, and to compare growth rates in industries and countries. However, these time series mask the turbulent process of firm entry and exit, and of job creation and destruction which takes place continuously in all sectors of the economy. Aggregate employment statistics cannot capture this turbulence, they do not reveal the firm characteristics of success and failure, neither do they allow an analysis of the consequences for employees of the continuous reallocation of jobs.

Hence, since the late 1970s data on firm dynamics and on job creation and destruction have been studied to enhance understanding of economic turbulence and of job gain and loss (Birch, 1987; Davis, Haltiwanger & Schuh, 1997; Bartelsman, Scarpetta & Schivardi, 2005; Cahuc & Zylberberg, 2006; Brown, Haltiwanger & Lane, 2006). These data decompose net employment measures into gross job flows and firm entry and exit, and therefore facilitate the analysis of the drivers and effects of labour market changes. Empirical studies on job flows have revealed a substantial amount of churning underlying net growth rates. Moreover, they have shown that considerable movements of job creation and destruction often occur simultaneously in the business cycle and within narrowly defined sectors (Davis, Haltiwanger & Schuh, 1997; Blanchflower & Burgess, 1996; Albaek & Sorensen, 1998; Faggio & Konings, 2001; Stiglbauer, Stahl, Winter-Ebmer & Zweimüller, 2002; Clayton & Spletzer, 2008). Since the late 1990s, longitudinal firm level databases have extended research possibilities in the field and have stimulated academic research on micro-economic drivers and macro-economic consequences of job creation and destruction, firm dynamics, and their impacts on employees (Persson, 1999; Abowd, Corbel & Kramarz, 1999; Foster, Haltiwanger & Krizan, 2001; Baldwin, Beckstead & Girard, 2002; Piekkola & Böckerman, 2002; Davis, Faberman & Haltiwanger, 2005). In policy-relevant research, job flow data are used as well, for example to study the effect of economic institutions and policy on employment and productivity growth (Scarpetta, Hemmings, Tresselt

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& Woo, 2002; Brandt, 2004; Gómez-Salvador, Messina & Vallanti, 2004; Haltiwanger, Scarpetta & Schweiger, 2006).

Pros and cons of administrative firm level data

Large administrative firm level data sets have become prevalent sources for the estimation of measures of firm dynamics and of job creation and destruction. Cross-sectional microdata from business registration, social security, or taxation systems are used to create longitudinal linked employer-employee data sets both at a national, a European and an OECD level (Albaek & Sorensen, 1998; Baldwin, Dunne & Haltiwanger, 1998; Persson, 1999; Korkeamäki & Kyyrä, 2000; Baldwin *et al.*, 2002; Eurostat, 2003; Abowd, Haltiwanger & Lane, 2004; Bartelsman *et al.*, 2005). The main advantages of these data sources are the complete, or nearly complete coverage of the target population, access to exact estimates for detailed sub-populations, cost-effectiveness, and reduction of the response burden on businesses (Vale, 2003).

Although the advantages of using administrative data are indisputable, these sources also have some drawbacks, which lead to inaccuracies in the estimations of firm dynamics and hence of job creation and destruction. One of the major problems arises from failures in the period-to-period linking of individual firms' records. Individual firms in administrative data sets are usually identified by a unique identification code, such as the business registration number, which allows the longitudinal integration of firm level information. When, however, the continuity of a firm's identification code is broken, records are falsely identified as new or closing firms, which results in an upward bias in firm dynamics and in job flow measures. A second problem is caused by the difficulty to identify changes in firm structure on the basis of administrative data, which likewise results in inaccuracies in the estimation of flow measures.

The first problem, failures in the period-to-period linking of individual firms' records, occurs when the identification code of a firm changes. This can be the result of a change in the legal form of the firm, a change of ownership, or simply a change of accountants (for discussion of the reasons see Vilhuber, 2009 and Baldwin *et al.*, 2002). The disappearance of the previous identification code of a firm from the data set is recorded as a firm closing involving the destruction of jobs, and the appearance of a new ID is classified as a new firm creating jobs. Since, however, the new firm

is economically identical to the previous one, no 'real' economic demographic event has taken place (Benedetto, Haltiwanger, Lane & McKinney, 2007; Ahmad, 2008), neither has the firm's employment been destroyed or newly created. Such linkage failures thus falsely define both firm openings and closings and hence yield an upward bias in firm dynamics and in job flow measures (Spletzer, 1998; Brandt, 2004; Abowd & Vilhuber, 2005).

While the first problem appears in case of broken 'one-to-one' links of individual firms, the second problem occurs when multiple firms are involved. Changes in firm structure, such as the fusion of the factors of production of several firms into one, or the division of a firm into multiple ones, can cause an upward bias in dynamics measures. Consider an example of the many-to-one case, which occurs in the event of a merger, an acquisition, or more generally a 'consolidation' (Pinxton & Spletzer, 2002). In this case, one of the previously existing firm IDs disappears from the data set, which is then classified as a firm closing involving job destruction. The successor firm, absorbing the jobs of the previous one(s), is classified as an expanding or a new employer creating jobs. Although the transfer of jobs in case of mergers and acquisitions is an economically significant event, it is generally accepted that it should not be included in measures of job creation and destruction (Persson, 1999; Baldwin *et al.*, 2002; Eurostat, 2003; Benedetto *et al.*, 2007; Ahmad, 2008). Failing to link the records of consolidating firms thus results in an upward bias in job flow measures. Similarly, it can easily be understood that the opposite 'one-to-many' event, which occurs in the case of a spin-off, a breakout, or a break-up, also causes an overestimation of job flow measures.

To address these longitudinal linkage problems in firm level data sets, different methods have been developed. Commonly applied methods use probabilistic matching based on similarities in partial firm identifiers. More recently, linkage methods based on employee flows have been developed as a complement or an alternative to probabilistic matching. This paper contributes to the latter approach by presenting a method for the establishment of linkages between firm identifiers using employee flow information. The data that are used stem from a Belgian social security register with linked employer-employee data covering 90 per cent of national employment. The motivation to develop this method has come from the lack of reliable firm level data on employment and business dynamics in Belgium, which severely hampers national research on labour market changes. In a recent working paper by the Na-

tional Bank of Belgium on job creation and destruction, for example, the authors point out that "the calculations are affected by the issue of mergers and acquisitions" (Heuse & Saks, 2009, p. 10). The aim of this paper is to show that a substantial quality improvement of firm dynamics and job flow measures can be reached by using simple criteria. The presented method is the result of a collaboration between the statistics department of the Belgian National Social Security Office and the Work and Organization research group of HIVA - Katholieke Universiteit Leuven.

The paper is structured as follows. Section 2 presents a brief overview of existing methods of linking firm identifiers. Section 3 contains the data and the definitions that are used. Section 4 describes the procedure that was followed to construct predecessor-successor links, and the decision rules that were implemented to distinguish between spurious and genuine openings and closings of firms. Section 5 provides an overview of the results for ten types of changes in firm structure or firm identifier. Section 6 explains the correction formula that is applied to adjust job creation and destruction measures. Section 7 presents the impact of the method on economic estimates: both indicators of firm dynamics and job creation and destruction measures are discussed. The findings are compared with the results of international research. Section 8 discusses the weakness of the method presented and proposes further elaborations. Section 9 concludes the paper.

2 Methods of linking firm identifiers

2.1 Matching based on partial firm identifiers

The one-to-one linkage problem of firm records in administrative data is well understood and has been tackled by a variety of methods. By connecting previous and subsequent administrative identifiers of firms, these methods reduce the occurrence of falsely defined births and deaths of firms, thus allowing more accurate job creation and destruction measures. The most commonly adopted methods are based on probabilistic matching: probable links between firm records are established on the basis of a comparison of partial identifiers of firms, such as name, location, and industry. For example, in a harmonized methodology for business demography, Eurostat and OECD recommend a matching process based on three 'continuity factors':

name, location and economic activity (Eurostat/OECD, 2007). The US Bureau of Labor Statistics adopts a probability-based weighted match process using name, address and phone number to link the records of individual establishments (Robertson, Huff, Mikkelson, Pivetz & Winkler, 1997; Abowd & Vilhuber, 2005). In some countries, probabilistic matching techniques are preceded by administrative editing and review based on information from surveys and other administrative data, such as information about the firm's predecessors and successors (Spletzer, 1998; Bycroft, 2003; Vartiainen, 2005; Clayton & Spletzer, 2008). Matching processes, implemented by software, are commonly complemented by analyst intervention to validate matches or, if necessary, to manually link the records of large firms (Eurostat/OECD, 2007, p. 36; Clayton & Spletzer, 2008, p. 6). Vilhuber (2009) provides an overview of current methods.

The second linkage problem, occurring when multiple firms are involved, is more difficult to address. Some record linkage methods are similarly adopted to identify relationships between firms that are involved in 'consolidations' or 'breakouts' (Pinxton & Spletzer, 2002; Mikkelson & Unger, 2006). Most of the above-mentioned methods, however, are not able to fully capture events such as mergers, split-offs, takeovers, and other forms of restructuring. Furthermore, compiling accurate job creation and destruction statistics in the case of these events causes additional difficulties (Pinxton & Spletzer, 2004; Eurostat/OECD, 2007, p. 26; Ahmad, 2008, p. 132). This is where the need for an alternative approach comes in.

2.2 Methods based on employee flows

The above-mentioned linkage processes make use of information on the continuity of controlling legal unit (name), activity (industry), and/or location (address) to establish links between unmatched records of the same firm. These methods do not take continuity of employment into account. Data on employee flows between firm identifiers can be used to fill this gap. If one of the main factors of production, the workforce, is identical in two administrative records, there is a high probability that these records relate to the same firm (Eurostat/OECD, 2007, p. 26; Benedetto *et al.*, 2007, p. 6; Ahmad, 2008, p. 132). Hence, continuity of employment, measured by flows of clusters of employees between two administrative firm identifiers, is a strong criterion to establish links between unmatched records of the same firm. This

means that a firm is considered continuous when it uses largely the same factors of production at two points in time. Furthermore, employee flows can be used to identify restructurings events: in case of a 'consolidation', employees previously registered in different firms are grouped into one firm record, and in case of a 'breakout', the employees of one firm are distributed among two or more records. It is clear that for the implementation of employee flow approach, linked employer-employee data are necessary.

Several countries have started to use employee flows to provide more reliable statistics on business and employment dynamics (Persson, 1999; Korkeamäki & Kyyrä, 2000; Baldwin *et al.*, 2002; Stiglbauer *et al.*, 2002; Bycroft, 2003; Benedetto *et al.*, 2007; Vilhuber, 2009). These methods generally follow the same logic: if a significant number, and/or a significant fraction of employees moves from one firm to another, then a relationship between a 'predecessor' and a 'successor' firm can be established. Most studies use the employee flow approach in order to remove spurious firm openings and closings from business dynamics statistics. Some also use this information to adjust job creation and destruction measures, or to identify changes in firm structure (Korkeamäki & Kyyrä, 2000, Mikkelson & Unger, 2006; Benedetto *et al.*, 2007). In this paper we do both. First, we use data on employee flows to distinguish between genuine firm openings and closings and other demographic events such as changes in administrative identifier or in organisational structure. Second, we propose an algorithm to correct year-to-year employment evolutions of firms involved in such events.

3 Data and definitions

The data in this study were obtained from a linked employer-employee data set which is maintained by the Belgian National Social Security Office (NSSO). NSSO collects and manages employer and employee social contributions. All employers hiring one or more employees have to register with the NSSO. They are required to submit quarterly declarations with information on wages and working times of every employee. Upon registration, the employer is assigned a unique identification number (NSSO number). Equally, every employee is uniquely identified by a social security number (INSS number). The quarterly declarations are filled out electronically, which ensures continuity of the employer identification, and which renders the

data ready to be processed. Local and provincial public employers are not included in the NSSO database. For reasons of confidentiality, NSSO data on unincorporated enterprises have not been included in the analysis presented in this paper.

The statistical units and indicators used in this paper have been developed according to international definitions and recommendations. This enables future incorporation of Belgian results in comparative research. For the main units of analysis - active employers, and employer openings and closings - we followed the joint Eurostat and OECD recommendations on business demography data collection (Eurostat / OECD, 2007; Ahmad, 2008). For indicators on job creation and destruction, we adopted the standard definitions proposed by Davis, Haltiwanger & Schuh (1997). The definitions will only be given briefly below. For detail and motivation, we refer to the cited references.

The central unit of analysis is the **employer**. Employers are firms hiring at least one employee. The definition of a firm in the NSSO database corresponds with the statistical unit of the enterprise recommended by Eurostat and OECD for business demography data collection:

> "The enterprise is the smallest combination of legal units that is an organisational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations. An enterprise may be a sole legal unit." [Council Regulation (EEC) No 696/93 of 15 March 1993]

Active employers and employer openings and closings in this paper are hence defined at the firm level. Because the quality of job flow measures depends on the correct identification of opening and closing units, job creation and destruction will also be estimated at the firm level. In large countries such as the U.S., job flow statistics are computed using establishment level data. The reason for this is that firm level data mask the job flows between different establishments of the same firm. For the study of business demography statistics in smaller countries such as the European ones, the firm is considered to be the most useful level of analysis (Ahmad, 2008; Eurostat, 2007). Several European studies, therefore, use firm level data for job flow measures. In smaller countries, the vast majority of firms (90 per cent in Belgium)

only have one establishment and thus firms and establishments align (Ahmad, 2008, p. 128). In smaller regions there is also considerable mobility of employees between establishments of the same firm, which would falsely be considered as job creation and destruction in an establishment approach. Furthermore, the use of firm level data enhances European comparative research since there is important variation in the definition of establishments across countries (Messina & Vallanti, 2007).

In this paper, the terms 'employer', 'firm', and 'employer firm' are treated as synonyms. The industry code of an employer is the code of its primary activity, which is assigned according to the NACE Rev.1 classification.

The **opening of an employer firm** - an 'employer enterprise birth' (Eurostat/OECD, 2007, p. 34) - coincides with the birth of a firm that has at least one employee in the year of birth and of firms that move from zero to one employee. Reactivations of 'dormant' employers having no employees for less than two years are not considered as openings. However, reactivations after two years or more, are. Thus far, an opening can be identified by using a simple quantitative criterion: each employer with at least one employee in year t and no employees in the two previous years, coincides with an opening. An important restriction to this definition is that no other firms are involved in the event: openings "do not include entries into the population due to: mergers, break-ups, split-offs or restructuring of a set of enterprises", neither do they include entries which are merely the result of a change of name, ownership, legal form, or activity (Eurostat/OECD, 2007, p. 34). In summary, employer openings involve "the creation of new production factors, in particular new jobs". To ensure that all recorded openings meet this definition, spurious openings will be tracked by means of clustered employee flows, and removed from the initial population of firm entries.

The definition of an **employer firm closing** - 'employer enterprise death' (Eurostat/OECD, 2007, p. 51) - mirrors that of an opening: the closing of an employer firm coincides with the "dissolution of a combination of production factors with the restriction that no other enterprises are involved in the event". They can be identified initially by a mere quantitative criterion, selecting all employers which move below the threshold of one employee for at least two years. Exits from the population due to changes of identification number, mergers, takeovers, break-ups, or restructuring of a set of firms are then removed from the initial population by means of the employee flow method.

A **job** is an employment position held by one employee in one firm. 'Employees' and 'jobs' are used as synonyms. Employees supplied by temporary employment agencies are not counted as personnel of the hiring firm, but of the employment agency. Quarterly employment at the firm level is measured as the total number of employees on the last day of the quarter. Annual employment at the firm level is measured as the number of employees on the last day of the second quarter (June 30).

We adopted the standard definitions for measuring **job creation and destruction** Davis, Haltiwanger & Schuh (1997) proposed in their research on U.S. manufacturing data. As explained above, however, all measures are computed at the firm level instead of at the establishment level. Jobs are counted as the number of persons employed by an individual firm. (Gross) job creation at time t (JC_t) equals employment gains summed over all firms that expand or start-up between $t-1$ and t, and (gross) job destruction (JD_t) equals employment losses summed over all firms that contract or shut down between $t-1$ and t. Total job reallocation (JR_t) can then be measured as the sum of job creation and destruction, while net employment change (JN_t) is the difference between the two. In this paper we use annual employment changes to estimate job flow measures: let $E_{i,t}$ denote employment of firm i at the end of the second quarter (June 30) of year t, and $E_{i,t-1}$ employment of firm i at the end of the second quarter of year $t-1$, and let F_{expand}, $F_{contract}$, F_{open}, and F_{close} denote the subsets of expanding, contracting, opening, and closing employers respectively between $t-1$ and t, then

$$\text{Job creation, } JC_t = \sum_{i \epsilon F_{expand}} (E_{i,t} - E_{i,t-1}) + \sum_{i \epsilon F_{open}} (E_{i,t} - 0)$$

$$\text{Job destruction, } JD_t = \sum_{i \epsilon F_{contract}} (E_{i,t} - E_{i,t-1}) + \sum_{i \epsilon F_{close}} (0 - E_{i,t-1})$$

To compare levels of job reallocation across countries, industries, or other subsets, normalized rates of job creation and destruction are used. Job creation and destruction rates between $t-1$ and t in a subset of firms are calculated by dividing total job creation JC_t and destruction JD_t in the subset by the average of total employment in year $t-1$ and t in the subset. The averaging of the denominator over two periods results in job flow rates ranging from -2.0 to +2.0 and reflecting creation and destruction symmetrically. Job reallocation and net growth rates are calculated using the

same denominator. For rates up to about ± 20 per cent, results are approximately the same as when using the more conventional denominator, i.c. employment in year $t-1$. However, potential outliers in the data are smoothed.

It is important to note that it is commonly accepted to measure gross job creation and destruction as aggregate net employment changes at the firm level. This implies that these measures do not reflect the creation and destruction of jobs within firms, and are hence an underestimation of real job creation and destruction.

4 Using employee flows to link firms and to identify spurious firm openings and closings

This section describes the linkage process developed by the NSSO to link across time firms with a different administrative identifier in two consecutive periods but employing a workforce which is largely or partially the same. The process results in data sets linking predecessor and successor firms in two consecutive quarters. Imposing additional criteria on the predecessor-successor links, two subsets are selected: one including spurious firm openings, the other spurious firm closings. In section 6, this firm-demographic information is used for the estimation of job creation and destruction measures.

4.1 Linking firms by using employee flows

The point of departure of the NSSO linkage process are quarterly microdata sets of all labour relations. Containing over 3 million observations every quarter, they each represent an employer-employee link. Both employers and employees are recorded by means of a unique identification number. It is important to note that since the quarterly employer declarations to the NSSO have been collected electronically, the NSSO microdata are unlikely to be contaminated by measurement error: neither employers nor employees can be assigned a wrong identification number, and an employee cannot be linked to an employer which is not his/her.

The linkage process consists of two steps. The first step is to compare all employer-employee links of two successive quarters $q-1$ and q. Depending on whether they

exist in both quarters, the links are classified into several groups. Table 6 in Annex summarizes the results for the quarters 2003/2 until 2008/1. Of all employer-employee relationships in a certain quarter, on average 92 per cent is continued in the next quarter, 3.5 per cent consists of employees moving to another employer in the next quarter, and 4.5 per cent of employees flowing out of the population. When compared to the previous quarter, 3.3 per cent represents a transition of employees from another employer, and 4.9 per cent consists of inflow.

In a second step, the paired quarterly employer-employee links are aggregated at the employer level. For each employer i and for every pair of quarters $q-1$ and q, a distinction can thus be made between (1) employees staying with employer i in both quarters, (2) new employees of i in q coming in from outside NSSO employment, (3) new employees of i in q coming in from other employers in $q-1$, (4) employees working at i in $q-1$ moving out of NSSO employment, and (5) employees of i in $q-1$ moving to other employers in q. For employees changing employer, the IDs of the previous or the next employer(s) are retained. The subsets (3) and (5), including employees changing employer, are of specific interest to us. When a 'significant' cluster of employees moves from employer i to employer j, then a relationship between a so-called predecessor and successor firm can be established. When, however, only a small cluster of employees is moving from employer i to employer j, this is considered as individual mobility of employees simply changing jobs.

The data sets containing quarterly predecessor-successor relationships are subsequently used to identify openings and closings of employer firms. Before proceeding, however, we briefly discuss the various decisions rules that can be implemented to identify 'significant' clusters of employee flows.

4.2 Significant clusters of employee flows

The basic assumption of the employee flow method is that if two firms have a different administrative identifier in two consecutive periods in time, but employ a workforce which is largely or partially the same, the IDs relate to the same, or to parts of the same firm. Clusters of employees 'moving' in the business register from one firm identifier to another thus give a strong indication about changes in firm structures and firm identifiers. What the minimum 'significant' size of the cluster

of employees should be in order to establish a link between such a predecessor and successor firm is, however, the subject of academic discussion. Depending on the aim of the study, different relative or absolute thresholds are proposed. The drawback of a low cut-off level is that it risks including a considerable amount of mobility of individual employees, which are simply job changes. A high threshold, on the other hand, risks failing to capture events involving small firms. Relative minimum levels between 20 per cent and 80 per cent of the firm's workforce are used, as well as absolute cut-off levels or a combination of both (see e.g. Albaek & Sorensen, 1998; Persson, 1999; Korkeamäki & Kyyrä, 2000; Benedetto *et al.*, 2007; Vilhuber, 2009). When comparing the relative magnitudes of clustered transitions of at least five employees, Benedetto *et al.* (2007) found that the majority of transitions is either very small, accounting for less than 10 or 20 per cent of the predecessor / successor firm's workforce, or very large, including at least 80 per cent or more of the predecessor / successor firm's employment. It is reasonable to assume that small transitions are mainly the result of individual mobility of employees between firms, whereas large transitions principally refer to changes in firm structure or identifier.

In the method described in this paper, we take all movements of clusters of at least 10 employees as a point of departure. These are considered 'significant' employee flows on the basis of which a link between a predecessor and successor firm can be established. Subsequently, additional criteria are imposed in order to identify spurious firm openings and closings. As to movements of less than 10 employees, we believe there is a high probability that the results of a mere quantitative employee flow method are affected by individual employee mobility. In order to identify changes in firm structures and identifiers involving small firms, we therefore propose that other methods are used to complement the employee flow approach (see discussion in section 8).

4.3 Identifying spurious firm openings and closings

As explained above, we define spurious firm openings and closings as entries or exits to the population which are not the result of the creation or destruction of new or existing factors of production, but of changes in firm identifiers or of firm restructurings. Our focus on openings and closings implies that only predecessor-successor relationships involving at least one entry or exit are taken into account. 'Significant'

employee flows between two continuous firms have not been included in our analysis.

To identify spurious firm openings and closings, two subsets of the predecessor-successor links are selected. The first subset singles out 'spurious openings' and their predecessors. Spurious openings are employers who (1) move from zero employment in quarter $q-1$ to employing at least 10 employees in quarter q ('entries'), and which are (2) involved in at least one 'significant' employee flow (of at least 10 employees) from a predecessor in $q-1$. The second subset selects the 'spurious closings' and their successors. These are employers who move (1) from employing at least 10 employees in quarter $q-1$ to zero employment in quarter q ('exits'), (2) involved in at least one 'significant' transition of employees (at least 10 employees) to at least one successor in q, and (3) of which at least 75 per cent of the workforce has moved to another employer in q. The latter additional condition for spurious closings is imposed to distinguish bankruptcies, which are true closings entailing real job destruction, from changes in firm structures (such as mergers and acquisitions) and in firm identifiers. In case of a bankruptcy, an important part of the workforce may be recruited by local competitors, certainly in industries facing labour market shortages. Experience of NSSO experts shows that 75 per cent is a natural upper cut-off value for this kind of employee flows.[2] In other words, the exit of a firm, of which less than 75 per cent of the work force has moved to another employer in the next quarter, is considered as a real closing. This threshold is close to the 80 per cent cut-off value which is proposed by Benedetto *et al.* (2007) to identify significant employee flows from predecessor firms.

The quarterly subsets of spurious firm openings and closings and their respective predecessors or successors are compiled into annual data sets containing predecessor-successor links. They allow the estimation of the intended economic indicators: measures of firm dynamics and of job creation and destruction on an annual basis. In the four periods of observation, 2003/04 to 2006/07, a stable share of about 0.75 per cent of the employer records in the NSSO register coincides with a spurious opening or closing, or with a predecessor or successor linked to one of these. This does not seem much, but as will be discussed in section 7, these records represent an important share of apparent openings and closings of employers with more than 10

[2]One of the reasons that in case of a bankruptcy not more than 75 per cent of the workforce is recruited by competitors, is that often in Belgium, part of the personnel makes us of the possibility of early retirement.

employees. Moreover, they are responsible for a disproportionately large share of apparent job creation and destruction.

5 Ten types of changes in firm structure

The links between predecessors and successor firms employing largely or partially the same workforce can be interpreted as different forms of firm restructuring or of a change of administrative identifier. In Table 1, ten types of possible relationships are distinguished on the basis of two criteria: (1) the number of predecessors and successors involved in the event, and (2) the predecessors and successor categories (entry, exit, continuation). Table 7 in Annex reports the relative frequencies of these ten categories in the annual predecessor-successor data sets (2003/04 till 2006/07). Table 2 below summarizes the results.

As shown in table 1, predecessors are divided into exits, which are employers with a positive employment in year $t-1$ and zero employment in year t, and continuations, which are firms with a positive employment in both years $t-1$ and t. Similarly, successors are divided into entries, which have a positive employment in year $t-1$ and zero employment in year t, and continuations. As explained above, the combination of both a continuing predecessor and a continuing successor does not occur in the data set because only predecessor-successor relationships involving at least one entry or exit have been taken into account.

The vast majority of employers in the predecessor-successor data sets are involved in a one-to-one inter firm relationship (Table 7 in Annex). The major part of these are combinations of one exiting and one entering employer ID. Since both firms share a significant part of their workforce, there is a strong indication that such a predecessor-successor link represents a mere change of firm identifier.

Table 2 reports that on average 43.7 per cent of the employers in the predecessor-successor data set is involved in a change of firm identifier (group 1). The second largest category comprises employers involved in a merger or takeover (28.5 per cent). A takeover is defined as one or more exiting predecessor linked to an existing successor. On average 21.6 per cent of the employers in the data set is involved in a one-to-one takeover, and 4.9 per cent in a many-to-one takeover. Similar to this type

Table 1: Ten types of predecessor-successor relationships

1 predecessor linked to 1 successor		
	Successor categories:	
Predecessor categories:	*1 entry*	*1 continuation*
1 exit	Change of firm identifier (group 1)	Takeover of a firm by an existing firm (group 2)
1 continuation	Split-off of part of an existing firm (group 3)	
n predecessors linked to 1 successor		
	Successor categories:	
Predecessor categories:	*1 entry*	*1 continuation*
1 exit	Merger of several firms into a new firm (group 2)	Takeover of several firms by an existing firm (group 2)
at least 1 of n continues	Merger of several (parts of) firms into a new firm (group 4)	
1 predecessor linked to n successors		
	Successor categories:	
Predecessor categories:	*n entries*	*at least 1 of n is a continuation*
1 exit	Break-up of 1 firm into several new firms (group 3)	Break-up of 1 firm and takeover of at least 1 of the parts by an existing firm (group 4)
1 continuation	Split-off of several parts of an existing firm into new firms (group 3)	
n predecessors linked to n successors		
	Split-off/break-up of an existing firm and takeover of at least 1 of the parts by another firm which also takes over a third firm (group 4)	

of restructuring are mergers, consisting of two or more exiting employers linked to one new employer (2.1 per cent). Because the difference between takeovers and mergers on the basis of these quantitative measures represent a technical rather than an economic distinction, these events are treated as one category (group 2). A third major group are split-offs and break-ups (group 3; 22.1 per cent). Again, most of these (17.6 per cent) are one-to-one relations, i.c. between a continuing predecessor and an entering successor. Such events are labeled as split-offs. One-to-many split-offs, consisting of a link between one continuing predecessor and more than one entering successor, also occur sporadically (2.5 per cent). A third restructuring event in group 3 is the break-up of one exiting firm into several entering successors (2.0 per cent). Again, the distinction between split-offs and break-ups is rather artificial, so

Table 2: Number and share of employers involved in a predecessor-successor relationship; Belgium, 2003/04 - 2006/07

Group		2003-04 n	2004-05 n	2005-06 n	2006-07 n	4-year average n
1.	Change in firm identifier	524	510	649	649	583
2.	Merger, take-over	440	324	385	372	380
3.	Break-up, split-off	339	233	281	331	296
4.	Combination of 2. and 3.	47	88	37	30	51
	Rest	21	19	22	26	22
	Total	1371	1174	1374	1408	1332
Group		2003-04 %	2004-05 %	2005-06 %	2006-07 %	4-year average %
1.	Change in firm identifier	38.2	43.4	47.2	46.1	43.7
2.	Merger, take-over	32.1	27.6	28.0	26.4	28.5
3.	Break-up, split-off	24.7	19.8	20.5	23.5	22.1
4.	Combination of 2. and 3.	3.4	7.5	2.7	2.1	3.9
	Rest	1.5	1.6	1.6	1.8	1.6
	Total	100	100	100	100	100

Source: NSSO - HIVA K.U.Leuven

these events have been grouped together. A last and minor group consists of more complex relations between firms, such as a mergers of parts of several firms into a new firm, or many-to-many linkages (group 4; 3.9 per cent). A residual category comprises cases which are difficult to interpret, such as linkages which are the result of changes in social security legislation, or employers who are successively successor and predecessor in two quarters of the same year.

Once spurious openings and closings have been identified, they can easily be removed from the population of entries and exits. This allows the more accurate identification of real openings and closings of employer firms. The impact of these adjustments on measures of firm dynamics is presented in section 7.

6 Adjusting measures of job creation and destruction

Since significant employee flows between firms represent the movement rather than the creation and destruction of factors of production, job creation and destruction measures not taking into account this information are biased. The upward bias of both measures is clear: in the case of a predecessor, the bare comparison of employment in year $t-1$ and t results in an overstatement of job destruction. For successors, it results in an overstatement of job creation. For example, when firm A, with 50 employees in year $t-1$, is taken over by firm B, with 100 employees in year $t-1$ and 150 in year t, unadjusted job flow measures will report the destruction of 50 jobs (at the level of predecessor A) and the creation of 50 jobs (by successor B).

The identification of spurious openings and closings of firms and their respective predecessors and successors allows the adjustment of annual job flow measures. Below, we propose the formula's for the adjustment of job creation and destruction at firm level for the employers involved in a clustered worker flow. The adjustment is achieved for every pair of years $t-1$ and t, by correcting the employment levels in $t-1$ of the employers involved in a predecessor-successor relationship. The employment levels in t are left unaffected; they are considered as the correct point of departure for the computation of job flow measures in t. The correction formula which is applied imposes a continuation of the workforce at the level of the successor between $t-1$ and t. In other words, we proceed as if the employees who have made a transition from the predecessor to the successor between $t-1$ and t, were already part the workforce of the successor in $t-1$. In our example, the employment levels in $t-1$ of firm A and B after adjustment will be 0 and 150 respectively, yielding job creation and destruction measures of zero.

Let $S_{i,t}$ and $S_{i,t-1}$ denote the registered number of jobs of a successor i in year t and year $t-1$, and $P_{j,t}$ and $P_{j,t-1}$ the registered number of jobs of a predecessor i in year t and year $t-1$, and let $\sum_{i=1}^{n} S_i$ denote the sum of the jobs of the n successors linked to the same predecessor, and $\sum_{j=1}^{m} P_j$ the sum of the jobs of the m predecessors linked to the same successor, then the adjusted number of jobs of a successor i in year $t-1$, $S_{i,t-1}^{adj}$, is given by

$$S_{i,t-1}^{adj} = S_{i,t-1} + \left[\frac{|S_{i,t} - S_{i,t-1}|}{\sum_{j=1}^{m} P_{j,t} + \sum_{i=1}^{n} (|S_{i,t} - S_{i,t-1}|)} \times \sum_{j=1}^{m} P_{j,t-1} \right]$$

and the adjusted number of jobs of a predecessor j in year $t-1$, $P^{adj}_{j,t-1}$, by

$$P^{adj}_{j,t-1} = P_{j,t-1} - \left[\frac{P_{j,t-1}}{\sum_{j=1}^{m} P_{j,t-1}} \times \mathbf{Z} \right]$$

with

$$\mathbf{Z} = \sum_{i=1}^{n} S^{adj}_{i,t-1}$$

Table 8 in Annex reports the specific versions of the correction formula for the different categories of predecessor-successor links. In most cases, the formula is easy to interpret. For example, in case of a predecessor exit, the total number of jobs of the predecessor is assigned to the successor. If an exiting predecessor is linked to multiple successors, the jobs of the predecessor are distributed over the successors according to the relative size of the successors in year t. In case of a predecessor continuation, expression of the correction formula is more complicated: only a certain proportion of the jobs of the predecessor(s) is assigned to the successor: this proportion corresponds to the relative share of the jobs of the successor in the sum of the jobs of the predecessor and the successor in year t. As a last example, in case of multiple successors, the relative shares of the jobs of the predecessor are assigned to the successors according to the successor's relative sizes in year t. For the specification of the correction formula in other situations we refer to Table 8.

When applied to the four years of observation, adjusted annual figures of job creation appear to be on average 14 per cent lower than registered job creation, and job destruction figures are reduced by 17 per cent after adjustment. The next section presents the main impacts of these corrections on job flow measures.

7 Impacts on measures of firm dynamics and of job creation and destruction

In this section we compare unadjusted statistics on employer openings and closings and on job creation and destruction with adjusted measurements based on the employee flow method. The impacts on economic indicators are documented and the results are compared with international measures.

The period the data in this paper relate to is 2003/04 until 2006/07. These were four years of stable and moderate employment growth without any important aggregate fluctuations. Unadjusted data, however, show strong annual variation, both in the number of firm openings and closings, and in job creation and destruction levels. After adjustment, annual variation is considerably reduced, hence resulting in a more realistic picture of firm and employment dynamics in the years under consideration.

In order to present the impact of the method on economic estimates, we limited the scope of the data to NACE sections C to K. Thus activities relating to production, construction, trade, and private services are covered, but agriculture, public administration, and public services such as education and health services are not. The reason for this limited coverage is that it allows us to compare the results for Belgium with those published by Eurostat for other European countries.

We start by documenting the impact of the employee flow method on firm dynamics statistics. We then turn to measures of job creation and destruction.

7.1 Employer openings and closings

Table 3 reports unadjusted figures of firm entry and exit and adjusted estimates after suppression of spurious openings and closings. Because our data set does not contain information on firm employment in 2002, openings can only be defined from 2004/05 on and closings only until 2005/06 (see section 3 for definitions). On average, 2.9 per cent of apparent firm openings are spurious ones and 3.5 per cent of all firms apparently closing down can be identified as spurious closings.

The shares of spurious openings and closings in total firm entry and exit are broken down by size in Table 9 in Annex. Because our method only identifies spurious openings and closings of firms with at least 10 employees, the size classes in table 9 are above this threshold. In the period of observation, we find that 35 to 50 per cent of total entries and exits of employer firms with at least 10 employees does not correspond to the real opening or closing of a firm. Not surprisingly, as the size of the entering/exiting employer increases, it becomes more probable that it is not a real opening or closing. Of all entering firms with 10 to 19 employees in the year of entry, almost one in three is the result of clustered employee flow. Once above the threshold of 100 employees, it becomes very unlikely that a new firm entering

Table 3: Unadjusted and adjusted estimates of employer enterprise openings and closings, and birth and death rates; Belgium, NACE Rev. 1.1 Sections C to K, 2003/04 - 2006/07

	Openings (n)			Closings (n)		
	Unadjusted	Adjusted	*Percentage difference*	Unadjusted	Adjusted	*Percentage difference*
2003/04				11363	10966	*3.5*
2004/05	13630	13291	*2.5*	11570	11225	*3.0*
2005/06	13826	13415	*3.0*	11494	11045	*3.9*
2006/07	14489	14023	*3.2*			
	Birth rate (%)			Death rate (%)		
	Unadjusted	Adjusted		Unadjusted	Adjusted	
2003/04				8.7	8.4	
2004/05	10.0	9.8		8.6	8.4	
2005/06	10.0	9.7		8.5	8.1	
2006/07	10.4	10.0				
3-year avg.	*10.1*	*9.8*		*8.6*	*8.3*	

Source: NSSO - HIVA K.U.Leuven

the data register coincides with the real opening of an employer. The correction of employer closings shows a similar pattern. Of all employers disappearing from the data register, and employing 10 to 19 employees in the year of exit, 25 to 36 per cent does not correspond to the real closing of an employer firm. Among employer closings with more than 100 employees, 50 to 100 per cent of the exits is not a real closing.

What is the impact of these corrections on common indicators of firm dynamics? We first discuss birth and death rates of employer firms. Birth rates in the period $t-1$ to t are calculated as the number of employer openings in $t-1$ to t divided by the number of active employers in t. Death rates in the period $t-1$ to t are calculated as the number of employer closings in $t-1$ to t divided by the number of active employers $t-1$. Since spurious openings and closings represent a relatively small share of total firm entry and exit, birth and death rates of employer firms after correction are only slightly lower than unadjusted rates (Table 3). In the three years under consideration, birth rates drop on average from 10.1 to 9.8 per cent, and death rates from 8.6 to 8.3 per cent.

Birth and death rates allow the comparison of the levels of entrepreneurship across countries and across industries. As an example, in Figure 1 in Annex the unadjusted

and adjusted birth rates for Belgium are compared with the available estimates for the European member states published by Eurostat (Schrör, 2008; http://epp.Eurostat.ec.europa.eu). The estimates for the member states are produced according to the definitions discussed in section 3. They cover the same sectors as the Belgian results (NACE C to K). Having relatively low employer firm birth rates, Belgium's position in the ranking of available estimates for the other member states does not change after correction for spurious openings.

Although spurious openings make up only a small share of total firm entries, they represent a disproportionally large share of total employment created by apparently new employers. This is where the importance of the correction method becomes clear. Table 4 shows that annual job creation by new employers on the basis of unadjusted measures ranges from 54 000 to 68 000 jobs in the years under consideration. Between 35.6 per cent and 48.5 per cent of this apparent job creation is the result of clustered employee flows moving from other employers. After correction, annual job creation by new employers is reduced to a range of 35 000 to 36 500 jobs. Not only is this a considerable decrease, the impact of the correction is also that the huge annual differences in job creation by new employers are flattened to smooth fluctuations, which certainly is a more realistic picture of the contribution of firm openings to employment in the period considered. The effect of correcting for spurious closings on job destruction by exiting employers is similar. Total job destruction due to employer closings is reduced by more than one third, and annual leaps are flattened considerably. Persson (1998) and Korkeamäki & Kyyrä (2000), studying the impact of employee flow corrections on the basis of Swedish and Finnish data respectively, report equally high impacts of spurious openings and closings on estimates of job creation and destruction associated with firm births and deaths.

To allow a cross-country or cross-industry comparison of the (direct) contribution of births and deaths to employment, normalized rates of job creation and destruction are used. These rates are calculated by dividing total employment in opening or closing employers by the average of total employment in all active employers in the period concerned. The impact of correcting for spurious openings and closings on these indicators is shown in Table 4. After correction, job creation rates by employer openings are reduced from 2.8 to 1.7 per cent on average, and job destruction rates associated with employer closings are reduced from 2.9 to 1.8 per cent. As is evident from Figure 2 in Annex, this adjustment considerably changes the position

Table 4: Unadjusted and adjusted estimates of job creation and destruction by opening and closing employer enterprises; Belgium, NACE Rev. 1.1 Sections C to K , 2003/04 - 2006/07

	Job creation by employer openings (n)			Job destruction by employer closings (n)		
	Unadjusted	Adjusted	*Percentage difference*	Unadjusted	Adjusted	*Percentage difference*
2003/04				62722	37383	*40.4*
2004/05	58241	36522	*37.3*	60288	39823	*33.9*
2005/06	54451	35054	*35.6*	56336	35339	*37.3*
2006/07	68044	35076	*48.5*			
3-year avg.			*40.5*			*37.2*
	Job creation rate by openings (%)			Job destruction rate by closings (%)		
	Unadjusted	Adjusted		Unadjusted	Adjusted	
2003/04				3.0	1.8	
2004/05	2.8	1.7		2.9	1.9	
2005/06	2.6	1.7		2.7	1.7	
2006/07	3.2	1.6				
3-year avg.	*2.8*	*1.7*		*2.9*	*1.8*	

Source: NSSO - HIVA K.U.Leuven

of Belgium in an international comparison of employment creation by newly born firms.

7.2 Job creation and destruction

Finally, we turn to measures of job creation and destruction. Table 5 compares unadjusted and adjusted estimates. In the four years under consideration, on average 14.5 per cent of apparent total job creation and 16.6 per cent of apparent total job destruction is the result of clustered employee flows. A large part of this is accounted for by spurious openings and closings of firms, as illustrated in the previous paragraphs. The other part is explained by existing firms taking over (parts of) other firms, in case of job creation; and by split-offs or mergers of parts of existing firms, in case of job destruction. Real job creation and destruction is not only lower than it appears from unadjusted data, annual fluctuations are also leveled off. It should be mentioned that the slight differences between net employment evolutions before and after adjustment are caused by employee flows between predecessors and successors

which do not belong both to the population of selected sectors (NACE C to K). We

Table 5: Unadjusted and adjusted estimates of job creation and destruction; Belgium, NACE Rev. 1.1 Sections C to K, 2003/04 - 2006/07

	Job creation (n)			Job destruction (n)		
	Unadjusted	Adjusted	*Percentage difference*	Unadjusted	Adjusted	*Percentage difference*
2003/04	185336	159023	*14.2*	170775	144332	*15.5*
2004/05	187178	160076	*14.5*	157675	133774	*15.2*
2005/06	190968	168204	*11.9*	160231	137801	*14.0*
2006/07	225026	186298	*17.2*	175794	137340	*21.9*
4-year avg.			*14.5*			*16.6*
	Job creation rate (%)			Job destruction rate (%)		
	Unadjusted	Adjusted	*Ppt difference*	Unadjusted	Adjusted	*Ppt difference*
2003/04	9.0	7.7	*1.3*	8.3	7.0	*1.3*
2004/05	9.0	7.7	*1.3*	7.6	6.4	*1.1*
2005/06	9.0	7.9	*1.1*	7.6	6.5	*1.1*
2006/07	10.4	8.6	*1.8*	8.1	6.4	*1.8*
4-year avg.	*9.3*	*8.0*	*1.4*	*7.9*	*6.6*	*1.3*

Source: NSSO - HIVA K.U.Leuven

conclude with rates of job creation and destruction, which allow the comparison of results across industries and countries. The impact of the use of the employee flow approach on overall rates of job creation and destruction is considerable. The impact on industry-specific job creation and destruction rates is even more pronounced. Table 5 shows that unadjusted job creation rates are reduced by 1.1 to 1.8 percentage points after correcting for employee flows. This results in real job creation rates of between 7.7 and 8.6 per cent in the four years considered, which are markedly lower rates than those of other countries. The adjustments of job destruction rates are of the same size and result in job destruction rates of between 6.4 and 7.0 per cent.

The differences between unadjusted and adjusted measures broken down by industry are presented in Table 10 in Annex. A first conclusion is that job creation and destruction rates are considerably reduced after correcting for employee flows, although not to the same extent in all years and industries. In NACE DI (Manufacture of other non-metallic mineral products), DJ (Manufacture of basic metals and fabricated metal products) and DL (Manufacture of electrical and optical equipment), for example, certain annual rates are reduced by 4 percentage points or more, whereas in other sectors and years, unadjusted and adjusted rates do not differ. Second, and

in line with the general trends discussed above, in most sectors, adjusted measures show less annual fluctuation in job creation and destruction. Where unadjusted measures report puzzling annual leaps in industry-specific job creation or destruction rates, these are mostly substantially reduced after correcting for employee flows. A third and last conclusion is that 'traditional' differences in job reallocation levels across industries remain unaffected by the correction method: industries with high job reallocation rates, such as construction (NACE F), hotel and restaurant sector (NACE H) and business services (NACE K), remain the ones with the highest levels after adjustment, and the gap between relatively low job creation and destruction rates in manufacturing and relatively high rates in services exists both before and after correction. In summary, we can conclude that the employee flow approach results in overall lower levels of job creation and destruction mainly by eliminating unreal annual leaps in specific sectors.

It is interesting to note how these adjustments affect the position of Belgium in an international comparison of job reallocation measures. Unlike statistics related to employer openings and closings, an internationally harmonized framework for job creation and destruction statistics does not exist. Although the calculation of the rates proposed by Davis & Haltiwanger is generally adopted, definitions of the building components (firm/establishment, employer, job) vary across countries. Moreover, the coverage of the population varies strongly as well, with regard to sectoral activity as well as to other aspects of the data. Nevertheless, when compared to other recent studies which adopt similar definitions and coverage, the job flow rates we found using the proposed method, are markedly lower. Studies covering both manufacturing and services, usually report annual job creation and destruction rates above 10 per cent, or in the U.S even above 15 per cent (see e.g. Persson, 1998; Piekkola and Böckerman, 2002; Pinkston and Spletzer, 2004). Even for a continental, 'rigid' economy as the one in Belgium, and in an economically favorable period, job creation and destruction rates of 8.0 and 6.6 per cent respectively are extremely low.

In a recent working paper on job flows in Belgium, based on another data source, the National Bank of Belgium (NBB) reports job creation and destruction rates in the four years considered which are, on average, equally low (Heuse & Saks, 2009). Since no correction for changes in firm structure was made, one would expect these rates to be higher than the adjusted measures found in this paper. The NBB results, however, exclude temporary work agencies (NACE 74.5) and do not reach full coverage in

small firms. Exactly these two firm categories are characterized by typically high job reallocation, hence excluding them lowers average rates. Despite similar averages, however, the variation in annual job creation and destruction rates reported in this paper is much smaller than the annual variation reported by the NBB. This is in line with our conclusion that correcting for employee flows reduces annual fluctuations.

Four explanations can account for the low job creation and destruction rates for Belgium reported in this paper. First, the Belgian economy has a rather rigid labour market where employment protection legislation prevents employers from causing strong cyclical adjustments in the workforce (Heuse & Saks, 2009). Second, the period the data in this paper relate to was a short and economically stable one. Third, the firm level was used for analysis, and not the establishment level, as is the case in most other studies on job flows. This implies that our data do not account for job reallocation taking place across establishments of the same firm. And finally, by adopting the employee flow approach, 15 per cent of apparent job flows could be traced as not corresponding to the real creation or destruction of jobs. Hence, annual job creation and destrcution rates had to be revised downwards by 1.4 percentage points on average.

8 Discussion

The presented method for the adjustment of measures of firm dynamics and of job creation and destruction does not take into account changes in firm structure and in firm identifiers involving employee flows of less than 10 employees. This means that it does not provide a criterion to distinguish between genuine and spurious openings and closings, and real and false job creation and destruction in small firms. The reason why a lower cut-off level for the tracking of clustered employee flows is not used, is because we believe that flows of less than 10 employees possibly include numerous cases of individual mobility of employees simply changing jobs. Therefore, in the case of small firms, the merely quantitative criteria of the employee flow approach should be complemented by a more qualitative approach based on additional information from other data sets. A possible way of proceeding could be to replicate the proposed method for clustered employee flows of less than 10 employees, and then randomly check the predecessor-successor relationships on the basis

of other administrative registers. The results of this sample can then be extrapolated to the total population.

9 Conclusion

Overestimation in measures of firm dynamics and hence job creation and destruction based on large administrative firm level data sets is well understood. The failure to properly link the identifiers of one and the same employer, and of predecessor and successor firms involved in a restructuring, results in an upward bias in statistics of firm dynamics and job reallocation. Commonly applied methods to address these problems use probabilistic matching based on similarities in partial firm identifiers. More recently, alternative linkage methods based on employee flows have been developed in the Scandinavian countries and the U.S. In keeping with this novel approach, this paper presents a method for the establishment of linkages between firm identifiers by using employee flow information. The lack of reliable firm level data on employment and business dynamics in Belgium has urged the development of a new approach. Taking advantage of the possibilities of a rich employer-employee data set covering all private employment in Belgium, the method was developed on the basis of a limited number of years (2003-2007). After evaluation, it is the intention to extend the analysis to a longer period, starting at the end of the 1990s, and to implement it as a standardized method, allowing annual updates of the results. This should lead to the establishment of a longitudinal linked employer-employee data set in Belgium, containing accurate information on firm and employment dynamics, and opening a range of possibilities in national and comparative research into labour market changes.

The method presented in this paper takes into account all movements of clusters of at least 10 employees between two firm identifiers to establish links between predecessor and successor firms. These links are interpreted as different forms of firm restructuring, of which ten types are distinguished. Additional criteria are then imposed in order to identify spurious firm openings and closings, such as thresholds for the employment level in the opening or closing year. This information is further used to adjust measures of firm dynamics and job creation and destruction.

The first conclusion is that restoring missing links between firms by making use of

clustered employee flows leads to a significant reduction of the upward bias in statistics of firm dynamics and of job reallocation. In the period of observation, we find that 35 to 50 per cent of total entries and exits of employer firms with at least 10 employees does not coincide with the real opening or closing of a firm. Not surprisingly, as the size of the entering of exiting firm increases, it becomes more likely that an entering or exiting does not correspond to a real opening or closing. After correcting for these 'spurious' events, the real contribution of firm births and deaths to annual job creation and destruction turns out to be considerably lower than is generally concluded on the basis of unadjusted data. Overall job creation and destruction levels are revised downwards as well after adjustment (by 14.5 and 16.6 per cent). This results in markedly lower annual job creation rates of around 8.0 per cent in the four years considered, and job destruction rates of around 6.6 per cent.

Secondly, the applied method reveals that annual variation in firm and employment dynamics measures is substantially lower than it appears from unadjusted data. Unadjusted data often report strong annual fluctuations, both in the number of firm openings and closings and in job creation and destruction levels. After adjustment, these fluctuations are considerably flattened, revealing more regular annual patterns in firm and employment dynamics. This is particularly true at the sectoral level. Puzzling annual leaps in industry-specific job creation or destruction rates are mostly substantially reduced after correcting for employee flows. This certainly yields a more realistic picture of employment changes in the considered period.

A third and last conclusion is that 'traditional' average differences in job reallocation levels across industries remain unaffected by the correction method. For example, the gap between typically high job creation and destruction rates in services compared to low rates in manufacturing, is not narrowed.

In summary, we can conclude that the employee flow approach results in overall lower levels of firm births and deaths and job creation and destruction, mainly by eliminating unreal annual leaps in specific sectors. The difference in results illustrates the importance of correcting for spurious openings and closings when using firm level data for macro- and micro-economic research. It shows that unadjusted data may have a considerable distorting impact on findings, especially when industry-specific patterns are considered.

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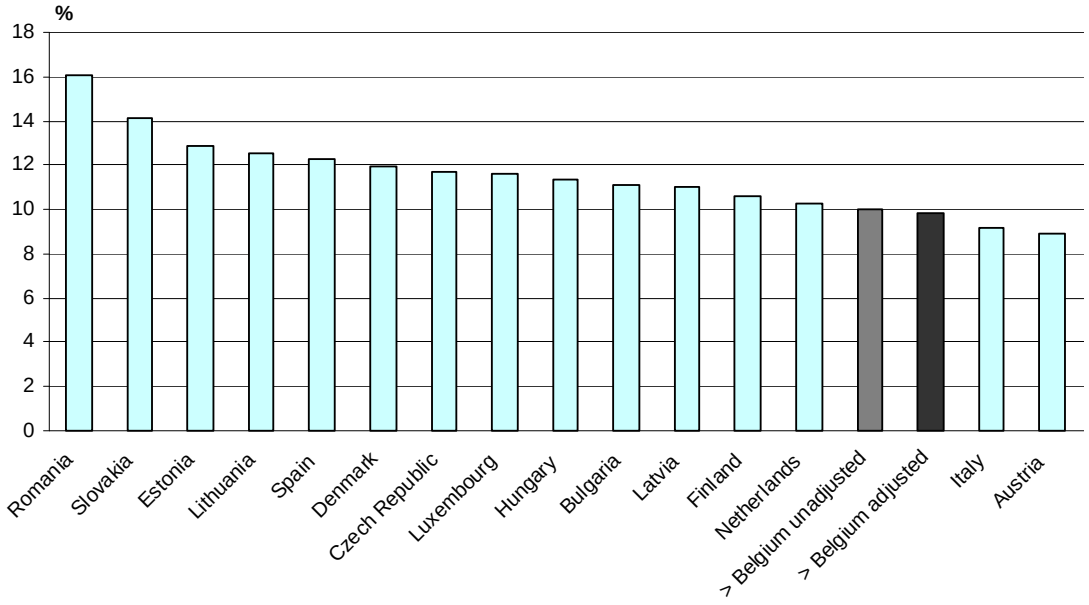
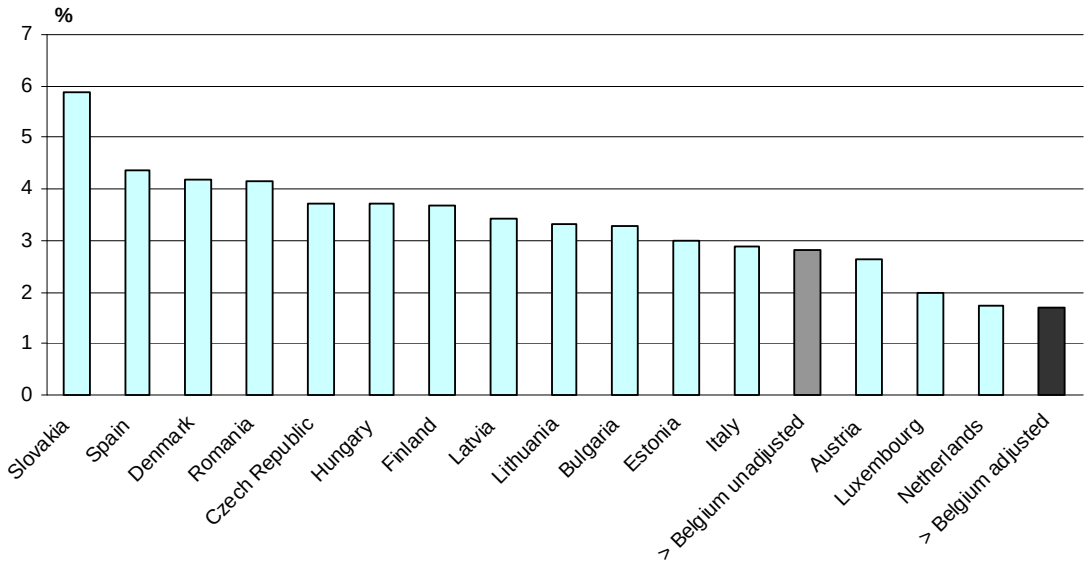
A Appendix

Figure 1: Comparison of employer enterprise birth rates, business economy (NACE Rev. 1.1 Sections C to K excluding 74.15); 2004/05



Source: Eurostat (SBS, Business demography); for Belgium NSSO - HIVA K.U.Leuven

Figure 2: Share of employment in newly born enterprises, business economy (NACE Rev. 1.1 Sections C to K excluding 74.15); 2005



Source: Eurostat (SBS, Business demography); for Belgium NSSO - HIVA K.U.Leuven

Table 6: Categories of employer-employee links in two consecutive quarters. Belgium, quarters 2003/2 - 2008/1

			Links not continued in q		New link in q				Links not continued in q		New link in q	
Quarter q-1	Total employer-employee links in q-1	Links continued in q	Employee transition to other employer	Employee outflow from the population	Employee transition from other employer	Employee inflow into the population	Total employer-employee links in q-1	Links continued in q	Employee transition to other employer	Employee outflow from the population	Employee transition from other employer	Employee inflow into the population
2003/q2	3197948	2928493	97720	171735			100%	91.6%	3.1%	5.4%		
2003/q3	3184043	2934811	93129	156103	93048	154406	100%	92.2%	2.9%	4.9%	2.9%	4.8%
2003/q4	3180687	2928932	113077	138678	88023	154785	100%	92.1%	3.6%	4.4%	2.8%	4.9%
2004/q1	3207132	2990788	93082	123262	109614	162635	100%	93.3%	2.9%	3.8%	3.4%	5.1%
2004/q2	3229828	2960200	106696	162932	90122	144742	100%	91.7%	3.3%	5.0%	2.8%	4.5%
2004/q3	3225853	2979982	92273	153598	101878	163482	100%	92.4%	2.9%	4.8%	3.2%	5.1%
2004/q4	3229666	2899443	197557	132666	86886	162270	100%	89.8%	6.1%	4.1%	2.7%	5.0%
2005/q1	3255345	3030555	95848	128942	191008	161937	100%	93.1%	2.9%	4.0%	5.9%	5.0%
2005/q2	3274820	3002496	106543	165781	93088	150537	100%	91.7%	3.3%	5.1%	2.8%	4.6%
2005/q3	3269777	3018441	94458	156878	101703	165291	100%	92.3%	2.9%	4.8%	3.1%	5.1%
2005/q4	3252862	3005140	120485	127237	88997	145215	100%	92.4%	3.7%	3.9%	2.7%	4.5%
2006/q1	3293002	3059362	108741	124899	117081	170024	100%	92.9%	3.3%	3.8%	3.6%	5.2%
2006/q2	3311646	3031915	120865	158866	104207	146835	100%	91.6%	3.6%	4.8%	3.1%	4.4%
2006/q3	3327066	3055773	112613	158680	116083	178798	100%	91.8%	3.4%	4.8%	3.5%	5.4%
2006/q4	3314527	3041492	131691	141344	106908	150619	100%	91.8%	4.0%	4.3%	3.2%	4.5%
2007/q1	3357427	3097957	120164	139306	128154	177609	100%	92.3%	3.6%	4.1%	3.8%	5.3%
2007/q2	3365871	3086854	120813	158204	117021	150293	100%	91.7%	3.6%	4.7%	3.5%	4.5%
2007/q3	3392908	3127385	108212	157311	116433	188925	100%	92.2%	3.2%	4.6%	3.4%	5.6%
2007/q4	3394801	3124728	135303	134770	103457	163319	100%	92.0%	4.0%	4.0%	3.0%	4.8%
2008/q1	3427770	3179879	114205	133686	131785	170610	100%	92.8%	3.3%	3.9%	3.8%	5.0%
Average							*100%*	*92.1%*	*3.5%*	*4.5%*	*3.3%*	*4.9%*

Source: NSSO

Table 7: Ten types of predecessor-successor relationships: relative frequencies in the annual predecessor-successor data sets; Belgium, 2003/04 - 2006/07

			Successor categories	
Predecessor categories	**1 to 1**		*1 entry*	*1 contin.*
	1 exit	2003/04	38.2	23.9
		2004/05	43.4	22.3
		2005/06	47.2	20.7
		2006/07	46.1	19.5
		Average	*43.7*	*21.6*
	1 continuation	2003/04	15.9	
		2004/05	17.0	
		2005/06	17.8	
		2006/07	19.7	
		Average	*17.6*	
	n to 1		*1 entry*	*1 contin.*
	n exits	2003/04	2.4	5.8
		2004/05	1.8	3.5
		2005/06	1.4	5.9
		2006/07	2.7	4.3
		Average	*2.1*	*4.9*
	min 1 continues	2003/04	1.6	
		2004/05	1.3	
		2005/06	1.1	
		2006/07	1.7	
		Average	*1.4*	
	1 to n		*n entries*	*min 1 cont.*
	1 exit	2003/04	4.2	1.1
		2004/05	1.5	5.2
		2005/06	1.6	0.9
		2006/07	0.9	0.4
		Average	*2.0*	*1.9*
	1 continuation	2003/04	4.7	
		2004/05	1.3	
		2005/06	1.0	
		2006/07	2.9	
		Average	*2.5*	
	n to n	2003/04	0.7	
		2004/05	1.0	
		2005/06	0.7	
		2006/07	0.0	
		Average	*0.6*	
	Unclear	2003/04	1.5	
		2004/05	1.6	
		2005/06	1.6	
		2006/07	1.8	
		Average	*1.6*	
	Total	2003/04	100.0	
		2004/05	100.0	
		2005/06	100.0	
		2006/07	100.0	
		Average	*100.0*	

Source: NSSO - HIVA K.U.Leuven

Table 8: Correction formulas for the adjustment of job creation and destruction measures

	Registered number of jobs					Adjusted number of jobs	
	Predecessor		Successor			Predecessor	Successor
	year t-1	year t	year t-1	year t		year t-1	year t-1
1 predecessor linked to 1 successor							
1 to 1	P_{t-1}	0	0	S_t		0	P_{t-1}
	P_{t-1}	0	S_{t-1}	S_t		0	$P_{t-1} + S_{t-1}$
	P_{t-1}	P_t	0	S_t		$P_{t-1} - [\mathbf{Z_1}]$	$\left[\frac{S_t}{P_t + S_t} * P_{t-1}\right] = \mathbf{Z_1}$
m predecessors linked to 1 successor							
m to 1	$P_{j,t-1}$	0	0	S_t		0	$\sum_{j=1}^{m} P_{j,t-1}$
	$P_{j,t-1}$	0	S_{t-1}	S_t		0	$\sum_{j=1}^{m} P_{j,t-1} + S_{t-1}$
	$P_{j,t-1}$	$P_{j,t}$	0	S_t		$P_{j,t-1} - \left[\frac{P_{j,t-1}}{\sum_{j=1}^{m} P_{j,t-1}} * \mathbf{Z_2}\right]$	$\left[\frac{S_t}{\sum_{j=1}^{m} P_{j,t} + S_t} * \sum_{j=1}^{m} P_{j,t-1}\right] = \mathbf{Z_2}$
1 predecessor linked to n successors							
1 to n	P_{t-1}	0	0	$S_{i,t}$		0	$\frac{S_{i,t}}{\sum_{i=1}^{n} S_{i,t}} * P_{t-1}$
	P_{t-1}	0	$S_{i,t-1}$	$S_{i,t}$		0	$S_{i,t-1} + \left[\frac{\lvert S_{i,t} - S_{i,t-1} \rvert}{\sum_{i=1}^{n} \lvert S_{i,t} - S_{i,t-1} \rvert}\right] * P_{t-1}$
	P_{t-1}	P_t	0	$S_{i,t}$		$P_{t-1} - \sum_{i=1}^{n} [\mathbf{Z_3}]$	$\left[\frac{S_{i,t}}{P_t + \sum_{i=1}^{n} S_{i,t}} * P_{t-1}\right] = \mathbf{Z_3}$

Table 9: Unadjusted and adjusted job creation and destruction rate by sector; Belgium, NACE Rev. 1.1 Sections C to K, 2003/04 - 2006/07

		Job creation rate				Job destruction rate			
		2003/04	2004/05	2005/06	2006/07	2003/04	2004/05	2005/06	2006/07
NACE Section		%	%	%	%	%	%	%	%
C	Unadjusted	6.5	3.7	5.0	3.3	-7.9	-4.7	-5.0	-4.1
C	*Adjusted*	*3.4*	*3.7*	*2.9*	*3.3*	*-4.8*	*-4.7*	*-3.5*	*-3.4*
DA	Unadjusted	6.8	7.2	6.3	5.8	-6.8	-7.3	-6.2	-5.6
DA	*Adjusted*	*5.8*	*6.3*	*5.1*	*5.5*	*-5.8*	*-6.4*	*-5.2*	*-5.0*
DB-DC	Unadjusted	2.9	3.5	4.6	5.5	-8.7	-10.2	-10.8	-10.1
DB-DC	*Adjusted*	*2.2*	*2.9*	*2.7*	*3.6*	*-8.0*	*-9.5*	*-9.0*	*-8.3*
DD	Unadjusted	7.9	10.2	6.1	6.1	-8.1	-9.5	-5.9	-6.4
DD	*Adjusted*	*6.9*	*6.3*	*5.8*	*5.8*	*-6.5*	*-5.5*	*-5.8*	*-5.6*
DE	Unadjusted	4.8	4.5	6.1	5.6	-6.8	-6.2	-7.6	-7.7
DE	*Adjusted*	*4.2*	*4.1*	*4.7*	*4.3*	*-5.9*	*-6.0*	*-6.2*	*-6.4*
DF-DG	Unadjusted	5.9	5.2	4.4	7.2	-7.8	-5.6	-3.5	-6.6
DF-DG	*Adjusted*	*2.2*	*2.9*	*3.2*	*6.0*	*-4.1*	*-3.5*	*-2.9*	*-5.3*
DH	Unadjusted	7.2	4.7	6.2	5.5	-10.5	-5.3	-8.4	-3.9
DH	*Adjusted*	*3.7*	*3.2*	*3.4*	*4.8*	*-5.7*	*-4.5*	*-4.7*	*-3.5*
DI	Unadjusted	4.4	8.3	5.0	7.1	-6.8	-9.6	-5.9	-5.1
DI	*Adjusted*	*3.8*	*4.3*	*4.7*	*3.8*	*-6.4*	*-5.5*	*-5.6*	*-3.9*
DJ	Unadjusted	5.1	9.7	8.2	10.5	-8.6	-6.7	-9.2	-9.8
DJ	*Adjusted*	*4.4*	*7.9*	*6.8*	*5.8*	*-7.4*	*-5.1*	*-7.8*	*-5.0*
DK	Unadjusted	5.7	5.8	5.4	7.7	-6.6	-6.0	-3.9	-3.0
DK	*Adjusted*	*4.9*	*4.6*	*4.9*	*6.9*	*-5.8*	*-4.1*	*-3.3*	*-2.4*
DL	Unadjusted	11.2	4.6	3.2	8.5	-14.8	-9.2	-5.8	-11.9
DL	*Adjusted*	*1.9*	*3.5*	*2.6*	*5.5*	*-8.8*	*-8.2*	*-5.6*	*-6.7*
DM	Unadjusted	6.0	3.7	3.8	4.0	-9.4	-3.9	-4.3	-9.8
DM	*Adjusted*	*5.8*	*3.6*	*3.4*	*3.2*	*-9.0*	*-3.9*	*-3.9*	*-10.0*
DN	Unadjusted	6.9	5.8	7.4	8.7	-9.9	-10.0	-10.6	-12.9
DN	*Adjusted*	*5.8*	*5.1*	*5.3*	*6.2*	*-9.2*	*-9.3*	*-7.7*	*-7.6*
E	Unadjusted	1.7	1.8	5.5	10.4	-7.2	-2.8	-0.4	-5.7
E	*Adjusted*	*1.7*	*1.8*	*5.4*	*7.4*	*-7.2*	*-2.8*	*-0.3*	*-2.7*
F	Unadjusted	10.8	11.8	13.7	12.8	-10.8	-10.4	-9.2	-9.4
F	*Adjusted*	*10.0*	*10.9*	*12.8*	*12.1*	*-9.5*	*-9.4*	*-8.3*	*-8.7*
G	Unadjusted	10.0	8.8	8.9	10.6	-8.3	-7.2	-7.7	-7.6
G	*Adjusted*	*8.7*	*8.1*	*8.1*	*8.9*	*-7.0*	*-6.4*	*-6.9*	*-6.2*
H	Unadjusted	21.0	21.4	15.6	16.4	-17.6	-16.2	-16.4	-15.1
H	*Adjusted*	*18.4*	*18.5*	*14.7*	*15.4*	*-14.9*	*-13.2*	*-15.5*	*-14.1*
I	Unadjusted	6.0	5.7	5.6	7.5	-5.5	-6.4	-5.2	-7.0
I	*Adjusted*	*5.6*	*5.0*	*4.9*	*6.0*	*-5.0*	*-5.8*	*-4.6*	*-5.4*
J	Unadjusted	3.7	3.4	3.9	5.6	-5.8	-4.6	-4.1	-4.9
J	*Adjusted*	*3.3*	*2.8*	*2.9*	*4.2*	*-5.4*	*-3.4*	*-3.1*	*-3.2*
K*	Unadjusted	12.5	14.4	16.2	16.9	-9.2	-9.1	-9.4	-10.1
*K**	*Adjusted*	*10.9*	*12.5*	*13.9*	*13.3*	*-7.8*	*-7.9*	*-7.3*	*-6.7*
74.502	Unadjusted	12.2	10.9	8.8	12.7	-1.6	-3.6	-6.7	-4.7
74.502	*Adjusted*	*12.2*	*7.4*	*8.5*	*11.7*	*-1.6*	*-2.1*	*-6.4*	*-3.6*
74.15	Unadjusted	18.2	11.4	17.0	10.6	-14.6	-8.5	-13.2	-17.7
74.15	*Adjusted*	*15.8*	*11.0*	*15.4*	*9.5*	*-13.2*	*-6.4*	*-6.9*	*-13.6*
Total	**Unadjusted**	**9.0**	**9.0**	**9.0**	**10.4**	**-8.3**	**-7.6**	**-7.6**	**-8.1**
Total	***Adjusted***	***7.7***	***7.7***	***7.9***	***8.6***	***-7.0***	***-6.4***	***-6.5***	***-6.4***

Source: NSSO - HIVA K.U.Leuven