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Turbulence underneath the big calm? Exploring the micro-evidence behind the flat trend of manufacturing productivity in Italy

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Turbulence underneath the big calm? Exploring the micro-evidence behind the flat trend of manufacturing productivity in Italy*

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Abstract

Italy ranked last in terms of manufacturing productivity growth according to OECD estimates over the last decade with a flat, if not declining, trend. In this work we investigate the underlying firm-level dynamics of enterprises on the grounds of a database developed by the Italian Statistical Office (ISTAT) covering the period 1989-2004 and containing information on more than 100,000 firms. Over the period not only the indicators of central tendency of the distribution of labour productivities have not significantly changed, but also the whole sectoral distributions have remained relatively stable over time, with their support at least not shrinking or even possibly widening over time. This is even more surprising if one takes into consideration the "Euro" shock that occurred during the period of investigation. On the contrary we observe that inter-decile differences in productivity have been increasing. Further, heterogeneous firms' characteristics (i.e. export activity and innovativeness) appear to have contributed to boost such intra-industry differences. Given such wide heterogeneities we resort to quantile regressions to identify the impact of a set of regressors at different levels of the conditional distribution of labor productivity. One phenomenon that we observe is what we call a tendency toward "neo-dualism" involving the co-existence of a small group of dynamic firms with a bigger ensemble of much less technologically progressive ones.

1 Introduction

In this paper, exploiting a newly developed database of Italian microdata, we investigate the firm-level dynamics underlying the flat trend in the aggregate productivity of the Italian manufacturing industry.

A *first* striking feature that emerges from the empirical analysis is the high degree of heterogeneity displayed by firms in the same sector along many dimensions of performance

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including labor productivity and growth rates (the results corroborate and refine upon those of Bottazzi et al., 2007). This heterogeneity is an intrinsic property of industries, no matter the chosen level of disaggregation.

The parameterization of the distributions also reveals that, given a general fat-tail property, the left tail is much fatter than the right one. This, in turn, corresponds to a higher heterogeneity in the performance of low productive firms, as opposed to the relative steepness of the right tail which is pointing to a few firms placed near some "efficiency frontier". The trend over time of such shape parameters confirms the persistently large differences in performances. Further, we also show that there is evidence of a widening of the differences between the most and least productive firms in each sector.

Second, as far as productivity is concerned our analyses highlight the apparent weakness of markets in selecting more efficient firms. The support of the sectoral distribution of firms' productivities is very wide and do not shrink over time, notwithstanding the "Euro" shock that occurred during the period of investigation. The event, which can be considered equivalent to a trade liberalization shock with perfectly fixed exchange rates, could have been expected to foster a process of market shares reallocation between firms in every industry and, as a result, contribute to shrink the support of the distribution of productivity among surviving firms. On the contrary the evidence displays a puzzling widened support.

A priori, good candidates for an explanation of the striking differences across firms, even within the same line of business ought to include firm-specific features which are sufficiently inertial over time and only limitedly "plastic" to strategic manipulation so that they can be considered, at least in the short term, "state variables" rather than "control variables" for the firm (Winter, 1987; Dosi et al., 2006). In fact, an emerging capability-based theory of the firm (cfr. Teece et al., 1994, Teece et al., 1997 and Dosi et al., 2008), identifies a fundamental source of differentiation across firms in their distinct problem-solving knowledge yielding different abilities of "doing things" - searching, developing new products, manufacturing, etc. (see Dosi et al., 2000, among the many distinguished others). Successful corporations, as one argues at more detail in the introduction to the Dosi et al. (2000), derive competitive strength from their above-average performance in a small number of capability clusters. Symmetrically, laggard firms often find hard the imitation of perceived best-practice production technologies because of the difficulty of identifying the combination of routines and organizational traits which makes companies good at doing whatever they do.

Among the possible "state" variables idiosyncratically associated with any one firm, we focus here upon innovativeness (proxied by patenting activities of the firm) as it entails specific organizational forms and capabilities not easy to be acquired by the firm in the short-term, and being or not being an exporter.

In this respect we found that, *third*, exporting and patenting activities are associated with different "types" of firms as revealed also in terms of the productivity distributions. Hence, as far as productivity is concerned, firms exporting[1] and/or patenting enjoy a superior performance than their non-exporting/ non-patenting competitors: there is a very robust evidence which holds in almost all sectors and years of analysis (see also Castellani and Zanfei, 2007; Serti and Tomasi, 2008). On the other hand, if we look at the profitability of the firm (as proxied by the ratio of returns on sales) the picture is more blurred. Labor productivity and innovation (patenting) are strongly related to the capability of the firm to generate profits, while this is not the case for the exporting activity as such (see also Grazzi, 2009). Finally, if we consider the relation between these variables and the growth process it becomes apparent

[1]Incidentally, notice that there is a large - and growing over time - percentage of Italian firms exporting.

that exporting and/ or patenting firms do *not* grow more than other firms.

Fourth, our data *do* reveal a (very) small number of “outliers” - top performers in terms of labor productivity, innovativeness, export and growth. However, their small number and share of value added as compared to the universe of the considered firms, is unable - at least up to 2004, our last year of observation - to affect the dynamics of the overall mean or even the shape of the relevant distributions over time.

2 Data

The database employed for the analyses, Micro.3, has been built through to the collaboration between the Italian statistical office, ISTAT, and a group of LEM researchers from the Scuola Superiore Sant’Anna, Pisa.[2]

Micro.3 is largely based on the census of Italian firms yearly conducted by ISTAT and contains information on firms above 20 employees in all sectors of the economy for the period 1989-2004. Further, it has been possible to link Micro.3 with other information collected by Istat, most notably for the present work, the data on international trade (COE) and with patent data. Starting in 1998 the census of the whole population of firms only concerns companies with more than 100 employees, while in the range of employment 20-99, ISTAT directly monitors only a “rotating sample” which varies every five years. In order to complete the coverage of firms in that range Micro.3 resorts, from 1998 onward, to data from the financial statement that limited firms have to disclose, in accordance to Italian law.[3]

In order to undertake intertemporal comparison, we deflate our data on current value variables making use of the 2 or 3 digit sectoral production price index provided by ISTAT and taking 2000 as the reference year.[4] The deflators are available from 1991 onward.

3 The evidence on labor productivity: levels and growth

The performance of Italy in terms of productivity growth over the last fifteen years or so has been poor. International comparisons (OECD, 2008) show that Italy ranked last in terms of growth of GDP per hour worked over the period 1995-2006 (see OECD, 2008, p. 17).

In general, the Italian economy registered a zero growth in the years 2001-2005 and an average annual growth below 1% in the previous period, 1995-2000. Only Spain did worse in this subperiod. The evidence on the manufacturing sector is even more dramatic: indeed if we consider the 1995-2005 period, then the average growth rate of value added per employee is negative (OECD, 2008). Again Italy is the only country, together with Spain, that registered a negative growth rate of productivity in the period under investigation.

One of the objective of the paper is to employ microdata to make sense of the flat trend in productivity observed at the aggregate level. A preliminary requirement in order to do that is that our dataset is indeed able to replicate the properties that we observe at the sectoral aggregate.[5]

[2]The database has been made available for work after careful censorship of individual information. More detailed information concerning the development of the database Micro.3 are in Grazzi et al. (2009).

[3]Limited companies (*società di capitali*) have to hand in a copy of their financial statement to the Register of Firms at the local Chamber of Commerce

[4]Istat provides the time series for the Italian economy at: *http://con.istat.it/default.asp*

[5]Note also that aggregate statistics for productivity typically report a measure, value added per worker, that is the ratio between the sum of all value added produced by the economy (or by one of its sectors) and

	91	92	93	94	95	96	97
15	54.4 (57.2)	58.9 (61.8)	58.2 (61.2)	56.6 (59.1)	54.9 (56.8) [49.2]	55.1 (57.1) [53.8]	56.6 (59.3) [51.6]
17	35.4 (36.1)	37.4 (38.2)	39.4 (40.3)	41.9 (43.5)	43.0 (44.5) [37.6]	40.6 (41.6) [40.3]	42.2 (44.5) [40.6]
18	25.8 (31.0)	26.2 (32.4)	27.7 (34.2)	29.0 (37.6)	32.3 (41.8) [27.3]	32.1 (39.0) [30.1]	30.8 (39.2) [29.0]
19	30.6 (35.7)	30.1 (34.8)	33.4 (39.7)	35.0 (41.6)	37.4 (46.1) [31.1]	35.4 (39.8) [34.4]	31.2 (34.0) [31.0]
20	35.1 (41.2)	37.9 (44.8)	38.7 (48.0)	39.2 (50.1)	40.6 (53.3) [34.1]	39.7 (47.9) [40.7]	39.2 (48.2) [41.4]
21	52.9 (57.1)	51.6 (54.2)	57.9 (61.9)	62.6 (68.0)	63.9 (69.9) [53.9]	67.8 (72.5) [63.0]	68.5 (75.4) [63]
22	61.4 (68.6)	65.4 (75.4)	63.7 (73.1)	63.0 (72.0)	59.9 (67.1) [47.2]	59.5 (64.6) [55.3]	63.9 (71.9) [55.1]
23	112 (115)	106 (109)	128 (134)	128 (132)	127 (130) [116]	124 (127) [131]	136 (139) [124]
24	59.0 (58.9)	64.1 (64.3)	65.2 (65.1)	72.3 (73.3)	84.1 (86.6) [75.2]	77.0 (77.9) [80.0]	76.3 (78.3) [77.8]
25	46.6 (47.8)	48.9 (50.8)	51.8 (56.0)	53.7 (58.1)	52.2 (56.0) [44.6]	51.6 (53.7) [50.0]	50.3 (54.7) [47.8]
26	50.9 (54.8)	52.7 (56.6)	51.9 (56.5)	54.8 (61.6)	57.4 (64.2) [46.4]	53.0 (57.1) [50.2]	53.8 (59.7) [50.5]
27	43.2 (43.0)	42.3 (41.3)	46.7 (46.4)	56.4 (57.9)	67.2 (70.0) [59.8]	56.5 (57.0) [56.5]	60.6 (62.6) [59.7]
28	40.0 (41.8)	41.0 (44.2)	41.8 (46.4)	43.5 (47.5)	46.3 (50.9) [39.8]	46.9 (49.8) [47.6]	45.1 (49.9) [46.5]
29	44.5 (45.2)	46.3 (47.7)	48.9 (51.2)	52.1 (55.1)	53.5 (55.4) [48.5]	52.3 (53.1) [54.6]	50.9 (52.4) [51.0]
30	64.1 (64.6)	88.5 (92.2)	82.3 (87.5)	79.9 (85.3)	74.4 (77.3) [52.4]	55.7 (55.7) [52.1]	66.0 (66.5) [59.8]
31	43.2 (45.1)	44.1 (46.4)	44.9 (47.4)	46.6 (49.5)	47.5 (49.8) [41.8]	45.1 (46.0) [43.9]	47.4 (49.1) [46.4]
32	44.7 (45.5)	44.5 (44.9)	44.6 (45.3)	43.9 (44.0)	43.8 (43.6) [42.3]	43.8 (43.9) [47.5]	47.1 (47.6) [49.2]
33	44.6 (46.3)	44.9 (46.9)	46.8 (50.1)	47.2 (49.0)	49.8 (50.8) [46.9]	47.6 (48.5) [51.0]	48.1 (51.0) [49.6]
34	37.4 (37.3)	35.2 (34.8)	27.8 (26.9)	36.3 (36.0)	46.6 (46.8) [43.1]	39.6 (39.3) [40.6]	52.1 (52.7) [51.4]
35	43.5 (44.2)	45.8 (44.7)	49.2 (49.3)	49.6 (47.0)	52.2 (53.9) [...]	43.8 (44.2) [40.2]	43.3 (43.9) [41.4]
36	34.9 (37.9)	35.8 (39.5)	37.0 (42.3)	37.2 (41.6)	39.1 (43.6) [33.0]	37.7 (39.5) [38.3]	37.6 (42.0) [38.4]

	98	99	00	01	02	03	04
15	57.6 (60.8) [55.4]	58.9 (62.4) [53.9]	58.3 (61.3) [53.1]	58.0 (60.2) [52.8]	61.1 (64.2) [56.2]	60.1 (63.5) [...]	58.9 (61.9) [...]
17	40.8 (42.1) [40.7]	40.8 (42.2) [40.4]	43.2 (45.2) [42.8]	42.0 (43.4) [42.3]	41.8 (43.2) [41.5]	40.2 (41.8) [40.2]	41.4 (42.8) [41.3]
18	32.3 (41.1) [29.5]	31.7 (39.9) [29.0]	34.6 (44.0) [34.1]	35.9 (44.8) [33.0]	35.8 (45.0) [33.0]	34.7 (44.2) [29]	36.4 (46.4) [32.8]
19	32.6 (37.3) [33.5]	34.4 (40.0) [36.3]	37.1 (43.1) [35.8]	37.2 (44.4) [35.3]	37.2 (45.5) [33.8]	36.7 (44.6) [31.6]	38.3 (45.5) [35.2]
20	38.8 (47.5) [40.6]	38.7 (45.9) [40.6]	40.9 (51.6) [42.7]	41.2 (49.5) [42.9]	41.2 (51.1) [42.1]	40.4 (48.8) [42.1]	41.9 (53.3) [42.9]
21	72.4 (85.0) [66.5]	70.0 (80.4) [61.2]	64.8 (74.5) [58.7]	61.6 (68.8) [63.4]	64.4 (71.8) [63.7]	63.7 (71.0) [59.3]	67.1 (75.7) [61.6]
22	63.2 (72.2) [56.5]	66.0 (77.2) [57.2]	70.4 (87.7) [60.3]	66.8 (81.1) [59.7]	67.5 (80.5) [63.2]	68.1 (82.4) [60.3]	75.0 (95.2) [64.5]
23	150 (154) [154]	126 (129) [133]	167 (177) [158]	169 (179 [162]	124 (130) [134]	128 (135) [126]	143 (156) [142]
24	79.6 (81.4) [79.0]	79.7 (81.2) [81.3]	82.0 (85.0) [81.2]	77.6 (78.9) [75.6]	83.5 (86.9) [78.5]	78.4 (80.4) [77.7]	82.1 (85.1) [74.2]
25	49.4 (53.3) [49.6]	50.9 (54.5) [49.5]	49.8 (53.9) [49.3]	48.1 (51.0) [49.4]	50.7 (55.1) [51.4]	49.0 (52.6) [49.1]	49.0 (52.1) [48.6]
26	53.6 (60.2) [51.3]	57.6 (65.7) [53.5]	58.3 (66.4) [54.4]	58.2 (66.9) [52.4]	61.6 (70.7) [54.7]	60.2 (69.5) [54.4]	60.2 (68.0) [54.3]
27	58.1 (60.6) [57.0]	56.5 (57.1) [56.2]	58.7 (60.6) [59.5]	53.7 (54.1) [54.0]	55.1 (55.4) [54.7]	55.5 (56.0) [54.9]	60.2 (63.1) [58.1]
28	44.0 (48.1) [47.0]	44.6 (49.4) [45.4]	45.6 (51.5) [46.5]	45.7 (49.7) [47.4]	47.3 (51.7) [46.8]	45.7 (50.3) [46.4]	45.8 (51.7) [44.9]
29	50.7 (52.9) [50.4]	51.0 (53.4) [50.7]	53.0 (55.2) [53.0]	52.3 (53.9) [53.4]	52.8 (54.8) [52.7]	50.7 (52.7) [51.4]	52.3 (54.5) [53.8]
30	44.3 (40.2) [72.4]	48.0 (39.8) [61.1]	49.3 (45.0) [50.2]	75.7 (88.3) [78.2]	50.0 (44.4) [33.0]	51.8 (52.3) [45.6]	66.3 (83.2) [50.7]
31	46.1 (48.1) [44.9]	47.2 (49.5) [47.2]	48.3 (50.7) [46.3]	47.6 (50.0) [44.0]	48.8 (51.2) [46.5]	48.9 (51.6) [45.4]	49.7 (53.4) [48.2]
32	47.8 (49.4) [45.0]	48.7 (50.0) [40.9]	60.9 (65.3) [64.9]	57.7 (60.4) [54.3]	52.6 (54.6) [48.8]	57.7 (60.5) [58.2]	61.7 (65.4) [56.5]
33	49.4 (53.4) [49.7]	48.4 (51.3) [50.2]	51.5 (55.0) [56.2]	52.2 (54.9) [53.1]	56.5 (61.4) [58.6]	51.3 (53.5) [52.7]	55.2 (59.1) [56.9]
34	43.8 (43.9) [43.9]	44.1 (44.2) [41.2]	45.7 (45.9) [44.8]	40.7 (40.3) [40.8]	48.6 (49.2) [36.1]	42.0 (41.6) [41.4]	52.1 (53.2) [41.2]
35	43.7 (44.0) [45.9]	46.2 (46.9) [44.9]	54.2 (56.5) [50.2]	51.8 (53.0) [50.0]	54.3 (56.2) [52.9]	51.4 (53.1) [49.3]	58.5 (61.2) [56.2]
36	38.4 (43.1) [39.9]	39.5 (45.0) [37.9]	40.3 (45.7) [41.9]	39.9 (44.3) [41.0]	38.9 (42.0) [39.8]	37.5 (39.8) [37.4]	37.7 (41.3) [37.7]

Table 1: Value added per employee (at constant 2000 prices) for firms above 20 employees, for firms above 100 employees (in brackets) and for the whole sector (Eurostat data in square brackets). Source: Our elaboration on Micro.3 and Eurostat.

Table 1 reports sectoral measures of labor productivities from Micro.3, covering firms over 20 employees, those for firms above 100 employees, in brackets, and Eurostat sectoral measures, covering the whole sector, in square brackets. The differences between the three reveal the robust positive relation between size and labor productivity (for a related work on a previous version of the database, see Bottazzi and Grazzi, forthcoming).[6]

Averages are in general higher in 2004 than at the beginning in 1991. However as we shall see, the differences in the levels of average productivity do not always turn to be significant (more on this in the following). Also notice that the comparisons of the levels of labor productivity over time suggest that the largest share of productivity growth occurred in the period 1995-2000.

the sum of all workers employed. As such every firm has a weight in the summation that is proportional to its size (both in terms of value added and numbers of employees). On the contrary, using microdata, not only we can (re)produce the same measure, but we can also estimate the average of the productivity of firms in a sector, its variance and the dynamics over time of the whole underlying distribution.

[6]Notice that Eurostat does not report sectoral data before 1995, while our microdata are available since 1989. However, the sectoral production price index is available starting in 1991. Hence, we report data for Micro.3 only from 1991 onward.

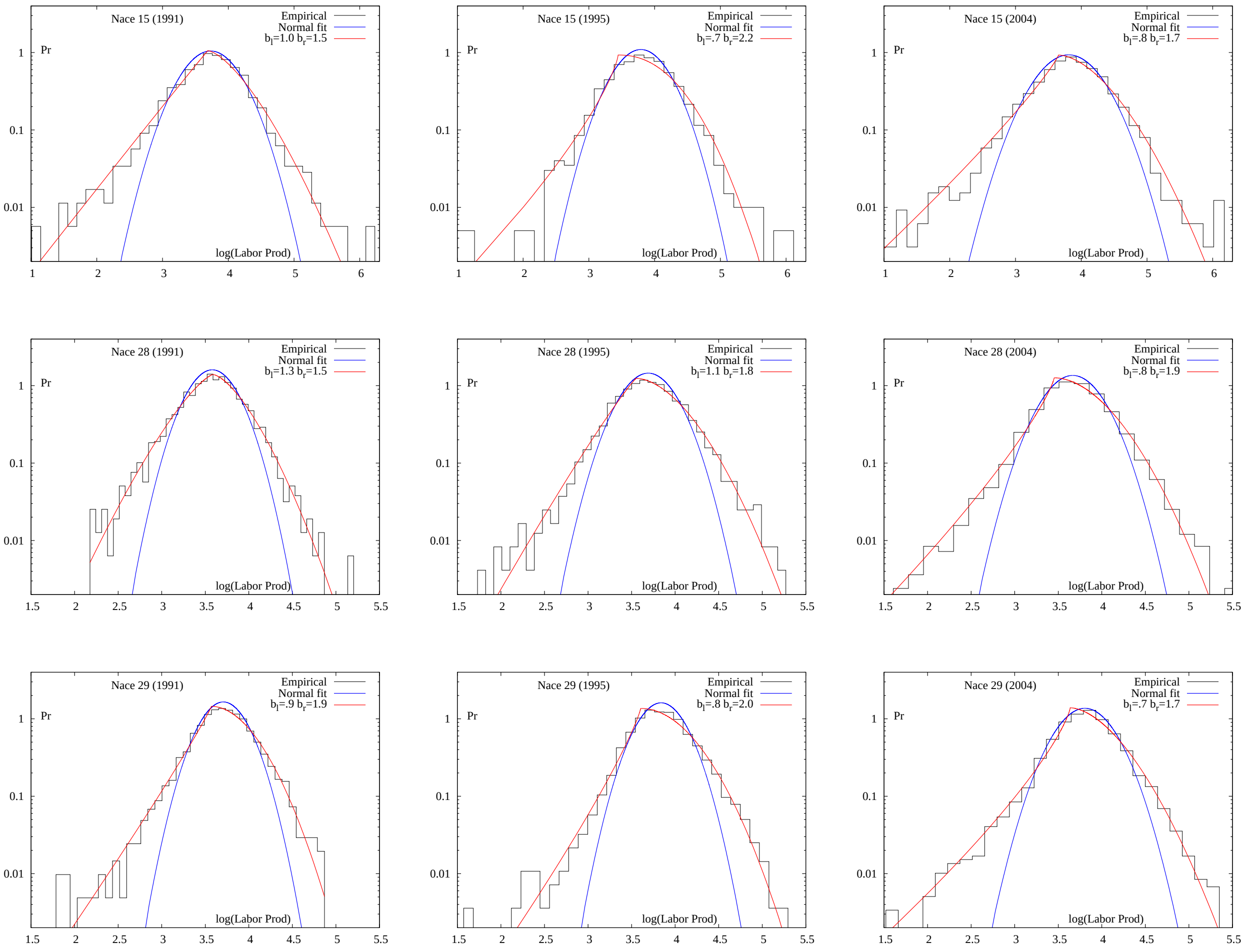

Figure 1: Empirical density of labor productivity for NACE 15, 28 and 29 together with the Normal and AEP fit. Notice that probabilities on the y-axis are in log scale in order to enhance the appreciation of the tails of the distributions.

3.1 High intra-sectoral heterogeneity

Let us turn now to firm level productivities to investigate the properties and evolution of the distributions over time.

In Dosi and Grazzi (2006) it was already shown, on a shorter window on the same database, that labor productivity displays a wide support, both at three and two digit levels of disaggregation. Further, it was also shown that such heterogeneity is highly persistent over time. What happened to such distribution after the shock associated with the introduction of the euro currency? Such an event, which can be considered equivalent to a trade liberalization with perfectly fixed exchange rates, could have been expected to foster the process of market share reallocation between firms in every industry and, as a result, contribute to shrink the support of the distribution of productivity in any given sector. In order to better investigate the distribution of the variable of interest, we will resort to a new family of distributions, the Asymmetric Exponential Power (AEP) distribution, introduced by Bottazzi and Secchi (2006) that allow to properly account for asymmetries and leptorkurtosis, with normality as a special

NACE	1991		1995		2000		2004	
	$\mathbf{b_l}$	$\mathbf{b_r}$	$\mathbf{b_l}$	$\mathbf{b_r}$	$\mathbf{b_l}$	$\mathbf{b_r}$	$\mathbf{b_l}$	$\mathbf{b_r}$
15	1.01 0.08	1.48 0.14	0.76 0.06	2.23 0.17	0.91 0.06	1.75 0.12	0.87 0.05	1.73 0.12
17	1.25 0.11	1.91 0.18	1.52 0.13	1.39 0.14	0.99 0.06	1.69 0.12	1.06 0.07	1.32 0.11
18	1.04 0.09	1.30 0.10	1.08 0.10	1.29 0.09	1.09 0.09	1.46 0.12	1.09 0.10	1.63 0.14
19	0.92 0.09	1.95 0.18	0.88 0.09	1.85 0.15	0.68 0.05	2.32 0.16	0.61 0.04	2.21 0.16
20	1.01 0.13	1.58 0.21	0.76 0.08	1.59 0.18	0.65 0.05	1.73 0.16	0.87 0.08	1.70 0.18
21	0.57 0.07	3.14 0.42	1.19 0.23	1.90 0.29	0.78 0.08	1.68 0.18	0.50 0.04	2.32 0.22
22	0.81 0.10	1.70 0.16	0.85 0.09	1.25 0.12	0.82 0.07	1.21 0.09	0.69 0.06	1.45 0.11
24	0.62 0.06	2.43 0.24	0.86 0.10	1.78 0.18	1.12 0.10	1.38 0.14	0.78 0.06	1.56 0.12
25	0.79 0.07	1.87 0.17	0.68 0.05	1.98 0.16	0.93 0.06	1.67 0.11	0.79 0.04	1.63 0.11
26	1.07 0.10	1.70 0.15	0.85 0.07	2.48 0.21	0.81 0.05	1.67 0.11	0.86 0.06	1.67 0.11
27	0.81 0.09	2.27 0.26	0.99 0.14	1.88 0.23	0.99 0.10	1.55 0.16	0.70 0.06	1.69 0.15
28	1.34 0.10	1.52 0.12	1.10 0.08	1.78 0.11	0.93 0.04	1.64 0.07	0.81 0.03	1.87 0.07
29	0.93 0.06	1.94 0.12	0.85 0.05	2.01 0.11	0.83 0.03	1.53 0.06	0.77 0.03	1.73 0.07
31	0.66 0.05	2.07 0.20	1.12 0.12	1.33 0.15	0.99 0.08	1.29 0.11	0.80 0.06	1.57 0.12
32	0.90 0.14	1.17 0.24	1.92 0.34	0.80 0.13	0.71 0.08	2.04 0.26	0.72 0.10	2.42 0.34
33	1.40 0.26	1.46 0.30	1.77 0.24	0.85 0.12	0.76 0.07	2.11 0.23	0.83 0.09	1.89 0.20
34	0.93 0.12	1.46 0.24	0.40 0.04	2.56 0.33	0.54 0.04	1.67 0.16	0.69 0.07	1.64 0.17
36	0.87 0.06	1.40 0.10	0.74 0.05	1.97 0.13	0.51 0.02	1.94 0.10	0.73 0.04	1.58 0.09

Table 2: Summary table of the sectors under analysis. Estimated $\mathbf{b_l}$ and $\mathbf{b_r}$ parameters and standard errors for the distribution of labor productivity. (deflated with the sectoral production price index)

case.[7]

In the following we are going to employ the AEP as it enables for a more flexible characterization of the distributions of labor productivities.[8] In particular, we will investigate the dynamics over time and across sectors of the left and right tail parameters, respectively b_l and b_r, thus also accounting for possible asymmetries in the distributions.[9]

Figure 1 displays the empirical density of (log) labor productivity for the food and beverage sector, NACE 15, fabricated metal products, NACE 28 and for the machine tool sector, NACE 29 together with the Normal and AEP fits for a selection of years. In all sectors, the departure from normality of the empirical distribution is impressive both with respect to the wideness of the support and also for the asymmetry of the two tails, which is also visually detectable in the plots of Figure 1. It is also noteworthy that there is no shrink in the support of the distributions, suggesting a persistently wide heterogeneity in the levels of efficiency. On the

[7]The AEP density presents the following functional form (Bottazzi and Secchi, 2006)

$$f_{\text{AEP}}(x;\mathbf{p}) = \frac{1}{C}\; e^{-\left(\frac{1}{b_l}\left|\frac{x-m}{a_l}\right|^{b_l}\theta(m-x)+\frac{1}{b_r}\left|\frac{x-m}{a_r}\right|^{b_r}\theta(x-m)\right)} \tag{1}$$

where $\mathbf{p} = (b_l, b_r, a_l, a_r, m)$, $\theta(x)$ is the Heaviside theta function and where the normalization constant reads $C = a_l A_0(b_l) + a_r A_0(b_r)$ with

$$A_k(x) = x^{\frac{k+1}{x}-1}\,\Gamma\left(\frac{k+1}{x}\right) . \tag{2}$$

The two positive shape parameters b_r and b_l, describe the tail behavior in the upper and lower tail, respectively; two positive scale parameters a_r and a_l, associated with the distribution width above and below the modal value and one location parameter m, representing the mode. The AEP reduces to the Exponential Power distribution Subbotin (1923) when $a_l = a_r$ and $b_l = b_r$.

[8]For issues concerning the comparisons of goodness of fit measures with other distribution refer to Bottazzi and Secchi (2006).

[9]The a_l and a_r are substantially stable and they are not reported.

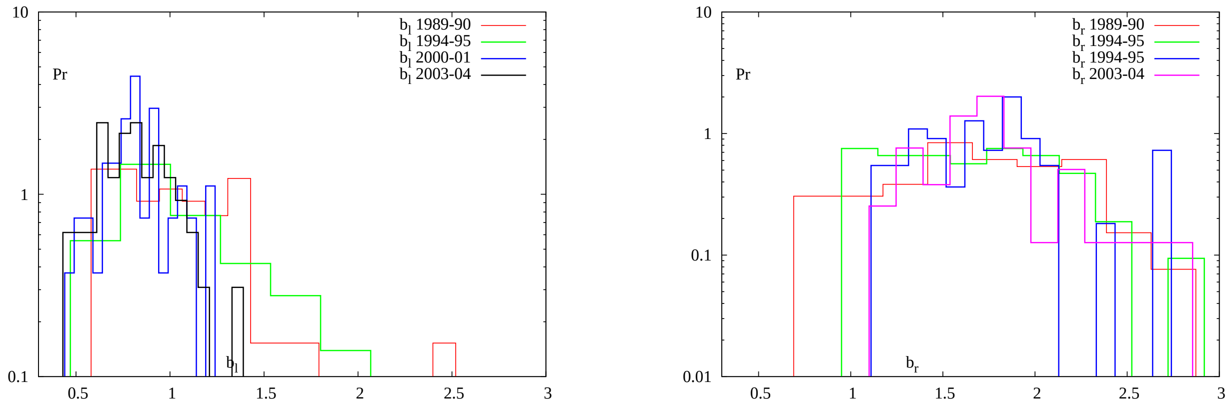

Figure 2: Binned empirical density of the b_l and b_r parameter values estimated over the 55 3-Digit sectors.

contrary, one detects a widening of the support. This is a first piece of evidence against the conjecture that the introduction of the euro has fostered any selection processes as a result of tighter competition.

The properties of the distribution that are revealed by the plots of Figure 1 hold for most of sectors, cf. Table 2. Notice indeed, that almost all b parameters in all sectors and years are smaller than two, meaning that the distribution display fat-tails properties. Another equally remarkable feature is the asymmetry of the empirical density: the left index is often smaller than the right one, suggesting that fat-tail property is stronger in the "low efficiency" side of the distribution. In fact, the b_l parameter is informative of different degrees of *sectoral tolerance* to inefficient firms. While the upper tail is likely to be constrained by the "frontier" state of technological knowledge, the evidence suggests a much looser constraint on the side of market selection which should plausibly operate against less efficient firms. Moreover note that both the b_l and b_l parameters have not changed much over time. If anything, b_l *decreases* in almost all sectors while b_r is roughly constant. The decrease in the value of b_l means that the left tail has become even fatter over time rather than shrinking: see Figure 2 reporting the binned empirical density of the b_l and b_r parameter estimated over the 55 three digit sectors with the highest number of observations.[10]

A more succinct account of the widening of the support is offered by the ratio of the average labor productivity of the top over the bottom decile for firms in each 2-digit sectors (Table 3). Notice that the 10% most productive firms in a sector are - in most cases - 5 to 6 times more productive than firms in the lowest decile. Again the widening of the support signals that the market does not appear to exert a strong discipline in selecting in favor of the most efficient firms and in causing the exit of the least efficient ones. Such evidence is also analyzed in Bottazzi, Dosi, Jacoby, Secchi and Tamagni (2009) where the issue of selection is addressed also considering, in a sort of evolutionary accounting exercise, the decomposition of the growth of labor productivity in any one industry between the reallocation of market shares to the more productive firms and the increase in productivity due to firm-level effects (the so-called "within" component): most growth, when it occurs, is due to the latter.

Having identified the characteristics of the distributions of labour productivity, what can

[10]Quite obviously, more disaggregated three digit sectors have much less observations than the corresponding two digit sectors in which they are nested. Thus in order to recover a higher number of observations we pool together subsequent years as follows, 1989-90, 1994-95, 2000-01, and 2003-04.

NACE	'89	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04
15	6.9	7.0	6.7	6.3	7.2	6.4	5.9	6.1	7.6	8.0	8.2	7.9	8.1	8.3	7.9	8.2
17	5.5	5.8	5.2	6.0	6.4	6.2	6.3	6.2	5.7	6.3	6.2	5.7	5.9	5.6	5.7	6.0
18	6.6	6.5	7.1	7.6	8.2	7.1	7.4	8.5	7.0	9.1	10.9	11.5	11.1	10.9	10.6	11.8
19	5.3	5.7	5.9	6.7	6.0	6.1	6.0	6.6	6.1	6.0	6.3	6.5	5.9	6.6	6.3	6.3
20	4.1	3.8	3.9	4.2	4.1	4.1	5.1	4.7	4.5	4.1	4.3	5.1	4.4	4.6	4.6	4.0
21	3.9	4.3	4.3	3.9	4.5	5.0	5.5	6.6	5.2	6.1	5.3	6.4	5.2	4.7	4.5	5.3
22	5.2	5.4	4.9	5.5	5.8	5.3	5.6	6.6	6.8	7.4	8.2	6.8	6.5	7.8	8.1	8.0
23	10.3	7.7	6.4	5.2	7.8	8.0	7.9	16.4	8.2	7.7	7.7	7.7	12.3	6.0	7.5	7.6
24	4.8	4.9	4.6	4.8	5.2	5.9	6.2	6.3	5.8	8.3	7.8	8.6	8.5	7.0	7.7	8.3
25	4.0	4.2	4.1	4.3	4.9	5.0	5.1	5.2	4.6	4.6	4.5	4.9	4.2	4.5	4.4	4.9
26	5.2	5.3	5.2	5.6	5.6	5.3	5.3	5.6	5.4	5.0	5.4	6.0	5.4	5.8	5.9	6.2
27	4.3	4.3	3.9	5.2	4.5	4.7	5.4	5.6	4.7	4.7	4.9	5.0	5.0	4.9	4.9	6.1
28	3.6	3.8	3.6	3.7	3.8	3.9	4.1	4.2	4.1	4.3	4.2	4.5	4.3	4.2	4.2	4.3
29	3.5	3.5	3.4	3.6	3.9	3.6	3.5	4.4	3.9	4.3	4.2	4.3	4.2	4.1	4.2	4.2
30	5.3	4.5	5.0	6.6	5.9	5.0	6.0	8.3	12.1	8.7	12.3	11.2	17.7	8.3	5.6	6.9
31	4.2	4.7	4.7	4.3	5.2	4.7	5.0	4.7	4.9	5.7	5.9	6.6	5.7	6.0	5.7	6.0
32	6.7	7.1	6.6	7.9	6.3	6.1	6.1	6.8	7.1	7.3	6.5	6.6	7.2	7.4	9.0	5.8
33	4.4	5.3	4.3	4.6	4.8	4.8	5.1	4.7	5.5	4.9	5.7	5.8	5.3	5.9	5.3	5.1
34	3.6	3.5	4.0	4.0	4.9	4.8	4.2	4.1	4.2	5.1	5.4	5.2	5.5	5.2	4.4	5.4
35	4.4	4.4	5.1	8.8	7.2	5.1	5.2	6.3	4.4	5.4	7.1	6.7	7.1	8.5	7.0	6.8
36	3.7	3.8	3.9	3.9	4.4	4.1	4.3	5.5	4.1	4.7	5.1	5.2	4.8	4.9	5.3	5.3
	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.1	0.2	0.2	0.2	0.1	0.2	0.4	0.2

Table 3: Ratio of the average productivity (and relative std err) of the top decile over the bottom one.

we say about its growth rates?

A robust property is that they display a tent-like shape, that is, they are fat-tailed, too (see Bottazzi et al., 2005); further they are symmetric with values of b_l and b_r close to one. Here let us check the properties of growth rates of productivity also on intervals longer than one year, trying to see whether the process of temporal aggregation has any relevant effect on the distribution of growth rates. In this respect, Figure 3 reports for sectors 15, 28 and 29, the growth rates of labor productivity for two five years intervals, 1991-95 and 2000-04, over which the growth rate is defined as the logarithmic difference of the average labor productivity in the last three years and the average productivity in the first two years of the subsample. The motivation of such measure lies in the attempt to capture 'longer terms' increases in labor productivity. The plots in Figure 3 reveal that also growth rates computed on such intervals, display a tent-like Laplacian shape. Such a long term "lumpiness" of productivity growth events clearly militates against the notion of productivity growth as a result of a smooth process made by small improvements. Rather, it appears often characterized by "big" idiosyncratic shocks (Dosi, 2007).

3.2 Comparisons over time

We have seen that the distribution of labor productivities across firms is persistently wide, with a support that appears to have widened over time. However, given their fat-tailed asymmetric shapes, one can hardly study their possible change over time by simply comparing averages.

Thus, in order to gain statistical precision in the comparison of the distributions of productivities in two different periods, we will perform formal tests of distributional equality based on the notion of stochastic (in)equality proposed by Fligner and Policello (1981).[11] Let F_t and F_p be the distributions of the variable of interest for the two periods t and p, respectively. Let us denote with $\mathbf{X}_t \sim F_t$ and $\mathbf{X}_p \sim F_p$ the associated random variables, and with X_t and X_p the two respective realizations. The distribution F_t is said to dominate F_p if $\text{Prob}\{X_t > X_p\} > 1/2$. That is, if one randomly selects two firms, one from the t period and one from the p period, the probability that the latter displays a smaller value of X is more

[11] More on such an application in Bottazzi, Grazzi, Secchi and Tamagni (2009).

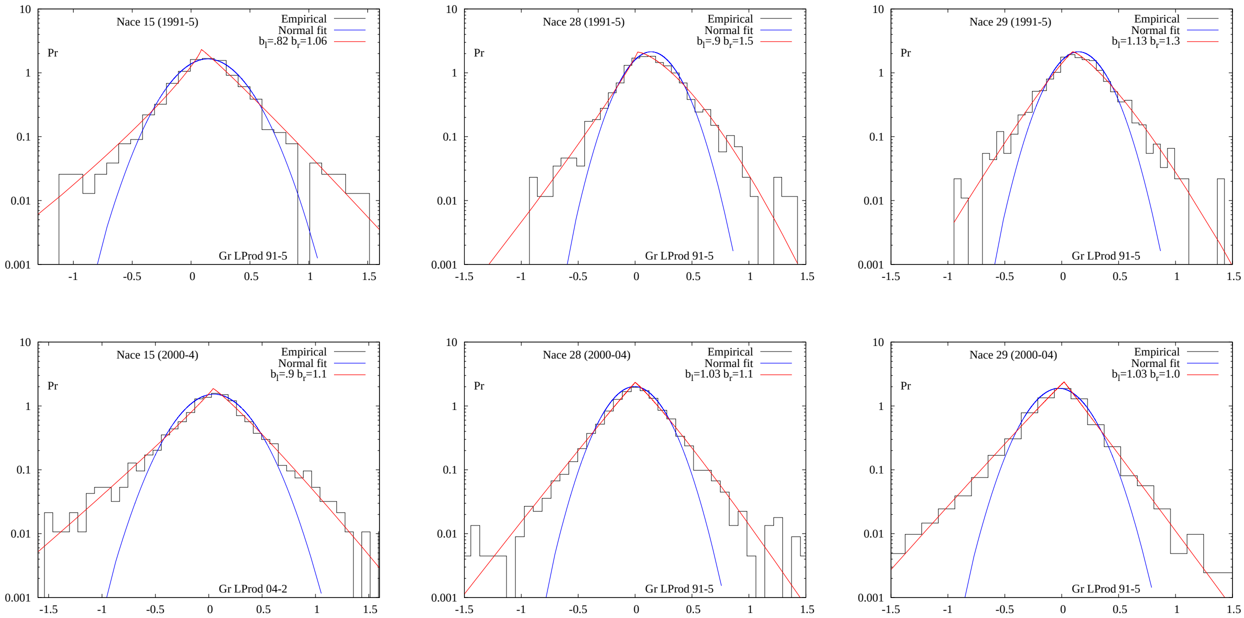

Figure 3: Empirical density of growth rates of labor productivity over five years periods, for NACE 15, 28 and 29 together with the Normal and AEP fit (deflated with the sectoral production price index).

than 1/2, or, in other terms, it has a higher probability of having the smallest value. Since

$$\text{Prob}\{X_t > X_p\} = \int dF_t(X)\, F_p(X) \quad , \tag{3}$$

a statistical procedure to assess which of the two distributions dominates can be formulated as a test of

$$H_0 : \int dF_t\, F_p = \frac{1}{2} \quad \text{vs} \quad H_1 : \int dF_t\, F_p \neq \frac{1}{2} \quad . \tag{4}$$

The procedure developed in Fligner and Policello (1981) provides a valid statistic for H_0. We apply their procedure exploiting the fact that, in case of rejection of the null, the sign of the Fligner-Policello (FP) statistic tells us which of the two distributions is dominating: a positive (negative) sign means that productivity in period t has a higher probability to take on higher values than in the other period. The test does not assumes neither normality nor equal variances and it can be interpreted as a test of stochastic (in)equality between the two distributions. We will use the Fligner-Policello statistics to compare the levels of productivity in different years. The analysis is performed taking 2004 as our benchmark year, to which the distributions from the other years are compared. A positive (negative) value of the statistics means that productivity was higher (lower) in 2004 than in the year of analysis. Values of the test statistics that are significant at the 5% level are in bold. Given the non-parametric nature of the test we require a minimum of 50 observations; hence we are bound to undertake it at the level of 2 digit sectors and only in some 3 digit ones.

The evidence from Table 4 on 21 2-digit sectors is not encouraging. In the post-euro subsample, 1999-2004, for most sectors it is not possible to conclude that productivity was higher in 2004 than in other years.

	91-04	92-04	93-04	94-04	95-04	96-04	97-04	98-04	99-04	00-04	01-04	02-04	03-04
15	**8.749**	**6.123**	**6.694**	**6.268**	**7.028**	**7.324**	**7.270**	1.464	1.003	**2.317**	**1.993**	-0.820	-0.020
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.143	0.316	0.021	0.046	0.412	0.984
17	**10.507**	**7.400**	**4.547**	0.546	1.433	**5.209**	**4.027**	**2.230**	**2.515**	-1.846	-0.069	-0.653	1.107
	0.000	0.000	0.000	0.585	0.152	0.000	0.000	0.026	0.012	0.065	0.945	0.514	0.268
18	**10.392**	**10.760**	**9.157**	**6.904**	**3.720**	**7.781**	**13.635**	**3.082**	**4.018**	1.292	-0.710	-0.499	0.977
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.196	0.478	0.618	0.329
19	**13.179**	**11.424**	**7.948**	**6.098**	**6.676**	**8.595**	**9.202**	**6.288**	**4.418**	0.257	0.847	1.398	**2.623**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.797	0.397	0.162	0.009
20	**7.757**	**5.846**	**5.129**	**5.306**	**4.705**	**4.593**	**5.750**	**3.730**	**2.255**	1.574	0.257	0.402	**1.985**
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.115	0.797	0.688	0.047
21	**3.819**	**2.693**	1.282	0.094	0.870	-0.272	0.197	-0.111	-0.797	**3.718**	0.613	-0.283	0.820
	0.000	0.007	0.200	0.925	0.385	0.786	0.844	0.912	0.425	0.000	0.540	0.777	0.412
22	-0.188	-0.098	0.945	0.394	-0.048	-1.042	-0.657	-0.261	-0.273	0.281	-0.756	0.320	1.025
	0.851	0.922	0.345	0.693	0.962	0.297	0.511	0.794	0.785	0.779	0.449	0.749	0.306
23	0.970	0.628	0.431	1.091	0.529	0.467	nan	-1.468	-1.610	0.717	-0.852	-0.912	-1.146
	0.332	0.530	0.667	0.275	0.597	0.640	nan	0.142	0.107	0.474	0.394	0.362	0.252
24	**2.048**	0.171	-0.220	-0.163	**-2.052**	**-3.284**	**-2.215**	-1.091	-1.717	-0.323	0.137	-0.672	-0.456
	0.041	0.864	0.826	0.871	0.040	0.001	0.027	0.275	0.086	0.747	0.891	0.502	0.648
25	**3.132**	1.482	0.775	-1.122	1.301	1.081	**2.193**	0.918	-0.609	0.821	1.588	-1.116	0.522
	0.002	0.138	0.438	0.262	0.193	0.280	0.028	0.359	0.543	0.412	0.112	0.264	0.602
26	**6.447**	**4.431**	**5.469**	**5.140**	**3.661**	**3.726**	**5.244**	**2.810**	1.191	0.906	1.394	-1.366	0.330
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.234	0.365	0.163	0.172	0.741
27	**5.736**	**3.729**	**3.192**	1.146	-1.649	-0.501	0.072	-1.196	**-4.548**	**-3.185**	**-2.708**	**-4.132**	**-3.321**
	0.000	0.000	0.001	0.252	0.099	0.616	0.943	0.232	0.000	0.001	0.007	0.000	0.001
28	**13.865**	**14.321**	**14.518**	**11.315**	**7.888**	**6.549**	**8.666**	**7.611**	**5.322**	3.180	-0.714	**-2.567**	0.727
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.475	0.010	0.467
29	**10.172**	**9.908**	**8.328**	**5.093**	1.176	1.150	**2.792**	**5.040**	**4.422**	-0.930	-1.195	-1.649	**4.046**
	0.000	0.000	0.000	0.000	0.240	0.250	0.005	0.000	0.000	0.352	0.232	0.099	0.000
30	nan	nan	nan	1.005	nan	nan	nan	**2.499**	0.805	1.538	1.702	0.994	1.003
	nan	nan	nan	0.315	nan	nan	nan	0.012	0.421	0.124	0.089	0.320	0.316
31	**9.997**	**9.157**	**9.608**	**8.055**	**5.566**	**5.095**	**4.783**	**3.418**	**2.699**	1.890	1.656	0.553	1.403
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.007	0.059	0.098	0.580	0.161
32	**4.883**	**4.318**	**5.940**	**4.973**	**4.336**	**2.887**	**2.064**	**6.136**	**4.792**	**4.030**	**2.995**	**3.441**	**2.799**
	0.000	0.000	0.000	0.000	0.000	0.004	0.039	0.000	0.000	0.000	0.003	0.001	0.005
33	**2.315**	**3.142**	**3.931**	**2.031**	-0.162	-0.267	0.353	**4.658**	**4.129**	**2.788**	1.933	1.294	**2.239**
	0.021	0.002	0.000	0.042	0.871	0.789	0.724	0.000	0.000	0.005	0.053	0.196	0.025
34	**5.724**	**5.524**	**5.435**	**3.291**	1.296	1.912	0.725	**1.966**	1.841	1.502	1.637	0.554	1.466
	0.000	0.000	0.000	0.001	0.195	0.056	0.469	0.049	0.066	0.133	0.102	0.580	0.143
35	**2.177**	nan	nan	nan	nan	**5.240**	**4.612**	**2.498**	**2.194**	1.341	1.691	**2.175**	**2.079**
	0.030	nan	nan	nan	nan	0.000	0.000	0.012	0.028	0.180	0.091	0.030	0.038
36	**6.957**	**5.827**	**4.506**	**4.611**	**2.159**	**2.804**	**3.803**	-1.427	-1.813	**-2.789**	**-4.100**	**-2.828**	0.839
	0.000	0.000	0.000	0.000	0.031	0.005	0.000	0.154	0.070	0.005	0.000	0.005	0.402

Table 4: Test of stochastic equality, year by year comparison for 2 digit sector. Observed value of the Fligner-Policello statistic and associated p-value. Rejection of the null means that the two distributions are stochastic different.

One has to go back to the first subperiod 1991-1995, and compare the distributions of labor productivity to that of 2004, in order to find that in most sectors the distribution has shifted to the right.

In Table 5 we focus again on the comparison of productivity in different years, and we consider averages over two consecutive years. Columns II and VII of Table 5 report the results of the FP test on the distribution of labor productivity in 1991-2 *versus* 1994-1995. The results of the test support the hypothesis that the bigger part of the (yet small) increase in productivity mostly occurred in the first subperiod. Indeed, the comparisons of labor productivity in 1991-92 *vs* 1994-95 suggest that in most sectors there has been a shift in the distributions, while this is not the case when comparing 1999-00 and 2003-04. In order to recover significant differences between the distribution of labor productivity one has to compare the first two years, 1991-2, with the very last two, 2003-4. It is only when we are considering the complete stretch of the sample period that we get clear evidence of an increase in productivity. Indeed, the positive and significant signs in the other columns of Table 5 are very few.[12] The evidence at the 3 digit level, shown in Appendix A is very much in line with the above.

Let us now turn to the intra-distributional dynamics of different firms.

[12]These results are largely invariant to size of the firm. The same analysis on firms bigger than 100 employees do not report different patterns.

NACE	1991-2 Vs 1994-1995	1991-2 Vs 2003-2004	1994-5 Vs 2003-2004	99-00 Vs 2003-2004	NACE	1991-2 Vs 1994-1995	1991-2 Vs 2003-2004	1994-5 Vs 2003-2004	99-00 Vs 2003-2004
15	**2.426**	**5.986**	**5.614**	**2.308**	27	**9.172**	**9.188**	1.893	**-3.179**
	0.015	0.000	0.000	0.021		0.000	0.000	0.058	0.001
17	**11.172**	**12.384**	0.692	-0.260	28	**10.956**	**11.847**	**6.782**	**5.768**
	0.000	0.000	0.489	0.795		0.000	0.000	0.000	0.000
18	**8.694**	**14.351**	**7.012**	**3.148**	29	**14.279**	**8.509**	-0.952	-0.271
	0.000	0.000	0.000	0.002		0.000	0.000	0.341	0.787
19	**8.561**	**12.696**	**6.235**	1.390	30	-1.223	0.793	1.477	1.302
	0.000	0.000	0.000	0.165		0.221	0.428	0.140	0.193
20	**2.308**	**5.691**	**3.562**	1.327	31	**5.892**	**8.745**	**5.378**	**2.201**
	0.021	0.000	0.000	0.184		0.000	0.000	0.000	0.028
21	**6.169**	**4.579**	0.062	1.707	32	**2.663**	**2.158**	1.926	**4.034**
	0.000	0.000	0.950	0.088		0.008	0.031	0.054	0.000
22	0.068	-1.791	1.533	-0.376	33	**4.063**	**3.056**	-0.184	**3.218**
	0.946	0.073	0.125	0.707		0.000	0.002	0.854	0.001
23	0.117	1.656	1.310	0.176	34	**5.920**	**4.651**	0.107	1.425
	0.907	0.098	0.190	0.860		0.000	0.000	0.915	0.154
24	**5.334**	**3.994**	0.466	-1.125	35	**2.453**	**2.909**	0.704	0.968
	0.000	0.000	0.641	0.261		0.014	0.004	0.482	0.333
25	**4.021**	0.423	1.932	-0.242	36	**5.732**	**4.746**	0.531	**-3.477**
	0.000	0.672	0.053	0.809		0.000	0.000	0.596	0.001
26	1.345	**4.284**	**3.463**	1.490					
	0.179	0.000	0.001	0.136					

Table 5: Test of stochastic equality. Observed value of the Fligner-Policello statistic and associated p-value. Rejection of the null means that the two distributions are stochastic different. Significant values are in bold.

		$t+1$: 1	2	3	4
	1	A	A		B
t	2	A	A		B
	3				
	4				C

Table 6: Definition of Productivity Laggards (A), Climbers (B), and Leaders (C).

4 Firms' Pecking orders and their dynamics

As already shown in Dosi and Grazzi (2006) firm productivities are relatively stable over time with autoregressive coefficients close to one (Dosi and Grazzi, 2006). Further evidence on the stickiness of the relative performance of firms can be captured by the transition probabilities across performance (in our case, productivity) quantiles. Indeed, other works have shown that year to year transition probabilities display a very high degree of persistence (Bartelsman and Dhrymes, 1998), and this is also true for longer time intervals (Baily et al. 1992 - see also Bartelsman and Doms 2000 for some review of the literature.).

Table 11 in Appendix B, reports the frequencies and probabilities of the transition matrix. Results confirm the high persistency in the performance of firms, as denoted by the high probabilities on the main diagonal.[13] Interestingly, the transition probabilities do not vary much among different sectors. Further, note that probabilities are higher for the persistently low/ high performance firms: the probabilities of remaining in the lowest/highest quartile are roughly equal to 70%. All this hints at the existence of persistently different groups of firms co-existing in the same industry but characterized by distinct "identities" and performance.

Which are the characteristics of the groups of firms that one may identify with the help of the transition probability matrix? In particular we will consider firms that lie persistently at

[13] Also notice that the transition probabilities for the one year interval, not reported here, display even higher persistency.

Sector 15

Variable	Laggards avg	Laggards std	Climbers avg	Climbers std	Leaders avg	Leaders std
Size	3.910	0.755	4.172	1.114	4.241	1.029
Export	0.696	0.437	0.889	0.323	0.879	0.313
Exp NACE4	2.469	3.367	2.667	3.573	6.811	7.958
Imp NACE4	2.891	4.460	3.722	6.337	8.201	10.64
Exp countr.	6.871	9.638	9.917	13.34	17.16	18.4
Imp countr.	3.080	3.786	4.028	5.479	6.923	6.268
Patent	0.008	0.089	0.056	0.236	0.042	0.201
GOM	6.043	5.437	6.499	4.157	13.7	8.738
Obs	505		18		214	
Trans Prob	84.94		6.055		72.99	

Sector 17

Variable	Laggards avg	Laggards std	Climbers avg	Climbers std	Leaders avg	Leaders std
Size	3.900	0.689	4.113	0.737	4.157	0.826
Export	0.757	0.408	0.942	0.216	0.873	0.313
Exp NACE4	4.174	4.798	6.673	4.731	7.563	7.886
Imp NACE4	4.493	5.569	8.481	6.144	9.976	8.657
Exp countr.	9.882	11.51	19.08	16.29	20.84	17.22
Imp countr.	4.332	4.631	8.039	5.731	8.976	6.418
Patent	0.008	0.086	0.039	0.196	0.052	0.223
GOM	7.698	6.492	7.227	7.648	15.76	8.620
Obs	534		26		229	
Trans Prob	80.73		7.860		69.24	

Sector 24

Variable	Laggards avg	Laggards std	Climbers avg	Climbers std	Leaders avg	Leaders std
Size	3.936	0.777	4.434	0.933	4.748	1.170
Export	0.924	0.251	0.971	0.121	0.949	0.195
Exp NACE4	5.952	6.034	8.941	14.03	8.704	8.116
Imp NACE4	8.253	7.149	15.18	11.47	16.36	13.04
Exp countr.	15.55	14.99	20.18	20.33	27.6	20.62
Imp countr.	6.626	4.581	11.59	9.321	11.3	6.366
Patent	0.061	0.239	0.118	0.332	0.241	0.429
GOM	8.069	6.160	5.815	6.813	17.96	9.207
Obs	314		17		137	
Trans Prob	81.88		8.865		71.45	

Sector 27

Variable	Laggard avg	Laggard std	Climbers avg	Climbers std	Leaders avg	Leaders std
Size	3.963	0.786	4.059	0.702	4.600	0.994
Export	0.751	0.411	1	0	0.942	0.208
Exp NACE4	3.781	6.299	2.928	2.620	5.159	5.173
Imp NACE4	3.603	7.395	3.357	3.704	9.849	9.668
Exp countr.	8.671	12.4	9.071	10.58	14.98	14.11
Imp countr.	3.006	4.228	6.857	8.586	10.28	8.253
Patent	0.030	0.170	0	0	0.044	0.206
GOM	8.442	6.177	6.125	3.993	12.72	7.009
Obs	237		7		113	
Trans Prob	81.16		4.794		77.4	

Sector 28

Variable	Laggards avg	Laggards std	Climbers avg	Climbers std	Leaders avg	Leaders std
Size	3.641	0.502	4.097	0.876	4.039	0.747
Export	0.566	0.474	0.700	0.420	0.874	0.314
Exp NACE4	2.552	4.083	3.962	5.008	6.772	7.300
Imp NACE4	1.786	4.022	5.150	7.248	6.831	8.181
Exp countr.	5.359	9.653	5.962	8.678	14.44	15.46
Imp countr.	1.452	2.246	3.262	3.445	5.147	4.817
Patent	0.017	0.129	0.075	0.266	0.091	0.288
GOM	8.874	5.278	8.259	6.583	17.77	9.017
Obs	1174		40		516	
Trans Prob	82.33		5.610		72.37	

Sector 29

Variable	Laggards avg	Laggards std	Climbers avg	Climbers std	Leaders avg	Leaders std
Size	3.812	0.711	4.388	1.030	4.319	0.880
Export	0.856	0.336	0.931	0.245	0.976	0.139
Exp NACE4	5.781	6.221	11.46	11.05	11.20	9.754
Imp NACE4	3.965	5.355	9.509	10.89	10.16	9.733
Exp countr.	16.36	15.97	24.88	17.89	30.61	21.42
Imp countr.	3.756	4.132	7.784	7.772	8.864	7.429
Patent	0.076	0.265	0.274	0.450	0.269	0.444
GOM	7.832	5.416	6.488	5.360	16.90	8.164
Obs	1101		51		486	
Trans Prob	78.67		7.288		69.45	

Table 7: Characteristics of Productivity Laggards, Climber, and Leaders (averages and standard deviations).

the bottom of the productivity distribution, the "productivity laggards" (A); those that on the contrary succeed in jumping to the top, i.e. the "productivity climbers" (B); and those that have been persistently in the top of the productivity distribution, the "productivity leaders" (C), refer to Table 6 for the definition of the three groups in the transition matrix.

Table 7 reports, for a selection of 2 digit sectors, the characteristics of the three aforementioned groups of firms at the beginning of the reference periods, that is, 2000 and 2001. First notice the very low percentage of firms that climbed up the productivity ranking. In terms of distinguishing features, first the leaders tend to be bigger than laggards (size is measured by the log of employment). Further, climbers are, on average, much bigger then laggards, and interestingly, they sometimes are bigger than leaders (as for instance in sectors 28 and 29). That is, climbers are already bigger at the beginning of the reference period, before the productivity "take off" actually occurred. Second, both climbers and leaders are more active exporters than laggards. This is even more evident when one considers the number of countries a firms is trading with, and also the number of products that the firm is exporting or importing.[14] Third, climbers and leaders distinguish themselves from laggards also in terms of patenting activities. What is however rather puzzling is the difference in profitability in the three groups of firms. It turns out, indeed, that laggards are more profitable than climbers in all but one sector. That is, laggard firms continue to lag behind in the productivity distribution, but they are not too worse off in such a situation. Indeed, their profit margins, though somewhat smaller then leaders, are larger than for productivity climbers.

[14]The measure is in terms of the number of 4 digit sectors in which the firms operate as an exporter and as an importer.

To sum up: the analysis of the intra-distributional dynamics and the associated firms' characteristics reveal an "ecology" of diverse co-existing types, also different in terms of export propensities and degrees of innovativeness.

5 The Determinants of Productivity Growth

Although, as we have seen, the growth in average sectoral productivities has been limited, it is important to identify the firm-level characteristics and behaviors which are conducive (or hinder) productivity growth.

Let us begin with the model

$$\Delta_{t,t+1}\Pi_i = \alpha + \beta_1\,\Pi_{i,t} + \beta_2\,\mathrm{Size}_{i,t} + \beta_3\,\mathrm{exp}_{i,t} + \beta_4\,\mathrm{pat}_{i,t} + \gamma\,\mathrm{controls}_{i,t} + \varepsilon_i \tag{5}$$

The growth of productivity is measured as the logarithmic differences between the average productivity in the last three years of either subperiod, that is 1993-95 and 2002-2004, and that over the first two years of the subperiods, 1991-92 and 2000-01. Accordingly, we will refer to the time index t to denote the average of a variable over the first two years of the subsamble, and $t+1$ as the average over the last three years. Then we consider as independent variables the initial levels of productivity at time t, $\Pi_{i,t}$, size (in terms of employment), as number of employees at time t, an export dummy that takes value one if the firm was exporting in both first two years,[15] a patent dummy that takes value one if the firm had any registered patents in the first two years. We also control for the location of the firm. Results of regression are reported in Table 8.

Let us focus on the left panel that reports results for the pre-euro period. The coefficient on the initial level of productivity is negative and often significant, confirming the (relatively mild) regression-to-the-mean tendency already identified in Dosi and Grazzi (2006). As far as the initial size of the firm is concerned, that does not appear to matter much as it turns out to be not significant in most sectors. Conversely, the export status is generally positive and significant. Firms that have exported in both initial years, have registered a higher growth of productivity in the next period. Finally the dummy accounting for registered patents of the firm is almost always not significant, suggesting that the relation between our proxy for innovativeness and productive efficiency might not be so direct. Only in few sectors, one of these is the machine tool industry, NACE 29, holding patents is related to higher productivity growth in the following period.

The only difference between the pre and post euro introduction that emerges from Table 8 concerns the effect of the export activity. A bit counterintuitively it appears that in the more recent years exporting is *less* associated with a higher productivity growth. However the phenomenon might simply be due to the fact that the percentage of firms exporting has steadily grown from the beginning of our sample period to the end. In 1989 there were - of course with some sectoral variation - 60% of firms above the 20 employees threshold, that were exporting. The same percentage in 2004 was around 80%, with some sectors, as for instance the machine tool, having 90% of firms that export (Grazzi, 2009). Given that nowadays almost all firms are involved in some form of international trade, it might be that the dummy variable export itself is not much related to an increase in productivity, and that a more fine grained investigation of the trade activities of firms is necessary to identify its relevance.

[15] In Grazzi (2009) it is shown that the export status is very stable over time. If a firm is exporting in a given year then there 90% chances that it will be exporting the following year, too.

	1991-95					2000-2004				
	const	lprod t	size	exp	pat	const	lprod t	size	exp	pat
15	**0.837**	**-0.202**	-0.000	0.026	0.024	**0.697**	**-0.191**	0.007	0.017	-0.021
	0.078	0.019	0.008	0.017	0.097	0.070	0.016	0.009	0.018	0.061
17	**0.577**	**-0.159**	0.009	**0.075**	**0.178**	**0.866**	**-0.254**	0.001	0.026	-0.001
	0.071	0.017	0.009	0.015	0.073	0.071	0.017	0.009	0.016	0.047
18	**0.384**	**-0.137**	**0.023**	**0.059**	0.000	**0.325**	**-0.125**	-0.002	**0.074**	-0.099
	0.069	0.022	0.011	0.020	0.000	0.078	0.022	0.013	0.026	0.151
19	**0.278**	**-0.100**	0.027	0.031	0.097	**0.522**	**-0.188**	0.017	0.015	-0.049
	0.088	0.024	0.015	0.025	0.119	0.078	0.019	0.013	0.026	0.059
20	0.178	**-0.104**	**0.057**	0.010	0.016	**0.738**	**-0.227**	0.025	-0.021	0.066
	0.132	0.034	0.019	0.023	0.108	0.098	0.027	0.015	0.020	0.062
21	**0.510**	**-0.103**	0.008	-0.019	**0.250**	**0.802**	**-0.220**	**0.028**	0.019	0.065
	0.160	0.040	0.017	0.031	0.125	0.099	0.025	0.014	0.025	0.058
22	**0.411**	**-0.174**	**0.051**	0.018	-0.135	**0.122**	**-0.096**	0.056	-0.012	-0.162
	0.098	0.025	0.012	0.020	0.135	0.085	0.022	0.012	0.020	0.088
23	-0.544	0.113	0.027	-0.006	**0.372**	**-1.219**	**-0.255**	0.009	0.028	0.000
	0.311	0.076	0.026	0.066	0.178	0.279	0.063	0.034	0.074	0.000
24	**1.099**	**-0.318**	**0.029**	**0.086**	0.019	1.149	**-0.271**	0.002	0.010	0.003
	0.131	0.029	0.011	0.032	0.042	0.099	0.021	0.011	0.042	0.032
25	**0.371**	**-0.151**	**0.052**	0.000	**0.103**	**0.713**	**-0.211**	**0.017**	0.002	0.013
	0.101	0.026	0.011	0.023	0.043	0.065	0.017	0.008	0.018	0.022
26	**0.686**	**-0.246**	**0.043**	**0.106**	0.042	**0.512**	**-0.165**	**0.047**	**-0.121**	**-0.089**
	0.076	0.019	0.009	0.017	0.077	0.074	0.019	0.010	0.016	0.037
27	**0.590**	**-0.207**	**0.054**	-0.008	-0.089	**0.469**	**-0.136**	0.015	0.003	0.065
	0.141	0.033	0.012	0.027	0.095	0.092	0.023	0.010	0.023	**0.044**
28	**0.734**	**-0.207**	0.000	**0.063**	0.013	**0.669**	**-0.206**	**0.024**	0.006	0.019
	0.073	0.019	0.009	0.012	0.036	0.041	0.010	0.006	0.008	0.016
29	**0.684**	**-0.205**	**0.022**	**0.051**	**0.057**	**0.912**	**-0.254**	0.009	0.019	0.012
	0.069	0.018	0.006	0.015	0.019	0.049	0.012	0.005	0.014	0.011
30	**1.326**	**-0.488**	**0.079**	**0.364**	-0.298	**1.537**	**-0.449**	0.034	0.129	0.109
	0.349	0.103	0.030	0.112	0.225	0.406	0.085	0.070	0.103	0.137
31	**0.694**	**-0.229**	**0.034**	0.020	0.040	**0.561**	**-0.151**	-0.002	0.013	0.007
	0.125	0.035	0.011	0.025	0.059	0.081	0.020	0.009	0.022	0.028
32	**1.082**	**-0.293**	-0.007	0.113	0.058	**1.212**	**-0.289**	-0.048	0.060	0.024
	0.212	0.054	0.018	0.061	0.112	0.212	0.051	0.026	0.058	0.081
33	**0.439**	**-0.145**	0.018	**0.106**	0.035	**0.912**	**-0.274**	0.018	**0.090**	0.007
	0.163	0.043	0.015	0.041	0.059	0.129	0.032	0.014	0.036	0.032
34	**0.870**	**-0.227**	-0.003	0.039	0.015	**1.247**	**-0.362**	0.012	0.047	0.023
	0.203	0.052	0.013	0.039	0.078	0.144	0.037	0.013	0.039	0.046
35	0.657	-0.156	0.047	0.249	-0.028	**0.889**	**-0.195**	-0.022	0.000	0.098
	0.914	0.191	0.063	0.182	0.106	0.197	0.047	0.023	0.049	0.081
36	**0.431**	**-0.164**	**0.032**	**0.048**	0.078	**0.767**	**-0.260**	0.014	0.043	**0.072**
	0.075	0.020	0.010	0.016	0.041	0.067	0.017	0.010	0.022	0.029

Table 8: Growth of productivity regression. OLS estimates. Standard errors in brackets. Coefficients significant at the 5% are in bold. Our elaboration on Micro.3

A natural candidate to be amongst the determinants of productivity growth is the investment activity, since it typically embodies productivity enhancing process innovation. The variable however is not available for the entire sample.[16]

Table 9 reports the results for the subsample covering also the investment variable of a regression model equal to equation 5 where we add investments among the independent variables. As for the other variables, we consider the average of investments over value added in the first two years of every subperiod. First, notice how all other coefficcients in Table 9 are stable with respect to the previous regression without investment (compare with Table 8). Further, and more relevant, notice that investment is positively and significantly associated to productivity growth in the period 1991-1995. In the second subperiod the evidence is more scant, and there are many sectors for which investment does not appear to exert a significant influence upon growth in productivity.

Let us now refine the analysis, and investigate which are the effects of the regressors at the different levels of the conditional distribution of the dependent variable, productivity growth. Given the significant and pervasive heterogeneities that have emerged in the analysis of the distribution of labor productivities and the growth rates (Section 3.1), there are reasons to

[16]In particular, the variable ‘investment’ is always available in the first subperiod, 1991-1995, whether in the second subperiod, 2000-2004 it is only available for firms surveyed by Istat, the National Office of Statistics. That amounts to all firms above 100 employees and a representative sample of firms in the employment range 20-100.

	1991-1995						2000-2004					
	const	lprod t	size	inv	exp	pat	const	lprod t	size	inv	exp	pat
15	**0.783**	**-0.198**	0.001	**0.295**	0.027	0.023	**0.693**	**-0.195**	0.011	**0.109**	**0.011**	-0.040
	0.078	0.019	0.008	0.056	0.016	0.095	0.098	0.022	0.011	0.042	0.026	0.070
17	**0.516**	**-0.142**	0.001	**0.385**	**0.080**	**0.172**	**0.921**	**-0.267**	-0.002	0.088	0.031	-0.016
	0.067	0.016	0.008	0.032	0.014	0.068	0.118	0.028	0.013	0.051	0.028	0.059
18	**0.373**	**-0.137**	0.021	0.590	**0.058**	0.000	**0.402**	**-0.170**	-0.002	0.181	**0.141**	-0.095
	0.069	0.022	0.011	0.258	0.020	0.000	0.160	0.044	0.025	0.274	0.055	0.183
19	**0.299**	**-0.107**	0.026	0.301	0.030	0.102	**0.640**	**-0.257**	**0.042**	**0.172**	0.018	-0.026
	0.089	0.024	0.015	0.226	0.025	0.119	0.134	0.033	0.018	0.055	0.051	0.068
20	**0.355**	**-0.145**	0.034	**0.450**	0.023	0.050	**0.947**	**-0.284**	0.013	0.123	**0.009**	0.095
	0.122	0.032	0.018	0.057	0.021	0.098	0.143	0.040	0.021	0.090	0.033	0.083
21	**0.589**	**-0.128**	-0.001	**0.317**	-0.005	**0.281**	**0.683**	**-0.205**	0.020	**0.128**	0.024	0.078
	0.155	0.039	0.016	0.066	0.030	0.120	0.141	0.035	0.018	0.065	0.042	0.065
22	**0.369**	**-0.168**	**0.050**	**0.414**	0.013	-0.124	**0.053**	-0.069	**0.054**	0.011	-0.033	-0.216
	0.097	0.025	0.012	0.114	0.020	0.133	0.145	0.036	0.019	0.070	0.039	0.152
23	-0.482	0.098	0.024	0.090	0.004	0.311	**1.608**	**-0.305**	-0.011	-0.271	0.055	0.000
	0.345	0.085	0.028	0.202	0.071	0.227	0.340	0.080	0.041	0.300	0.091	0.000
24	**0.642**	**-0.209**	**0.028**	**0.209**	**0.071**	0.011	**1.001**	**-0.215**	-0.012	0.036	-0.005	0.013
	0.130	0.029	0.010	0.023	0.029	0.038	0.136	0.029	0.014	0.019	0.053	0.036
25	**0.367**	**-0.153**	**0.050**	**0.158**	0.001	**0.100**	**0.541**	**-0.166**	0.015	-0.083	0.032	0.002
	0.100	0.025	0.011	0.071	0.023	0.043	0.106	0.028	0.011	0.042	0.036	0.029
26	**0.715**	**-0.258**	**0.037**	**0.348**	**0.111**	0.030	**0.653**	**-0.220**	**0.058**	**0.276**	**-0.115**	-0.074
	0.075	0.019	0.009	0.063	0.017	0.076	0.100	0.024	0.012	0.052	0.024	0.042
27	**0.573**	**-0.200**	**0.052**	0.031	-0.009	-0.085	**0.410**	**-0.129**	0.016	0.023	0.016	0.079
	0.143	0.034	0.013	0.037	0.027	0.095	0.121	0.030	0.012	0.048	0.034	0.053
28	**0.753**	**-0.216**	-0.003	**0.298**	**0.060**	0.008	**0.726**	**-0.225**	**0.025**	0.003	0.001	0.001
	0.072	0.019	0.009	0.058	0.012	0.035	0.080	0.021	0.009	0.028	0.017	0.023
29	**0.681**	**-0.206**	**0.020**	**0.371**	**0.051**	**0.059**	**0.960**	**-0.264**	0.009	0.023	-0.010	0.006
	0.069	0.018	0.006	0.079	0.015	0.019	0.083	0.020	0.007	0.062	0.030	0.015
30	**1.409**	**-0.518**	**0.088**	-0.312	**0.386**	-0.302	**1.744**	**-0.492**	0.027	-0.626	0.041	0.190
	0.420	0.129	0.038	0.669	0.131	0.245	0.453	0.103	0.078	0.465	0.120	0.121
31	**0.760**	**-0.248**	**0.024**	**0.540**	0.018	0.035	**0.602**	**-0.158**	-0.009	0.146	0.044	0.037
	0.122	0.034	0.011	0.108	0.024	0.057	0.119	0.029	0.013	0.105	0.034	0.035
32	**1.026**	**-0.281**	-0.008	0.328	0.104	0.050	**0.847**	**-0.163**	**-0.071**	0.031	0.009	0.019
	0.216	0.055	0.018	0.262	0.061	0.112	0.254	0.066	0.029	0.047	0.084	0.080
33	**0.445**	**-0.143**	0.015	0.257	**0.102**	0.036	**1.099**	**-0.318**	0.014	0.090	0.086	0.008
	0.163	0.043	0.015	0.229	0.041	0.059	0.197	0.051	0.019	0.124	0.059	0.043
34	**0.947**	**-0.238**	-0.022	**0.571**	0.027	0.034	**0.987**	**-0.291**	0.002	0.181	0.097	0.015
	0.196	0.050	0.013	0.133	0.037	0.075	0.180	0.047	0.016	0.138	0.058	0.047
35	0.089	-0.153	0.048	1.109	0.226	-0.054	1.060	**-0.268**	-0.015	0.387	0.043	0.095
	2.062	0.228	0.075	3.416	0.230	0.149	0.247	0.062	0.024	0.355	0.064	0.083
36	**0.482**	**-0.182**	**0.028**	**0.452**	**0.051**	0.078	**0.634**	**-0.212**	0.005	0.107	0.030	0.040
	0.074	0.020	0.010	0.082	0.016	0.040	0.110	0.029	0.013	0.075	0.043	0.036

Table 9: Growth of productivity regression (II) with observed investments. OLS estimates. Standard errors in brackets. Coefficients significant at the 5% are in bold.

believe that such effects might be rather different at different deciles.

5.1 Quantile Regressions Analysis

In the previous section we have investigated the effects of a set of regressors on the growth rate of productivity via Ordinary Least Squares (OLS). OLS models the effects exerted by a set of covariates on the conditional mean of the dependent variable. However, the covariates often influence the whole distribution of the dependent variable, not only the mean value (Koenker and Basset, 1978).[17] For instance we might observe that a change in the covariates may have opposite effect on the high and the low deciles of the dependent variables. In our case, for example, it might be that the productivity enhancement effects of some covariates are different at low and high deciles.

Figure 4 and 5 reports, respectively for the first and second subperiod, the results for some sectors which are quite illustrative for the generality of them. Each of the two figures display on top (bottom) the effects associated to investment (export) at different deciles of the conditional distribution of productivity growth.

The plots display a trend that is not detectable with OLS estimates, which are represented by the flat line. Thus, concerning investment in the first subperiod (top panel of Figure 4), it appears that what one might call "return from investments" are higher for firms that have

[17]For a comprehensive introduction to quantile regression techniques refer to Koenker (2005).

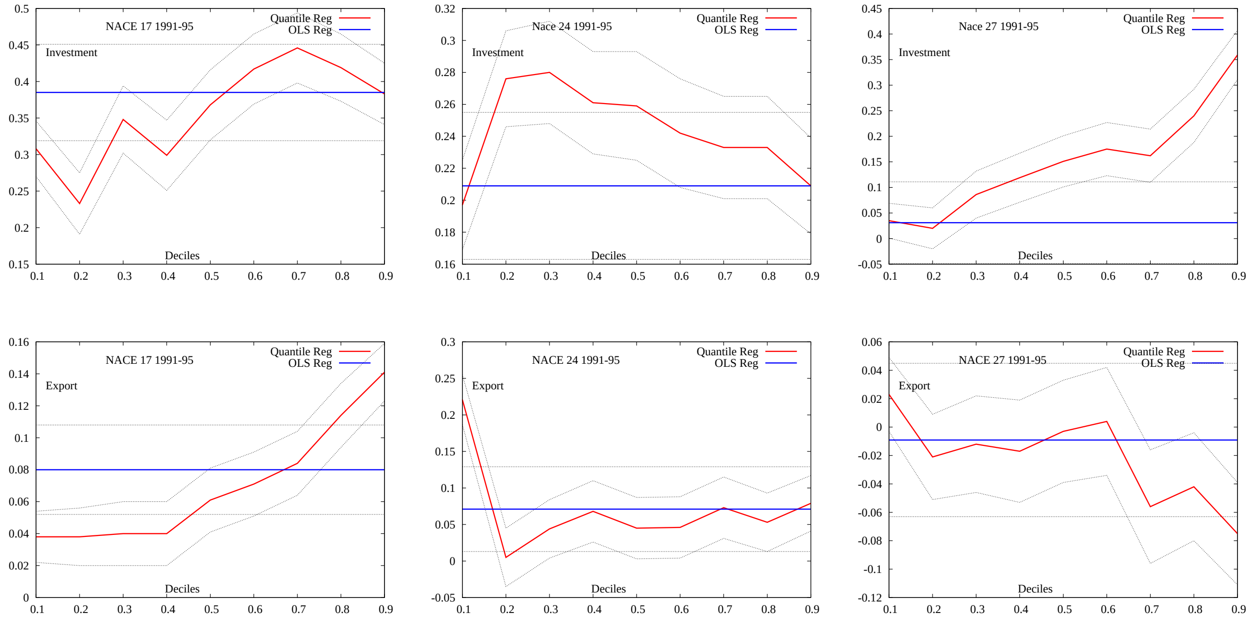

Figure 4: Quantile regression estimates. **Top** The effect of investment on productivity growth in the first subperiod, 1991-95. The error band is of two standard errors. **Bottom** The effect of export on productivity growth in the first subperiod, 1991-95.

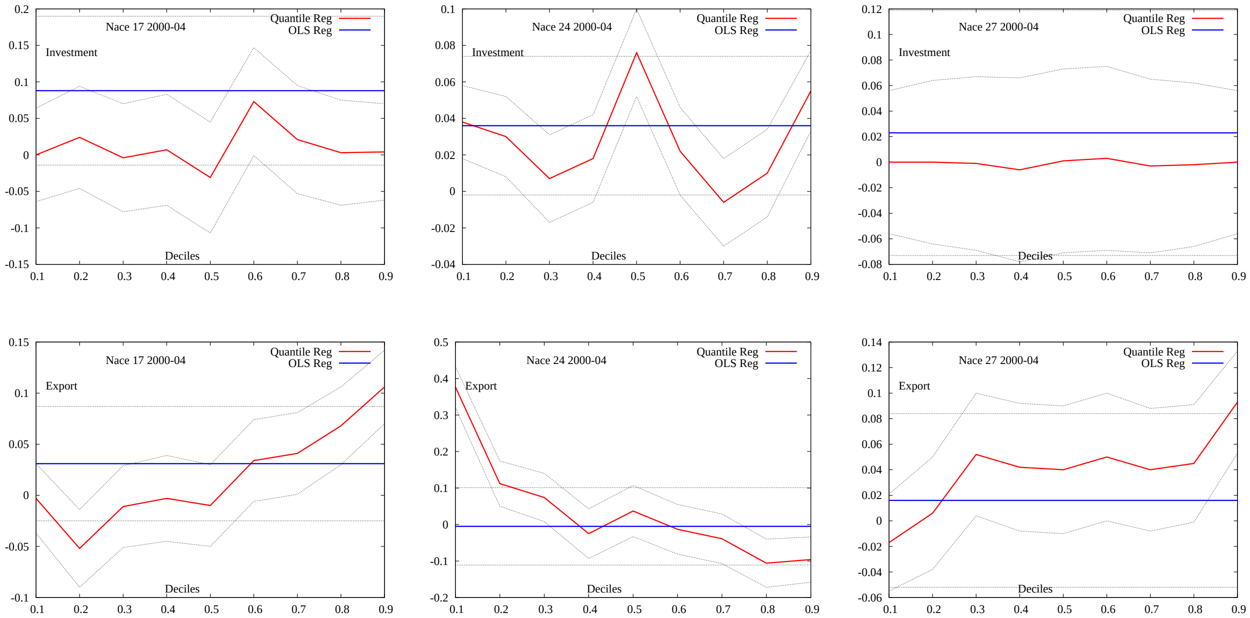

Figure 5: Quantile regression estimates. **Top** The effect of investment on productivity growth in the second subperiod, 2000-2004. The error band is of two standard errors. **Bottom** The effect of export on productivity growth in the second subperiod, 2000-2004.

registered a higher productivity growth, meaning that investing in the first two years, 1991-92, has proven more beneficial for firms in the top decile of the conditional distribution of productivity growth. In the latter period and focusing on export (bottom panel of Figure 5), one notices that the effects of export activities at different deciles yield, for some levels of the conditional distribution, coefficients that are significantly different from zero. Further, we also observe that, with the exception of the chemical sector, NACE 24, exporting activity has been associated with a higher productivity growth especially for firms in the higher deciles of the conditional distribution.

Jointly taken these two pieces of evidence suggest that, even during this two decades of low productivity growth, the effects associated to variables that may spur productivity are unevenly distributed among firms. In particular, it is those firms that report a higher growth that benefit more of export activity or investment.

Such uneven distribution is reminding of the so-called "Matthew effect" in science (Merton, 1968): "to those who have will be given, from those who have not will be taken away...". This also shed some light on the sort of "low productivity trap" underlying the persistence of both low performance and high performance types identified above.

6 Final remarks

The micro longitudinal analysis in this work adds insights to the diagnostic of the state of the Italian manufacturing industry, but also bears important implications for the general understanding of the dynamics of industries, well beyond the Italian example.

Specifically on Italy, our data support a relatively bleak view of a manufacturing system which *in general* is locked in an industrial structure and in organization forms that hinder expansion and productivity growth (a similar view is voiced in Bank of Italy (2009)). Conversely, at a first look our diagnosis sounds more pessimistic that the analyses put forward by Mediobanca - Unioncamere (2008) and Coltorti (2004) and also by Baldwin et al. (2007) and Lanza and Quintieri (2007) who all point from different angles at the existence of an ensemble of quite vital and dynamic firms able to successfully adjust to the "Euro shock" - successfully changing their product mix and able to seize new market and investment opportunities. The conflict however in our view is only apparent and is mainly grounded in a sample selection bias. So, for example, the Mediobanca sample considers a subset of medium size firms which is likely to partly overlap with our "leader type" identified in the foregoing analysis. A significant ensemble of dynamic firms is certainly there and our analysis confirms it. However their number and size relative to the whole sector is not sufficient to push forward the overall performance indicators (in our case, sectoral labor productivities).

There are also patterns revealed by our data which might well hold beyond the Italian boarder. One phenomenon that we see in the Italian data but may well be there also in other countries is the steady co-existence, to repeat, of a group of dynamic firms with a generally bigger ensemble of much less technologically progressive firms which nonetheless survive quite comfortably, possibly exploiting local markets niches. Let us call such pattern as the tendency toward *neo-dualism*[18] involving the steady co-existence of the two types of firms.

The Italian experience concerning the selective effect of the Euro shock, or better, the lack of it, also adds further evidence to the general idea that market do not do such a great job in relocate resources across firms characterized by different levels of efficiency (the point is analyzed at greater length in Bottazzi, Dosi, Jacoby, Secchi and Tamagni 2009). If confirmed by comparable evidence from other countries, the conjectures on "neo-dualism" and on weak

[18]The word "dualism" has been historically used to stand for the co-existence of a "modern" and a "traditional" sector, with supposedly the industrialization process fostering the expansion of the former and the progressive disappearance of the latter.

market selection, together would offer a view of market competition and market dynamics somewhat less sanguine that the *sturm und drang* of Schumpeterian creative destruction.

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A Productivity levels and differences: 3 digit analysis

Table 10 reports the same analysis on the levels of productivity performed in Section 3.2 and focuses on 3 digit sectors in order to verify if the aggregated analysis at 2 digit has introduced any bias in the results. This is not the case and results are coherent with the 2 digit level analysis. Comparing the year 2004 and 2000, there are indeed 10 sectors (out of the 61 that fulfill the data requirements) in which productivity is higher in 2004 than in 1999. But there are 6 for whom the reverse is true; and for all the other sectors the differences in the distribution of productivity in the two years are not significant.

Consider now year 2004 versus 1995. Productivity is higher in 2004 for 20 sectors. Yet for 2/3 of our sample it is not possible to reject the null that the distribution of productivity has not shifted to the right. Thus, as it was for the analysis at the 2 digit level (cf. Table 4), in order to recover some evidence of significantly different levels of productivity between two years, one has to compare the first and last year in the sample: in this case productivity is higher for most of sectors for which observations are available.

	91-04	92-04	93-04	94-04	95-04	96-04	97-04	98-04	99-04	00-04	01-04	02-04	03-04
151	**5.575**	**4.510**	**4.705**	**5.942**	**6.363**	**4.313**	**3.633**	0.981	**2.622**	**3.471**	1.904	0.002	-0.147
155	**2.490**	0.928	1.188	0.631	0.939	1.949	1.763	1.118	0.367	0.472	1.101	-0.944	-0.408
158	**4.365**	**3.407**	**3.485**	**3.113**	**4.474**	**4.311**	**3.944**	**2.340**	1.549	1.520	**2.416**	0.461	1.215
159	**5.193**	**2.972**	**2.852**	**2.925**	**2.328**	**2.627**	1.281	1.814	-0.085	0.068	0.502	-0.561	-0.567
171	**3.517**	-0.076	-1.653	**-5.066**	**-3.242**	0.159	0.244	-0.334	-0.124	-1.876	-0.307	0.257	0.745
172	**4.649**	**3.828**	1.418	-0.660	-1.651	0.896	0.797	-0.156	0.640	**-1.986**	-1.097	-0.351	1.339
173	**3.062**	**2.047**	1.442	-1.312	1.175	**2.988**	1.755	0.654	1.509	-1.010	-0.157	-1.013	-0.112
175	**4.617**	**4.669**	**2.925**	1.839	1.795	**2.096**	1.546	0.585	1.167	-0.393	-0.190	-1.104	-0.394
177	**8.557**	**6.655**	**6.164**	**5.603**	**4.967**	**5.314**	**3.422**	**4.011**	**3.459**	1.206	0.907	1.507	1.707
182	**10.360**	**10.547**	**8.855**	**6.574**	**3.552**	**7.416**	**13.168**	**2.997**	**4.039**	1.456	-0.537	-0.525	0.954
191	**2.359**	1.546	-0.639	-0.794	-1.542	**2.848**	**4.117**	**2.228**	0.655	**-2.915**	-0.216	-0.029	1.602
193	**11.181**	**9.654**	**7.224**	**5.155**	**6.117**	**6.037**	**7.577**	**5.140**	**3.671**	0.512	0.120	0.757	1.801
202	**3.586**	1.756	0.599	-0.029	-1.316	0.405	0.962	0.764	0.990	0.442	-0.039	0.469	**2.199**
203	**4.677**	**4.124**	**3.667**	**5.051**	**4.311**	**4.970**	**3.851**	**4.686**	**3.358**	**2.619**	1.943	1.090	1.190
205	**2.548**	**2.171**	1.647	**2.068**	1.216	1.028	1.092	0.613	0.318	-0.174	-0.459	0.843	1.269
211	1.830	1.319	0.107	-1.109	**-2.089**	-0.161	-0.039	-1.135	-0.526	0.294	-0.269	-0.277	1.006
212	**3.901**	**2.863**	1.762	0.742	**2.131**	0.284	0.338	0.812	-0.389	**4.591**	1.240	0.050	0.540
221	0.352	0.188	1.371	1.657	1.291	1.757	1.161	1.542	1.214	1.948	1.167	0.835	0.498
222	0.466	0.032	1.280	0.136	0.057	-0.582	0.557	-0.442	-0.679	-0.810	-1.316	-0.042	1.084
241	-0.483	-1.489	-1.854	**-2.710**	**-4.611**	**-3.161**	**-2.800**	-1.896	-1.511	-1.548	-0.286	-0.519	-0.372
243	1.585	1.013	-0.078	-0.072	-0.200	-0.307	0.329	0.899	-0.248	0.870	1.950	0.245	0.193
244	**2.362**	1.017	1.528	**2.411**	1.710	1.064	-0.153	0.949	-0.187	0.438	-0.102	-0.378	0.186
245	-0.151	-0.758	-0.601	-1.319	-0.197	-0.503	-0.590	-0.380	-0.385	-0.260	-0.508	-0.025	-0.507
246	1.551	0.999	0.667	0.096	-0.899	**-2.641**	-1.881	-1.191	**-2.397**	-0.949	-1.323	-0.858	-0.479
251	1.502	0.221	-0.141	-1.803	-0.286	-0.031	-0.206	1.796	1.310	0.169	1.180	-0.002	0.546
252	**2.301**	1.637	0.899	-0.455	1.449	1.021	**2.384**	0.585	-1.272	0.818	1.199	-1.197	0.296
261	**2.335**	**2.418**	**2.306**	0.813	-0.054	-0.315	0.737	-0.146	0.053	-0.494	-0.224	-0.304	1.137
262	**2.794**	**2.059**	0.387	-0.372	-0.377	-0.446	0.036	-1.088	-1.326	-0.172	-0.018	-0.621	-0.055
263	0.782	0.251	-1.542	**-2.186**	**-2.243**	1.040	0.003	-0.578	-0.557	-0.888	0.024	-1.091	-0.442
264	**3.468**	1.653	**3.736**	**5.435**	**7.653**	**8.015**	**5.927**	**10.504**	**7.911**	**6.617**	**4.345**	**3.251**	**2.671**
266	**4.685**	**3.756**	**7.601**	**7.717**	**4.823**	**3.073**	**3.714**	**5.225**	**3.560**	**2.649**	1.456	-1.211	0.247
267	1.035	1.021	-0.068	-0.494	-0.366	0.542	-0.057	-1.952	-1.749	-1.192	-0.343	-0.257	-0.460
273	**3.238**	**2.637**	**3.333**	1.503	-0.052	0.681	1.078	0.766	-1.917	-0.078	-0.097	0.173	0.985
275	**2.236**	0.665	0.942	0.084	-1.831	-1.908	-1.751	**-3.954**	**-5.018**	**-5.041**	**-4.098**	**-5.614**	**-4.653**
281	**7.383**	**9.403**	**10.441**	**9.980**	**6.679**	**4.733**	**5.252**	**7.236**	**5.230**	**5.332**	1.119	-0.904	-0.259
282	0.797	0.377	0.116	0.590	0.334	-0.177	-0.041	-0.300	-0.423	0.347	0.401	-0.813	-0.505
284	**4.466**	**3.961**	**4.193**	**2.380**	0.442	1.389	**2.403**	1.190	1.045	0.294	0.255	-0.527	0.454
285	**9.145**	**8.685**	**9.370**	**7.362**	**6.057**	**5.160**	**7.131**	**6.108**	**5.123**	**3.193**	0.617	0.148	**2.231**
286	**4.630**	**4.481**	**3.569**	1.753	0.119	-0.016	0.056	1.035	-0.271	-0.462	**-2.168**	**-2.062**	-0.638
287	**5.636**	**4.460**	**3.932**	**2.607**	1.164	1.281	**2.989**	1.205	1.245	-0.937	-1.137	-1.855	-0.962
291	**5.548**	**4.651**	**3.837**	**2.419**	0.388	0.265	1.505	**3.934**	**3.842**	1.012	1.876	1.636	**2.266**
292	**4.900**	**4.609**	**5.886**	**4.351**	**2.717**	**2.850**	**3.994**	**5.125**	**3.408**	1.020	0.357	-0.073	**2.062**
293	**5.269**	**3.927**	**3.066**	**2.377**	1.639	1.108	1.856	**2.441**	1.713	1.238	0.778	0.114	1.026
294	**2.441**	**3.735**	**2.981**	1.164	-1.569	-1.626	-1.128	-0.536	0.471	**-3.063**	**-2.554**	-1.367	**2.712**
295	**5.049**	**6.430**	**3.842**	**2.534**	-1.920	-0.435	-0.038	1.473	1.309	**-2.195**	**-2.743**	**-2.565**	1.501
297	1.257	0.672	0.290	-0.201	0.613	1.096	1.349	0.997	0.130	0.033	0.561	-0.895	-0.140
311	**5.185**	**4.930**	**5.391**	**4.127**	**3.225**	**2.120**	1.426	**2.136**	0.743	0.589	1.171	0.538	0.728
312	**4.602**	**3.325**	**3.248**	**2.921**	**2.161**	**2.235**	**2.148**	1.131	1.093	0.795	1.117	-0.140	0.629
313	1.409	1.284	1.898	1.070	-0.877	0.090	0.416	-0.696	-0.276	-0.704	0.106	0.654	0.344
315	**3.108**	**2.865**	**2.893**	**2.186**	**1.979**	1.717	1.536	1.810	1.243	0.389	0.166	-0.912	0.113
316	**6.258**	**5.280**	**5.657**	**4.698**	**4.039**	**3.323**	**3.576**	**2.799**	**2.095**	**2.244**	1.270	0.457	1.054
321	**3.832**	**3.223**	**3.980**	**3.000**	1.748	1.950	0.443	**4.320**	**3.326**	1.770	**2.068**	**2.482**	**2.323**
322	1.398	1.871	**3.589**	**3.469**	**3.606**	**2.219**	**2.020**	**4.004**	**3.051**	**3.318**	**2.124**	1.945	1.581
331	**3.036**	**3.582**	**2.790**	**2.334**	1.862	**1.977**	**2.597**	**2.911**	**2.618**	**2.356**	0.855	1.050	0.848
332	**2.867**	**2.722**	**2.958**	1.738	1.168	1.098	1.123	1.659	**2.020**	0.513	1.331	0.267	0.519
334	0.728	0.481	0.485	-0.382	-1.621	**-2.766**	-1.379	**2.276**	**2.519**	1.645	1.318	0.447	1.500
342	**3.907**	**4.140**	**4.835**	**4.863**	**2.351**	1.932	**3.182**	1.157	0.812	0.194	-0.159	-1.013	1.171
343	**3.645**	**3.243**	**2.814**	0.769	0.020	1.620	-0.390	**1.979**	**1.971**	1.945	**2.237**	1.674	1.070
361	**4.717**	**4.159**	**2.999**	**3.362**	1.457	**2.903**	**4.040**	-1.669	**-2.515**	**-3.307**	**-3.834**	**-2.808**	1.231
362	**2.153**	**2.930**	**2.968**	**2.051**	0.376	-0.369	0.485	-1.043	-0.682	-1.552	-1.581	-0.396	0.920
366	**5.306**	**3.865**	**3.527**	**2.975**	**2.080**	**2.550**	**2.827**	1.560	1.729	1.309	-0.719	-0.192	-0.220

Table 10: Test of stochastic equality, year by year comparison for 3 digit sector. Observed value of the Fligner-Policello statistic and associated p-value. Rejection of the null means that the two distributions are stochastic different. Source: Our elaboration on Micro.3.

B Transition Probabilities matrix

Transition probability matrix over the period 2000-2004. Productivity in t is defined as the average of productivity in 2000 and 2001, and in $t+1$ as the average over the years 2002 to 2004.

Sec		1	2	3	4	Sec		1	2	3	4
15	1	73.12	22.37	3.34	1.00	26	1	74.56	19.01	4.47	1.86
15	2	21.37	53.42	20.37	5.01	26	2	21.62	54.05	20.50	3.73
15	3	3.34	21.04	53.76	22.04	26	3	2.98	21.62	54.80	20.50
15	4	2.00	3.34	22.70	71.79	26	4	0.75	5.22	20.13	74.18
Sec		1	2	3	4	Sec		1	2	3	4
17	1	68.83	22.64	6.04	2.42	27	1	67.01	25.98	6.84	0.00
17	2	23.25	46.79	23.85	6.04	27	2	26.67	41.71	25.98	5.47
17	3	6.64	22.64	48.00	22.64	27	3	6.15	28.03	47.86	17.78
17	4	1.21	7.85	22.04	69.13	27	4	0.00	4.10	19.15	77.26
Sec		1	2	3	4	Sec		1	2	3	4
18	1	75.52	20.70	2.24	1.12	28	1	70.92	22.42	5.19	1.40
18	2	20.14	57.06	19.58	2.80	28	2	22.42	48.91	24.53	4.20
18	3	2.24	20.14	58.18	19.02	28	3	5.05	24.53	48.35	22.14
18	4	1.68	1.68	19.58	78.32	28	4	1.54	4.20	22.00	72.18
Sec		1	2	3	4	Sec		1	2	3	4
19	1	72.01	25.76	1.58	0.53	29	1	63.70	26.08	8.27	1.85
19	2	24.70	50.99	21.55	2.63	29	2	24.08	43.46	26.93	5.42
19	3	2.63	18.92	52.04	26.28	29	3	8.41	22.66	45.32	23.51
19	4	0.53	4.20	24.70	70.96	29	4	3.71	7.70	19.24	69.68
Sec		1	2	3	4	Sec		1	2	3	4
24	1	69.77	23.77	5.17	1.03	36	1	67.95	24.48	5.48	1.93
24	2	25.32	47.03	21.19	6.72	36	2	24.48	46.38	25.44	3.86
24	3	4.13	22.74	52.71	20.67	36	3	5.15	23.51	48.95	22.54
24	4	0.52	6.72	21.19	71.32	36	4	2.25	5.80	20.29	71.50

Table 11: Transitional Probabilities matrix over the five year period, 2001-04.