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# 1 Introduction

The comparison between large and small firms' employment behavior has been the focus of multiple strands of empirical and theoretical research. Questions about the growth of businesses of different firm size have been raised since Gibrat (1931). The author proposed both a theoretical framework and a set of empirical findings pointing toward the so-called Law of Proportional Effect. The main idea underlying Gibrat's law is that the growth of a firm is proportional to its size, implying that large and small enterprises should experience similar relative changes in size. This finding has been rejected by subsequent empirical research, which has indicated that small firms tend to have larger growth rates, in terms of number of employees. Sutton (1997) provides an excellent review of the theoretical and empirical discussion around Gibrat's work, and a more recent survey on the empirical literature related to the Gibrat's Law can be found in Santarelli et al. (2006). More recent papers include Lotti et al. (2009), and Calvo (2006), among others, and Hohti (2000) for the Finnish economy.

A related empirical literature has been interested in determining which type of firm is driving the (net) job creation of an economy. Since Birch (1981), there has been a lot of discussion around the fact that small firms are the main force underlying employment growth. This view has been the center of political debate, where public support to small businesses has been advocated in the light of their large growth enhancing capabilities. However, the original insights by Birch have been contested in multiple empirical works, which have pointed out possible statistical fallacies. Examples of this literature are Davis et al. (1996), Neumark et al. (2011) and Haltiwanger et al. (2013). In these papers it has been found that, after adjusting for possible biases, small firms do not create more net jobs compared to large ones, or at least not in such a dramatic way as found in Birch's seminal work. For the Finnish economy, Ilmakunnas and Maliranta (2003), and more recently Wit and Kok (2014) and Anyadike-Danes et al. (2014) examine the relation between firm sizes and net job flows.

Another empirical work that concerns the comparison between the job creation stemmed from large and small firms is Moscarini and Postel-Vinay (2012). In this paper, the authors show that big employers' growth rate has a larger negative correlation with aggregate unemployment, compared to the one of small companies. In particular, they find that the differential between employment growth in large and small firms (in deviations from trend) has a large negative correlation with the unemployment rate (also in deviations from trend). In other words, large firms seem to be more procyclical compared to small ones. They find that this regularity holds for all sectors of the US economy and for multiple countries.

In this paper, we reconcile these different empirical literatures to study the disparities between Finnish small and large firms with respect to employment behavior. Using firm-level monthly data spanning from January 1998 to September 2014, we investigate three empirical questions. Are Finnish small companies growing more (relative to their size) than large firms? Are small enterprises accountable for higher net job creation rates? Finally, are small firms less procyclical than big ones as found in Moscarini and Postel-Vinay (2012)? We find that small businesses have experienced, on average, higher growth rates compared to large ones, leading us to reject the Gibrat's law for Finland. However, this result is dependent on the way we define an enterprise as small or large. We also observe that companies with fewer workers have been the leading force of employment creation in Finland, both for long-lasting enterprises and for data including entries and exits. Finally, we confirm the results of Moscarini and Postel-Vinay, finding that large firms are more responsive to aggregate business cycle conditions than small ones. This holds true for both average growth rates, common factors estimated with principal components and even idiosyncratic shocks. Interestingly, this correlation seems to be generated mainly during economic contractions.

The datasets we employ are optimal to explore these issues. Not only we consider the great majority of Finnish firms, covering multiple sectors of the economy, but the fact that we have monthly data is allowing us to use statistical models which require a large time dimension (such as the factor analysis of Stock and Watson (2002) employed in Section 4.3). In the studies reported above, the data is usually available at annual or quarterly frequency. In addition various papers, e.g. Hohti (2000), have relied only on one sector of the economy, such as the manufacturing sector.

The contribution of this research is not limited only to the data source employed and to the effort of combining different empirical questions, derived from different literatures, in a cohesive analysis. To explore the issues raised in Moscarini and Postel-Vinay (2012), we adopt the factor model of Stock and Watson (2002) to examine how the common components and the idiosyncratic shocks of firms of different size class relate to the business cycle.

The rest of the paper is organized as follows. In Section 2, we discuss the methodologies used to examine the aforementioned questions. In Section 3, we describe the data and in Section 4 we report the empirical results. Section 5 concludes.

## 2 Methodology

The empirical questions studied in papers such as Birch (1981) and Sutton (1997) have proven to be very sensitive to the choice of the sample and to the methodology employed. For example, in Birch (1981) the size class of a given firm is determined by the base year of the interval on which the growth rate is calculated. As pointed out in Davis et al. (1996), this classification method, however, can create a serious overestimation of the growth rate of small firms, due to the regression to the mean bias. In particular, enterprises can be classified as small based only on a temporary shock which is reverted as time goes on. To solve this issue they propose a dynamic classification method which defines a firm as small or large depending on the average size between the periods in which the growth rate is computed. However, as argued by Moscarini and Postel-Vinay (2012), allowing companies to change size class over time might create a reclassification bias. If firms can change type during their lifespan, then in expansions we would see large businesses as the main drivers of employment growth, while during recessions many firms would become small and we would wrongly impute low job creation to employers in that class.

In this paper, we take care of these two issues by not allowing enterprises to change size type over the course of their existence and by using two classification methods. We define business units as small or large based on their initial observation, but we also use the average number of employees over their lifespan (the average size measure of Davis et al. (1996)). We compare the results obtained using different classification methodologies for robustness. Moreover, we compute the growth rates of individual firms following:

$$g_{it} = \frac{L_{it} - L_{it-12}}{(1/2L_{it} + 1/2L_{it-12})} \tag{1}$$

where $L_{it}$ is the number of employees in firm $i$ at time $t$. Formula (1) has been shown to reduce the regression to the mean bias and has been adopted in the previous studies such as Moscarini and Postel-Vinay (2012). Notice that we are working with year-on-year growth rates to control for mergers and split-offs, as required by the methodology of Statistics Finland (we discuss this in more detail in Section 3). Year-on-year growth rates have also the benefit of reducing the seasonal effects in a time series. Using statistical seasonal adjustment methodologies (such as TRAMO-SEATS, see Maravall (2006)) on our panel of firms would be computationally intensive, given the number of enterprises in our dataset, while year-on-year growth rates provide a simpler procedure to get rid of uninteresting seasonal variations.

The last issue we need to take care of is the effect of entry and exit. While it is interesting, in terms of policy design, to analyze firms that have been active in a fairly long period, discarding entry and exit would lead to potentially wrong conclusions. We can expect that newly created firms belong usually to the small class size. Hence, removing them would underestimate the contribution of small enterprises in job creation. Moreover, firm dynamics might have a very strong effect on the cyclical patterns of job creation. For these reasons, we carry out our analyses both on a dataset with only continuous firms and one including companies entering and leaving the market. However, the factor analysis is only conducted on continuous firms. It is possible to impute missing values using methodologies such as in Doz et al. (2012) but it would be computationally burdensome. Moreover, it is not entirely clear how sensible it is to impute values for periods before the start of a firm or after it ceased to exist.

While the Gibrat's hypothesis is tested by examining the individual firm's growth rates (their cross-sectional average), to understand which type of employer has been driving the net job creation, we need to look at the total employment generated by a given size class, as it is done in, e.g., Neumark et al. (2011). Also in this case, we analyze both a dataset with entry and exit and one with only long-lasting enterprises. While the creation of jobs due to new firms is interesting in terms of supporting new entrepreneurs, examining the employment flows stemmed from stable firms is also crucial to indicate optimal policies. In this analysis, we use the more common growth rate formula:

$$g_t = \frac{L_t - L_{t-12}}{L_{t-12}} \tag{2}$$

where $L_t$ indicates the sum of employees for a given size class at time $t$.

To study the issues discussed in Moscarini and Postel-Vinay (2012), we use (1) to compute firm-level growth rates and subsequently we take the cross-sectional average for each month. The final series is given by $\frac{1}{N}\sum_{i=1}^{N} g_{it}$, where $N$ is the number of firms in a size class at time $t$. We then extract the cyclical component from $g_{t,big} - g_{t,small}$ using the Hodrick-Prescott filter with high $\lambda$ values. We examine the correlation of this variable, denoted as $\widehat{g}_t$, with the cyclical component of the unemployment rate, again extracted with the HP filter. Even though the correlation between the unemployment rate and the differential average growth rate of firms in different class sizes and sectors is interesting, we also analyze the correlation between the deviations from the trend of the aggregate unemployment rate and the common components extracted from the firm-level data. Similarly to the other empirical questions examined, we use both types of class-size definitions, but we limit the factor analysis to firms that are always present in the sample.

Assume we have $N$ firms and $T$ time periods in our dataset. We then model the firm-level growth rates of employees' numbers (denoted by the $T \times N$ matrix $G$) using the static factor representation of Stock and Watson (2002):

$$G = F\Lambda' + \epsilon, \tag{3}$$

where $F$ are the $K$ common factors, $\Lambda$ is the $N \times K$ matrix of factor loadings, and $\epsilon$ is the $T \times N$ matrix of idiosyncratic components. The $\epsilon$ are allowed to be cross-sectionally and serially (weakly) correlated. We estimate the common factors by principal component methodology, i.e. the factors are given by the scaled eigenvectors associated to the largest eigenvalues of matrix $GG'$.

This representation allows us to study also the idiosyncratic shocks hitting different types of firms and how they relate to the aggregate unemployment rate. In a way, we verify the presence of a granular effect in the Finnish economy, see Gabaix (2011), by checking if the idiosyncratic shocks associated to large firms are comoving with the aggregate unemployment. To analyze the correlations between the common shocks underlying different type of firms' employment behavior, we calculate the common component $C = \Lambda F$ for small and large firms and apply a similar procedure as in the case of the average growth rate of personnel. Finally, we examine the correlation between the differential average idiosyncratic shock of large and small firms, and the detrended unemployment rate. A negative correlation would point out to a possible granularity in the Finnish economy, even though we cannot establish a clear causal link between the individual shocks and the aggregate economic conditions without analyzing the actual origins of the firm-level idiosyncrasies.

## 3 Data Description

The data for our analysis is extracted at the premises of Statistics Finland, the Finnish National Statistics agency. We are able to access the entire universe of Finnish firms for monthly employment figures. This administrative data is based on the monthly value added tax and employment contributions made by each firm to the tax authority. Based on these data sources, the statistical office estimates the full-time equivalent (FTE) personnel figures for each enterprise that has paid out salaries or dividends in the near past. FTE is a unit that indicates the workload of an employed person in a way that makes workloads comparable. For example two persons working half time will equal one FTE, and similarly one person working extra hours will contribute more than one FTE. The Standard Industrial Classification (TOL) [1] classification for each firm is available from the Business Register which we combine with the monthly business data. The main part of our analysis is based on the monthly observations of FTE in each firm, for the time period covering all the months from January 1998 to September 2014. In this paper we also analyze the continuing firms in a separate sample that ends on December 2013.

The main variables of our study are the year-on-year growth rates of the firm-level employment. This type of data has been challenging to analyze because of the difficulty of controlling for mergers and split-offs. In our case, this problem is mitigated by the employed methodology of Statistics Finland. They obtain information on the relations between legal units from the tax authority, and deduce whether any firm is part of a merger or split-off. If this is the case, they correct the resulting bias in the year-on-year growth rates. In our data, the enterprises that disappear as a result of a merger are not considered as exits, but rather their employees become part of the continuing firm. This is achieved by estimating the employment in continuing companies one year ago as if the merged firms were already operating as one unit. Details of this procedure are presented in the Appendix A.

Our data includes all the firms that can be classified as small, medium, or big based on their personnel[2]. We classify business units into three size classes, following the definitions of Statistics Finland: over 250 employees (big), 50-250 employees (medium), and 0-49 employees (small). The TOL classification is available for each firm, so

[1] The 6 digit statistical classification system for economic activities used in the European statistical system

[2] Firms that have paid out salaries or dividends in the near past, so that it is possible to estimate the number of employees by the methodology of Statistics Finland

we further divide the companies into different sectors. Five industries are analyzed separately; manufacturing, trade and services, construction, finance and the public sector. In Tables 1 and 2, we report the number of firms for each size class in each sector. We use both the initial observation and the average number of employees to determine the size class of an enterprise.

| Size | Small | Medium | Big |
|---|---|---|---|
| Manufacturing | 31564 | 759 | 235 |
| Services | 153568 | 884 | 222 |
| Public | 14287 | 422 | 411 |
| Construction | 31387 | 122 | 22 |
| Financial | 2071 | 54 | 17 |
| TOTAL | 232878 | 2240 | 908 |

Table 1: Average number of firms for each size class within sector, class defined by initial observation

| Size | Small | Medium | Big |
|---|---|---|---|
| Manufacturing | 31468 | 874 | 224 |
| Services | 153144 | 1247 | 294 |
| Public | 14199 | 514 | 413 |
| Construction | 31323 | 176 | 32 |
| Financial | 2034 | 77 | 33 |
| TOTAL | 232168 | 2887 | 996 |

Table 2: Average number of firms for each size class wsithin sector, size determined using the average number of employees

From Tables 1 and 2, we see that small firms are by far the most numerous in all sectors of the Finnish economy. Moreover, the type of size classification does shift the number of firms towards higher size classes, but this effect is not very pronounced. It seems that most small businesses, defined by their initial number of employees, stay small for the rest of their existence.

It is interesting to examine the behavior of different types of firms conditional on survival. For this reason, we also analyze a dataset which excludes entry and exit. For these companies, we limit our analysis up to December 2013. Small firms have a tendency of reporting their data late in the year, which would lead us to consider many small firms as exiting during 2014. Using the end of 2013 as final point of our analysis makes sure that we are not omitting any firm just because of slow data reporting. This issue is milder in the case of entry and exit, where continuing businesses are just a small part of the dataset. Moreover, given their small numbers, we merge the large and medium firms in the finance sector. After applying this restriction onto our data, we are left with the sample described in Table 3 and 4.

| Sector | Small | Medium | Big |
|---|---|---|---|
| Manufacturing | 12566 | 442 | 140 |
| Services | 53316 | 563 | 159 |
| Public | 4646 | 275 | 312 |
| Construction | 9783 | 67 | 13 |
| Financial | 522 | 45 | 45 |
| TOTAL | 80834 | 1392 | 668 |

Table 3: Average number of continuous firms for each size class within sector, size determined using first observation

| Sector | Small | Medium | Big |
|---|---|---|---|
| Manufacturing | 12542 | 483 | 123 |
| Services | 53158 | 683 | 197 |
| Public | 4571 | 333 | 304 |
| Construction | 9749 | 97 | 17 |
| Financial | 503 | 64 | 64 |
| TOTAL | 80524 | 1660 | 705 |

Table 4: Average number of continuous firms for each size class within sector, size determined using the average number of employees

As visible from the above tables, the number of companies included in the analysis is greatly reduced, with the number of small enterprises especially affected by the exclusion of entry and exit. However, this subset of firms is very interesting in terms of policy-making.

The factor models used in Section 4.3 require balanced datasets. This means that not only we need continuing firms over the January 1998 to December 2013 period, but they also must not present any missing values. It might happen that Statistics Finland has information about an enterprise existing in the market at time $t$, without knowing the actual value of personnel. While this situation is not problematic when we compute average growth rates or the total number of employees, it does not allow the estimation of principal components. We report the number of firms included in this last subset in Tables 5 and 6.

| Sector | Small | Medium | Big |
|---|---|---|---|
| Manufacturing | 5858 | 370 | 91 |
| Services | 26541 | 451 | 114 |
| Public | 1804 | 255 | 277 |
| Construction | 3553 | 65 | 9 |
| Fiancial | 314 | 34 | 34 |
| TOTAL | 38070 | 1175 | 525 |

Table 5: Average number of continuous firms with no missing values for each size class within sector, size determined using first observation

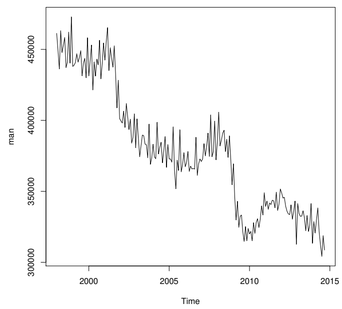
| Sector | Small | Medium | Big |
|---|---|---|---|
| Manufacturing | 5843 | 403 | 73 |
| Services | 26426 | 549 | 131 |
| Public | 1763 | 301 | 272 |
| Construction | 3533 | 92 | 10 |
| Finance | 303 | 45 | 45 |
| TOTAL | 37868 | 1390 | 531 |

Table 6: Average number of continuous firms with no missing values for each size class within sector, size determined using the average number of employees

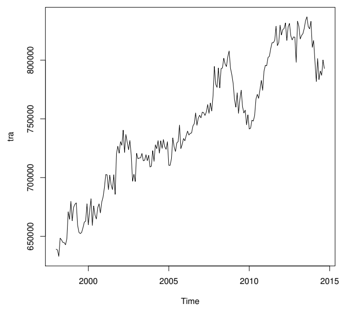
As we can expect, removing series with missing values leads to a further reduction of the number of companies in our dataset. However, except for the big firms in construction, we have a sufficiently large cross-section to be confident in our factor estimates. In theory, it would be possible to impute the missing values using an EM-algorithm as in Stock and Watson (2002) but this procedures would be computationally unfeasible when we have a very large number of companies in our dataset.

## 4 Empirical Results

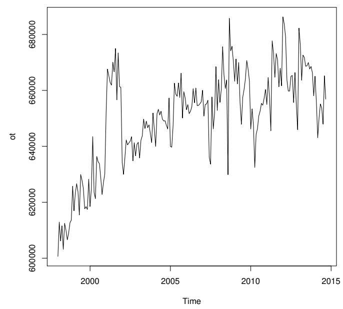
The Finnish job market has experienced dramatic changes in the last 15 years. In Figure 1, we report the seasonal adjusted number of employees belonging to a given sector from January 1998 up until September 2014. Notice that here we include entry and exit, meaning that the great majority of Finnish firms is included.



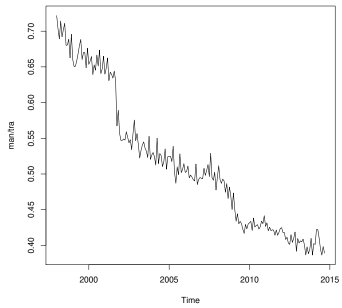
(a) Manufacturing



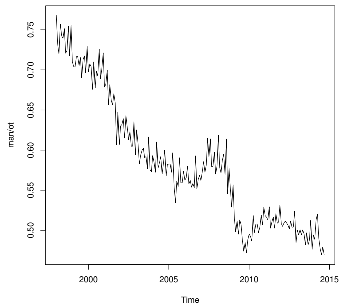
(b) Services



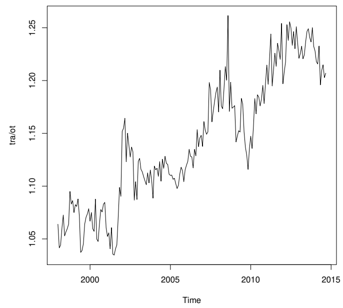
(c) Public



(d) Man./Ser.



(e) Man./Pub.



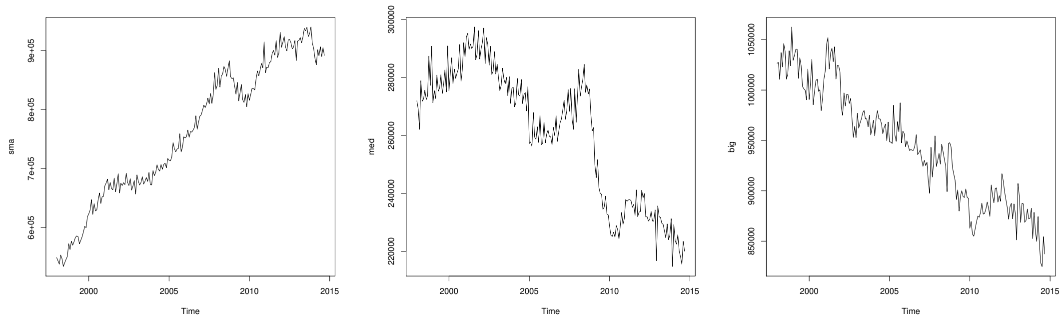
(f) Ser./Pub.

Figure 1: Total number of employees for each sector (upper panel) and their relative importance (lower panel).

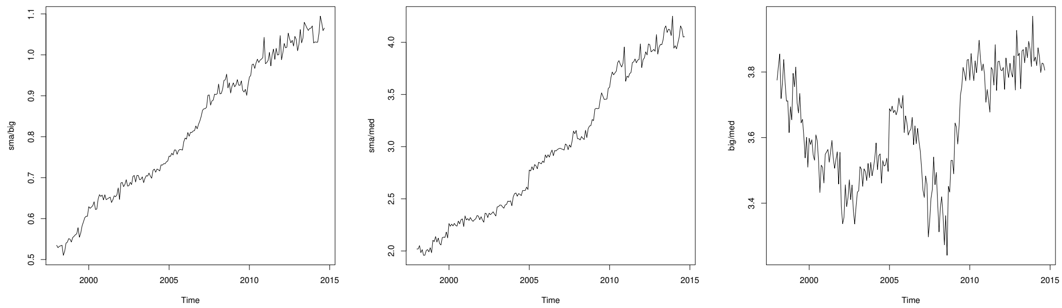
From these plots, it is clear that the manufacturing and the service sectors have experienced extremely different trends. While services have been steadily increasing since the end of 90's, the manufacturing sector has faced a constant decline in the number of employees. On the other hand, the public sector had a fairly clear rise between the end of 90's and the beginning of 2000's, but it seems to have been stabilized ever since. We need to remember that the public sector usually follows fairly different employment patterns compared to private firms. These plots also show evidence for the dramatic impact of the Great Recession, with job levels yet to recover completely from the plunge in 2008.

From the bottom half of Figure 1, we see the relative importance of these sectors in the Finnish economy. Since the beginning of the sample, manufacturing has been less important than the service sector in terms of employment levels. Moreover, there has been a steady declined in the share of employment due to the manufacturing sector. In January 1998, the manufacturing firms accounted for 70% of the number of employees relative to the service sector, while in September 2014 this figure dropped to around 40%. A fairly similar pattern can be found when we compare the manufacturing and the public sector. The importance of services has grown also with respect to the public sector, even though not in such a large magnitude as in the comparison with manufacturing.

Being interested in the relation between small and large firms employment patterns, we proceed by looking at how the Finnish economy has changed with respect to which size class of enterprises has been predominant. In Figure 2, we report the number of employees in small, big and medium firms. Moreover we report the ratio between different size class to see their relative importance in the economy.




(a) Small (b) Medium (c) Big



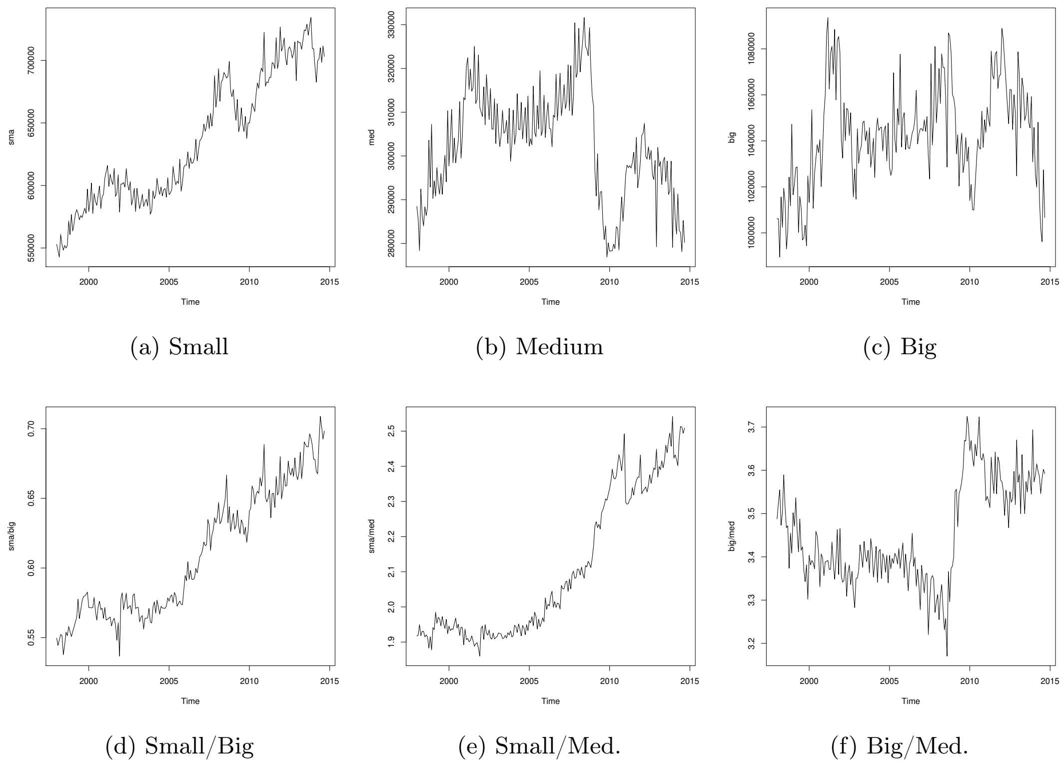

(d) Small/Big (e) Small/Med. (f) Big/Med.

Figure 2: Total number of employees for each firm's size class (defined using the first observation) and their relative importance.

One of the most striking feature we can gather from these plots is the extremely divergent pattern taken by small firms in comparison to big and medium enterprises. While both large and medium size companies have faced a constant decay in the number of employees, small firms have experienced a steady growth (even tough it is clearly visible the effect of the Great Recession). Also, it is remarkable to see how the job market in Finland has shifted from large to small firms. In the beginning of the sample, the number of employees in small firms was only half of the workers in large firms. This relationship has dramatically changed over the time period in this study and since mid

2011, small enterprises have been the major employer of the Finnish economy. Medium firms have been less important in terms of workers throughout the whole time period of this study.

The plots reported in Figure 2 are based on the size classification which considers the firm size at the beginning of the sample. As we pointed out, classifying businesses as small or large based on their first observation can lead to an overestimation of the job creation generated from small firms. For comparison, we report similar graph as in Figure 2, this time with class size determined by the average number of employees over the lifespan of the company.




(a) Small (b) Medium (c) Big

(d) Small/Big (e) Small/Med. (f) Big/Med.

Figure 3: Total number of employees for each firm's size class (defined using the average number of employees) and their relative importance.

Using the alternative size classification leads to slightly different conclusions. While small and medium firms maintain similar patterns compared to the previous figure, large companies' employees numbers do not show the same strong decay as in Figure 2. Moreover, when we consider the comparison between small and big firms job contribution, we see that while small businesses have become more important in the Finnish job market over the last 15 years, they do not surpass large ones in terms of number of employees in the end of the sample, as in the case of initial size classification.

The three questions raised in the introduction are analyzed separately in the next three subsections.

### 4.1 Who grows more?

First, we study the unweighted average of the growth rate of the number of employees for firms belonging to different size-classes. In particular, we verify whether the Gibrat's law holds for Finnish firms in different sectors, or if small companies tend to have higher growth rates as pointed out in, e.g., Hohti (2000). The growth rates are computed using (1) and both initial and average size classifications are used to define the type of firm. The results are reported in Table 7.

Average growth rate

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| Small | 0.22 | 1.68 | 2.68 | 2.86 | 2.62 |
| Medium | -3.11 | -1.77 | -0.11 | -0.38 | -1.71 |
| Big | -3.57 | -0.59 | -0.17 | -0.46 | -2.16 |
| Average Size | Man. | Tra. | Pub. | Con. | Fin. |
| Small | 0.15 | 1.63 | 2.62 | 2.84 | 2.51 |
| Medium | -0.84 | 3.65 | 1.18 | 3.92 | 1.86 |
| Big | -1.67 | 1.96 | 0.57 | 0.61 | -0.58 |

Table 7: Average growth rate (percentages) for small, big and medium firms in different sectors.

From this table we see that the Gibrat's law does not seem to hold in Finland for all the sectors under consideration. When we adopt the initial size classification methodology, small firms exhibit larger growth rates with respect to both medium and big companies for all sectors. While large and medium firms in the manufacturing sector have experienced, on average, a strong decline in the number of employees, small businesses seem to have been fairly stable. For the trade, construction, public and finance sectors the result is similar, with small firms having a positive growth rate, on average, against the negative growth rates of large and medium enterprises.

In the average size classification case, small firms in the manufacturing, construction, public and financial sectors show higher growth compared to larger companies. However, the same cannot be said for the trade and services. Here, both medium and big firms present higher growth rates compared to small ones. This can indicate that successful small firms in the service industry move to the medium and big category as time goes on. In any case, the Gibrat's law seems not to hold in Finland, given widely differing average growth rates for different types of business units.

So far, we have examined growth rates for enterprise data including entry and exit. Most of the new companies entering in the market are small and only later on they hire more employees and move to other class sizes. Our class definition based on the average number of employees can milden this issue, but it can still create a distorted picture of how small firms are growing. Moreover, for policymakers it might be interesting to see the growth rates of small firms which are surviving over time, i.e. that are creating a constant flow of jobs. Newcomers might have initially large growth rates, but might last for only a short period of time. To investigate the Gibrat's law for more stable firms, we use a dataset including only businesses present during the whole sample period.

Below, we report the average growth rates for small, medium and large enterprises which have been present throughout the sample. Results are for both size classification methodologies.

Average growth rate

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| Small | 0.44 | 1.44 | 2.29 | 1.97 | 1.21 |
| Medium | -2.14 | -0.81 | 0.57 | 0.33 | -0.51 |
| Big | -4.19 | -1.01 | -0.06 | 0.53 | -0.51 |
| **Average Size** | **Man.** | **Tra.** | **Pub.** | **Con.** | **Fin.** |
| Small | 0.33 | 1.38 | 2.17 | 1.94 | 1.19 |
| Medium | -0.14 | 2.72 | 1.27 | 3.65 | 0.12 |
| Big | -1.08 | 2.20 | 0.48 | 3.88 | 0.12 |

Table 8: Average growth rate (percentages) for continuous small, big and medium firms in different sectors without entry and exit.

Table 8 indicates again that we cannot point out a unique relationship between firm size and growth. When we base our size class definition on the first observation of a firm, we get that small firms grow faster than large and medium enterprises for all the sectors of the economy. Using the average number of employees to define a firm as small or large gives us remarkably different results. The fact that we get similar results as in Table 7 indicates that entrant firms do not play an important role in terms of the Gibrat's Law in Finland, while the size-classification criterion does. While small enterprises (conditional on surviving over the whole sample period) grow more in the manufacturing and other sectors, the reverse is true for the service sector and the construction sector. It is important to notice that the service industry is by far the most important in the Finnish economy.

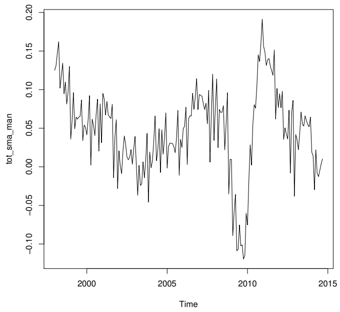
Looking at the results reported in this subsection, we can draw few conclusions. First of all, the Gibrat's Law does not seem to hold in Finland for all sectors and types of firms analyzed. Furthermore, the different growth rates are not caused by the temporary growth of young small firms, but even considering long lasting businesses does not change the conclusion that size affects the growth rate of the firms. This is in contrast to what is found in Lotti et al. (2009), where it is argued that the Gibrat's Law holds in the long-run. If this is the case, we should see a convergence towards similar growth rates when examining firms that survive during the period 1998-2014.

When analyzing the growth rates in terms of small versus large firms, we cannot find a single pattern. Let's consider first the case where entry and exit is allowed. If we look at firms defined as small or big based on their first observation, which likely leads to an overestimation of successful small firms, we see that enterprises starting with few employees experience higher growth rates in all sectors. However, if we use average size to determine the size class we get a different result. Now, small firms have larger growth rates with respect to big ones for all sectors, except for the service and trade. Given that the service sector is by far the most important in the private job market (i.e. excluding the public sector), this result must be kept in mind.

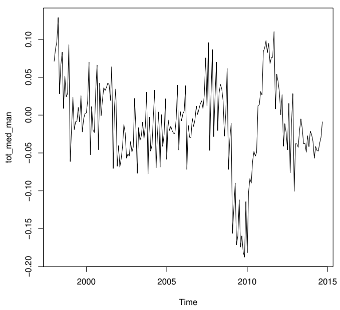
Even if we disregard entry and exit from our dataset, we find similar results with respect to the growth-size relationship. If we base the size definition on the first observation in a firm's life, the conclusion we draw is that the small firms grow more, while when we use average size definition the pattern is reverted for the trade an services sector. From a policymaker point of view, it is extremely interesting to see that entrant firms are not the main driver of the size-growth relationship.

### 4.2 Who creates more jobs?

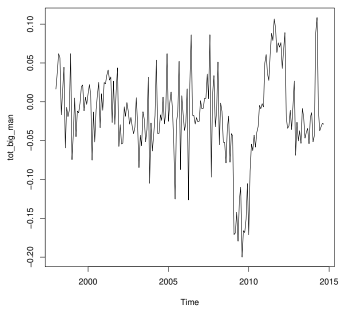
After having investigated the growth rates of firms of different size, we now turn to examine which type of enterprises has created more (net) jobs in different sectors of the Finnish economy during the period going from January 1998 to September 2014. As it is done in the previous subsection, we report different results for different class size definitions and for datasets with and without entry and exit. First, we plot the growth rates of total employment generated by small, medium and large firms in the manufacturing and service sectors.



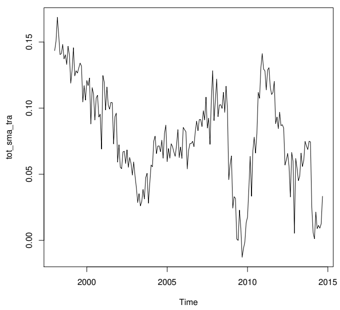

(a) Small Manufacturing



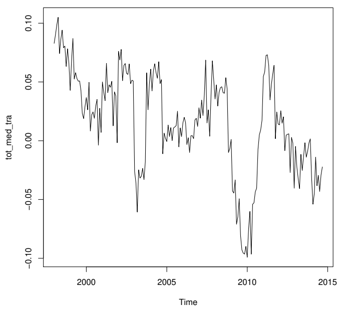

(b) Medium Manufacturing



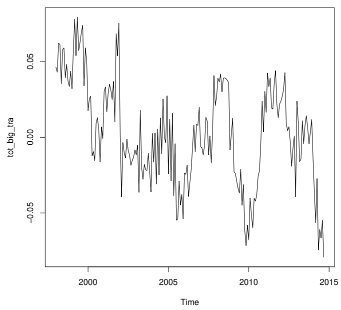

(c) Big Manufacturing




(d) Small Services

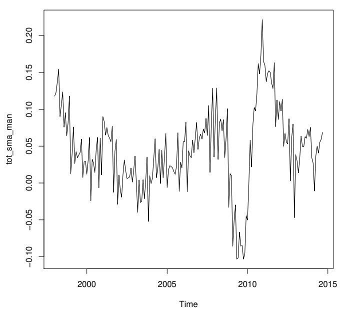



(e) Medium Services

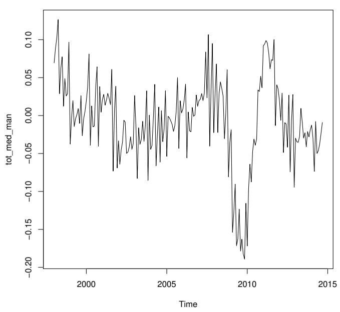



(f) Big Services

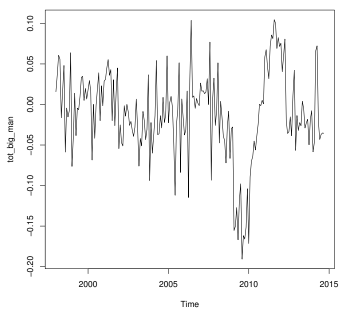
Figure 4: Growth rates of the total number of employees in different sectors, size class defined using the first observation.



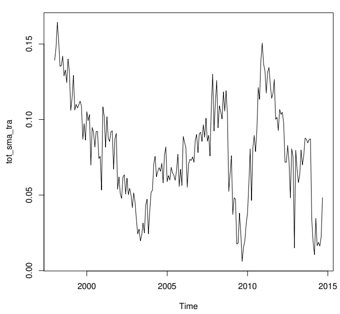

(a) Small Manufacturing



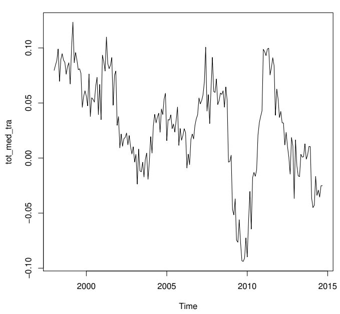

(b) Medium Manufacturing



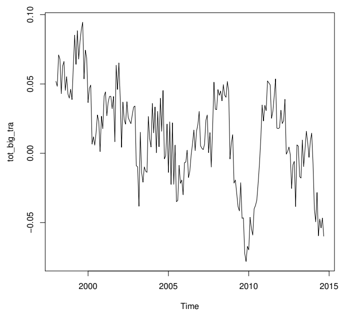

(c) Big Manufacturing




(d) Small Services




(e) Medium Services




(f) Big Services

Figure 5: Growth rates of the total number of employees in different sectors, size class defined by the average number of employees.

One of the most striking features of Figure 4 and 5 is how the recent crisis has affected the Finnish job market. Enterprises of all size class and sectors have faced a severe decline in the number of workers and growth rates fail to raise even nowadays. Moreover, it is interesting to notice the striking similarity of the plots, regardless of the classification methodology adopted.

To get a clearer picture of which kind of firms has generated more net jobs within a sector, we look at the average of the growth rate of total workers, calculated following the standard formula (2). Again we consider both initial and average size classifications, to see how defining a firm to be small or large affects our results. Following the findings of Davis et al. (1996) and Neumark et al. (2011) we expect the growth rates to get closer when we use the average number of employees to determine the class of an enterprise.

Average net job creation

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| Small | 4.64 | 7.89 | 9.58 | 10.31 | 3.01 |
| Medium | -1.09 | 1.63 | 0.70 | 2.07 | 1.12 |
| Big | -1.76 | 0.26 | 0.44 | 0.52 | -1.80 |
| **Average Size** | **Man.** | **Tra.** | **Pub.** | **Con.** | **Fin.** |
| Small | 4.51 | 7.90 | 9.71 | 10.59 | 7.52 |
| Medium | -0.71 | 2.95 | 1.08 | 4.41 | 2.50 |
| Big | -1.21 | 1.29 | 0.53 | 0.46 | -1.28 |

Table 9: Average net job creation rate (percentages) for small, big and medium firms in different sectors.

From Table 9, we see that small firms have created more net jobs, on average, compared to large and medium enterprises. Surprisingly, how we define a firm to be small or large does not seem to affect our results. Even after using the average size to select in which class a company falls, small employers generate considerably more jobs than the others.

After having examined the data including entry and exit, we now turn to firms that survive over our sample period. In this way, we try to disentangle the job creation due to new businesses (which might not survive for long) and the one generated by growing existing firms. We report the results for both classification methods.

Average net job creation

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| Small | 2.11 | 3.67 | 4.99 | 3.51 | 1.37 |
| Medium | 0.03 | 1.60 | 1.04 | 3.94 | 0.71 |
| Big | -2.89 | -0.41 | 0.50 | -0.12 | 0.71 |
| **Average Size** | **Man.** | **Tra.** | **Pub.** | **Con.** | **Fin.** |
| Small | 0.96 | 2.34 | 2.83 | 2.99 | 1.36 |
| Medium | -0.30 | 2.17 | 0.90 | 3.91 | 0.65 |
| Big | -2.10 | 1.26 | 0.56 | 1.57 | 0.65 |

Table 10: Average net job creation rate (percentages) for small, big and medium continuous firms in different sectors without entry and exit.

Based on these results we see that small firms which have survived between 1998 and 2014 have generated relatively more jobs compared to their large counterparts. This result holds true for all sectors and for both classification methodologies. However, using the average size as classification criterion leads to smaller differential between the small and large firms (medium firms growth rates are even more similar or even exceed the growth of the small counterparts). This is in line with what is found in Neumark et al. (2011), where they show that the classification method can have a converging effect onto the growth rates of small and big firms.

So, far we have studied the net job creation of small versus big firms, relative to the number of workers employed in those class of companies using formula (2). Yet, it might be more meaningful to examine the net job creation relative to the overall number of employees in the sector of interest. In this way, we are able to compare straightforwardly the net job creation of small and large businesses. This can be done by using

$$g_t = \frac{L_{t,Size} - L_{t-12,Size}}{L_{t-12,Total}} \tag{4}$$

for each sector of this study. Here, $Total$ represent the sum of the number of employees inside a given sector. In the next tables, we report the average growth rates attributable to each size class, using (4). We do this using both initial and average number of employees classifications, and for both datasets with and without entry and exit.

| Average net job creation | | | | | |
|---|---|---|---|---|---|
| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
| Small | 1.56 | 4.46 | 0.78 | 6.82 | 0.96 |
| Medium | -0.30 | 0.40 | 0.06 | 0.51 | 0.20 |
| Big | -0.75 | 0.12 | 0.37 | 0.10 | -0.58 |
| Average Size | Man. | Tra. | Pub. | Con. | Fin. |
| Small | 1.33 | 3.89 | 0.65 | 6.52 | 1.24 |
| Medium | -0.20 | 0.72 | 0.10 | 1.10 | 0.35 |
| Big | -0.55 | 0.44 | 0.44 | 0.09 | -0.99 |

Table 11: Average net job creation rate (percentages) for small, big and medium firms in different sectors relative to total employees in the sector.

| Average net job creation | | | | | |
|---|---|---|---|---|---|
| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
| Small | 0.57 | 1.72 | 0.20 | 2.22 | 0.26 |
| Medium | -0.04 | 0.36 | 0.07 | 0.96 | 0.25 |
| Big | -1.45 | -0.13 | 0.38 | -0.12 | 0.24 |
| Average Size | Man. | Tra. | Pub. | Con. | Fin. |
| Small | 0.25 | 1.00 | 0.14 | 1.78 | 0.18 |
| Medium | -0.08 | 0.48 | 0.07 | 0.93 | 0.21 |
| Big | -1.06 | 0.49 | 0.44 | 0.29 | 0.27 |

Table 12: Average net job creation rate (percentages) for small, big and medium continuous firms in different sectors relative to total employees in the sector.

Tables 11-12 confirm our initial results. Across all size classification methods and sectors, small firms have been the main job creator in the Finnish economy. The only exception is the public sector, which is expected to show very different employment patterns. Continuous firms of different size classes have experienced more similar net job creation rates, with the financial sector showing a very small difference between small and large companies. The size classification has again a converging effect on the job creation.

Overall, the main finding of this subsection is that Finnish small firms have generated substantially higher net job creation rates, both relative to their contribution to a sector and to the total number of employees in the industry. The size classification methodology and the exclusion of entry and exit affect the magnitude of this relationship, reducing the net job creation attributed to enterprises with fewer employees (as found in the literature), but small firms show a consistently higher contribution to the growth of Finnish employment.

### 4.3 Who is more procyclical?

We now turn to the question, raised in Moscarini and Postel-Vinay (2012), about the correlation between the aggregate unemployment rate and the growth rates of firms of different size. In their work, the authors find that large enterprises are more sensitive to business cycle conditions compared to small companies. This finding holds for all sectors, in multiple countries and seems not to be caused by the entry and exit patterns.

We start by replicating the same exercise carried out in their paper, i.e. we compute the firms' growth rate using (1) and take the cross-sectional average within a size class. We define this average growth rates as $g_{t,size}$ where size can be small, medium or big. Finally, we correlate the differential of the average growth rates between large and small firms (in deviation from trend), which we denote as $\widehat{g}_t$, with the cyclical component of the aggregate unemployment rate. Both series are detrended using the Hodrick-Prescott filter with a large $\lambda$ value (we follow the suggestion of Shimer (2012)).

First, we compute these correlations using the datasets which include entry and exit. We do this for both type of size classification explained earlier, i.e. using the initial size and the average size over an enterprise life. Results are reported in Table 13.

Correlation with unemployment rate

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| $\widehat{g}_t$ | -0.13* | -0.23** | -0.00 | -0.23*** | -0.16** |
| Average size | Man. | Tra. | Pub. | Con. | Fin. |
| $\widehat{g}_t$ | -0.13* | -0.30*** | 0.01 | -0.30*** | -0.24*** |

Table 13: Correlation between the differential between average growth rate of big and small firms in different sectors, and the detrended unemployment rate.*, **, *** indicates statical significance at a 10/5/1 % confidence level, respectively

From the tables above, we see that the findings of Moscarini and Postel-Vinay (2012) hold for the Finnish economy, when we include entry and exit. Small firms tend to be substantially less procyclical compared to large ones and this is evidenced in a negative correlation coefficient between the big-small firms differential and the aggregate unemployment. This holds for most sectors, except for public enterprises. In this case, small and big firms' net job creation show a similar correlation with the detrended unemployment rate. Government controlled firms tend to have very different employment patterns compared to private companies and are in general less affected by the business cycle.

We now repeat the analysis excluding the effects of firms leaving and entering in the market. Table 14 includes the correlation between the average growth rates of continuous firms and the detrended unemployment rate.

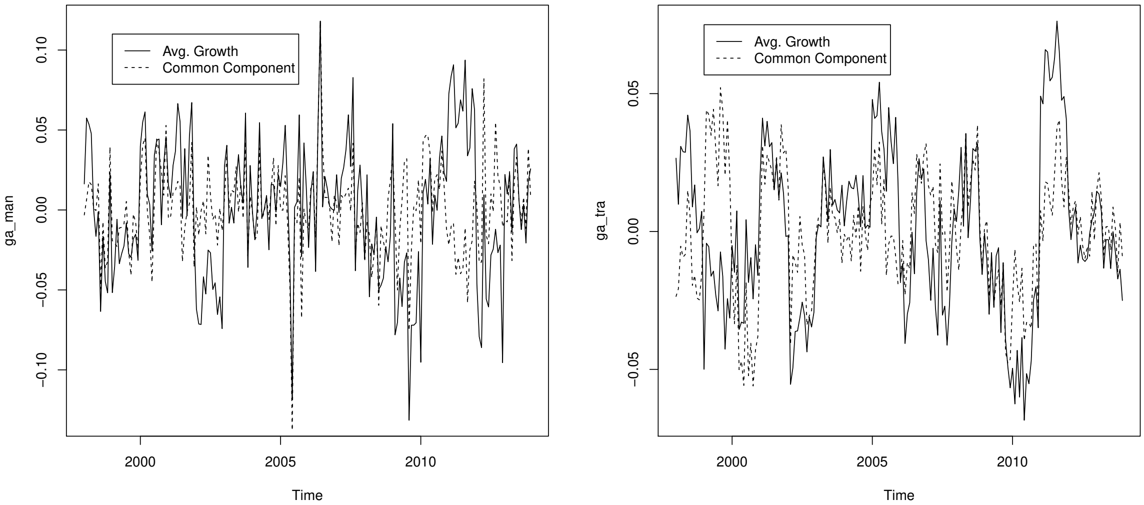
Correlation with unemployment rate

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| $\widehat{g}_t$ | -0.01 | -0.11 | 0.01 | -0.08 | -0.20*** |
| Average Size | Man. | Tra. | Pub. | Con. | Fin. |
| $\widehat{g}_t$ | -0.14** | -0.21*** | 0.02 | -0.13* | -0.28*** |

Table 14: Correlation between average growth rate (percentages) and the detrended unemployment rate for continuous small, big and medium firms in different sectors. *, **, *** indicates statical significe at a 10/5/1 % confidence level, respectively

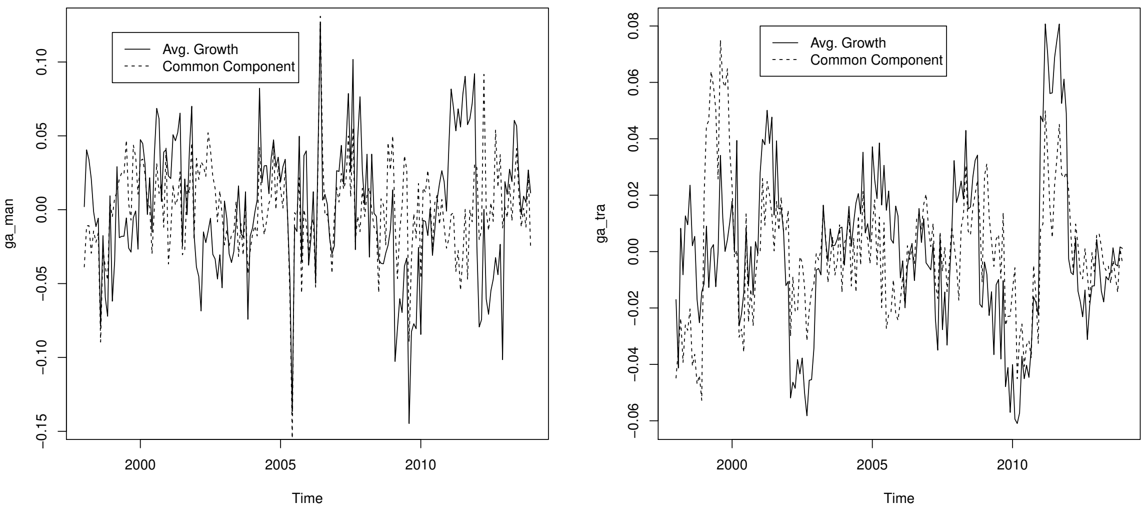
The exclusion of entry and exit slightly changes our conclusions. When we use the initial observation type of size classification, we get that the manufacturing sector does not show the same behavior as in Moscarini and Postel-Vinay (2012), with the very low correlation between the unemployment rate and the differential. For the other sectors, the correlation between the differential employment growth and the detrended unemployment rate reflects again the pattern found in Table 13. Also in this case, the public sector presents a very different behavior with respect to the prociclicality of different firms. Notice that in the case of continuous firms, the method of size classification affects the correlation between the differential employment growth and the unemployment rate. Using the average number of employees as determinant of the size of units leads the correlations to be lower, except for the public sector.

So far, we have been focusing on the relation between the average net job creation and the unemployment rate. However, a related interesting question is whether the common shocks underlying firms employment have a different correlation with the aggregate economic conditions, based on firm's size. We estimate the comovements underlying our firm-level data using the factor model of Stock and Watson (2002), described in Section 2, and we select the number of factors with the Bai and Ng (2002) criteria. Using the estimated factors and the corresponding factor loadings we can compute the cross sectional average of the common component $C = F\Lambda'$ for small and large firms. We then detrend the differential between these common components in the same fashion as we did for the average growth rates. We denote this variable as $\widehat{C}_t$. We first plot the big versus small differential of the average growth rates and of the estimated common components for the services and manufacturing industries.




(a) Manufacturing (b) Services

Figure 6: Average growth rate and common component differential for firms defined using the first observation.




(a) Manufacturing (b) Services

Figure 7: Average growth rate and common component differential for firms defined using the average size.

As we can see from Figure 6 and 7, the differentials of the growth rate and of the common components are positively correlated, with coefficients ranging to 0.41

to 0.55. However we can notice some large differences during times of high volatility, e.g., right after the Great Recession. In the tables below, we report the correlations between the common components and the aggregate unemployment rate, however only for continuous firms without any missing values.

Correlation with unemployment rate

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| $\widehat{C}_t$ | 0.18** | -0.30*** | -0.09 | -0.21*** | 0.20*** |
| **Average Size** | **Man.** | **Tra.** | **Pub.** | **Con.** | **Fin.** |
| $\widehat{C}_t$ | -0.12* | -0.26*** | -0.12* | -0.11 | 0.20*** |

Table 15: Correlation between the detrended unemployment rate and $\widehat{C}_t$.*, **, *** indicates statical significe at a 10/5/1 % confidence level, respectively

Using common components instead of the average growth rates does not produce dramatically different results. As in the continuous firms analysis, the way we classify the companies' size class affects our conclusions, at least for the manufacturing sector. If we use the first observation to define an enterprise as small or large, we get that for the manufacturing industry small firms are more procyclical than big ones. Again, if we use the average number of employees as a measure of firm size, the result is overturned to what Moscarini and Postel-Vinay (2012) find. Interestingly, for the financial sector we get that large enterprises are less procyclical than small ones, for both types of size classification.

We have looked at the common forces underlying firm-level personnel data. Not only we focused on the latent factors, but the average of the net job creation rate can be seen as part of the common component. In our dataset, the correlation between the average net job creation and the common factors of the same type of firms can be as high as 0.85, indicating that these series contain similar information as the factors. Yet, it is interesting to see the relation between the idiosyncratic shocks affecting different companies and the business cycle. To do this, we simply estimate the average idiosyncratic shocks using (3), compute the differential between the large and small businesses and calculate the correlation with the detrended unemployment. These idiosyncratic shocks are denoted as $\widehat{\epsilon}_t$. Recently, there has been an extensive macroeconomic literature on the effect of idiosyncratic shocks of individual firms onto the aggregate economy. An example from this research is Gabaix (2011), where the author formulates the "granular hypothesis". The main idea of this paper is that shocks affecting large firms have a considerable impact on the aggregate business cycle, because they do not average out due to the fat tail of the firm size distribution of many economies. If we find a large negative correlation between the differential idiosyncratic shock and the detrended unemployment rate then we would have evidence for granularity in the Finnish job market.

Below we present the correlation between the unemployment rate and the average idiosyncratic components for different categories of firms.

Correlation with unemployment rate

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| $\widehat{\epsilon}_t$ | -0.21*** | -0.08 | 0.03 | -0.27*** | -0.25*** |
| Average Size | Man. | Tra. | Pub. | Con. | Fin. |
| $\widehat{\epsilon}_t$ | -0.13* | -0.34*** | 0.10 | -0.16** | -0.25*** |

Table 16: Correlation between the average idiosyncratic component and the detrended unemployment rate for continuous small, big and medium firms in different sectors. In the table, *, **, *** indicates statical significance at a 10/5/1 % confidence level, respectively

Table 16 evidences a strong negative correlation between the idiosyncratic components differential and the detrended unemployment rate, pointing toward a possible granular effect in the Finnish economy. Individual shocks affecting large companies are more procyclical, indicating that temporary idiosyncrasies in large firms might have significant effect on the aggregate employment.

So far, we have looked at unconditional correlations and found similar results as in Moscarini and Postel-Vinay (2012). Overall, large firms seem to be more procyclical than small ones. This conclusion does not perfectly reconcile with what we found in the previous subsections. As we have seen, small firms have been the main force behind net job creation for all sectors of the Finnish economy, while we have now found that large firms should create more jobs during expansions and destroy more of them during recessions. The mean of the year-on-year change in unemployment is -0.24, which indicates that Finland has experienced a steady decay in the unemployment rate. If the large enterprises would be consistently more procyclical, on average, they should create more jobs than small ones. The discrepancy between our empirical results can be explained by looking at how the correlation between the detrended unemployment rate and the differential net job creation of large and small firms changes with the business cycle. In other words, is the more pronounced procyclicality of large enterprises due to higher job creation during expansions or due to higher job destruction during times of high unemployment? To check for this, we compute the correlations between the differential net job growth and the unemployment rate conditional on the detrended unemployment being below its average (expansions) or above its average (recession). We do this for both size classification methodologies and for both data including entry and exit, considering only continuous firms.

Correlation with unemployment rate

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| $\widehat{g}_t$\|Expansion | 0.09 | 0.01 | -0.06 | -0.30*** | -0.03 |
| $\widehat{g}_t$\|Recession | -0.29*** | -0.25*** | 0.04 | -0.25*** | 0.09 |
| Average Size | Man. | Tra. | Pub. | Con. | Fin. |
| $\widehat{g}_t$\|Expansion | 0.04 | -0.09 | -0.05 | -0.34*** | -0.07 |
| $\widehat{g}_t$\|Recession | -0.25*** | -0.30*** | 0.07 | -0.26*** | -0.08 |

Table 17: Correlation between the differential between average growth rate of big and small firms in different sectors, and the detrended unemployment rate conditional on business cycle. In the table, *, **, *** indicates statical significance at a 10/5/1 % confidence level, respectively

Correlation with unemployment rate

| Initial Observation | Man. | Tra. | Pub. | Con. | Fin. |
|---|---|---|---|---|---|
| $\widehat{g}_t$\|Expansion | 0.12* | 0.05 | 0.01 | -0.02 | -0.05 |
| $\widehat{g}_t$\|Recession | -0.23*** | -0.20*** | 0.05 | -0.23*** | -0.29*** |
| Average Size | Man. | Tra. | Pub. | Con. | Fin. |
| $\widehat{g}_t$\|Expansion | -0.04 | -0.10 | 0.03 | -0.09 | -0.09* |
| $\widehat{g}_t$\|Recession | -0.27*** | -0.19*** | 0.08 | -0.18** | -0.35*** |

Table 18: Correlation between the differential between average growth rate of continuous big and small firms in different sectors, and the detrended unemployment rate conditional on business cycle. In the table, *, **, *** indicates statical significance at a 10/5/1 % confidence level, respectively

Tables 17 and 18 give us an interesting piece of evidence that can help us reconcile the results of Moscarini and Postel-Vinay (2012) and the larger contribution of small firms to net job creation. Independently of the classification methodology and of whether we include entry and exit in the dataset, we find that the correlation between the differential net job creation and the unemployment rate is consistently higher (in absolute terms) during the recession periods. On the other hand, the correlation becomes positive during expansions, contradicting our previous results. It seems that, for the Finnish economy, larger firms are more responsive to high unemployment rates but are not more procyclical than small enterprises during expansions. The original reasoning behind the Moscarini and Postel-Vinay (2012) findings lays in the greater ability of big firms to increase the number of employees during favorable economic conditions. In contrast, small firms have more credit constraints, so they are not able to hire as much as they would like to. During recessions, large employers need to reduce the number of workers to adjust their production, while small enterprises do not have this necessity because they did not increase the number of employees during previous expansions. This reasoning does not hold in light of the results in Tables 17-18, because the high negative correlations appear only during recessions. It seems that large firms have destroyed more jobs during tougher economic conditions but did not hire more than small businesses during expansions. This might indicate that large firms have shifted to a less labor intensive productions while small firms, possibly due to credit constraints, have not improved their technology to rely less on the labor input. These results are particularly evident in the manufacturing and service sectors, while the public sector and the construction one do not seem to experience the same pattern. However, the construction industry is fairly small in terms of employees and the public sector likely follows very different logics in terms of employment decisions. The shift to less labor intensive production is discussed in Kyyra and Maliranta (2008), where they document the declining labor share of the Finnish economy. They point out that the leading cause of the fall in the labor share is due to the reallocation of production to less labor reliant enterprises, rather than the adjustments within firms. Another explanation for this higher procyclicality of large firms during times of economic contraction can be found in Böckerman and Maliranta (2012), where the authors find a negative effect of globalization on the labor share in the Finnish manufacturing sector (possibly because large firms move their production outside Finland). In particular, they find a shift in the value added toward capital intensive firms, which we can argue to be the larger companies.

As a summary, in this subsection we have examined the procyclicality of small and large firms with respect to employment patterns. We found that the stylized facts studied in Moscarini and Postel-Vinay (2012) hold for the Finnish economy, except for the public sector, and for the manufacturing industry when we use continuous firms classified based on their first observation. Not only we have seen that differential growth rates are substantially negative correlated with the aggregate unemployment rate, but also the common component and the idiosyncratic shocks associated to large firms seem to be more correlated with the business cycle. Finally, we have seen that these relations are mostly generated during recessions.

## 5 Conclusions

In this study, we examine three crucial empirical questions related to the employment behavior of small and large Finnish firms. Using monthly data containing personnel figures for the vast majority of Finnish companies of the last 15 years, we unify different literatures regarding the growth and cyclicality of the job market. In particular, we verify which type of firms has experience higher growth rates of the number of employees, which one has been the main job creator and the one which correlates more with the business cycle. In line with the previous research, we have taken into account the possible biases generated by the size-classification methodology and by the presence of entry and exit.

We find that the Gibrat's law, i.e. firms' growth rates should be independent of their size, does not hold in Finland. As pointed out in the previous literature, e.g. Hohti (2000), small firms have experienced larger growth rates, compared to large companies. However, this result is reverted for the service sector (the most important in Finland in terms of workforce) when we use the average number of employees to classify firms. Nevertheless, the exclusion of entry and exit does not change these findings.

We contribute to the literature started by Birch (1981) by examining the contribution of small and large firms to the net creation of jobs in Finland. We find that smaller companies have been driving employment growth for all sectors of the Finnish economy, with the exception of the public sector. In line with Neumark et al. (2011), the classification methodology has an impact on this result, even more so when we consider continuous firms only. However, the use of different subset of firms impacts the magnitude of the different net job creation rate, without affecting the direction of our results.

Finally, we examine the results of Moscarini and Postel-Vinay (2012) for the Finnish economy. We find that the stylized facts they established hold in Finland, except for the public sector and the manufacturing sector (only in the case where use continuous firms with classification based on the first observation). Interestingly, we find that this negative correlation is created during times of high unemployment, while during time of favorable economic conditions large and small firms show similar cyclical patterns. This indicates that the procyclicality shown by large firms is due to higher job destruction during recessions, and not because of a more pronounced propensity to hire during expansions. We do not restrict our analysis to the differential average growth rates, but we consider also the common and idiosyncratic components of the Stock and Watson (2002) factor model. We find similar results also for these two variables, with the common and idiosyncratic shock differentials showing negative correlations for all types of classification and sectors. This last result points toward a Finnish granularity, as suggested in Gabaix (2011). However, we need to take in consideration the issues raised by Stella (2014) and Foerster et al. (2011), with respect to the identification of the effect of the idiosyncratic shocks. The statistical model used in this paper does not allow a clear distinction between the effect of common shocks and the propagation of individual shocks from a single firm to the rest of the economy. To take care of this issue, we would need to filter the data to take into account the possible relations between various firms, as it is done in the aforementioned works. This issue can be the subject of future studies.

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## 6 Appendix A: Adjustment for entry and exit.

In this appendix, we discuss the details the procedure adopted by Statistics Finland to control for merger and split-offs in a set of enterprises. Assume that firm 1 is examined after an event (merger or split-off) where $N$ firms are involved. Then the estimated employment of firm 1 one year ago is calculated by:

$$emp(firm_{1,t-12}) = \frac{emp(firm_{1,t}) * emp(firm_{1,t-12}, firm_{2,t-12}...firm_{N,t-12})}{emp(firm_{1,t}, firm_{2,t}...firm_{N,t})}$$

where $t$ is the time periods in which the adjustment is computed, and $N$ is the number of firms involved in a merger or split-off. The sum of the previous year employment levels in all the firms involved in the event is divided for each continuing firm weighted by their relative size at present time $t$. Let us go through some simple numerical examples to see how this works:

1. Assume a firm A with 2 employees in period $t$, that had 1 employee in $t$-12. Firm A acquires firm B with 1 employee at time $t$, m and 1 employee one year ago. Firm A, which continues existing, will be assigned a new estimated number of employees for the comparison year, in order to make the growth rates comparable year-on-year. The comparison values of firm A is estimated as $\frac{2(1+1)}{(2+1)} = 4/3$, and the rate of change for A becomes $(2 + 1)/(4/3) = 2.25$ (as opposed to 3 if no correction is done)

2. Consider the situation where firm A is split into smaller units, say B and C. A has 3 employees at time $t - 12$, B has 3 employees at $t$ and C has 2 workers at $t$. B and C did not exist at $t - 12$, so their comparison values become: $(3/3)3 = 3$ and $(2/3)3 = 2$, resulting in the rate of change for B and C to be 3/3 and 2/2 (equal to 1 for both firms). The growth rate is forced to be the same among the continuing firms after a split-off.