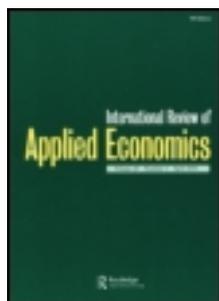


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## **Spatial disaggregation patterns and structural determinants of job flows: an empirical analysis**

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The paper investigates the changes in job creation and destruction flows at a very disaggregated level of analysis. We analyse whether job flows at lower levels of spatial aggregation display regularities that are in line with national ones in a bid to disentangle the role of labour market institutions. Using a unique database of the population of firms in Trentino (a north-eastern province of Italy) from 1991 to 2001, we find that: (1) job flows show a ‘fractal’ tendency, i.e. many regularities appear to be scale invariant (magnitude of flow and persistence) and that job flow magnitude is in line with the average values for Italy; (2) there are some qualifications to their ‘fractality’: the contribution of entrant firms to the job creation process is lower than the corresponding contribution at national level, as is the share of job destruction accounted for by exiting firms; and (3) firm size and age influence job flows.

**Keywords:** labour reallocation; job creation; job destruction; spatial disaggregation two-stage Heckman estimator

**JEL classifications:** C34, J23, L11

### **1. Introduction**

This paper explores the differences in labour market job flow dynamics at different levels of spatial aggregation. The main aim is to understand whether a local labour market displays job flow regularities that are in line with those observed at national level. Focusing on the role and influences of labour market institutions, it is important when analysing job flow dynamics to determine whether or not the institutional characteristics of the labour markets influence the patterns of job flow at different aggregation levels. There are several studies that have analysed a single spatial dimension (national, regional or local), which have provided an image of the job flow regularities at that particular level, but have not provided accurate explanations for these patterns, mostly because they have ignored the role of labour market institutions. This paper tries to fill this gap by exploring the effects of labour market characteristics on shaping job flow patterns at both national and local levels. The changes in job flow dynamics at different levels of aggregation have crucial policy implications, especially when institutional set-ups and/or the idiosyncratic characteristics of firms are considered as the determinants of job flows.

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We use an original and unique database (DM10TN) that includes data collected by INPS<sup>1</sup> (the Italian Social Security Institution) and the local ISTAT office<sup>2</sup> (National Statistics Institute). The data cover the labour market of Provincia Autonoma di Trento, also referred to as Trentino. This province is particularly useful for this analysis because of its specific institutional setting of being part of a region that has great autonomy. Trentino enjoys a higher degree of autonomy than other Italian regions and provinces, and is able to implement a wide set of local economic policies. Hence, we might expect that local job flow patterns would differ widely from national level patterns.

The DM10TN database, which was used in our empirical analysis, includes information on employees and demographic aspects of the population of firms active in Trentino during the period 1991–2001. It provides monthly data on all sectors in the economy, including manufacturing, construction and services. We are particularly interested in the magnitude of job flows, their stability and their cyclic nature over the analysed period, to provide an answer to our main research question of whether or not the dynamics of job flows are similar at different levels of aggregation (national vs local). We also conduct analyses at different levels of disaggregation (by sector, age and size) in order to disentangle the sectoral dynamics and to highlight the role of firm size and age in changing labour market dynamics. Finally, we perform an analysis of the structural determinants of job creation and destruction, with the aim of highlighting the existence or non-existence of the role of institutional setup when controlling for the structural determinants of job flows.

Our study provides several distinct contributions to the literature. First, the results reveal the ‘scale invariant’ nature of job flows in relation to many aspects confirmed by previous research (see Faggio and Konings 2003; Stahl et al. 2003; Barnes and Haskel 2002). Second, the study shows the role of national institutional factors in governing job flows at local level. The local flows identified are, indeed, in line with the average values for Italy. However, some national level patterns are not reproduced at local level. The magnitude of job flows as a result of incumbent firms at local level is in line with that at national level, whereas the role of entrant firms appears to be lower. Sectoral job flow patterns are similar to those at national level, but the degree of job shifting between sectors is lower. The persistence of job flows reveals that the majority of the jobs created and destroyed represent permanent changes in the employment levels of firms. Third, the analysis of the structural determinants of job flows demonstrates that observable heterogeneity accounts for most of the variations in job creation and job destruction. Finally, we use an original dataset composed of high quality monthly data and an extended two-step Heckman procedure with two thresholds in the self-selection equation.

The paper is organised as follows. The next section starts with a brief review of the two approaches to job flow dynamics developed in the literature and positions our study with respect to them. We then describe the panel dataset underlying this study before presenting the econometric model and describing the estimation technique and the empirical specification. Next we present and discuss the results of the univariate and multivariate analysis, before finally drawing some concluding remarks.

## **2. Theoretical background**

This study is positioned between two approaches in the literature. On the one hand, there is an extensive literature on labour markets, which focuses on the role of regional

idiosyncrasies in determining unemployment rates (Brunello, Lupi and Ordine 2000, 2005). In particular, there is evidence that a regional institutional set-up with very distinctive wage characteristics might strongly influence local labour market performance, irrespective of the national aggregate institutional framework. However, this literature does not provide insights on job flow patterns at different levels of analysis. On the other hand, there are several contributions that suggest that the degree of disaggregation along different dimensions (e.g. sectoral and geographic) could influence the analysis, resulting in different labour market performance. In other words, job flows may or may not be fractal in nature.<sup>3</sup> Taking these two strands of literature into account, in this paper we analyse job flow regularities at local level, emphasising those features that differentiate the national from the local institutional labour market setup. More precisely, we would expect the labour market tightness and the high degree of public intervention in the local economy to be influential factors in explaining some of the observed differences. However, if the national institutional setup plays a more important role than other factors then, at lower levels of aggregation, we should observe job flow regularities that are in line with national ones. This would prove that job flow regularities are 'fractal' in nature (Blanchflower 1994).

The empirical and theoretical literature has highlighted the importance of job flow analysis (Burda and Wyplosz 1994; Davis, Haltiwanger and Schuh 1996; Blanchard and Diamond 1990; Pissarides 2000; Acs et al. 1999). A frequent result is that labour markets are continually shaped by the phenomena of job creation and job destruction. The magnitude of job flows is relevant in deriving alternative theories of unemployment and wage determination. In the case of the USA the large size of job flows has enhanced various theories that model unemployment as a frictional phenomenon (Pissarides 2000). The geographical dispersion of jobs as well as the heterogeneity of the available skills relative to firms' requirements represent (among other things) sources of friction in the labour market. At the same time, the persistence of job flows in the labour market puts some limits on the validity of the theories based on the contraposition of different groups of employees (insiders) and unemployed (outsiders) that seem to explain the persistent positive unemployment rates in the economy. The empirical studies on gross job flows are important in the analysis of employment dynamics at firm/plant level. Davis and Haltiwanger (1999) associate the largest job flows with the youngest firms/plants. Their results establish a solid relationship between firm age and firm heterogeneity. Furthermore, their analysis provides empirical evidence of the importance of market selection mechanisms and their effects on industry evolution (Dosi et al. 1995). The magnitude of job flows points to the limitations involved in modelling industrial dynamics using representative firms. The relevant and persistent heterogeneity of firms implies that aggregation processes function to smooth the asymmetries and non-linearities of employment dynamics at firm level.

Olley and Pakes (1992) and Baily, Bartelsmann and Haltiwanger (1996) find evidence that the reallocation of jobs and productive inputs from less to more efficient firms accounts for a large proportion of the productivity gains at industry level. Accordingly, job flow data are very useful for analysing the relationship between the reallocation process and productivity and salary growth.

Finally, job flows are a good instrument to use to explore the nature of the business cycle and its relations with such processes as the reallocation of jobs and employees. Different phases of business cycles are characterised by different degrees of job creation and destruction; however, even if an expansion/contraction of the economy takes place, job destructions/creations will still be present and relevant.

Davis, Haltiwanger and Schuh (1996) observed contemporaneous job creation and destruction, which might be considered an indicator of the importance played by firm heterogeneity and the underlying selection processes in the labour market.

### **3. The data**

We perform our analysis on an original dataset constituted of monthly firm-level data on the population of firms active in Trentino from 1991 to 2001. This database represents a unique collection of data for Italy, both in terms of its census nature, and its level of detail which allows us to follow all firms that were active for at least one month over a 10-year period. Our panel of data does not suffer any disadvantages as a result of sample design and/or data collection constraints.

The source of our data is the local ISTAT bureau, which uses original data from INPS. These data come from DM/10 forms, which collect information on social security registrations submitted by employers located in the province of Trento. The DM/10 includes all firms with at least one employee and collects monthly figures.<sup>4</sup> We rearranged the data to change the unit of observation and to enable examination of firm-level labour performance. During the observation period employers were allowed to register with INPS as many times as the number of sectors in which their firms were active. In fact, a different ATECO2002 (the SIC Code in 2002) sector of activity for workers employed in the same firm, resulted in separate employer INPS registrations. Hence, we grouped all the records for the same firm into a single record, based on the fiscal identity of the employer linked to each individual registration. The resulting database refers to 'firms' identifiable by their fiscal identity.

Our resulting unbalanced panel is composed of around 24,000 observations per year and two groups of variables: the first related to firm demographic data, and the second relating to information on employees.

The demographic section includes information on the 5-digit sector of activity (ATECO2002 code), the exact date of entry of the firm into the database, the exact date of exit from the database, and firm age. The ATECO2002 code is assigned to each firm according to its prevalent activity identified as the sector in which the highest number of the firm's workers is employed.

The second part of the database contains monthly variables on number of employees, job creation and destruction, job creation and destruction rates, net employment gains, net employment rates of change, total job reallocation and excess job reallocation, and job reallocation and excess job reallocation rates. The data present a discontinuity in the year 1997 owing to the changes in the Italian law concerning privacy, which meant that ISTAT did not publish any data for that year. We calculate annual averages for the above variables and we group age and size into classes. A detailed definition and discussion on size and age classes is provided below.

## **4. Methodology**

### **4.1 Basic definitions**

The literature provides several different definitions of job flows and ways of estimating them, taking into account the distortions besetting these procedures. The main difficulty consists of identifying the job flows for individual firms, where a single job is defined as an employment position that can be filled (or temporarily not) by a worker. We must emphasise here that worker flow is a slightly different concept:

worker flow does not always equate with job flow (even though there is a huge overlap between the two). For instance a firm could decide to fire a worker, but not eliminate the corresponding job. Thus, very few available microdata are perfectly suited to measuring job flows at firm level. They mainly consist of small sample data, referring to a limited geographical region over a limited period of time<sup>5</sup> or of matched employer–employee data (see Abowd and Kramarz 1999). Our methodology includes an estimation of the number of jobs created and destroyed within a very short period of time (one month) in order to minimise the biases.

The capacity of an economy to generate jobs can be measured by looking at the changes in employment level over a certain time interval.

The standard way to measure the jobs created within a firm is to take the number of employees in two periods and compare them. Therefore, we define job creation for sector  $I$  at time  $t$  ( $JC_{It}$ ) as the employment increases in expanding firms, where the comparison is made by looking at employment levels at time  $t-1$  and at time  $t$  – plus the number of employees of new firms that enter that sector at time  $t$ . Similarly, we measure job destruction at time  $t$  in sector  $I$  ( $JD_{It}$ ) as the sum of decreases in the employment levels of firms plus the decreases in number of employees as a result of firm exits from that sector.

The growth rates for both job creation and destruction are obtained by dividing job creation and destruction levels by a measure of sector size. Defining the size of a firm  $i$  as the average size in period  $(t, t-1)$ :  $Z_{it} = 1/2(N_{it} + N_{it-1})$ , the corresponding employment growth rate is given by:  $g_{it} = \Delta N_{it}/Z_{it}$ . The growth rate is bound between  $[-2, 2]$  and behaves symmetrically in contractions and expansions. The standard measure usually implemented in the literature is bounded in  $[-1, +\infty)$  and shows non-symmetric reactions to expansions and contractions. Consequently, the sector  $I$  rate of job creation can be written as:

$$jc_{It} = \sum_{i \in S^+, i \in E_{It}} \frac{Z_{it}}{Z_{It}} g_{it} = \frac{JC_{It}}{Z_{It}} \tag{1}$$

Similarly the sector job destruction rate is given by:

$$jd_{It} = \sum_{i \in S^-, i \in X_{It-1}} \frac{Z_{it}}{Z_{It}} |g_{it}| = \frac{JD_{It}}{Z_{It}} \tag{2}$$

Equations (1) and (2) show that sectoral rates of creation and destruction can be obtained from a weighted average of individual growth rates, the weight given by employment shares. Following the seminal work by Davis, Haltiwanger and Schuh (1996), other important definitions are:

*net employment growth rate:*  $net_{It} = jc_{It} - jd_{It}$ , which gives us the net change in employment level as a result of job creation and destruction;

*total job reallocation:*  $jr_{It} = jc_{It} + jd_{It}$ , which is a measure of the degree of gross ‘activity’ in the labour market, and represents a measure of the overall capacity of the system to create and destroy jobs;

*excess job reallocation:*  $xjr_{It} = jr_{It} - |net_{It}|$ , which provides an indicator of the labour market capacity to reallocate jobs when we control for the effect of growth; it provides a measure of the job changes necessary to accommodate changes in employment.

All these measures can be calculated for the whole economy as well as for subsets of the economy obtained through different disaggregation directions, namely age, size and region.

#### 4.2 *The regression analysis*

In order to measure the impact of structural determinants on job creation and destruction flows we performed a regression analysis. We rearranged the data in order to work with a pooling of yearly information. The panel structure of the data is preserved through the introduction of dummies identifying different years.

A preliminary analysis reveals that both fixed, and random effect assumptions can be rejected. The standard ordinary least squares (OLS) parameter estimations are biased as a result of a possible selection bias in the data (for details see Maddala 1985). More specifically, during one year a firm can be in three different states: expansion, contraction and inaction, depending on the sign of its net employment change. Such subdivision is endogenous with respect to the firm's characteristics, i.e. firms can be self-selected into one of the three groups based on their characteristics. To correct for this bias we use an alternative econometric model: a modified two-stage Heckman estimator (HMM), which generates consistent estimations of the parameters.

We consider three latent variables ( $jc_{it}^*$ ,  $jd_{it}^*$ ,  $I_{it}^*$ ), which identify the behaviours of firm  $i$  in year  $t$  and for which it is possible to write the following equations:

$$jc_{it}^* = x'_{it}\beta_{jc} + u_{it,jc}, \quad (3)$$

$$jd_{it}^* = x'_{it}\beta_{jd} + u_{it,jd}, \quad (4)$$

$$I_{it}^* = z'_{it}\gamma + \varepsilon_{it}, \quad (5)$$

where  $x_{it}$  is a vector containing all the explanatory variables and  $z_{it}$  is a vector of variables that are used to select firms. Equation (3) is the job creation equation, (4) is the job destruction equation, and (5) represents the self selection equation.

If we define  $w_{it}$  as the whole set of explanatory variables that are contained in  $x_{it}$  and  $z_{it}$ , then  $v_{it} = (u_{it,jc}, u_{it,jd}, \varepsilon_{it})$ . Finally we assume:

$$v_{it} | w_{it} \sim N(0, \Sigma), \quad (6)$$

in which the elements of the conditional variance–covariance matrix  $\Sigma$  are allowed to be non-zero. Note that the above hypothesis highlights the endogeneity of selection. The self-selection issue can be rewritten as follows:

$$J_{it} = \begin{cases} jc_{it} & \text{if } I_{it}^* > \mu^+ \\ 0 & \text{if } \mu^- < I_{it}^* < \mu^+, \\ jd_{it} & \text{if } I_{it}^* < \mu^- \end{cases} \quad (7)$$

where  $\mu^-$  and  $\mu^+$  represent the thresholds entailed in the self-selection equation (5) which allow firms to change job flow status.

We do not fully observe  $I_{it}^*$ , we observe only the variable  $I_{it}$  which gives indications of the sign of  $I_{it}^*$ :

$$I_{it} = \begin{cases} 1 & \text{if } I_{it}^* > \mu^+ \\ 0 & \text{if } \mu^- < I_{it}^* < \mu^+ \\ -1 & \text{if } I_{it}^* < \mu^- \end{cases} \quad (8)$$

Under these assumptions, it is possible to write the expected value of job creations  $jc_{it}$  conditional on: (1) the dependent variables  $x_{it}$ ; and (2) an additional term representing the self-selection:

$$E[(J_{it} | w_{it}, I_{it}^*) > \mu^+] = x'_{it} \beta_{jc} + E(u_{jc,it} | w_{it}, I_{it}^*) = x'_{it} \beta_{jc} + \frac{\sigma_{1,\varepsilon}}{\sigma_\varepsilon} \lambda\left(\frac{\mu^+ - z'_{it}\gamma}{\sigma_\varepsilon}\right), \quad (9)$$

where  $\lambda(\cdot)$  is the inverse Mills ratio calculated at the point:  $(\mu^+ - z'_{it}\gamma) / \sigma_\varepsilon$ . Similarly we can write the expression for the conditional expected value of job destructions  $jd_{it}$ :

$$E[(J_{it} | w_{it}, I_{it}^*) < \mu^-] = x'_{it} \beta_{jd} + E(u_{jd,it} | w_{it}, I_{it}^*) = x'_{it} \beta_{jd} + \frac{\sigma_{2,\varepsilon}}{\sigma_\varepsilon} \lambda^*\left(\frac{\mu^- - z'_{it}\gamma}{\sigma_\varepsilon}\right), \quad (10)$$

where  $\lambda(\cdot)^*$  is the complement of the Mill' ratio calculated at the point:  $(\mu^- - z'_{it}\gamma) / \sigma_\varepsilon$ .

From equations (9) and (10) we derive a more appropriate functional form to use in our analysis: two augmented regressions for job creation and job destruction in which the Mills ratio and its complement respectively are present as additional explanatory variables. The joined estimation of these regressions can be made using a modified two-stage Heckmann procedure. The standard Heckmann procedure implies a first stage in which an ordered probit model with two possible outcomes for independent variables is estimated. The modified procedure consists of estimating an ordered probit with three possible outcomes at the first step instead of only two. The independent variable is represented by the selectivity term  $I_{it}$ , indicating the sign on net employment change, which, as noted above, can have three values:  $-1, 0, +1$ . The result of the probit estimation provides a consistent estimation of both the Mills ratio and its complement. We use these estimations in a second step in which augmented regression models are estimated via OLS.<sup>6</sup>

We run the two stages using the same set of independent variables for the first and the second step of analysis. It is worth noting that (1) the non-linearity of the Mills ratio and of its complements, and (2) the assumption of linearity in the second step functional forms ensure the identification of the system (Maddala 1985).

### 5. Univariate analysis

In this and the following section we present the results of our analysis. First, we investigated the effects of disaggregation on job flow dynamics along single dimensions (age, size, industrial classification) in order to understand whether job flows tend to be 'fractal' in nature, that is, to test whether many job flow regularities remain invariant at the local level. Second, in the multivariate analysis, we performed a regression

analysis to identify the effects of the determinants of job flows, maintaining all other factors constant.

### 5.1 *Employment dynamics and the magnitude of job flows*

As depicted in Figure 1, the level of total employment in the period analysed is stable until 1996, and from 1998 shows an upward trend.<sup>7</sup> From 1991 to 2001 the total number of employees increases from around 70,000 to around 80,000. The main contribution to employment growth comes from services, while construction and manufacturing maintain a fairly stable trend, although in 1996–1998 manufacturing suffered a major decline with negative troughs at the end of those years.

A pervasive characteristic of the data is its seasonality: services and construction, in particular, show high monthly variability over the course of a year. The highest number of employees in all macrosectors occurs in September, while a negative peak can be found in November.

An interesting starting point for the analysis is to investigate whether job flow phenomena in a local labour market have some traits in common with national ones. Table 1 shows the average values of job flow rates for Italy, for some European countries, and for Trentino. The results of the comparison are interesting. Trentino shows job creation and destruction flows of similar magnitudes to national ones (Italian as well as European). The reallocation rate for Trentino is around 21.2%, in line with the

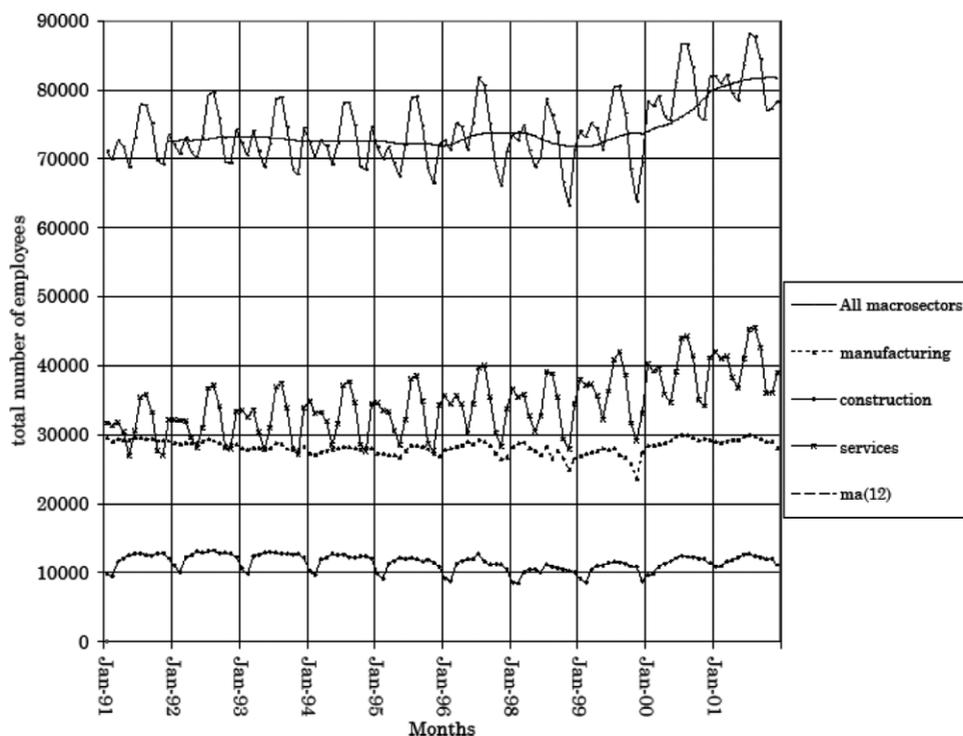


Figure 1. Monthly employment volume in Trentino during the period 1991–2001: all macrosectors, manufacturing, construction, and services. *Source:* Authors' own elaborations on database DM10TN, PAT (2001) and PAT (1998).

Table 1. The role of exits and entries in determining the flows: a cross-country comparison.

Countries	Time	Job creation	Job destruction	Job reallocation	Job creation rate		Job destruction		Net
					Entries	ncumbents	Incumbents	Exits	
Germany	1987–1992	9	7.5	16.5	2.5 (28%)	6.5 (72%)	5.6 (75%)	1.9 (25%)	1.5
France	1984–1991	12.7	11.8	24.4	6.1 (48%)	6.6 (52%)	5.5 (47%)	6.3 (53%)	0.9
Austria	1978–1998	8.9	8.9	17.9	3.1 (35%)	5.8 (65%)	6 (66%)	3 (34%)	0
Sweden	1987–1995	11.2	12.1	23.3	5.4 (48%)	5.8 (52%)	10.4 (86%)	1.7 (14%)	-0.9
UK	1985–1991	8.7	14.6	23.3	2.7 (31%)	6 (69%)	9.6 (66%)	5 (34%)	2.1
Italy	1987–1992	11	10	21	3.8 (35%)	7.2 (65%)	6.2 (62%)	3.8 (38%)	1
Trentino	1991–2001	12.21	8.99	21.20	3.07 (25.1%)	9.14 (74.9%)	6.37 (70.9%)	2.62 (29.1%)	3.21

Source: Authors' own elaborations on data DM10TN, PAT (2001) and PAT (1998) and Davis and Haltiwanger (1999).

results for Italy. We must underline that the lack of available data does not allow us to make comparisons over the same period of time.

Table 1 also shows the contribution to job creation process of firms that enter the local market (entrants) and the contribution to job destruction of firms that exit the local market (exiting). Entrants contribute less to job creation at the local level than at the national levels (Italian and European). In particular, in Trentino 25% of the job creation rate is explained by entrants, while the percentage for Italy rises to 35%. However, Trentino's exiting firms contribute to a job destruction rate that is lower than the national one (29% vs 38%).

Figure 2 provides an analysis of flow structure evolution over the years. The analysis takes into account the yearly average of job creation and job destruction rates, and the net employment changes for the whole economy. Figure 2 also reports gross domestic product (GDP) growth rates for Trentino, for the years 1992–2001. Cyclical features of job creation and destruction seem to be confirmed: job creation moves pro-cyclically and job destruction moves anti-cyclically. Net employment growth, calculated as the difference between yearly creation and destruction rates, is also pro-cyclical. Figures 3–5 depict the cyclical behaviour of the three macrosectors and confirm the cyclical patterns observed at aggregate level.

The lack of data for 1997 biases the results for 1998 even if we correct job flow estimations. Indeed, they appear not to be in line with the rest of the series. Both services and construction show a negative trend for job destruction and a positive one for job creation. The pattern in the manufacturing macrosector is stable for both job creation and job destruction rates.

These results illustrate that the existence of job flows over the business cycle is also pervasive at local level. In general, empirical evidence on job flows, both at country and local level, can be interpreted considering two phenomena: (1) the heterogeneity of agents, which is pervasive and persistent over time; and (2) the disequilibrium

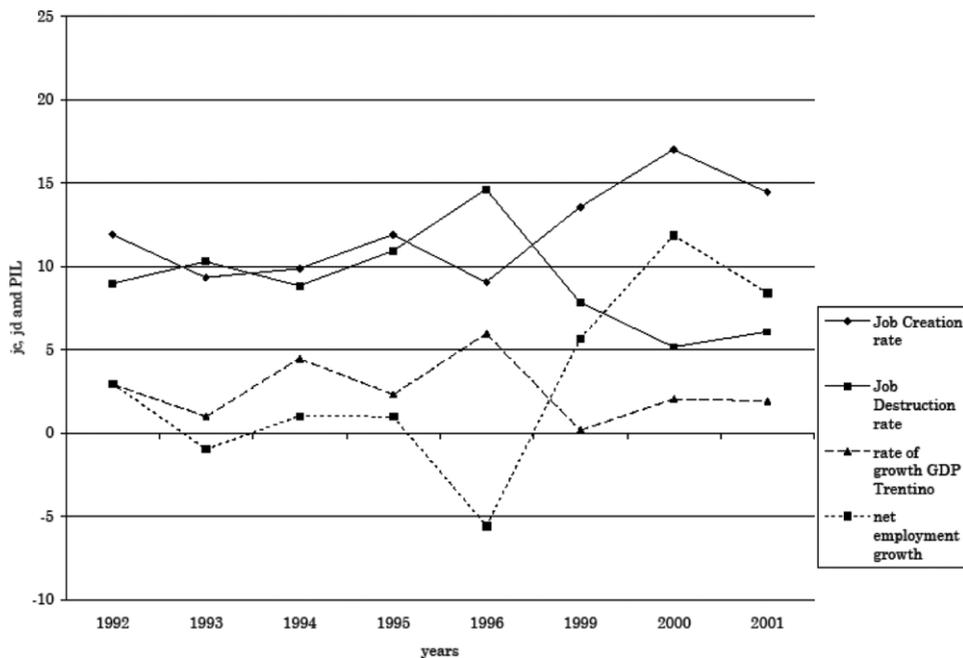


Figure 2. Aggregate yearly job creation and destruction rates, net employment growth and rate of growth of GDP in Trentino over the years 1991–2001. Source: Authors’ own elaborations on database DM10TN, PAT (2001) and PAT (1998).

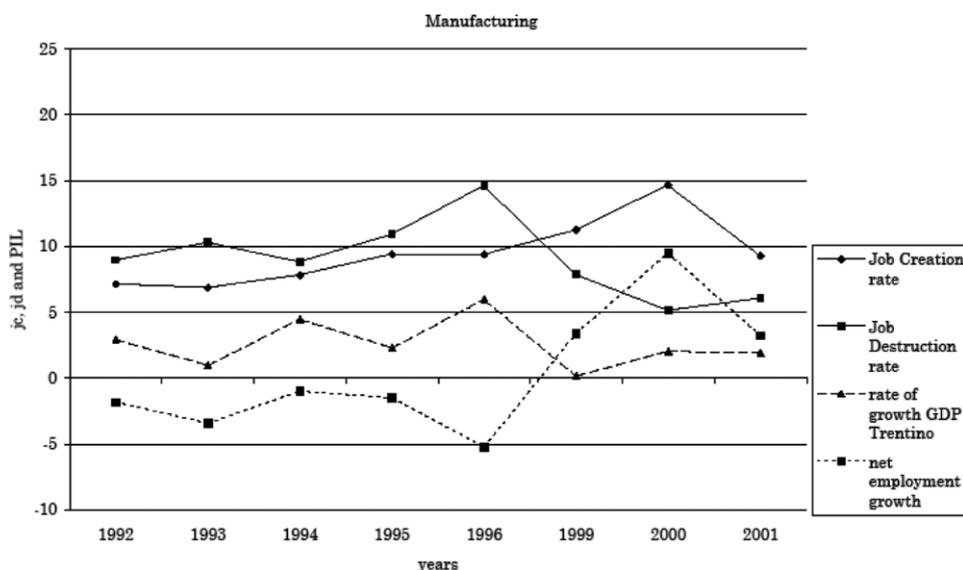


Figure 3. Manufacturing macrosector yearly job creation and destruction rates, net employment growth and rate of growth of GDP in Trentino over the years 1991–2001. Authors’ own elaborations on database DM10TN, PAT (2001) and PAT (1998).

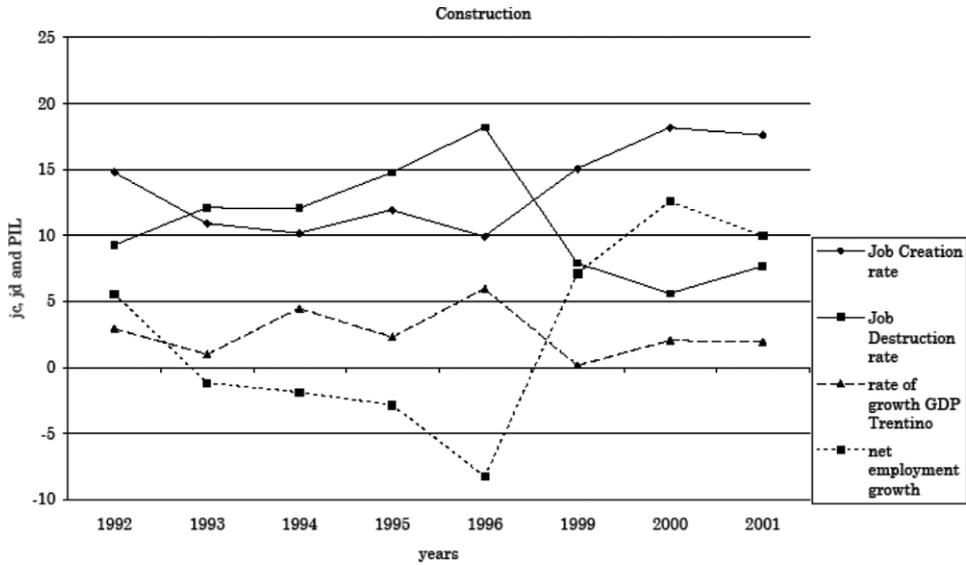


Figure 4. Construction macrosector yearly job creation and destruction rates, net employment growth and rate of growth of GDP in Trentino over the years 1991–2001. Source: Authors’ own elaborations on database DM10TN, PAT (2001) and PAT (1998).

micro-conditions, which generate regular dynamics of job creation and destruction at macro level.

This is particularly important when we consider that the existing theoretical literature on labour markets does not account for heterogeneity. In fact, the standard theoretical frameworks, despite their variety,<sup>8</sup> usually make assumptions of homogeneity and

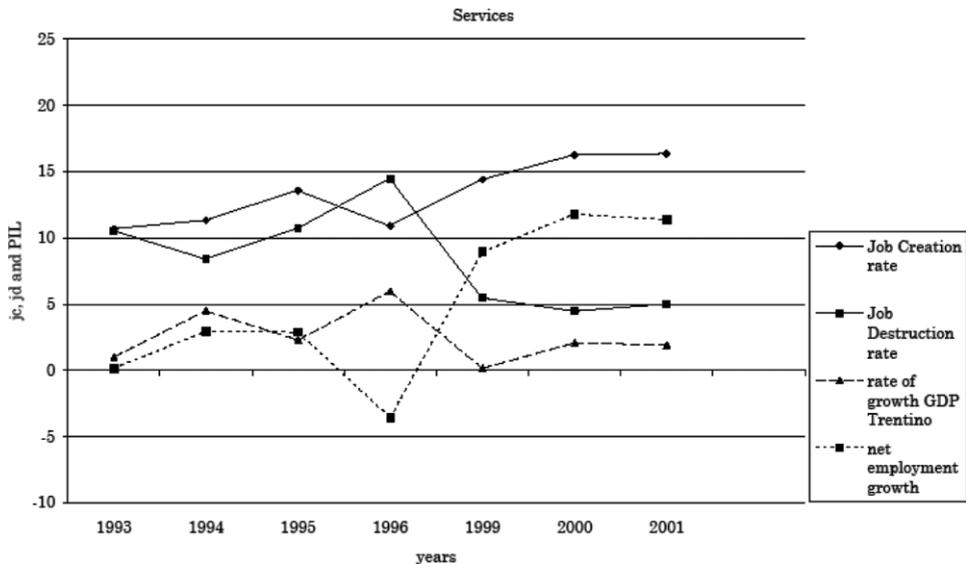


Figure 5. Services macrosector yearly job creation and destruction rates, net employment growth and rate of growth of GDP in Trentino over the years 1991–2001. Source: Authors’ own elaborations on database DM10TN, PAT (2001) and PAT (1998).

perfect rationality of agents. As a consequence, the results of the models are given in terms of equilibrium conditions of a representative maximising firm (or/and worker). The success of these models in interpreting regularities such as job flow dynamics is, at best, mixed.<sup>9</sup> In particular, by construction they avoid all issues related to the aggregation of heterogeneous agents, and their ability to interpret the regularities that emerge from the heterogeneity of firms' and workers' behaviours and from nonlinear aggregation patterns is low.<sup>10</sup>

This empirical evidence on job creation and destruction acts as a natural counterpart to the evolutionary view of the economic system (Nelson and Winter 1982; Dosi and Winter 2002). In particular, job flows can be interpreted as an observable counterpart to the micro-level out-of-equilibrium heterogeneous behaviours of both firms and workers. In this viewpoint, it is possible to reconcile the empirical evidence with the theory. Note that in the case of representative agent assumption – or in the case of a relaxed assumption, of a given number of homogenous firms – it seems difficult to justify the fact that in the same period two firms decide, respectively, to create and destroy jobs, given that they are more likely to experiment with the same market conditions and are identical. We cannot observe both phenomena simultaneously. The endogenous matching models try to overcome this problem but, for the moment, their results seem to be limited to studying the property of the matching function and they make use of many restrictions in the modelling technique in order to obtain an analytical solution to the model (see Cao and Shi 2000; Julien, Kennes and King 2000).

Firms and workers behave differently because they are persistently heterogeneous over time and react differently to market conditions and to competitive pressures. Moreover, the market functioning enhances the differences among agents and leads to a widening of the differentials of competitive advantages. As a consequence, market selection sorts out the least efficient firms. In this context, labour market regularities are obtained from the models in terms of the *emerging properties* of the market (Dosi and Nelson 1994).<sup>11</sup>

## 5.2 Job flows and size of firms

There are many studies that emphasise the importance of small businesses (Barnes and Haskel 2002; Davis and Haltiwanger 1999; Picot and Dupuy 1998). There is evidence that small firms are more active in creating and destroying jobs than larger firms.

Birch (1987) and other US studies (Davis, Haltiwanger and Schuh 1996) show that the majority of the net creation of jobs is due to small firms, regardless of the methodology used to measure the impact of small firms. This empirical regularity is important for the design of public policies, and especially policies for local labour markets. For several years the economic policies of Trentino have aimed at enhancing entrepreneurial activity in the province using different forms of incentives.

Analysis of job flows by firm size implies a subdivision of firms into size classes. When performed on longitudinal data and on arbitrary bounds this can introduce some distortions, known as the 'distribution fallacy'.<sup>12</sup> The distribution fallacy, as noted by Davis, Haltiwanger and Schuh (1996), is related to the eventual migration of firms across size classes. The larger the migration, the higher the overestimation of the relative weight of small firms in creating or destroying jobs. In addition, the problem could be made worse by the temporary nature of these fluctuations. In order to

minimise the distribution fallacy we need to choose a proxy for firm size that minimises class migration over the entire period of observation.

In the literature at least three different size proxies have been applied to longitudinal data: (1) base year employment; (2) the current average; (3) the long run average. The first uses the number of employees in the base year to proxy for firm size. The current average utilises the average number of employees in two contiguous periods. The third proxy makes use of the average of the number of employees over a longer period of time to smooth employment and to minimise the effects of temporary migrations across classes. Furthermore, it overcomes measurement error and transitory shock problems, which can affect the size of firms – in particular small firms (Davis, Haltiwanger and Schuh 1996). The use of one proxy instead of another is not neutral and leads to substantial differences in the results. To analyse the role of size in shaping job flows, we use long run averages computed on the yearly number of employees for the period of observation.

Table 2 reports job creations as a percentage for each size class. Small firms with 1–9 employees are responsible for the majority of job creations and job destructions in the system: 58% of creations and 50% of destructions are concentrated in this size class. Other classes present shares of creations and destructions that do not exceed 14%. Moreover, the contribution of classes to job flows seems to decrease as we consider those classes that refer to larger firms.<sup>13</sup>

The above results confirm the importance of small firms to flow dynamics in absolute terms. There is an open question regarding the relative capacity of small firms to create and destroy jobs. It can be argued that even if their contribution to flows in the Trentino economy is high, this could be explained by the bias towards small firms in this local economy, but nothing can be concluded about the capacity of firms in different size classes to create and destroy jobs. To disentangle the dynamic capacity of firms we calculated job creation and destruction rates for each size class, which is presented in Table 2. The smaller the firm size, the higher the corresponding rate of job creation and destruction. The reallocation rate for the size class of 1–9 employees is around 29% and this decreases as we move towards larger firm size classes, reaching a minimum value of 10%. The role played by small firms becomes clearer if we consider excess job reallocation rates. A negative correlation between firm size and

Table 2. Job flows by size classes using long run average estimations.

		jc	jd	jr	xjr	net	Percentage contributions to sectoral flows	
							jc%	jd%
All macrosectors	Average values	12.21	8.99	21.20	17.98	3.21		
	from 1 to 9 empl.	17.83	11.45	29.28	22.90	6.38	57.77	50.35
	from 10 to 19	10.93	9.49	20.42	18.98	1.45	12.22	14.40
	from 20 to 49	8.88	7.95	16.83	15.90	0.92	10.21	12.42
	from 50 to 199	6.93	6.96	13.90	13.87	-0.03	10.56	14.40
	from 200 to 499	10.22	5.95	16.16	11.89	4.27	6.07	4.79
	500+	5.57	4.71	10.28	9.42	0.86	3.17	3.64

jc: job creation rate; jd: job destruction rate; jr: job reallocation rate; xjr: excess job reallocation; net: net employment growth.

excess job reallocation is evident: the excess reallocation rate of small firms is two and a half times that of large firms. Firm size matters with respect to the capacity of reallocating jobs.

### 5.3 Sectoral distribution of flows

Another aspect to investigate is the evidence emerging for job flow dynamics in different sectors. Sectors differ for several reasons and we would expect that they would behave differently in terms of job flows. In this section we study job flows at macrosector level for the manufacturing, construction and services sectors.<sup>14</sup>

As the intuition suggests, these macrosectors show different dynamics in terms of job flows. Table 3 presents average annual job flows for these three macrosectors. The manufacturing sector displays lower levels of job creation and destruction than in services and construction. The higher job reallocation rate evident in services is explained by the high job creation rate in this sector – the job destruction rate is lower in services than in the other two macrosectors. Thus, most of the net creation of jobs can be attributed to the services sector.

If we look at excess job reallocation we can see that the services sector has lower gross reallocation to create jobs than the other two macrosectors, due to its lower job destruction rate. This empirical evidence is in line with the stylised facts; see Davis and Haltiwanger (1999).

Figures 6 and 7 respectively, present the percentage distribution of job creation and job destruction, by macrosectors and by size classes, using the long average method.<sup>15</sup> The macrosectors show a common pattern of a relatively higher number of job creations and destructions in firms in the first size class (1–9 employees) compared to the other classes. Small manufacturing firms make a smaller contribution to total job creation and destruction than small firms in the other macrosectors; moreover, the percentage flows are over 10% in the firm size classes 10–19, 20–49, 50–199 and 200–499 employees. With the exception of the first class, we can observe an increasing percentage in contributions, with a peak for the 50–199 class for both creations and destructions. Small firms (1–9 employees) in the services and construction macrosectors are responsible for 70% of flows; other classes present decreasing percentages of job flows with larger firms accounting for smaller percentages.

Table 4 shows that the manufacturing sector presents higher rates of creation and destruction for smaller firms. The pattern is the same for excess job reallocation. Net employment growth is smaller for larger firms (in the 500+ employees' class), and the main engine of growth is in small firms with 1–9 employees.

The pattern in the construction macrosector confirms the importance of small firms in generating and destroying jobs. The magnitude of the job creation rate is negatively related to firm size.

Table 3. Average job flows over the period 1991–2001 for macrosectors.

	jc	jd	jr	xjr	net
All macrosectors	12.21	8.99	21.20	17.98	3.21
Manufacturing	9.85	8.94	18.79	17.88	0.91
Construction	13.53	10.95	24.47	21.89	2.58
Services	13.67	8.37	22.04	16.75	5.29

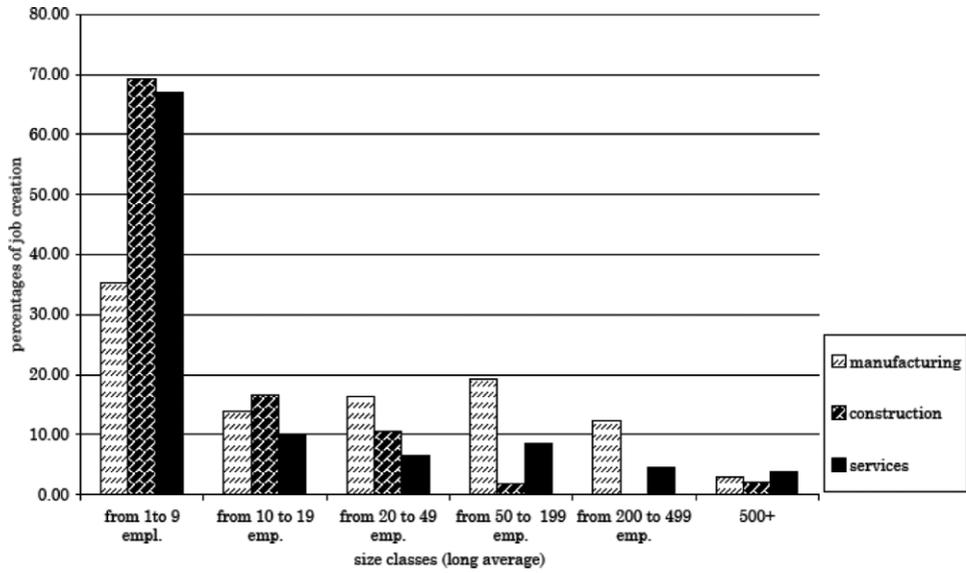


Figure 6. Average percentage contribution to job creation over the years 1991–2001 by size classes using annual data and long average size measure.

In the services macrosector, job flows are more equally distributed over size classes, and net growth in the macrosector over the period under analysis is the result of balanced contributions from firms in different classes. In particular, large firms with 200–499 employees play a major role. This divergent evidence arises from a combination of effects: an expansion of the macrosector *per se*, and the

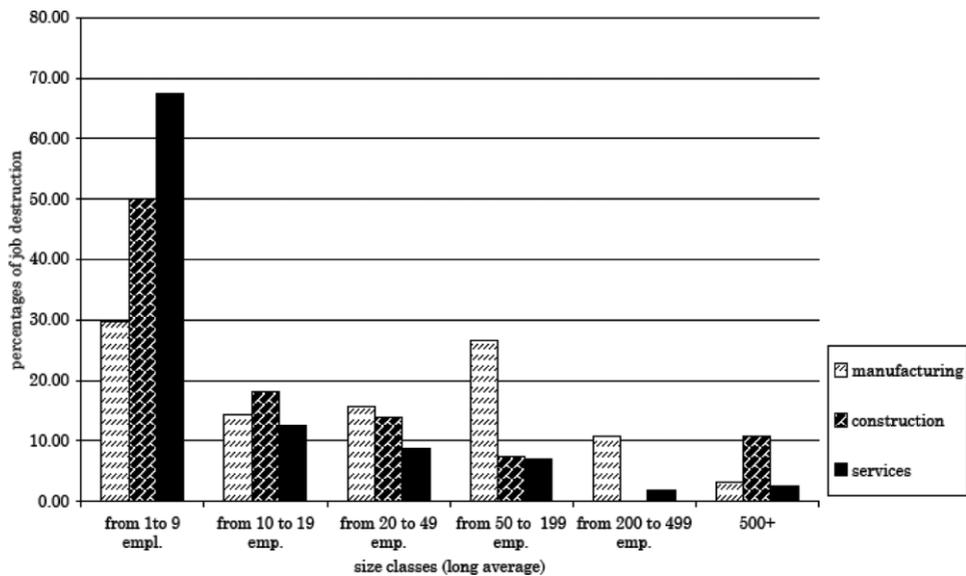


Figure 7. Average percentage contribution to job destruction over the years 1991–2001 by size classes using annual data and long average size measure.

Table 4. Comparison of average annual based job creation and destruction flows by size classes and by macrosectors using current vs long average measure of firms' size.

		jc	jd	jr	xjr	net
All macrosectors	Average values	12.21	8.99	21.20	17.98	3.21
Manufacturing	Average values	9.85	8.94	18.79	17.88	0.91
	from 1 to 9 empl.	15.93	12.13	28.06	24.26	3.80
	from 10 to 19	10.34	9.75	20.09	19.50	0.59
	from 20 to 49	9.59	8.34	17.94	16.69	1.25
	from 50 to 199	6.35	7.95	14.30	15.89	-1.59
	from 200 to 499	10.28	8.08	18.37	16.17	2.20
	500+	4.39	4.24	8.64	8.49	0.15
Construction	Average values	13.53	10.95	24.47	21.89	2.58
	from 1 to 9 empl.	20.79	12.56	33.36	25.13	8.23
	from 10 to 19	11.44	10.39	21.82	20.77	1.05
	from 20 to 49	7.42	8.19	15.61	16.38	-0.77
	from 50 to 199	2.69	9.88	12.56	19.76	-7.19
	from 200 to 499			0.00	0.00	0.00
	500+	2.52	10.91	13.43	21.81	-8.39
Services	Average values	13.67	8.37	22.04	16.75	5.29
	from 1 to 9 empl.	17.61	10.89	28.50	21.78	6.72
	from 10 to 19	11.19	8.75	19.94	17.51	2.43
	from 20 to 49	8.84	7.27	16.11	14.54	1.57
	from 50 to 199	8.98	4.46	13.44	8.92	4.52
	from 200 to 499	10.12	2.57	12.69	5.14	7.55
	500+	7.44	3.01	10.45	6.03	4.42

different structure of services firms in terms of capital intensity of the technologies employed.

#### 5.4 Role of firm age in determining flows

Firm age plays an important role in the flow dynamics of job creation and destruction activity. In particular, the role of entrant firms in the job creation process is significant given the implications on local industrial and labour market policies.

Coherently with the literature (see Davis, Haltiwanger and Schuh 1996), we define entrant firms as those firms that have been active in the market for less than 12 months.

Table 5 shows job flows disaggregated between age classes. We again see the contribution to job creation of entrant firms (25%). Young firms (from 2 to 5 years old) account for a consistent proportion of new jobs (27%) as do old firms (35%). Also, the majority of job destruction is in old firms (60%). Firms that are 'middle-aged' (2–10 years old) account for 25% of job destructions. Figure 8 shows the annual contributions of entrant firms to job creation. The annual flow of job creation from entrant firms varies between 10% and 26%, and is directly correlated with the phases of the economic cycle.

Table 5. Age classes distribution of job creation and destruction flows: decomposition among age classes of aggregate flows.

	Rates subdivision		Percentage contributions to sectoral flows	
	jc	jd	jc%	jd%
All macrosectors	12.21	8.99		
from 0 to 1 year old	3.07	0.11	25.13	1.17
from 2 to 5 years	3.32	1.85	27.20	20.60
from 6 to 10 years	1.57	1.65	12.90	18.34
>10 years	4.24	5.38	34.78	59.88

To deepen the analysis we study creation and destruction rates in each macrosector, disaggregated by age classes (Table 6).

At sectoral level, manufacturing entrant firms account for 20% of average job creation. Job creation and destruction rates for entrant firms in the services and construction sectors are above 26%. Entrant firms in construction make the highest contribution to job creation (28%).

This sectoral ranking with respect to job creation represents a stylised fact (see, for example, Davis and Haltiwanger 1999).

The contribution to job creation in each macrosector in the other age classes reveals a non-linear relation between intensity of flows and firm age. Job destruction

Table 6. Job flows by macrosectors and age classes of firms: decomposition among age classes of macrosectors flows.

	jc	jd	Percentage contributions to sectoral flows	
			jc%	jd%
Manufacturing	9.85	8.94		
from 0 to 1 year old	2.01	0.02	20.369	0.199
from 2 to 5 years	2.78	1.31	28.222	14.699
from 6 to 10 years	1.32	1.48	13.437	16.586
10+ years	3.74	6.12	37.972	68.516
Construction	13.53	10.95		
from 0 to 1 year old	3.81	0.12	28.181	1.086
from 2 to 5 years	4.10	2.46	30.339	22.515
from 6 to 10 years	1.82	1.91	13.473	17.424
10+ years	3.79	6.46	28.007	58.974
Services	13.67	8.37		
from 0 to 1 year old	3.67	0.17	26.885	2.041
from 2 to 5 years	3.49	2.08	25.556	24.864
from 6 to 10 years	1.69	1.70	12.391	20.263
10+ years	4.81	4.42	35.168	52.832

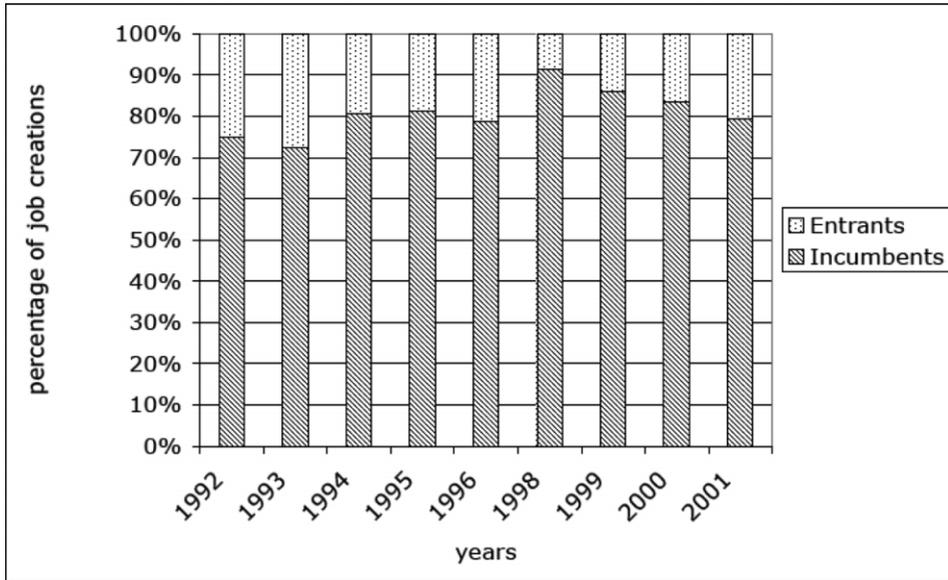


Figure 8. Yearly percentage job creation contribution of entrant firms.

patterns within age classes in the manufacturing sector seem to reveal a positive correlation between firm age and job destruction: the majority of jobs lost are in older firms.

Finally we focus on the dynamics of firm exits and on the effects that these exiting firms exert in the system in relation to job flows.

Figure 9 depicts average annual percentage job destruction caused by exiting firms. We can see that the business cycle shapes the destruction flows accounted for by exits. On average two-thirds of destructions are due to exits.

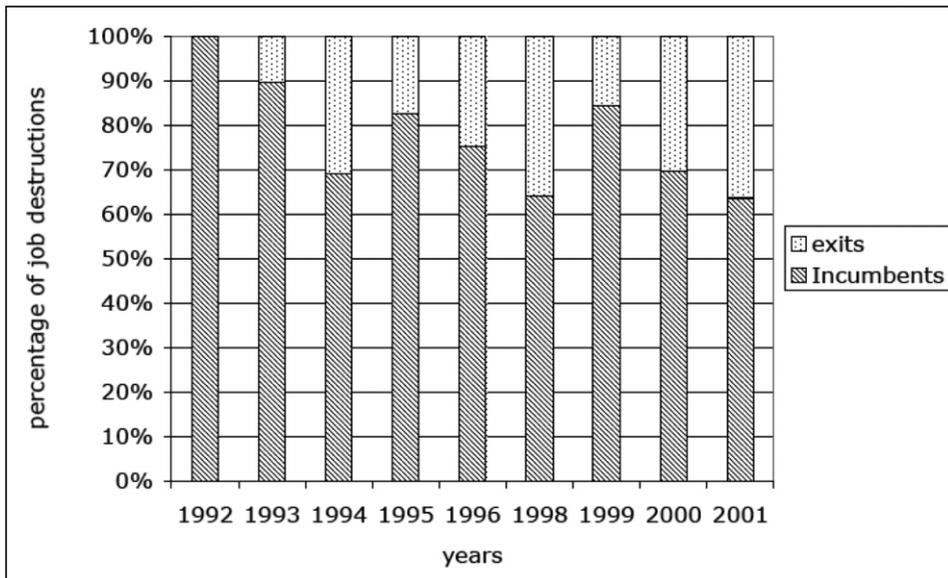


Figure 9. Yearly percentage job destruction contribution of exit firms.

## 6. The multivariate analysis

### 6.1 Determinants of job creation and destruction flows

In this section we perform a multivariate analysis to investigate the determinants of job flows. Equations (11) and (12) give the linear functional forms with which we model job creation and job destruction respectively.

$$jc_{it} = \alpha + \beta_1 \log(Size_{it}) + \beta_2 \log(Age_{it}) + \beta_3 dummysize_{it} + \beta_4 age_{it}^2 + \beta_5 Size_{it} * Age_{it} + \beta_6 rateGDP_{it} + \sum_{s \in S} (\beta_{7s} 2digsector_{s,it}) + \sum_{t \in T} (\beta_{8t} year_{it}) + \varepsilon_{jc,it} \quad (11)$$

$$jd_{it} = \alpha + \beta_1 \log(Size_{it}) + \beta_2 \log(Age_{it}) + \beta_3 dummysize_{it} + \beta_4 age_{it}^2 + \beta_5 Size_{it} * Age_{it} + \beta_6 rateGDP_{it} + \sum_{s \in S} \beta_{7s} 2digsector_{s,it} + \sum_{t \in T} (\beta_{8t} year_{it}) + \varepsilon_{jd,it} \quad (12)$$

in which: (1)  $\log(Size)$  is the log of the average annual size of a firm measured by the number of employees; (2)  $\log(age)$  is the log of a firm's age expressed in months of activity; (3)  $dummysize$  is a dummy variable, whose value is one if the firm's size is smaller or equal to one employee and zero otherwise in order to capture the impact of micro firms; (4)  $age^2$  is a squared transformation of age to capture the non-linear effects of age; (5)  $Size * Age$  is the interaction term between the size and the age of a firm; (6)  $rateGDP$  is the rate of change of the regional GDP to control for the business cycle; (7)  $2digsector_s$ , for  $s \in S$ , are the sector dummies at 2 digit level to control for sectoral effects; and (8)  $\beta_{8t} year_t$ ,  $t \in T$ , represent the year dummies. Table 7 presents the estimation results for the job creation and job destruction equations, using the modified HMM procedure described in earlier.

The selectivity term (the Mills ratio) we included is strongly significant in both the job creation and the job destruction equations. This indicates the existence of a selection bias for firms, which distorts the standard OLS estimations and confirms the need for correction of the results. The ancillary statistics confirm the goodness of fit.

In the job creation equation all the explanatory variables used are significant, while in the job destruction equation the dummy for size and nonlinear effects of age seem to disappear.

Firm size is positively correlated with job creation and negatively correlated with destruction rates if we control for sectors and time dummies. The magnitude of the estimated parameter seems to suggest that the role of size is stronger in the process of destruction than in creation. If we take into account the size dummy (for firms with less than two employees) we can reconcile the earlier descriptive evidence with the results of our regression: this dummy is significant in the job creation equation (Equation 11) but not significant in the job destruction equation (Equation 12). In both cases the estimated parameter is positive. Small firms play a key role in creating jobs but the effect is completely absorbed by firms with only one employee (0.38).

The estimated coefficient for firm age reveals the role of young firms: job creation decreases as the firm ages (-0.27). Moreover, there is a nonlinear linkage between job creation and firm age as the significance of the squared transformation of age reveals. If we look at the job destruction equation compared to the job creation equation, a symmetric pattern emerges: destructions are positively related to firm age (0.21) and no nonlinear effects are present.

Table 7. Structural determinants of job creation and destruction flows: a regression analysis. ATECO 2-digits sectors used as controls.

Independent variables	Parameter estimation	SE	<i>z</i>	<i>P</i> > <i>z</i>
Job creation equation				
<i>lsize</i>	0.07894	0.0125	6.30	0.000
<i>lage</i>	-0.27101	0.0226	-11.98	0.000
<i>dummy_size</i>	0.38350	0.0165	23.26	0.000
<i>age2</i>	1.39E-06	3.32E-07	4.20	0.000
<i>age*size</i>	-1.36E-06	4.65E-07	-2.93	0.003
<i>GDP</i>	0.04383	0.0043	-10.14	0.000
<i>Controls:2-digit sectoral dummies, years dummies</i>				
Anciliary statistics				
<i>Sigma2</i>	0.45217	0.0558	8.11	0.000
<i>Rho3</i>	-1.02621	0.0201	-51.05	0.000
Job destruction equation				
<i>Lsize</i>	-0.17323	0.0145	-11.93	0.000
<i>Lage</i>	0.20526	0.0249	8.25	0.000
<i>dummy_size</i>	0.02588	0.0176	1.47	0.143
<i>age2</i>	-6.43E-07	4.49E-07	-1.43	0.152
<i>age*size</i>	4.53E-06	8.28E-07	5.47	0.000
<i>GDP</i>	0.15287	0.0092	16.72	0.000
<i>Controls:2-digit sectoral dummies, years dummies</i>				
Anciliary statistics:				
<i>Sigma2</i>	3.41203	0.4043	8.44	0.000
<i>Rho3</i>	-0.89167	0.0047	-191.04	0.000

SE=Standard error.

The interaction term (*Size\*Age*) reveals the existence of a combined, although small, effect of age and size.

The GDP growth rate of the local economy appears to be positively related to the rate of job creation–job destruction. This confirms the role played by macroeconomic conditions in generating job flows. In particular, this result shows that during upswings there is a higher degree of job reallocation activity. Put differently, the existence in the system of growth opportunities leads to higher competition, which in turn, leads to higher job creation for ‘winning’ firms and higher job destruction for ‘loser’ firms. Once again, the pervasive contemporaneous presence of firms in the process of job creation and destruction can be interpreted as the effect of persistent heterogeneity of firm characteristics. Firms’ differential capabilities can be considered to be a source of labour market dynamics.

## 7. Conclusions

The study analyses job flows in Trentino from 1991 to 2001 using high quality monthly data. The empirical findings can be summarised in four key points: (1) Job flows show a ‘fractal’ tendency, i.e. many regularities appear to be scale invariant

(magnitude of flows and their persistence). In particular the magnitude of the job flows is in line with the average values for Italy; (2) There are some qualifications to this ‘fractality’: the contribution of entrant firms to the job creation process is lower than the corresponding contribution at national level, e.g. the share of job destruction attributable to exiting firms is around 20%, which corresponds to almost half of the contribution of exiting firms at national level; (3) Size and age strongly shape job flows; (4) Job shifts between macro sectors are rare.

The resulting picture of the Trentino labour market raises some interesting issues. The magnitude of flows being in line with the Italian national level can be interpreted as the direct effect of national institutions governing the labour market and thereby constraining local performance.

Sectoral differences in job flows confirm the received wisdom about the different behaviours of sectors: the services and construction sectors appear to be more dynamic than the manufacturing sector, although there are more likely to be changes in individual employment levels. Compared to services, the manufacturing sector is more ‘sticky’ given its characteristics, e.g. nature of the production process, degree of capital intensity, etc.

Firm size and age are the two major structural determinants of job flows. A strong negative correlation emerges between job flows and these variables. Small and new firms in particular are responsible for the higher percentages of job creation and destruction. However, our results suggest that geographical disaggregation is a factor in job creation and destruction flows. In fact, the above evidence coupled with the low contribution of entrant firms to job flows represents a particularity of the Trentino region. In particular, it seems that small young firms do create jobs, but are unable to grow.

The sectoral differences described above, coupled with evidence of extremely low levels of job shifts between sectors, seem to reflect the inability of the local level to seek more efficient utilisation of production factors.

This evidence supports the interpretations of industry dynamics based on both observable and unobservable firm heterogeneity. We have shown that heterogeneity of flows persists even within firms with similar characteristics. Finally, this analysis provides evidence that structural variables account for only 20% of the variance in job creation and destruction flows.

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### **Notes**

1. INPS: Istituto Nazionale della Previdenza Sociale.
2. ISTAT: Istituto Nazionale di Statistica.
3. See Blanchflower (1994) for an analysis on job creation and destruction in which the concept of fractality is used.
4. Details about DM/10 model can be found in Gallo (2003).

5. One of these examples is the IDA database in which information about the Danish economy is collected. More information about it can be found on the Denmark statistic website at the address: <http://www.dst.dk/HomeUK/Guide/Varedeklarationer/emnegruppe/>. See also Lee (1983) for a theoretical extension on the issue and for an application.
6. See Frazis (1993) for an application of the same procedure on the effects of different degrees on performances of students. Alonso-Borrego and Collado (2002) apply the method to study the role of innovation in job creation and destruction flows.
7. We recall that we do not have data for the period from January 1997 to December 1997.
8. See Ashenfelter and Card (1999) for a complete picture of the state-of-the-art of labour market literature. Pissarides (2000) provides an exhaustive survey of matching models that appears to be the main theoretical approach in labour market studies.
9. See Blanchard and Diamond (1989) for a discussion about the issue and for a good example of matching model that try to account for job flows.
10. See Kirman (1992) for a discussion about the fallacies emerging from using a representative agent in the economic analysis.
11. See Leombruni (2003) and Fagiolo, Dosi and Gabriele (2004) for a discussion about the use and an example of the interpretative power of evolutionary modelling in the labour market. In particular, Fagiolo, Dosi and Gabriele (2004) propose an evolutionary model able to interpret most of the labour market dynamics based on less restrictive assumptions in terms of the number of firms and workers and in terms of their homogeneity restrictions in behaviour. They demonstrate that once the usual models of the labour market are abandoned, it is possible to reproduce and explain different regularities of the labour market in a dynamic perspective. In this framework, any restriction in the steady state is not necessary in order to solve the model. They analyse the labour market in its dynamic evolution over time and map different institutional setup with different growth regimes for the system.
12. See Baldwin, Dunne and Haltiwanger (1998), Barnes and Haskel (2002) and Davis, Haltiwanger and Schuh (1996).
13. The linkage between firm size and job creation and destruction is negative. Although, the descriptive evidence contains some bias due to the choice of size classes. The regression analysis discussed below clarifies the point.
14. The regression analysis undertaken earlier takes into consideration a finer level of disaggregation to account for sectoral differences. The sectoral controls are included at 2 digit ATECO2002 level.
15. Results obtained using current average size methodology are similar.

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