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Tjalling C. Koopmans Research Institute
Utrecht School of Economics
Utrecht University

Vredenburg 138
3511 BG Utrecht
The Netherlands

telephone	+31 30 253 9800
fax	+31 30 253 7373
website	www.koopmansinstitute.uu.nl

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How to reach the authors

Please direct all correspondence to Elena Cefis.

Giulio Bottazzi
Giovanni Dosi
Angelo Secchi
S. Anna School for Advanced Studies
P.zza Martiri della Libertà 33
I-56100 Pisa
Italy

Elena Cefis
Utrecht University
Utrecht School of Economics
Vredenburg 138
3511 BG Utrecht
The Netherlands
University of Bergamo
via dei Caniana 2
I-24127 Bergamo,
Italy
E-mail: e.cefis@econ.uu.nl

Utrecht School of Economics
Tjalling C. Koopmans Research Institute
Discussion Paper Series 03-17

Invariances and Diversities in the Evolution of Manufacturing Industries*

Giulio Bottazzi[a]
Elena Cefis[b]
Giovanni Dosi[a]
Angelo Secchi[a]

[a]S. Anna School for Advanced Studies, Pisa Italy

[b] University of Bergamo
Utrecht School of Economics

December 2003

Abstract
In this work we explore some basic properties of the size distributions of firms and of their growth processes both at aggregate and disaggregate levels. First, we investigate which properties of firm's size distributions and growth dynamics are robust under disaggregation. Second, at a disaggregate level, we try to identify those features which are generic and hold across all or most of the considered three digit sectors distinguishing them from sector-specific ones. Concerning firm growth, we mainly focus on the characterization of the distribution of growth rates, studying, again, the possible differences between sectors and between levels of aggregation. Finally, we begin to explore the relations between measures of size distributions and the nature of the underlying growth processes and discuss some admittedly unresolved puzzles.

Keywords: Panel Data, Wage Distribution, Inequality, Mobility

JEL classification: L11, D21, C14, O30

Acknowledgements
We wish to thank the seminar participants at Nuffield College (University of Oxford), the Tinbergen Institute (University of Amsterdam), Amsterdam Institute for Advanced Labour Studies and the 2003 Meeting of the European Society of Population Economics for valuable comments, and Nigel Stuttard at National Statistics for providing the NES data. Financial support from the Leverhulme Trust project "The labour market consequences of technical and structural change" is gratefully acknowledged. Please direct all correspondence to Elena Cefis.

* Support by the Italian Ministry of Education, University and Research MIUR (grant n. A.AMCE.E4002GD), the S.Anna School of Advanced Studies, Pisa (grant n. E6003GB) and the University of Bergamo (grant ex 60\%, n. 60CEFI02, Dept. of Economics) is gratefully acknowledged. The research would not have been possible without the precious help of the Italian Statistical Office (ISTAT) and in particular of Roberto Monducci. The participants of the Conference ``A Tribute to Sid Winter'' (Wharton School, University of Pennsylvania, October 2003) and of the Conference in ``Honour of Josef Steindl'' (Vienna, September 2003) provided helpful comments. The usual disclaimers apply.

1 Introduction

In this work we explore some basic properties of the size distributions of firms and of their growth processes both at aggregate and disaggregate levels. The data concern Italian manufacturing firms with more than 20 employees over the period $1989 - 1996$. The disaggregated analysis is performed using firms classification by sector of principal activity, .

The aim of this exercise is twofold. First, we investigate which properties of firms size distributions and growth dynamics are robust under disaggregation, i.e. do show the same character and nature when analyzed at the coarse level of the whole industry and at the finer sectoral level. Second, at the disaggregated level, we try to identify those features which are generic and hold across all or most of the considered three digit sectors distinguishing them from sector-specific ones.

Our analysis of firms size distribution adds novel evidence to, and links with that old stream of investigations highlighting the widespread occurrence of skewed distributions involving the coexistence of firms of widely different sizes (see among many others Gibrat (1931); Hart and Prais (1956); Ijiri and Simon (1977); Quandt (1966); Simon and Bonini (1958); Stanley et al. (1995); Steindl (1965)). Refining on that literature, a first question we address concerns the inter-sectoral variability of such distributions, especially with regards to the upper tail.

Concerning the analysis of firms growth dynamics, we mainly focus on the characterization of the distribution of growth rates, studying, again, the possible differences between sectors and between levels of aggregation. The roots of this part of the investigation draw back to the classic explorations of the properties of stochastic firm growth: cf., following Gibrat (1931), Steindl (1965), Ijiri and Simon (1977) and Simon and Bonini (1958) on the empirical side, and to the wide literature testing with mixed success Gibrat's conjecture on the independence of growth rates from initial size (see among many others Dunne et al. (1988); Evans (1987); Hall (1987); Mansfield (1962)). Here we move a step forward and, irrespectively of the possible effects of initial conditions, broadly in line with Stanley et al. (1996), Bottazzi et al. (2001), Bottazzi et al. (2002), we analyze and compare the shapes of the distributions themselves.

Finally we begin to explore the relations between measures of size distributions and the nature of the underlying growth processes and discuss some admittedly unresolved puzzles.

After a brief description of the data (Section 2), in Section 3 we study size distributions, by sectors and in the aggregate. Next, Section 4 addresses the distributions of growth rates. Finally, in Section 5 we report some analyses of the relationships between the two foregoing levels of analysis.

2 Data Description

This research draws upon the MICRO.1 databank developed by the Italian Statistical Office (ISTAT)[1]. MICRO.1 contains longitudinal data on a panel of several thousand Italian manufacturing firms with employment of 20 units or more over around a decade. Since the panel is open, due to entry, exit, fluctuations around the 20 employees threshold and variability in response rates, we consider only the firms that are present both at the beginning and at the end of our window of observation. For statistical reliability we restrict our analysis to the period $1989 - 1996$ and to the sectors with more than 44 firms reducing the number of sectors under study from 97 to 55.

In this work we are exclusively interested in the process of *internal* growth, as opposed to the growth due to mergers, acquisitions and divestments. In order to control for these phenomena we build "super-firms" which account throughout the period for the union of the entities which undertake such changes. So, for example, if two firms merged at some time, we consider them merged throughout the whole period. Conversely, if a firm is spun off from another one, we "re-merge" them starting from the separation period [2].

3 Size Distribution

We start with the statistical analysis of firm size distribution at different level of aggregation and considering 3 different proxies of firm size. We define $S_{i,j}(t)$, $L_{i,j}(t)$ and $VA_{i,j}(t)$ the size of firm i in sector j at time t respectively in terms of Total Sales, Number of Employees and Value Added. Here $j \in \{1, \ldots, 55\}$.

The analysis of this Section is developed along four different but complementary directions. First we investigate the stationarity of firm (log)size distributions. Second we explore their shape comparing the different definition of firm size and the different level of aggregation. Third we introduce an indirect measure of concentration in order to describe the upper tail of size distributions in different sectors. Finally we investigate the dynamic properties, in term of the autoregressive structure, of the process that governs the change in firms sizes.

Stationarity

Let check for the stationarity of size distributions in the aggregate. Fig. 1, Fig. 3 and Fig. 5 report the probability densities in 4 different years of $\log(S_i(t))$, $\log(L_i(t))$

[1] The database has been made available to our team under the mandatory condition of censorship of any individual information.

[2] For more details on this database and on the variables used in this paper see Bottazzi et al. (2002).

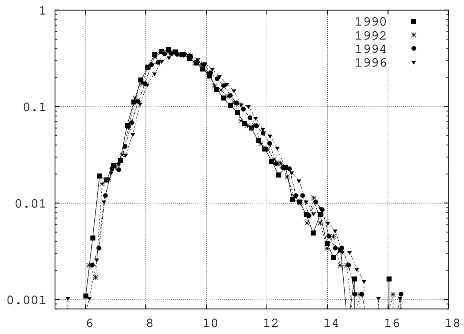

Figure 1: Empirical Densities of $\log(S_i)$ in different years. Size measured in terms of Sales.

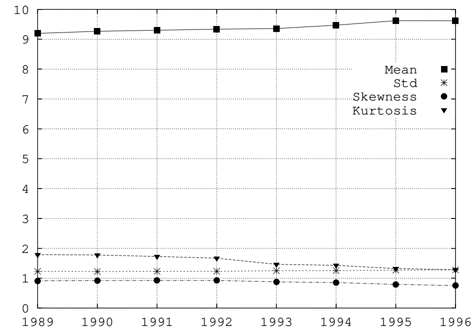

Figure 2: The time dynamic, 1989-1996, of the first 4 moments of the size (Sales) distribution.

Figure 3: Empirical Densities of $\log(L_i)$ in different years. Size measured in terms of Number of Employees.

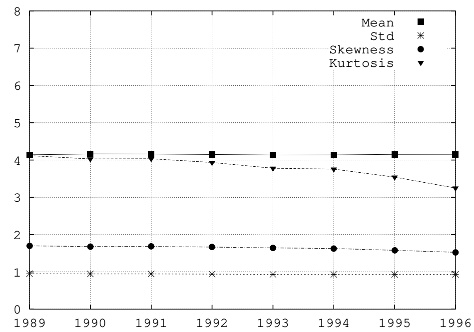

Figure 4: The time dynamic, 1989-1996, of the first 4 moments of the size (Number of employees) distribution.

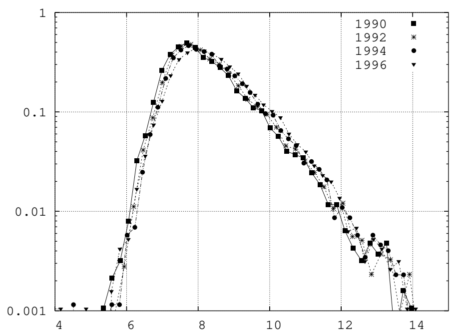

Figure 5: Empirical Densities of $\log(VA_i)$ in different years. Size measured in terms of Value Added.

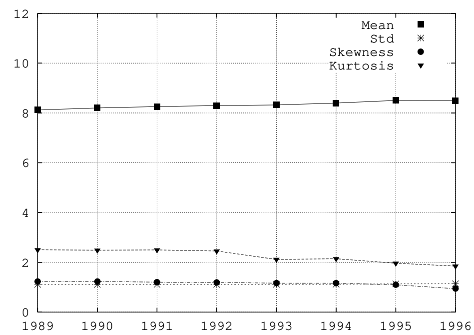

Figure 6: The time dynamic, 1989-1996, of the first 4 moments of the size (Value Added) distribution.

and $\log(VA_i(t))$ of firms aggregated over all the 55 sectors. Visual inspection reveals that all these densities display a substantial stationarity in the years included in our time window for all the proxies considered. This property of size distributions is confirmed when we consider the time evolution, over the whole time range $1989 - 1996$, of their first 4 moments reported in Fig. 2, Fig. 4 and Fig. 6. Apart from a mild upward trend in the mean log size (only for Total Sales and Value Added), all the moments display very stable time behaviors.

This regularity is replicated also at sectoral level. In all the 55 sectors considered here, the shape and the first 4 moments of the size distribution show stable time behaviors except, again, a possible existence of mild positive trend in the mean.

Shape

A second general property of firms size distributions concerns their shape. The huge literature on this point (among others Hart and Prais (1956), Ijiri and Simon (1977), Quandt (1966), Simon and Bonini (1958)) robustly share the conclusion that they display a strong right-skewed shape which has been approximated with different distributions including LogNormal, Pareto or Yule ones. Our analyses of aggregate data do confirm this general result. This is apparent again in Fig. 1, Fig. 3 and Fig. 5. Incidentally note that the shape of these distributions does not seem to strongly depend on the proxy used for firm size even if, as expected, when the variable analyses is $\log(L(t))$, the number of employees, the shape is strongly affected by the cut at 20 employees that characterizes our databank. Finally our analysis offers a piece of evidence contrary to Stanley et al. (1995). In the latter in this paper it is suggested that the upper tail of the size distribution of firms is too thin relative to the LogNormal rather than too fat, while it is clear that the distributions shown here appear more right-skewed than LogNormal[3] ones.

The picture looks different when we analyze the size distributions at more disaggregated level and consider each of the 55 sectors. Our investigation shows that sectoral size distributions do not display the characteristic shape observed in the aggregate: while some sectors do present distributions that are not very dissimilar from the ones shown for the aggregate, others are almost LogNormal, and yet others are bi-modal or even multi-modal. Fig. 7, Fig. 8, Fig. 9 and Fig. 10 show size densities for 4 different sectors chosen to highlight the high degree of observed heterogeneity in their shapes.

An important conclusion is that the characteristic shape observed in the aggregate for the firms size distribution, as mentioned approximated by e.g. LogNormal, Pareto or Yule distributions, at least in the case of Italian firms, is mainly an out-

[3]In our log scale plot a LogNormal density would appear as a convex parabola.

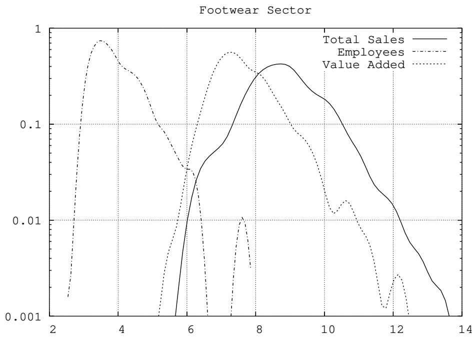

Figure 7: Densities of $\log(S_i)$, $\log(L_i)$ and $\log(VA_i)$ for Footwear (SIC 193).

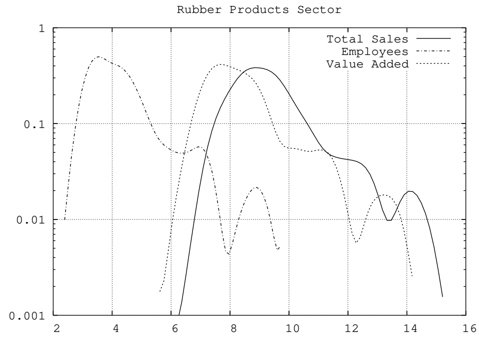

Figure 8: Densities of $\log(S_i)$, $\log(L_i)$ and $\log(VA_i)$ for Rubber Products (SIC 251).

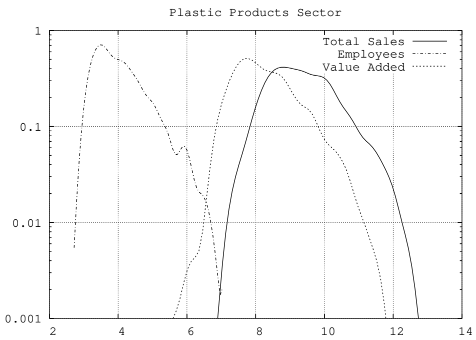

Figure 9: Densities of $\log(S_i)$, $\log(L_i)$ and $\log(VA_i)$ for Plastic Products (SIC 252).

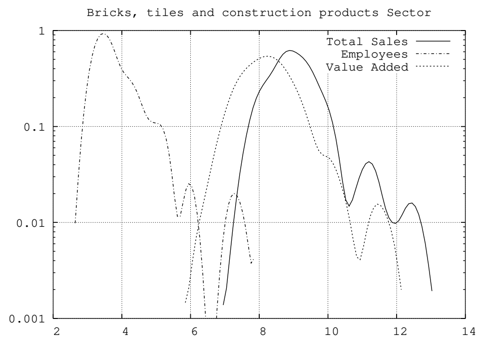

Figure 10: Densities of $\log(S_i)$, $\log(L_i)$ and $\log(VA_i)$ for the Construction Materials (SIC 264).

come of aggregation, as it appears for manufacturing as a whole but not in most sector-specific distributions (note also that Bottazzi and Secchi (2003) find similar evidence on U.S. manufacturing firms).

Sectoral patterns

A natural further step building on the foregoing analysis regards the possibility of characterizing different sectors using a synthetic index that can roughly describe some of the properties of the size distributions themselves.

Given the limits of our database, let us focus just on the upper tail of the distributions and introduce an indirect measure of concentration, namely

$$d_{20}^{4}(t) = \frac{C_4}{C_{20}} \qquad t = 1989, \ldots, 1996 \tag{1}$$

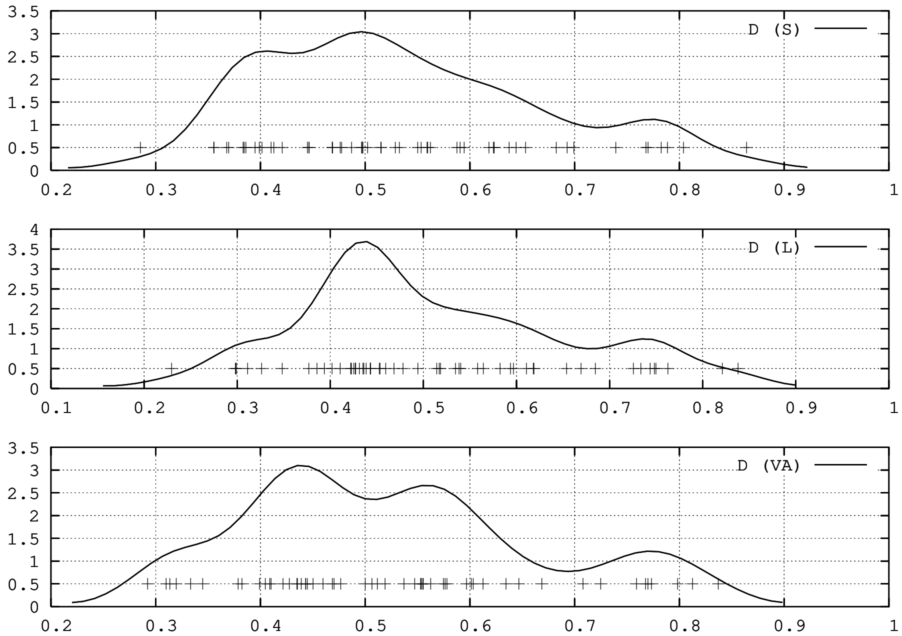

Figure 11: Probability densities (kernel estimates) of the concentration index D_{20}^4 in terms of Total Sales, Number of Employees and Value Added. The support of these densities is [0.2 1].

where C_4 and C_{20} are the sums of market shares of the top 4 and 20 firms in a sector, respectively. We consider this particular measure of concentration in order to overcome the lack of information about the lower tail of the size in the MICRO.1 database. Indeed d_{20}^4 measures the relative importance of the first 4 firms, in term of size, compared with the first 20. If a sector is highly concentrated, d_{20}^4 would be near to 1: in fact, it is easy to verify that if the size of the entire sector is shared by less than 5 firms, d_{20}^4 would be exactly 1. On the contrary, for a sector where at least the first 20 firms have exactly the same size, one would obtain $d_{20}^4 = 0.2$.

In order to obtain a more robust characterization of the upper tail of the size distribution we consider the average value of d_{20}^4 over all the 8 years $(1989-1996)$ under analysis:

$$D_{20}^4 = \frac{1}{8}\sum_{t=1}^{8} d_{20}^4(t) \ . \tag{2}$$

The values of D_{20}^4 for all the sectors and under the three size proxies are reported in Table 1, Table 2 and Table 3. It is apparent that in line with the shapes of the sectoral size distributions, this concentration index displays an high degree of heterogeneity across sectors. For example in the case of Total Sales it ranges from 0.28 in the rubber products sector to 0.86 in the fabricated metal product sector and it covers almost all its notional support. In order to give a synthetic account of this last piece of evidence we report in Fig. 11 a kernel estimation of D^4_{20} densities for Total Sales, Number of Employees and Value Added. This plot confirms the high degree of sectoral heterogeneity in the level of concentration in the top tail irrespectively of the size proxy used. Moreover densities in Fig. 11 show "multimodal" shapes hinting at the existence of distinct groups of sectors sharing roughly similar concentration profiles.

A natural set of questions that stems from the structural properties of manufacturing sectors just described concerns firm growth processes. What are the specific characteristics of the growth processes that generate such kind of size distributions? Are they characterized by the same degree of heterogeneity? Do they present any specific autoregressive structure?

Autoregressive Structure

Consider first the autoregressive structure of the firm size time series again both in the aggregate and at sectoral level.

In the aggregate, we estimate an AR(1) process on $\log(X_i)$ where $X \in \{S, L, VA\}$. For this purpose in order to eliminate possible trends in the average size we consider the normalized (log) size:

$$x_i(t) = \log(X_i(t)) - \frac{1}{N}\sum_{i=1}^{N}\log(X_i(t)) \tag{3}$$

subtracting from the (log) size of each firm the average (log) size of all the firms. (Here N stands for the total number of firms in our panel). On these observations we estimate the AR(1) model

$$x_i(t) = \phi\, x_i(t-1) + \epsilon_i(t) \tag{4}$$

We do not introduce any firm-specific term for the (log) size average, thus implicitly accounting for different firms as different realizations of the same stochastic process. We use a *Four-Stages Instrumental Variables Estimator* (Ljung (1987) pag. 403) in order to get around problems due to possible structures and heteroscedasticity in the error terms. This estimation procedure yields an approximately optimal set of instruments. The estimated coefficients are found to be $\phi = 0.967 \pm 0.002$, $\phi = 0.960 \pm 0.002$ and $\phi = 0.937 \pm 0.002$ for Total Sales, Employees and Value Added, respectively. Hence we conclude that, irrespectively of the size proxy used, our analysis supports the existence of a unit root in the size dynamic process. Notice that this result is well in accordance with many previous studies (cfr. among many others Hart and Prais (1956); Bottazzi and Secchi (2003); Hymer and Pashigian (1962); Mansfield (1962); Simon and Bonini (1958)) on different databases. However, we are aware that these estimates of the autoregressive parameter might just be a consequence of the neglect of heterogeneity at firm level. Indeed, in Cefis et al. (2002) it has been shown that when such an heterogeneity is taken into account, the autoregressive parameter distributions have a large support $(0.3, 1.2)$ while a unit root characterizes the size dynamic process just for less than 20% of the firms.

Let us now consider the sectoral dynamics and let $X_{ij}(t)$ represent the size of the i-th firm, belonging to the j-th sector, at time t where again $X \in \{S, L, VA\}$. Here $j \in \{1, \dots, 55\}$ and if N_j is the number of firms in the j-th sector then $i \in \{1, \dots, N_j\}$. Again we define the normalized sectoral (log) sales as:

$$x_{ij}(t) = \log(X_{ij}(t)) - \frac{1}{N_j} \sum_{i=1}^{N_j} \log(X_{ij}(t)) \tag{5}$$

subtracting from the (log) size of each firm the average (log) size of all the firms operating in the same sector. Applying the same methodology just used for the aggregate case we estimate the model

$$x_{ij}(t) = \phi_j \, x_{ij}(t-1) + \epsilon_{ij}(t) \tag{6}$$

The results are reported in the third column of Table 1, Table 2 and Table 3. One observes a substantial homogeneity in the estimated AR coefficients in different sectors and with respect to different size proxies: they are all significant and very close to 1. In particular the estimated ϕ ranges from 0.88 to 1.01 with an average across all the sectors equal to 0.96 if Total Sales are considered, from 0.82 to 0.99 with an average of 0.93 for Employees and from 0.87 to 1.00 with an average of 0.95 for Value Added. One may conclude that also at sectoral level, the firm growth process is well described by a geometric Brownian motion.

The unit-root evidence however is by no means the end of the story. In particular, one is interested in the properties of the distributions of growth rates and their temporal profiles, since this offers precious clues on the structure of "competitive shocks" driving the growth of firms.

4 Growth rates distribution

Consider the growth rates defined as the first difference of normalized (log) size according to:

$$g(x_{i,t}) = x_i(t) - x_i(t-1) \qquad x \in \{s, l, va\} \tag{7}$$

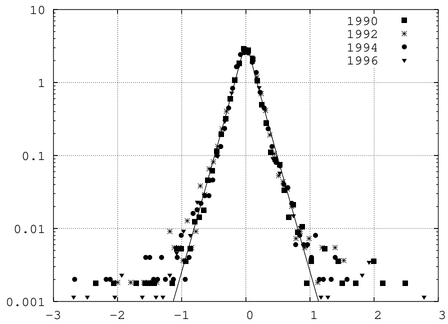

Figure 12: Growth rates distributions in different years. Size measured in terms of Sales.

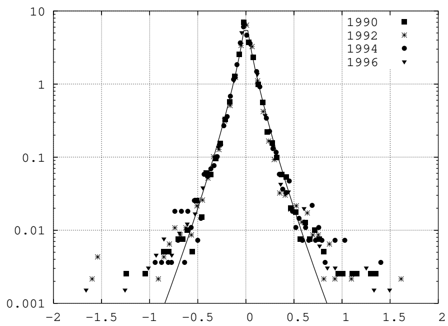

Figure 14: Growth rates distributions in different years. Size measured in terms of number of employees.

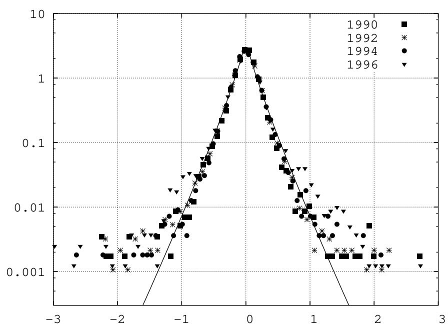

Figure 16: Growth rates distributions in different years. Size measured in terms of Value Added.

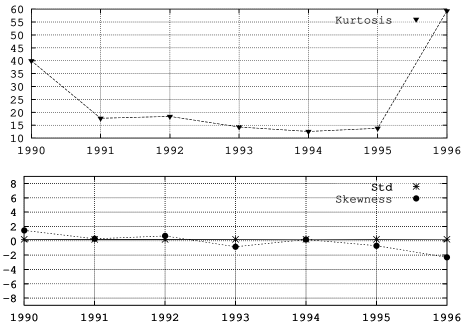

Figure 13: The time profile, 1989-1996, of the moments of the growth rates distribution (Total Sales).

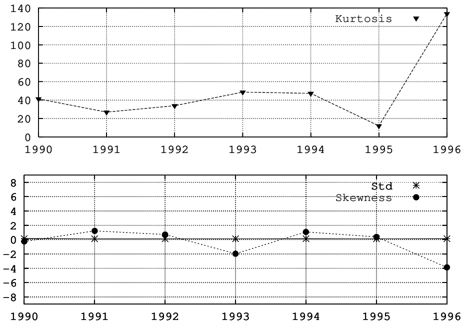

Figure 15: The time profile, range 1989-1996, of the first moments of the growth rates distribution (Number of Employees).

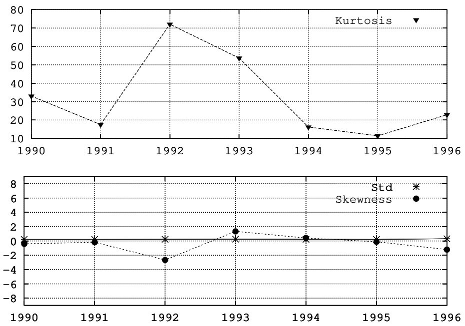

Figure 17: The time profile, 1989-1996, of the first moments of the growth rates distribution (Value Added).

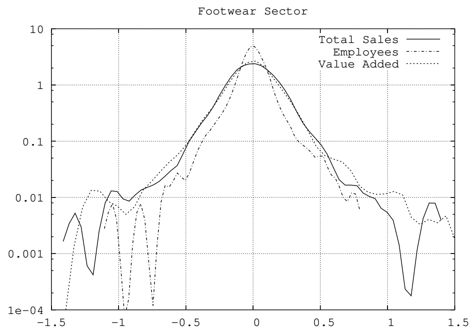

Figure 18: Kernel estimation of total sales, number of employees and value added growth rates densities for Footwear (SIC 193).

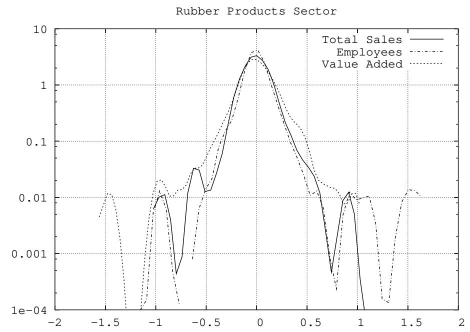

Figure 19: Kernel estimation of total sales, number of employees and value added growth rates densities for Rubber Products (SIC 251).

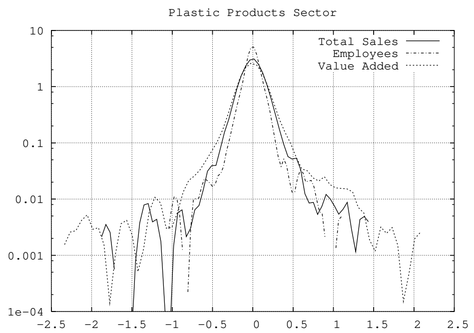

Figure 20: Kernel estimation of total sales, number of employees and value added growth rates densities for Plastic Products (SIC 252).

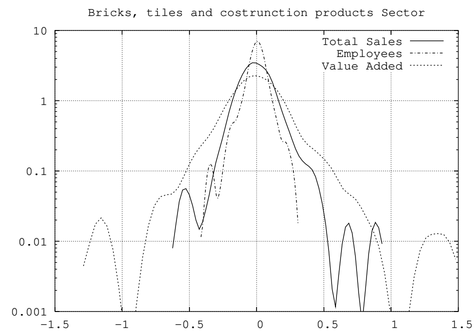

Figure 21: Kernel estimation of total sales, number of employees and value added growth rates densities for Construction Materials (SIC 264).

at aggregate level and

$$g(x_{ij,t}) = x_{ij}(t) - x_{ij}(t-1) \qquad\qquad x \in \{s, l, va\} \tag{8}$$

at sectoral level. Notice that from (3) the distribution of the g's is by construction centered around 0 for any t.

Stationarity

Fig. 12, Fig. 14 and Fig. 16 report in a log scale and for 4 different years, 1990, 1992, 1994 and 1996, the empirical densities of firm growth rates aggregated over all the sectors (as from equation (7)). These plots offer strong evidence in support of the stationarity of the growth rates distribution. This is broadly confirmed by the time profile of their standard deviation and skewness, reported in Fig. 13, Fig. 15 and Fig. 17. Conversely the dynamics of the kurtosis displays more variability (see top panels in Fig. 13, Fig. 15 and Fig. 17). Note, however, that this volatility in the kurtosis is mainly due to a small number of outliers: major jumps and falls can be explained by the appearance and disappearance in different years of a very small number of extremely large or extremely small growth events.

Similar regularities emerge when we analyze the growth rates distributions at sectoral level: they are stationary in all the sectors and for each of the sizes proxies considered.

Shape

As shown in a seminal paper by Stanley et al. (1996) is known that firm growth rates density in the case of the aggregate U.S. manufacturing displays a characteristic tent-shape that is well approximated by a Laplace distribution. Note that the "tent" on the log scale implies tails that are fatter than Gaussian ones. In turn, from an interpretative point of view, such an evidence hints at underlying drivers of corporate growth involving relatively frequent and relatively "big" events - unaccountable by little Gaussian shocks-. Fig. 12, Fig. 14 and Fig. 16 show that this is the case also for Italian manufacturing firms.

Is this picture different when we change the point of view and we analyze firm growth rates distributions at sectoral level? The answer is negative. Indeed, as suggested in Bottazzi and Secchi (2003b), also at sectoral level the growth rates distributions display a tent-shape that is remarkably similar across very different sectors. Interestingly, Fig. 18, Fig. 19, Fig. 20 and Fig. 21 report examples of kernel estimations of growth rates densities[4] for the same 4 sectors chosen indeed in Section 3 since they displayed very different size distributions. Notice that also at the sectoral level these distributions are characterized by the presence of a small number of extreme observations. Moreover in line with the evidence on size distributions the shape of the growth rates densities does not seem to depend very much on the size proxy used is very weak.

Sectoral characterization

In order to characterize more precisely the growth rates distributions of different sectors we adopt the parametric approach suggested in Bottazzi and Secchi (2002). We consider a flexible family of probability densities, known as the Subbotin family (Subbotin, 1923) that includes as a particular cases the Laplace and the Gaussian

[4] In the figures all the 7 years of data are pooled together under the assumption of stationarity of the growth process.

densities. This family is defined by 3 parameters: a positioning parameter μ, a scale parameter a and a shape parameter b. Its functional form reads:

$$f_S(x) = \frac{1}{2ab^{1/b}\Gamma(1/b+1)}\, e^{-\frac{1}{b}\left|\frac{x-\mu}{a}\right|^b} \tag{9}$$

where $\Gamma(x)$ is the Gamma function. The lower is the shape parameter b, the fatter are the density tails. For $b < 2$ the density is leptokurtic while it is platikurtic for $b > 2$. For $b = 2$ this density reduces to a Gaussian and for $b = 1$ to a Laplace distribution. We undertake maximum likelihood estimations of the a and b parameters for each sector (the parameter μ is set to 0 by the normalization in (3)).

The results are reported in the last two columns of Table 1, 2 and 3. Regarding the shape parameter b, some (small) intersectoral differences emerge, but the estimates for all size proxies are highly concentrated around their means suggesting a remarkable homogeneity in the shapes of growth rates distributions: Fig. 22 presents synthetic account of the densities of the a and b parameter estimated over all the sectors for each size proxy.

This approach allows us also to throw some light on the impact that different size proxies can have on the estimates of growth rates distributions themselves. Consider again the data aggregated across all the sectors. If one fits the Subbotin distribution on growth rates expressed in terms of different size proxies one obtains the following ordered pairs $(0.96, 0.13)$, $(0.76, 0.06)$ and $(0.87, 0.14)$ that represent the estimated a and b in (9) for Total Sales, Number of Employees and Valued Added respectively. It is not surprising that the distribution that displays the fattest tails (i.e. the lowest value of b) and the smallest width (i.e. lowest a) concerns growth rates in terms of employees since this is surely the variable characterized by the highest intrinsic "degree of lumpiness". Growth processes in this dimension are more like than others to present relatively large events (also in absolute terms), due to e.g. minimum scales of plants that are suddenly opened or closed and other sources of indivisibilities.

Autoregressive structure

Consider now firm growth rates as defined in (7) and (8). Let us analyze the autoregressive structure of their time series.

We begin from the aggregate level and using the same multi-stages procedure adopted for equation (4) we estimated

$$g(x_{i,t}) = \phi^g\, g(x_{i,t-1}) + \epsilon_{i,t} \qquad\qquad x \in \{s, l, va\}\ . \tag{10}$$

One obtains an estimated autoregressive coefficient equal to $\phi^g = -0.043 \pm 0.005$, $\phi^g = -0.084 \pm 0.005$ and $\phi^g = 0.026 \pm 0.004$ for Total Sales (S), Employees (L) and Value Added (VA), respectively.

Notice that they are significantly different from zero even if very small[5]. We also estimated an AR(2) process on the same observations

$$g(x_{i,t}) = \phi_1^g \, g(x_{i,t-1}) + \phi_2^g \, g(x_{i,t-2}) + \epsilon_{i,t} \tag{11}$$

always obtaining a two-lag coefficient ϕ_2^g not significantly different from zero and an identical one lag coefficient $\phi_1^g \sim \phi^g$. We conclude that the AR(1) model completely accounts for the autoregressive structure in data whatever size proxy is used.

Move to the analysis of the autoregressive structure of growth rates at sectoral level. We estimated an AR(1) model

$$g(x_{ij,t}) = \phi_j^g \, g(x_{ij,t-1}) + \epsilon_{ij,t} \quad . \tag{12}$$

The results for the different sectors and different size proxies are reported in Table 1,Table 2 and Table 3. Our interpretation is still ridden of question marks.

First, it is not clear if the estimated coefficients depend or not on the size proxy used. Indeed even if most of the sectors present substantial homogeneity in the autoregressive coefficients obtained considering different size proxies, there are sectors for which ϕ^g strongly differ. For instance, the Rubber Products sector presents a mild positive autoregressive coefficient in terms of total sales, a mild negative AR coefficient in terms of number of employees and an AR coefficient that is not significantly different from 0 in terms of value added.

Second, the estimated AR coefficients display a significant degree of sectoral heterogeneity, as shown by their range of variation: ϕ_g spans from -0.24 to 0.15 for total sales, from -0.3905 to 0.2115 for the number of employees and from -0.1868 to 0.1398 for value added[6]. A more detailed analysis of these results reveals that, even if approximately half of the sectors do not show any AR structure in growth rates (coefficients in sectors like Wearing Apparel, Publishing, Basic Chemicals, Pharmaceuticals, Treatment and Coating of Metals, Measure, Control Navigation Instruments and some others are not significantly different from 0), there are sectors that present mild positive autoregressive coefficients , like for instance Domestic Appliances, Printing, Carpets Rugs and other Textiles, while in some cases it is possible to observe negative autoregressive coefficients (cfr. for instance Machine Tools and TV and Radio transmitters).

In principle, the properties of the autoregressive processes in corporate growth (or lack of them) should bear significant links with underlying processes of innovation, investment and competition. For example, more "lumpy" innovative or investment events (e.g. new products or new, major, plants) might be expected

[5] The standard deviations of gs, gl and gva are approximately equal to 0.2, 0.13 and 0.25.

[6] The average across all the sectors of the estimated parameter ϕ_g is -0.027 for total sales, -0.067 for the number of employees and 0.013 for value added.

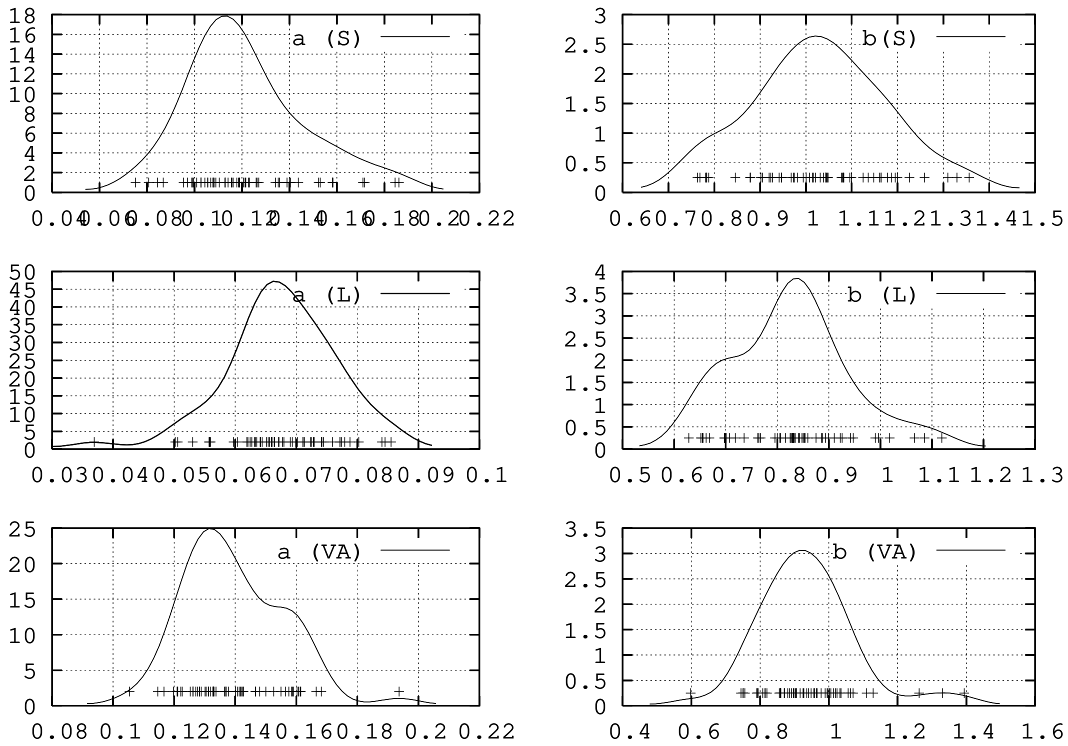

Figure 22: Probability densities (kernel estimations) of the Subbotin parameters a and b estimated in all the 55 sectors analyzed and for all the three size proxies used.

to bear long-lasting influences on the patterns of expansion or contraction of all firms competing within (roughly) the same markets. However, our evidence does not provide yet the ground for any easy taxonomy.

5 Firm size and growth volatility

Since the early investigation of Hymer and Pashigian (1962), it has been suggested that the variance of manufacturing firms growth rates should decrease when their sizes increase, and, indeed, recent contributions based on different databases (see among others Amaral et al. (1997); Bottazzi et al. (2001)) show that the standard deviation of growth rates scales with firm size according to a Pareto Law $\sigma(g/S) \sim S^{\beta}$ with β approximately equal to -0.2.

We checked the existence of such a relation also on our database. The results are that both at sectoral and aggregate levels it is *not* possible to observe any negative relation between standard deviation of growth rates and size[7]. Possible interpretations of the lack of this relation are suggested in Bottazzi et al. (2002). They refer first, to the possible weaker role of the diversification processes in Italian firms[8]. Second, it could happen that even when diversification occurs, it happens in sectors whose demand profiles are highly correlated. A third possible explanation concerns the possibility that the absence of any relation between growth rates variance and size could be just a statistical artifact coming from the way firms are defined, mainly for fiscal reasons.

The relationship between structural characteristics of the various industries and their growth may be checked also by searching for any correlation between the parameters that characterize, in all the sectors we are considering, average firm size by sector, the concentration proxy (D^4_{20}) and growth rates distributions (a and b). We observe just a mild negative correlation between average size and the values of the parameter b[9]. This negative correlation implies that sectors with higher average size are the ones where the tails of the growth rates distribution are fatter (i.e. characterized by lower b's) thus suggesting for these sectors greater "lumpiness" in firm growth processes. A part from this relation, however, we were not able to identify any other significant correlation among the foregoing variables. Such an evidence suggests indeed that the specificities in the growth process do not show any correlation with conventional indicators of industry structure such as average firm size or proxies for concentration.

Moreover, as a first attempt to identify some possible technological determinants of the structure and processes described above, we have checked whether the parameters D^4_{20}, a and b cluster in any way resembling the taxonomy of industrial sectors - based on distinct patterns of innovation - developed by Pavitt (1984) and refined in Marsili (2001). However, the evidence we have to report so far is largely negative or at least inconclusive. The differences across sectors identified here do not seem to map into such a taxonomy.

6 Conclusion

In this work we have taken a fresh look at both the shape of industrial structures and the processes of firm growth, based on a large longitudinal database of Italian manufacturing firms.

Some of the findings do corroborate already known stylized facts. For example,

[7]We do not observe also any relation between average growth rates and size.

[8]For a theoretical interpretation of the link between diversification processes and variance of growth rates see Bottazzi (2001).

[9]This correlation is significant and equal to -0.54 and -0.32 for total sales and number of employee respectively, while is not significantly different from 0 for value added.

i) The evidence at both sectoral level and in the manufacturing aggregate reveals, with no exception, skewed distribution of firm sizes.

ii) The large support of all these distributions confirms the coexistence of firms of very different size - also within similar lines of activity - thus also ruling out the empirical plausibility of notions such as those of “representative firm” and “optimal size”.

Moreover,

iii) The processes of corporate growth are all well described by “tent-shape” (that is exponential) distributions.

Other pieces of the evidences, however, suggest interesting conjectures and puzzles. They include the following:

iv) While the processes of growth (as mentioned characterized by exponential distributions) look rather similar across sectors and between levels of aggregation (i.e. 3 digit sectors versus aggregate manufacturing), this does not apply to size distributions which display different shapes across sectors, with evidence in several cases also of bimodality or, sometimes, even multimodality. In turn, this hints at the possible existence of distinct “types” of firms characterized also by different modal sizes. Moreover, the evidence - corroborating a conjecture from Dosi et al. (1995) and Marsili (2001) - shows that a Pareto tail in the distribution is mainly the outcome of aggregation, as revealed by its presence for manufacturing as a whole but not in most sector-specific distributions.

v) The robust occurrence of exponential distributions of growth rates represents as such a bit of a confirmation of a puzzle. Indeed, the non-normality of growth shocks and the fatness of its tails hint at the presence of some powerful correlating mechanisms. In principle, they are likely to be of two types. A first source of correlation is likely to be the very competition mechanism: if the market share of one firm grows, the one of its competitor is bound to shrink (for a formulation explicitly yielding tent-shape statistical properties cfr.Bottazzi and Secchi (2003b)). A second source is likely to stem from some intrinsic “lumpiness” of the growth processes associated with the discreteness of events like entering/leaving a new market, building a new plant, introducing a new product and so on.

vi) Again, on the side of puzzles, as already noted, rather similar processes of growth appear to yield significantly diverse sectoral size distributions. How can it happen? Which more subtle differences in the dynamics are responsible for such patterns? Our conjecture here is that in fact one might be able to trace back the differences in industry structures (and the smaller ones in growth processes) into some underlying inter-sectoral differences in the process of technological and organizational innovation (e.g. the levels of technological opportunities and the degree of cumulativeness of innovation profiles), the degree of "lumpiness" of investments, and the specificities in the competition process. However, our negative results on a Pavitt-type taxonomization hint also at the urgency of finding finer proxies for the sector-specific characteristics of both technologies and competitive mechanisms.

Certainly, the foregoing evidence adds to the view that the processes of industrial evolution can be hardly captured by the simplest stochastic dynamics. At the same time, building sounder bridges between theoretical interpretations of the processes of innovation/competition corporate growth, on one hand, and empirical regularities, on the other, is likely to require also novel sources of evidence regarding e.g. innovative activities, investment rules, pricing behaviors and forms of market organization.

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Ateco code	Sector	# of Firms	D^4_{20}	AR(1)levels	AR(1)diff.	Estim. b	Estim
151	Production, processing and preserving of meat	114	0.42	0.98 ± 0.02	0.05 ± 0.04	0.76	0.0
155	Dairy products	85	0.68	0.97 ± 0.02	0.06 ± 0.05	0.78	0.0
158	Production of other foodstuffs (brad, sugar, etc...)	157	0.62	0.98 ± 0.01	-0.01 ± 0.03	0.95	0.1
159	Production of beverages (alcoholic and not)	94	0.39	0.94 ± 0.02	0.04 ± 0.05	0.85	0.1
171	Preparation and spinning of textiles	154	0.38	0.96 ± 0.01	-0.05 ± 0.04	1.23	0.1
172	Textiles weaving	171	0.56	0.95 ± 0.01	-0.06 ± 0.03	1.12	0.1
173	Finishing of textiles	181	0.49	0.92 ± 0.01	-0.10 ± 0.03	1.15	0.1
175	Carpets, rugs and other textiles	90	0.47	1.00 ± 0.02	0.09 ± 0.05	1.05	0.1
177	Knitted and crocheted articles	162	0.50	0.98 ± 0.01	-0.01 ± 0.03	0.92	0.1
182	Wearing apparel	379	0.53	0.97 ± 0.01	-0.01 ± 0.02	1.03	0.1
191	Tanning and dressing of leather	87	0.37	0.92 ± 0.02	-0.20 ± 0.05	1.10	0.1
193	Footwear	245	0.50	0.98 ± 0.01	-0.07 ± 0.03	1.20	0.1
202	Production of plywood and panels	52	0.47	0.97 ± 0.02	-0.12 ± 0.06	0.90	0.1
203	Wood products for construction	59	0.48	1.00 ± 0.02	0.07 ± 0.06	0.88	0.1
205	Production of other wood products (cork, straw, etc...)	56	0.39	0.98 ± 0.02	-0.07 ± 0.06	1.33	0.1
211	Pulp, paper and paperboard	46	0.77	0.99 ± 0.02	-0.07 ± 0.07	0.93	0.1
212	Articles of paper and paperboard	180	0.55	0.99 ± 0.01	-0.15 ± 0.04	1.01	0.1
221	Publishing	72	0.59	0.96 ± 0.02	-0.02 ± 0.04	0.78	0.0
222	Printing	199	0.62	0.99 ± 0.01	0.11 ± 0.03	1.26	0.1
241	Production of basic chemicals	80	0.45	0.97 ± 0.02	-0.02 ± 0.05	0.91	0.1
243	Paints, varnishes, printing inks and mastics	58	0.50	1.00 ± 0.02	0.02 ± 0.06	1.08	0.0
244	Pharmaceuticals, medicinal chemicals and botanical products	97	0.40	0.96 ± 0.02	0.01 ± 0.04	0.88	0.1
245	Soap and detergents, cleaning and toilet preparations	46	0.79	0.97 ± 0.03	0.06 ± 0.07	0.97	0.1
246	Other chemical products	51	0.51	0.98 ± 0.03	0.13 ± 0.06	0.79	0.1
251	Rubber products	87	0.77	0.98 ± 0.02	0.09 ± 0.04	1.05	0.1
252	Plastic products	352	0.28	0.95 ± 0.01	-0.06 ± 0.02	1.01	0.1
261	Glass and glass products	87	0.59	0.99 ± 0.02	-0.01 ± 0.05	1.08	0.1
262	Ceramic goods not for construction	59	0.65	0.97 ± 0.02	0.02 ± 0.06	1.18	0.1
263	Ceramic goods for construction	91	0.41	0.98 ± 0.02	0.05 ± 0.05	1.04	0.1
264	Bricks, tiles and construction products in baked clay	84	0.64	0.97 ± 0.02	0.00 ± 0.05	1.16	0.1
266	Articles in concrete, plaster and cement	141	0.35	0.91 ± 0.02	-0.24 ± 0.04	0.95	0.1
267	Cutting, shaping and finishing of stone	69	0.56	0.98 ± 0.02	0.00 ± 0.05	1.16	0.1
273	First processing of iron and steel	82	0.45	0.88 ± 0.02	-0.03 ± 0.04	0.77	0.1
275	Casting of metals	125	0.74	0.94 ± 0.02	-0.07 ± 0.04	1.04	0.1
281	Structural metal products	156	0.40	0.91 ± 0.02	-0.05 ± 0.04	1.31	0.1
284	Forging, pressing, stamping and roll forming of metal	132	0.37	0.97 ± 0.02	-0.08 ± 0.04	1.14	0.1
285	Treatment and coating of metals	182	0.50	0.88 ± 0.02	-0.02 ± 0.03	1.02	0.1
286	Cutlery, tools and general hardware	149	0.38	0.95 ± 0.02	-0.04 ± 0.04	0.98	0.1
287	Other fabricated metal products	265	0.86	0.97 ± 0.02	0.03 ± 0.04	0.99	0.1
291	Machinery for the production and the use of mechanical power	224	0.70	0.94 ± 0.01	-0.06 ± 0.03	1.00	0.1
292	Other general purpose machinery	199	0.41	0.95 ± 0.01	-0.07 ± 0.03	1.04	0.1
293	Agricultural and forestry machinery	54	0.48	0.96 ± 0.03	0.00 ± 0.07	0.97	0.1
294	Machine tools	114	0.69	0.93 ± 0.02	-0.15 ± 0.04	1.08	0.1
295	Other special purpose machinery	424	0.55	0.93 ± 0.01	-0.14 ± 0.02	1.08	0.1
297	Domestic appliances not elsewhere classified	59	0.64	1.01 ± 0.02	0.16 ± 0.05	1.19	0.1
311	Electric motors, generators and transformers	71	0.59	1.01 ± 0.02	-0.09 ± 0.06	0.94	0.1
312	Manufacture of electricity distribution and control equipment	70	0.56	0.98 ± 0.02	-0.22 ± 0.06	0.78	0.1
316	Electrical equipment not elsewhere classified	91	0.79	0.96 ± 0.02	-0.03 ± 0.06	1.02	0.1
322	TV and radio transmitters and lines for telephony and telegraphy	44	0.80	0.95 ± 0.03	-0.14 ± 0.07	0.92	0.1
332	Measure, control and navigation instruments	51	0.53	0.95 ± 0.03	0.05 ± 0.06	1.19	0.1
342	Production of bodies for cars, trailers and semitrailers	50	0.50	0.94 ± 0.03	-0.15 ± 0.06	1.10	0.1
343	Production of spare parts and accessories for cars	125	0.62	0.95 ± 0.02	-0.04 ± 0.04	1.05	0.1
361	Furniture	444	0.44	0.96 ± 0.01	-0.03 ± 0.02	0.97	0.1
362	Jewelry and related articles	84	0.51	0.95 ± 0.02	0.04 ± 0.05	1.36	0.1
366	Miscellaneous manufacturing not elsewhere classified	68	0.35	0.95 ± 0.02	0.08 ± 0.06	1.16	0.1

Table 1: Proxy of size: Total Sales. Autoregressive coefficients (both in levels and differences), the concentration measure D^4_{20}, and estimated a and b as from (9).

Ateco code	Sector	# of Firms	D_{20}^{4}	AR(1)levels	AR(1)diff.	Estim. b	Estim
151	Production, processing and preserving of meat	114	0.45	0.97 ± 0.02	0.07 ± 0.04	0.84	0.07
155	Dairy products	85	0.75	0.97 ± 0.02	0.03 ± 0.05	0.81	0.07
158	Production of other foodstuffs (brad, sugar, etc...)	157	0.54	0.98 ± 0.01	-0.01 ± 0.03	0.70	0.07
159	Production of beverages (alcoholic and not)	94	0.43	0.95 ± 0.02	-0.07 ± 0.05	0.70	0.08
171	Preparation and spinning of textiles	154	0.49	0.96 ± 0.01	0.08 ± 0.03	0.85	0.07
172	Textiles weaving	171	0.62	0.96 ± 0.01	-0.02 ± 0.03	0.85	0.05
173	Finishing of textiles	181	0.43	0.95 ± 0.01	0.14 ± 0.03	0.71	0.0[illegible]
175	Carpets, rugs and other textiles	90	0.43	0.95 ± 0.02	0.07 ± 0.04	0.83	0.0[illegible]
177	Knitted and crocheted articles	162	0.41	0.94 ± 0.01	0.05 ± 0.03	0.70	0.0[illegible]
182	Wearing apparel	379	0.53	0.95 ± 0.01	0.03 ± 0.02	0.84	0.07
191	Tanning and dressing of leather	87	0.31	0.95 ± 0.02	0.03 ± 0.05	1.12	0.07
193	Footwear	245	0.43	0.95 ± 0.01	-0.03 ± 0.03	0.80	0.07
202	Production of plywood and panels	52	0.52	0.95 ± 0.03	-0.05 ± 0.08	0.70	0.0[illegible]
203	Wood products for construction	59	0.44	0.98 ± 0.03	0.04 ± 0.05	1.02	0.07
205	Production of other wood products (cork, straw, etc...)	56	0.30	0.91 ± 0.03	-0.15 ± 0.06	0.83	0.08
211	Pulp, paper and paperboard	46	0.76	1.00 ± 0.02	-0.01 ± 0.07	0.83	0.04
212	Articles of paper and paperboard	180	0.47	0.96 ± 0.01	0.09 ± 0.04	0.82	0.0[illegible]
221	Publishing	72	0.56	0.92 ± 0.02	0.05 ± 0.04	0.66	0.0[illegible]
222	Printing	199	0.67	0.95 ± 0.01	0.01 ± 0.03	0.72	0.0[illegible]
241	Production of basic chemicals	80	0.42	0.94 ± 0.02	0.12 ± 0.05	0.63	0.0[illegible]
243	Paints, varnishes, printing inks and mastics	58	0.44	0.97 ± 0.02	0.02 ± 0.06	0.88	0.05
244	Pharmaceuticals, medicinal chemicals and botanical products	97	0.35	0.96 ± 0.02	-0.06 ± 0.05	0.70	0.07
245	Soap and detergents, cleaning and toilet preparations	46	0.75	0.97 ± 0.03	-0.01 ± 0.09	0.65	0.0[illegible]
246	Other chemical products	51	0.51	0.96 ± 0.02	0.08 ± 0.06	0.85	0.07
251	Rubber products	87	0.73	0.95 ± 0.02	-0.19 ± 0.04	0.65	0.07
252	Plastic products	352	0.30	0.95 ± 0.01	0.05 ± 0.02	0.81	0.07
261	Glass and glass products	87	0.58	0.97 ± 0.02	0.01 ± 0.04	0.86	0.0[illegible]
262	Ceramic goods not for construction	59	0.54	0.96 ± 0.02	0.13 ± 0.05	0.99	0.07
263	Ceramic goods for construction	91	0.44	0.96 ± 0.02	0.11 ± 0.05	0.80	0.0[illegible]
264	Bricks, tiles and construction products in baked clay	84	0.60	0.97 ± 0.02	-0.09 ± 0.05	0.83	0.05
266	Articles in concrete, plaster and cement	141	0.38	0.90 ± 0.02	-0.09 ± 0.04	0.74	0.07
267	Cutting, shaping and finishing of stone	69	0.48	0.94 ± 0.02	-0.02 ± 0.06	0.83	0.07
273	First processing of iron and steel	82	0.33	0.89 ± 0.03	-0.00 ± 0.04	0.67	0.0[illegible]
275	Casting of metals	125	0.73	0.96 ± 0.02	-0.05 ± 0.04	0.95	0.07
281	Structural metal products	156	0.40	0.87 ± 0.02	0.04 ± 0.04	0.92	0.09
284	Forging, pressing, stamping and roll forming of metal	132	0.39	0.95 ± 0.02	-0.03 ± 0.04	0.94	0.07
285	Treatment and coating of metals	182	0.30	0.90 ± 0.02	-0.07 ± 0.04	0.93	0.08
286	Cutlery, tools and general hardware	149	0.43	0.99 ± 0.01	0.08 ± 0.04	0.89	0.0[illegible]
287	Other fabricated metal products	265	0.82	0.96 ± 0.01	0.03 ± 0.02	0.76	0.07
291	Machinery for the production and the use of mechanical power	224	0.68	0.96 ± 0.01	0.01 ± 0.03	0.85	0.07
292	Other general purpose machinery	199	0.46	0.98 ± 0.01	0.08 ± 0.03	0.83	0.07
293	Agricultural and forestry machinery	54	0.45	0.96 ± 0.03	-0.05 ± 0.06	0.83	0.08
294	Machine tools	114	0.65	0.96 ± 0.02	0.00 ± 0.04	0.89	0.07
295	Other special purpose machinery	424	0.39	0.96 ± 0.01	0.08 ± 0.02	0.83	0.07
297	Domestic appliances not elsewhere classified	59	0.62	0.99 ± 0.02	0.04 ± 0.05	1.09	0.08
311	Electric motors, generators and transformers	71	0.59	0.99 ± 0.02	0.05 ± 0.05	0.91	0.07
312	Manufacture of electricity distribution and control equipment	70	0.52	0.97 ± 0.02	-0.15 ± 0.06	0.66	0.08
316	Electrical equipment not elsewhere classified	91	0.74	0.95 ± 0.02	0.02 ± 0.04	0.83	0.08
322	TV and radio transmitters and lines for telephony and telegraphy	44	0.84	0.98 ± 0.03	-0.05 ± 0.07	0.76	0.07
332	Measure, control and navigation instruments	51	0.56	0.95 ± 0.02	0.06 ± 0.06	0.77	0.0[illegible]
342	Production of bodies for cars, trailers and semitrailers	50	0.44	0.94 ± 0.03	0.08 ± 0.07	1.07	0.07
343	Production of spare parts and accessories for cars	125	0.61	0.96 ± 0.02	0.10 ± 0.04	0.90	0.08
361	Furniture	444	0.23	0.96 ± 0.01	0.02 ± 0.02	0.89	0.07
362	Jewelry and related articles	84	0.44	0.95 ± 0.02	0.03 ± 0.05	0.83	0.0[illegible]
366	Miscellaneous manufacturing not elsewhere classified	68	0.42	0.91 ± 0.02	0.01 ± 0.05	1.00	0.08

Table 2: Proxy of size: Number of Employees. Autoregressive coefficients (both in levels and differences), the concentration measure D_{20}^{4}, and estimated a and b as from (9).

Ateco code	Sector	# of Firms	D^4_{20}	AR(1)levels	AR(1)diff.	Estim. b	Estim
151	Production, processing and preserving of meat	114	0.45	0.95 ± 0.02	-0.08 ± 0.05	0.87	0.13
155	Dairy products	85	0.77	0.93 ± 0.02	-0.05 ± 0.05	0.87	0.14
158	Production of other foodstuffs (brad, sugar, etc...)	157	0.61	0.96 ± 0.01	0.03 ± 0.04	0.90	0.13
159	Production of beverages (alcoholic and not)	94	0.40	0.91 ± 0.02	-0.05 ± 0.05	0.86	0.10
171	Preparation and spinning of textiles	154	0.41	0.89 ± 0.02	-0.23 ± 0.04	0.86	0.10
172	Textiles weaving	171	0.56	0.94 ± 0.02	-0.03 ± 0.04	1.11	0.15
173	Finishing of textiles	181	0.52	0.89 ± 0.02	-0.09 ± 0.03	1.02	0.13
175	Carpets, rugs and other textiles	90	0.44	0.95 ± 0.02	-0.20 ± 0.05	0.90	0.14
177	Knitted and crocheted articles	162	0.51	0.93 ± 0.02	-0.12 ± 0.04	0.81	0.14
182	Wearing apparel	379	0.55	0.95 ± 0.01	-0.04 ± 0.02	0.76	0.12
191	Tanning and dressing of leather	87	0.38	0.89 ± 0.03	-0.08 ± 0.05	1.04	0.10
193	Footwear	245	0.50	0.94 ± 0.01	-0.10 ± 0.03	0.86	0.13
202	Production of plywood and panels	52	0.55	0.89 ± 0.03	-0.23 ± 0.06	0.79	0.14
203	Wood products for construction	59	0.47	0.93 ± 0.03	-0.10 ± 0.06	0.74	0.12
205	Production of other wood products (cork, straw, etc...)	56	0.31	0.92 ± 0.03	0.04 ± 0.08	0.79	0.12
211	Pulp, paper and paperboard	46	0.76	0.98 ± 0.03	-0.39 ± 0.08	0.93	0.19
212	Articles of paper and paperboard	180	0.54	0.96 ± 0.01	-0.11 ± 0.04	1.01	0.13
221	Publishing	72	0.58	0.92 ± 0.03	0.14 ± 0.04	0.60	0.13
222	Printing	199	0.65	0.94 ± 0.01	0.02 ± 0.04	0.94	0.12
241	Production of basic chemicals	80	0.44	0.94 ± 0.02	-0.10 ± 0.05	0.75	0.10
243	Paints, varnishes, printing inks and mastics	58	0.44	0.98 ± 0.02	-0.03 ± 0.07	0.95	0.11
244	Pharmaceuticals, medicinal chemicals and botanical products	97	0.41	0.93 ± 0.02	-0.02 ± 0.05	0.86	0.10
245	Soap and detergents, cleaning and toilet preparations	46	0.77	0.98 ± 0.03	0.06 ± 0.07	1.06	0.14
246	Other chemical products	51	0.48	0.89 ± 0.03	0.05 ± 0.05	0.81	0.14
251	Rubber products	87	0.77	0.97 ± 0.02	-0.01 ± 0.05	0.97	0.13
252	Plastic products	352	0.29	0.93 ± 0.01	-0.15 ± 0.02	0.81	0.13
261	Glass and glass products	87	0.56	0.99 ± 0.02	-0.07 ± 0.05	1.03	0.12
262	Ceramic goods not for construction	59	0.60	0.96 ± 0.02	0.01 ± 0.06	1.06	0.11
263	Ceramic goods for construction	91	0.44	0.95 ± 0.02	-0.13 ± 0.06	0.79	0.13
264	Bricks, tiles and construction products in baked clay	84	0.57	0.90 ± 0.03	-0.04 ± 0.07	1.00	0.10
266	Articles in concrete, plaster and cement	141	0.38	0.90 ± 0.02	-0.21 ± 0.04	0.89	0.10
267	Cutting, shaping and finishing of stone	69	0.56	0.92 ± 0.03	-0.08 ± 0.05	0.96	0.13
273	First processing of iron and steel	82	0.31	0.87 ± 0.03	-0.03 ± 0.05	0.94	0.17
275	Casting of metals	125	0.72	0.92 ± 0.02	-0.11 ± 0.04	1.07	0.13
281	Structural metal products	156	0.33	0.82 ± 0.02	-0.07 ± 0.04	1.01	0.10
284	Forging, pressing, stamping and roll forming of metal	132	0.40	0.94 ± 0.02	-0.06 ± 0.04	0.96	0.13
285	Treatment and coating of metals	182	0.32	0.83 ± 0.02	-0.05 ± 0.03	1.13	0.15
286	Cutlery, tools and general hardware	149	0.44	0.93 ± 0.02	-0.06 ± 0.03	1.00	0.13
287	Other fabricated metal products	265	0.84	0.94 ± 0.01	-0.08 ± 0.03	0.91	0.13
291	Machinery for the production and the use of mechanical power	224	0.71	0.92 ± 0.01	-0.10 ± 0.03	0.88	0.14
292	Other general purpose machinery	199	0.42	0.95 ± 0.01	-0.06 ± 0.04	0.89	0.14
293	Agricultural and forestry machinery	54	0.46	0.96 ± 0.03	-0.14 ± 0.07	0.90	0.14
294	Machine tools	114	0.67	0.91 ± 0.02	-0.17 ± 0.04	0.99	0.15
295	Other special purpose machinery	424	0.51	0.91 ± 0.01	-0.08 ± 0.02	0.98	0.10
297	Domestic appliances not elsewhere classified	59	0.63	0.99 ± 0.02	0.21 ± 0.06	0.99	0.12
311	Electric motors, generators and transformers	71	0.60	0.98 ± 0.02	-0.05 ± 0.05	1.33	0.14
312	Manufacture of electricity distribution and control equipment	70	0.55	0.97 ± 0.02	-0.15 ± 0.06	0.96	0.15
316	Electrical equipment not elsewhere classified	91	0.81	0.93 ± 0.02	-0.07 ± 0.05	0.90	0.14
322	TV and radio transmitters and lines for telephony and telegraphy	44	0.80	0.91 ± 0.03	-0.08 ± 0.06	0.75	0.17
332	Measure, control and navigation instruments	51	0.60	0.95 ± 0.03	-0.05 ± 0.06	1.39	0.13
342	Production of bodies for cars, trailers and semitrailers	50	0.43	0.91 ± 0.03	-0.04 ± 0.07	1.26	0.15
343	Production of spare parts and accessories for cars	125	0.58	0.92 ± 0.02	-0.06 ± 0.04	1.02	0.15
361	Furniture	444	0.34	0.91 ± 0.01	-0.08 ± 0.03	0.82	0.13
362	Jewelry and related articles	84	0.47	0.91 ± 0.02	-0.04 ± 0.05	0.93	0.13
366	Miscellaneous manufacturing not elsewhere classified	68	0.43	0.92 ± 0.03	0.10 ± 0.06	0.92	0.13

Table 3: Proxy of size: Value Added. Autoregressive coefficients (both in levels and differences), the concentration measure D^4_{20}, and estimated a and b as from (9).