Dipartimento di Statistica
"Giuseppe Parenti"

Dipartimento di Statistica "G. Parenti" – Viale Morgagni 59 – 50134 Firenze - www.ds.unifi.it

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Structural Economic Characteristics and Performance of Industry Sectors in Italy

Laura Grassini, Alessandro Viviani

Università degli Studi
di Firenze

Economic Statistics

STRUCTURAL ECONOMIC CHARACTERISTICS AND PERFORMANCES OF INDUSTRY SECTORS IN ITALY

Laura Grassini
Alessandro Viviani

1. Introduction

The present paper deals with a comparison of Italian industrial sectors in 2000, on the basis of a number of performance indicators. The analysis takes into account an important structural feature: firm's size in terms of employment. A graphical analysis is conducted in order to show the effect of this structural feature of firms on their economic performances. Moreover, an additional performance index is provided through an analysis of efficiency.

The paper is structured as follows. Section 2 deals with a description of the economic information provided by disposable data (Istat, 2002). Section 3 contains a graphical analysis of profitability indexes with respect to the size of enterprises (in terms of employment).

Section 4 and 5 are devoted to a comparison among sectors, on the basis of the efficiency analysis. Specifically, section 4 contains a description of a commonly used efficiency measure based on the *Data Enveloping Technique (DEA)* which a method of linear programming. Section 5 describes the results of the empirical analysis.

The results contained in this paper were presented at the International Conference on Economic and Social Statistics at the Jinang University, Guangzhou, China (17-18th December, 2002).

2. Data

Data are derived from two different surveys on more than 60,000 enterprises, as established by the UE (Regulation n. 58/97): *(a)* a sample survey on the enterprises with 1-99 employers; *(b)* a census survey on the enterprises with 100 employers and over (Istat, 2002).

Data show a structural picture of the economic performance of the Italian industry and service sectors in 1999 and 2000, with a disaggregation into economic activities, size and region. Data essentially consist of information derived from the income statement which measures the success of an enterprise over a given period of time (one year).

In our analysis, we consider 19 economic activities and 5 size class in terms of number of employers: '1-9', '10-19', '20-49', '50-100', '100 and over'. And, for a given level of aggregation of units (size class), the following data are used:

SA: sales volume
VA: value added which is the difference between revenues and costs
FI: the amount of fixed investments acquired within the year
CL: the amount costs of labour costs
OM: the gross operating margin; it is the difference between *VA* and *CL.*

Monetary values are expressed in Euro currency (current values).

3. Descriptive analysis

Table 1 and Table 2 give a synthetic picture of the situation of the industry and service sectors in Italy, in the years 1999 and 2000.

In 1999 the number of firms of the industry and service sectors are about 3,9 million with 14,3 millions of employers and a value added of 500 milliards Euro. As shown in Table 1, smaller firms (1-9 employers) absorb a large amount of employers (49%) dependents (25%), sales (32%) and the 34% of value added; in addition more than 67% of employers is represented by non-dependent workers. The firms with more than 99 employers absorb the 24% of employment and produce the 36.6% of value added.

The nominal labour productivity, measured by *value added/number of employers,* is almost 34,8 thousands Euro with a maximum in the larger firms (39,600 Euro) and a minimum in the smaller firms (24,500 Euro). The return of sale, measured by *gross operating margin/sales,* is 8.6% for the whole sectors. The values are significantly higher for the smaller firms; it is due to the minor incidence of the cost of labour; in the industry sector the return of sales ranges from 19.9% for the smaller firms to 10% for the larger enterprises.

In 2000, the total number of firms is more than 4 million (+4%) with 14.7 million of employers (+3%) and a value added of 534 milliards Euro. Smaller firms (1-9 employers) absorb the 48.5% of employment, 24% of dependents, 30% of sales, 32% of value added. These firms experimented a light reduction in the quote of sales and value added.

As known, Italy is peculiar among the industrialized countries because of the overwhelming dominance of small firms. This kind of industry and size specialization makes Italy more similar to many emerging countries than to the main features of the G7 economies. The most different features between small and large firms is the structure of employment, as expressed by the ratio *N/D=number of employers/number of dependents.* As shown in Tables 1 and 2, the percentage of dependent workers is higher with the increase of size.

Table 1 – Economic data by economic activity and size of employment(*)

(Euro, 1999 current values. Source: Istat, 2002)

	Employers *N*	Dependents *D*	N/D (%)	Sales *SA (mln €)*	Value added *VA (mln €)*	*VA/N (1,000€)*	*CL/D (1,000 €)*	*FI/N (1,000 €)*	*OM/SA (%)*	*VA/SA (%)*
Industry										
1-9	1,225,228	575,212	46.9	90,127	28,774	23.5	18.8	4.9	19.9	31.9
10-19	736,619	635,141	86.2	71,820	22,796	30.9	20.6	5.0	13.5	31.7
20-99	1,259,382	1,200,865	95.4	184,650	52,113	41.4	25.7	6.8	11.5	28.2
100 over	1,746,911	1,740,417	99.6	430,853	105,649	60.5	35.8	9.5	10.0	24.5
Total	*4,968,140*	*4,151,635*	*83.6*	*777,451*	*209,332*	*42.1*	*28.2*	*7.0*	*10.7*	*26.9*
Construction										
1-9	934,906	374,221	40.0	67,062	20,111	21.5	20.3	3.1	18.7	30.0
10-19	205,229	178,206	86.8	19,049	5,813	28.3	22.0	3.3	9.9	30.5
20-99	187,609	177,909	94.8	21,256	7,122	38.0	25.4	4.1	12.2	33.5
100 over	84,094	83,661	99.5	18,041	4,051	48.2	36.5	4.8	5.5	22.5
Total	*1,411,838*	*813,997*	*57.7*	*125,409*	*37,097*	*26.3*	*23.4*	*3.4*	*6.4*	*29.6*
Services										
1-9	4,866,350	1,361,333	28.0	451,638	123,607	25.4	19.5	4.7	21.5	27.4
10-19	621,888	527,227	84.8	113,313	22,312	35.9	22.5	6.5	9.2	19.7
20-99	846,228	803,308	94.9	161,223	33,032	39.0	24.8	7.1	8.1	20.3
100 over	1,593,193	1,584,353	99.4	268,436	72,693	45.6	31.6	7.7	8.4	20.5
Total	*7,927,659*	*4,276,221*	*53.9*	*994,609*	*251,645*	*31.7*	*25.4*	*5.7*	*14.4*	*25.3*
Total										
1-9	7,026,484	2,310,766	32.9	608,827	172,493	24.5	19.5	4.5	20.9	28.3
10-19	1,563,736	1,340,574	85.7	204,182	50,922	32.6	21.5	5.4	10.8	24.9
20-99	2,293,219	2,182,082	95.2	367,129	92,267	40.2	25.3	6.7	10.1	25.1
100 over	1,201,726	1,155,225	96.1	235,077	47,632	39.6	26.1	6.7	7.4	20.3
Total	*14,307,637*	*9,241,853*	*64.6*	*1,897,470*	*498,074*	*34.8*	*26.5*	*5.9*	*8.6*	*26.2*

(*) *N*: number of employers; *D*: number of dependents; *min*: millions. *CL:* labour costs, *FI:* fixed investment; *OM:* operating margin

Table 2 – Economic data by economic activity and size of employment(*)

(Euro, 2000 current values. Source: Istat, 2002)

Size class	Employers *N*	Dependents *D*	D/N (%)	Sales *SA (mln €)*	Value added *VA (mln €)*	*VA/N (1,000€)*	*CL/D (1,000€)*	*FI/N (1,000€)*	*OM/SA (%)*	*VA/SA (%)*
Industry										
1-9	1,224,593	573,996	46.9	92,638	29,022	23.7	18.9	4.7	19.6	31.3
10-19	740,124	643,682	87.0	83,094	25,340	34.2	21.8	5.2	13.6	30.5
20-99	1,264,445	1,205,434	95.3	198,725	54,941	43.5	26.4	7.6	11.6	27.6
100 over	1,775,544	1,768,545	99.6	508,749	119,947	67.6	37.1	11.4	10.7	23.6
Total	*5,004,706*	*4,191,657*	*83.8*	*883,205*	*229,250*	*45.8*	*29.1*	*7.9*	*12.1*	*26.0*
Construction										
1-9	972,153	393,545	40.5	68,499	22,157	22.8	19.4	4.0	21.2	32.3
10-19	218,897	192,461	87.9	21,227	6,318	28.9	21.3	2.2	10.5	29.8
20-99	200,397	190,868	95.2	23,769	7,548	37.7	26.5	4.5	10.5	31.8
100 over	86,629	85,870	99.1	15,640	3,737	43.1	35.5	5.6	4.4	23.9
Total	*1,478,076*	*862,744*	*58.4*	*129,136*	*39,761*	*26.9*	*23.0*	*3.9*	*15.4*	*30.8*
Services										
1-9	4,959,774	1,343,187	27.1	475,850	121,251	24.4	20.1	3.7	19.8	25.5
10-19	656,176	563,770	85.9	123,368	24,374	37.1	23.2	4.9	9.2	19.8
20-99	898,525	853,049	94.9	185,110	36,714	40.9	25.9	5.3	7.9	19.8
100 over	1,757,112	1,741,231	99.1	303,023	82,698	47.1	32.4	9.0	9.7	27.3
Total	*8,271,587*	*4,501,237*	*54.4*	*1,087,351*	*265,036*	*32.0*	*25.7*	*5.1*	*13.7*	*24.4*
Total										
1-9	7,156,520	2,310,728	32.3	636,987	172,430	24.1	19.7	3.9	19.9	27.1
10-19	1,615,197	1,399,913	86.7	227,688	56,032	34.7	22.3	4.7	10.9	24.6
20-99	2,363,367	2,249,351	95.2	407,604	99,202	42.0	26.2	6.5	9.9	24.3
100 over	3,619,285	3,595,646	99.3	827,412	206,382	57.0	32.4	10.1	10.2	24.9
Total	*14,754,369*	*9,555,638*	*64.8*	*2,099,691*	*534,046*	*36.2*	*27.0*	*5.9*	*13.1*	*25.4*

(*) *N*: number of employers; *D*: number of dependents; *min*: millions. *CL:* labour costs, *FI:* fixed investment; *OM:* operating margin

The analysis is then focused on the industrial economic activities in 2000, with the exclusion of Mining, Constructions and Energy sector. Specifically, in comparison with the other economic activities, Energy sector exhibits very large profitability indices and portion of sales (more than 13%), with a limited number of employers (almost 3%).
The analysis of profitability (Grassini e Viviani, 1997) is based on the multiplicative formula of *VA/SA* by *OM/VA,* which gives the *return of sales (ROS)*. In fact:

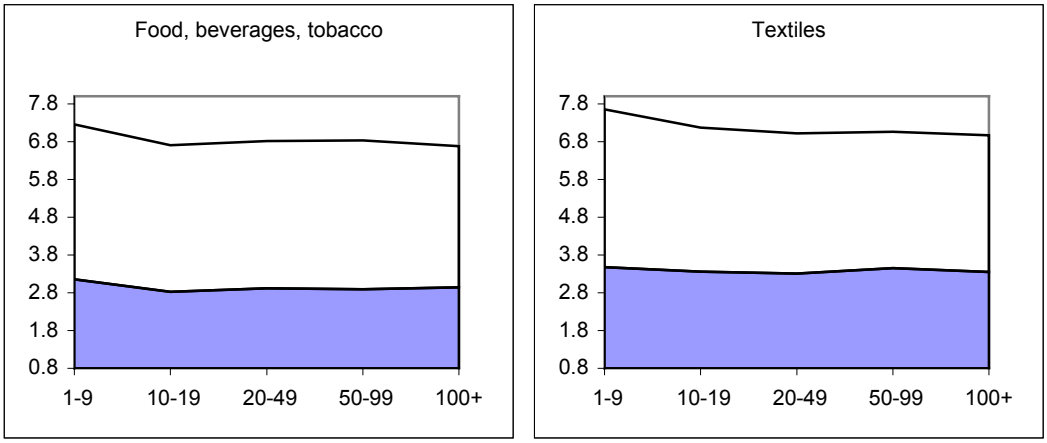
$$ROS = (VA/SA)\ (OM/VA)$$

The ratio *VA/SA* expresses the effect of current costs (with the exclusion of cost of labour and capital invested in the production); *OM/VA* shows the incidence of costs of labour on value added. Through the logarithmic transformation we obtain:

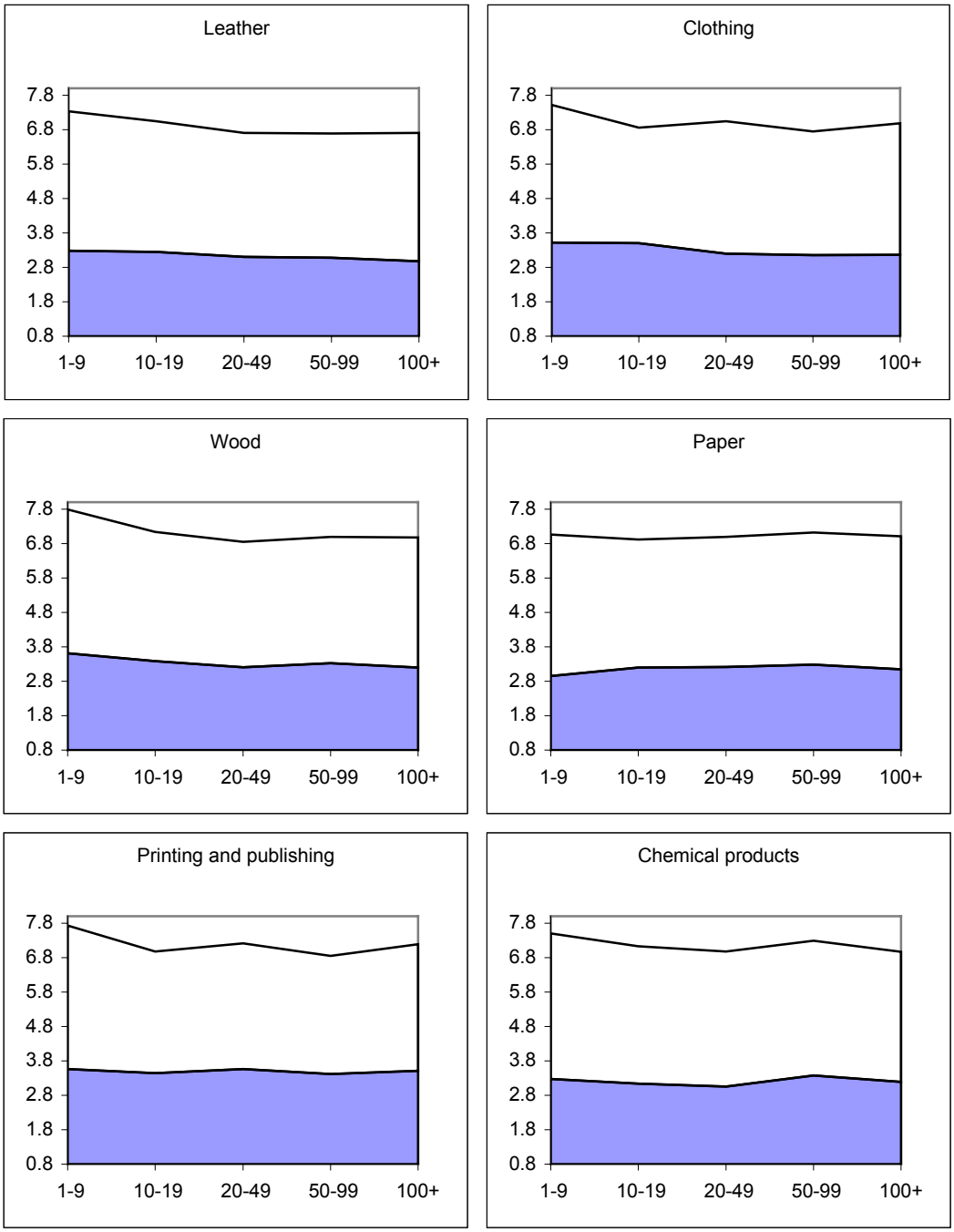
$$ln(ROS) = ln(VA/SA) + ln(OM/VA)$$

The composition of *ln(ROS)* into these two components is represented in Graph 1, for each sector and dimensional class. We can note how the incidence of labour costs is generally increasing with the increase of firm's size. This situation occurs especially in the sectors Vehicles and Office machinery.
Additional data referred to each economic activities and size are contained in the tables at the bottom of the paper (Tables 4, 5 and 6).

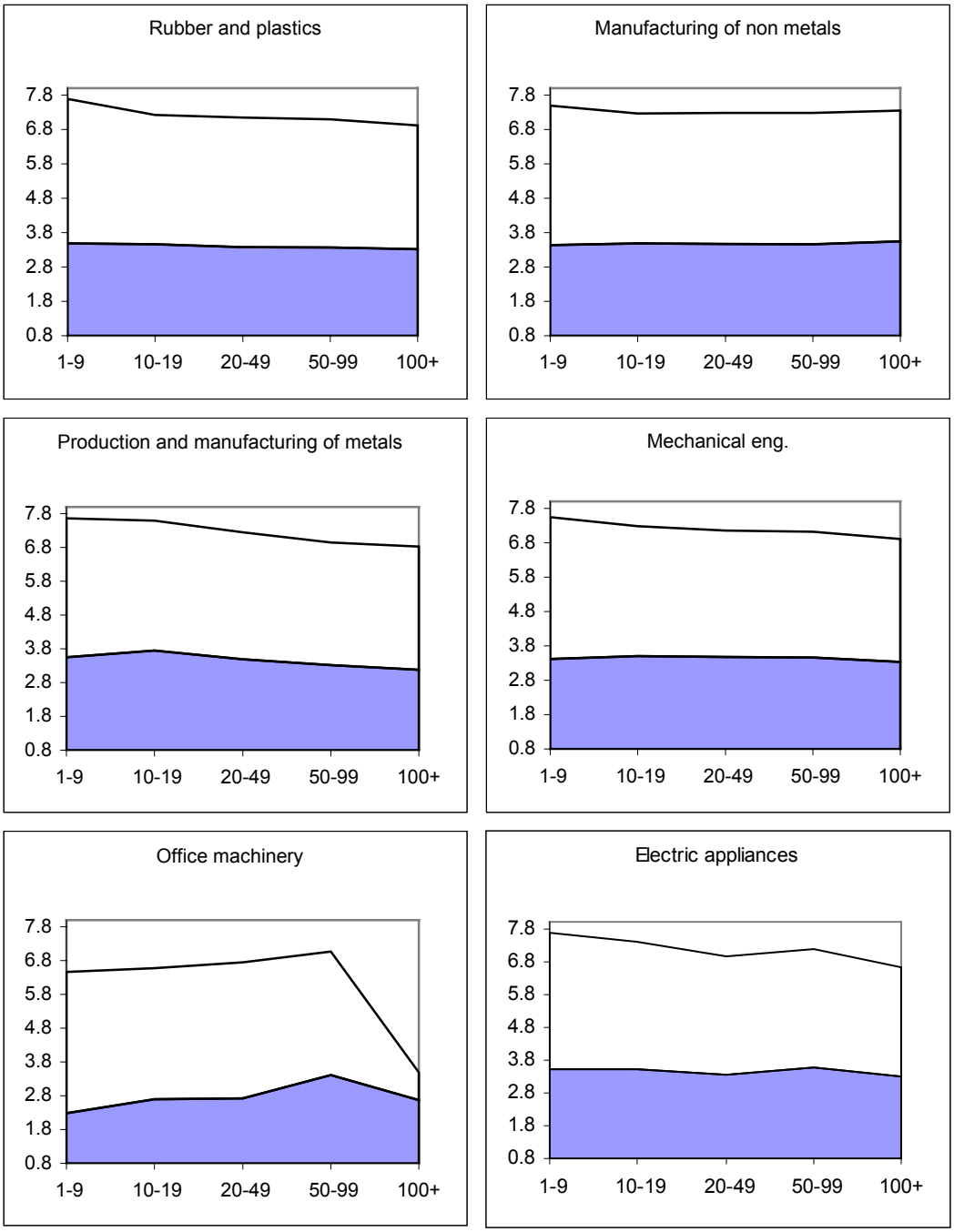
Graph 1 – Profitability characteristics of sectors and dimensional class
(shaded area: *ln(VA/SA)*; blank area: *ln(OM/VA)*; 2000 data)



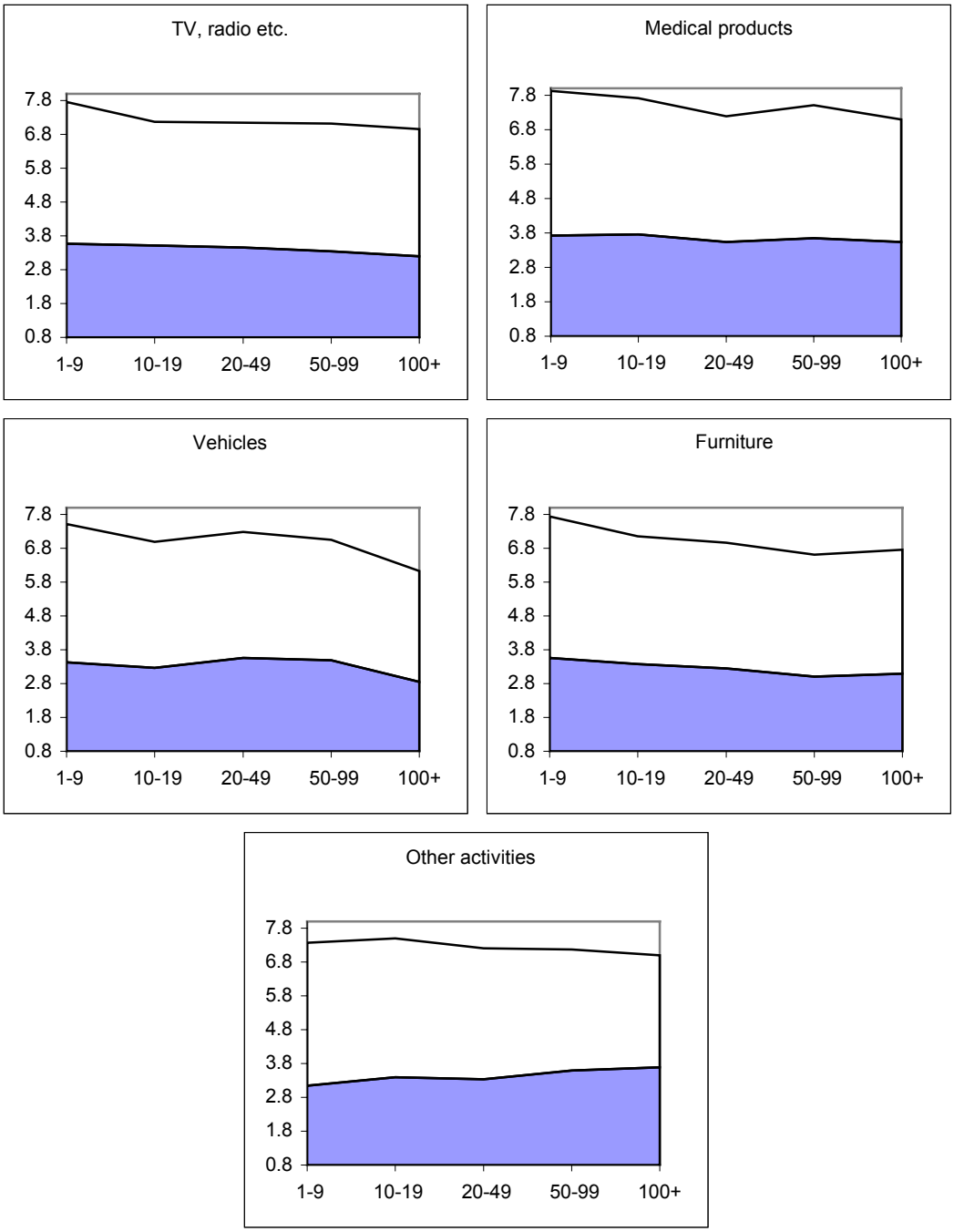
Graph 1 – *(continuing)*



Graph 1 – *(continuing)*



Graph 1 – *(continuing)*



4. Efficiency measurement concepts and *DEA*

Firms' performance can differ across industries for various reasons. For example, they use different technologies or operate at different scales. It follows that, from a theoretical point of view, the statistical analysis of efficiency cannot be correctly conducted on data relating to different industrial sector or economic activities, but it should be based on homogeneous productive units. However, comparisons among the performances of different sectors often are developed to provide some *benchmark* value. For example, performances of the public sectors are compared with the one of similar activities of the private sectors, in order to evaluate the direction of improvement processes and interventions.

In this paper, we investigate the use of the statistical approaches on efficiency (Lovell and Smith, 1993) as a framework to compare different industries. Specifically, in our empirical application, we followed the nonparametric approach (Norman and Stoker, 1991), as explained in the followings.

The empirical analysis of efficiency is based on the estimation of a *frontier,* which represents the maximum amount of output obtainable by a given amount of input. *Data Envelopment Analysis (DEA)* is a non-parametric mathematical programming approach to frontier estimation(Charnes, Cooper e Rhodes, 1978; Gazzei, Lemmi e Viviani, 1997).

A non-parametric approach seems to be more suitable than the parametric one, as a framework to compare different economic activities (Castelli, Pesenti e Ukovich, 1998).

The discussion of DEA models presented here is brief, with little technical detail and are limited at the case of only one input and one output.

Let us consider n productive units and the amounts of input and output (x_i, y_i) of each unit i $(i=1,...,n)$. The purpose of *DEA* is to construct a non-parametric envelopment frontier *over* the data points such that all the data points lie on or below the frontier (i.e.: no points lie over the frontier).

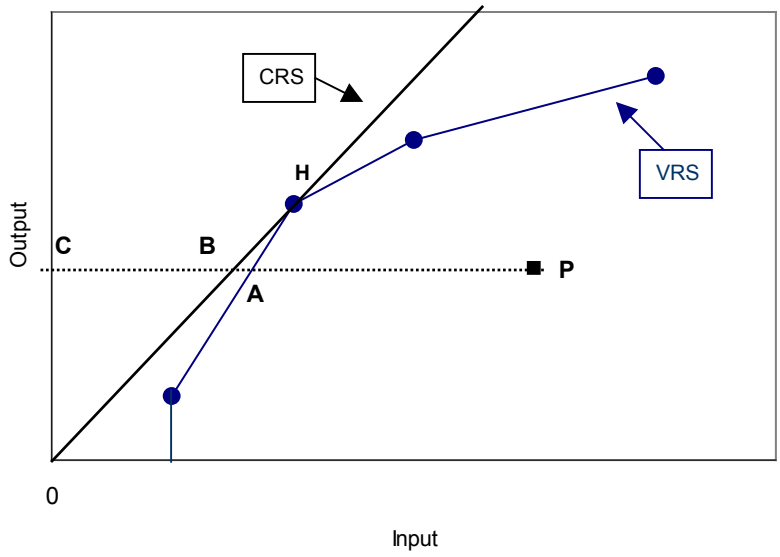
Graph 2 describes the method. The points represent the n (in the case of the graph, $n=5$) productive units or processes. Under the assumption of *constant return to scale* (if the input changes, the output changes proportionally), the frontier is the one labelled by *CRS;* only the process H is efficient because lies on that frontier. Under the assumption of *variable return to scale (VRS)*, only P is inefficient whereas the other four points lie on the frontier. The *VRS* frontier in Graph 2 is characterized by *non increasing return to scale (NIRS)*: if the input changes, the output changes less than proportionally. In the case of one input and one output, *VRS* frontier obtained by *DEA* assumes a piecewise linear form.

From these frontiers, an *input-oriented* efficiency measure can be derived. For each productive units i, this measure is the ratio between the smallest amount of input (numerator) which is needed to produce the same output y_i and the amount of input x_i currently used by i (denominator).

In the case of *CRS* frontier, the *input-oriented* efficiency measure for the process P is CB/CP; in the case of *VRS* frontier, the *input-oriented* efficiency of P is CA/CP. It is clear

that these measures assume values in the interval [0,1], where 1 represents full efficiency. If this index is equal, for example, to 0.8, it means that inputs can be reduced by 20% to produce the same amount of output.

Graph 2 – Frontiers derived from a *DEA* analysis



Let us consider $\boldsymbol{x}$ as the $(n\times 1)$ vector of the input for the n productive units and $\boldsymbol{y}$ the $(n\times 1)$ vector of the output. Operationally, the *CRS* frontier is determined by resolving, for each unit *i-th*, the following minimization problem, through linear programming technique:

$$min_{\theta,\boldsymbol{\lambda}} \quad \theta$$

under restrictions

$$-y_i+\boldsymbol{y}'\boldsymbol{\lambda}\geq 0$$
$$\theta x_i-\boldsymbol{x}'\boldsymbol{\lambda}\geq 0$$
$$\boldsymbol{\lambda}\geq 0$$

where $\boldsymbol{\lambda}$ is a $(n\times 1)$ vector of weights and θ is the efficiency measure for the unit *i-th,* both $\boldsymbol{\lambda}$ and θ to be determined through minimization. Note that the linear programming problem must be solved n times, one for each productive unit in the data set.

NIRS frontier is determined by resolving, for each unit *i-th*, the following minimization problem:

$$min_{\theta,\boldsymbol{\lambda}} \quad \theta$$

under restrictions

$$-y_i + \boldsymbol{y'\lambda} \geq 0$$
$$\theta x_i - \boldsymbol{x'\lambda} \geq 0$$
$$\boldsymbol{\lambda} \geq 0$$
$$\boldsymbol{I'\lambda} \leq 1$$

where $\boldsymbol{I'}$ is the $(1 \times n)$ unit vector.

5. Empirical results of *DEA*

DEA approach is applied as a framework to compare industrial sectors. For this aim we used *VA* as output and the sum *CL+FI* as input. We used *Excel* software to solve the minimization problem.

Graph 3 shows the 57 productive units (19 for each of the three dimensional class). The graph exhibit a general situation of *CRS*. Hence we derived a *CRS* frontier.

The estimated input oriented efficiency measures, under *CRS* assumptions, are in Table 3. Remember that value 1 means the best performance. In this case, the meaning of the values must be considered as a tool to compare different industries and different dimensional classes.

The results in Table 3 give a picture of the incidence of the costs on the production process. In fact, from the descriptive analysis, we know that the incidence of labour costs is major for larger firms. Therefore, the different performances observed along the row of Table 3 are likely determined by this structural characteristic.

Graph 4 summarizes the results obtained through the *CRS* frontier by focusing our attention on the industrial economic activity. The bar length is represented by the sum of the three efficiency indexes estimated for the three dimensional classes. The order of the sectors in the graph is with respect to decreasing values of that sum. Clothing, Office machinery and Medical products exhibit the best performances whereas Other activities, Rubber and plastics, TV radio, the worse performances.

Graph 5 provides a comparison among size classes. This graph type was originally proposed to represent cyclical data (for example time series) but it is suitable also for a broader type of quantitative data (Krzanowski and Marriott, 1994).

The benchmark sector is represented by Office machinery in '1-19' dimensional class (Graph 5) and that size class experienced higher level of efficiency with some exception

(i.e. Clothing in the largest class is more efficient),. These result give a significant picture of the Italian industry sector.

Graph 3 – *VA* versus labour costs plus fixed investments *(FI+CL)*
(millions Euro; 2000 data. Source: Istat, 2002)

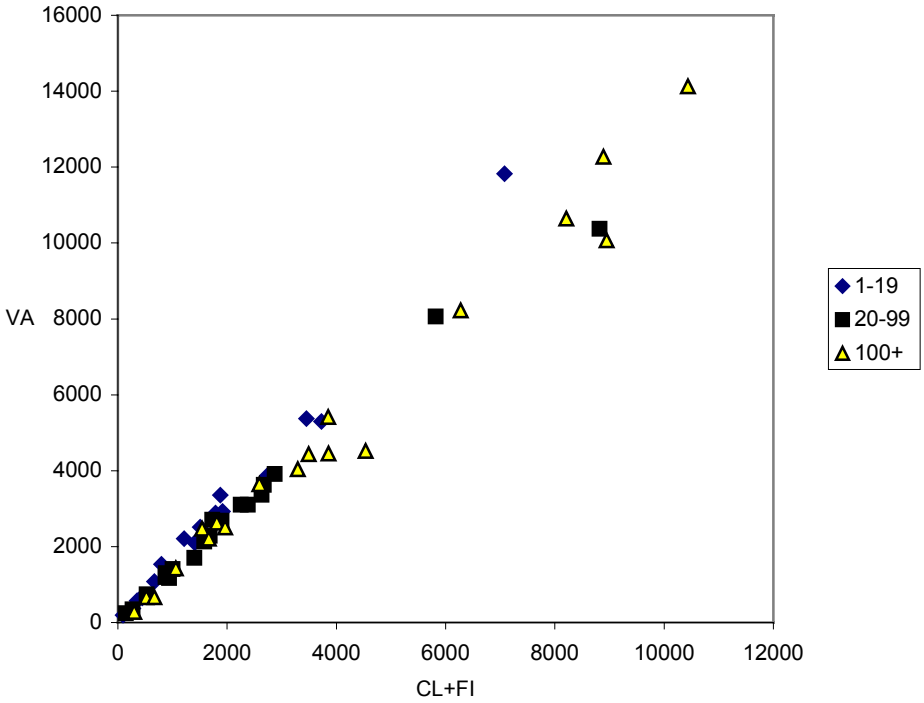
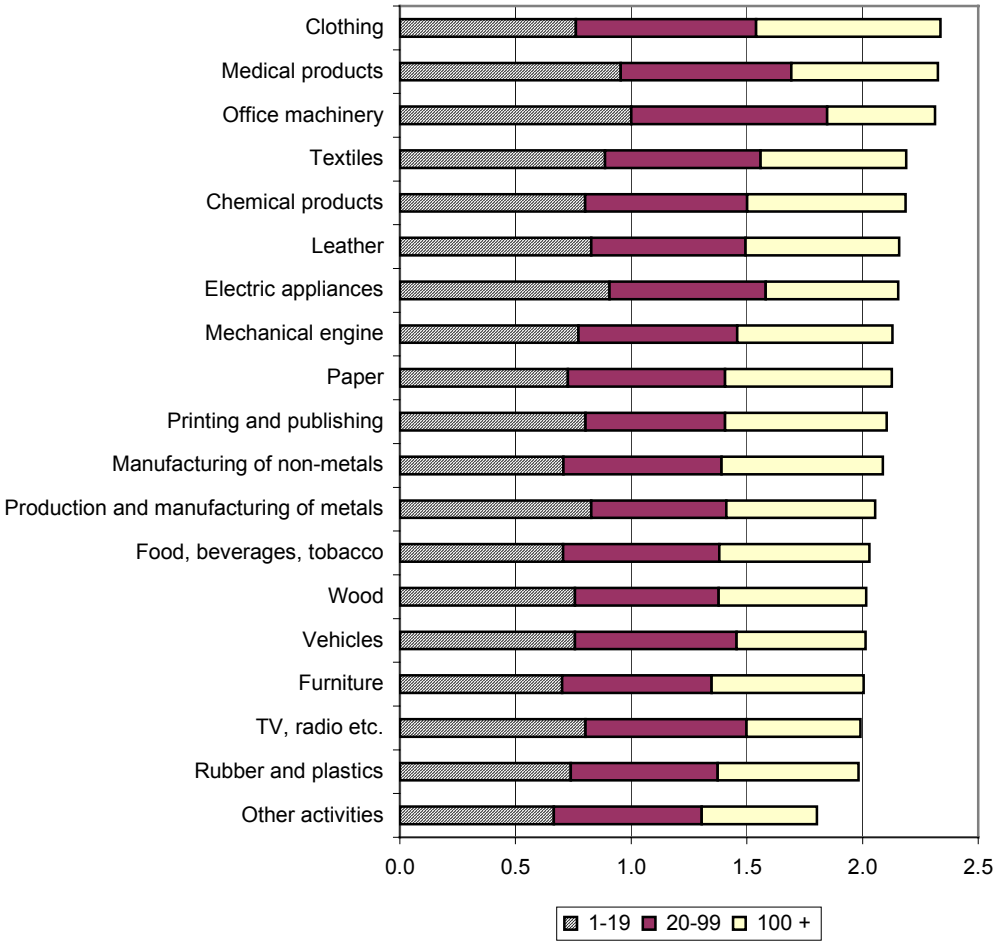


Table 3 – Performance measures based on *CRS* frontier

Economic activity (industry)	Size class (n. of employers)		
	1-19	20-99	100 and over
Food, beverages, tobacco	0.7050	0.6759	0.6492
Textiles	0.8867	0.6728	0.6298
Clothing	0.7615	0.7778	0.7972
Leather	0.8269	0.6670	0.6641
Wood	0.7571	0.6208	0.6375
Paper	0.7259	0.6792	0.7220
Printing and publishing	0.8018	0.6042	0.6979
Chemical products	0.8008	0.7009	0.6844
Rubber and plastics	0.7390	0.6350	0.6092
Manufacturing of non-metals	0.7066	0.6840	0.6977
Production and manufacturing of metals	0.8280	0.5829	0.6433
Mechanical eng.	0.7715	0.6870	0.6712
Office machinery	1.0000	0.8463	0.4671
Electric appliances	0.9067	0.6746	0.5731
TV. radio etc.	0.8018	0.6960	0.4936
Medical products	0.9548	0.7370	0.6345
Vehicles	0.7574	0.6980	0.5581
Furniture	0.7013	0.6456	0.6574
Other activities	0.6659	0.6387	0.4988
Mean	**0.7947**	**0.6802**	**0.6309**

Source: Istat, 2002

Graph 4 – Performance measures based on *CRS* frontier
(bar length: sum of the efficiency indexes for the three size classes)



Graph 5 –*CRS* frontier: a comparison among size classes (200 data)

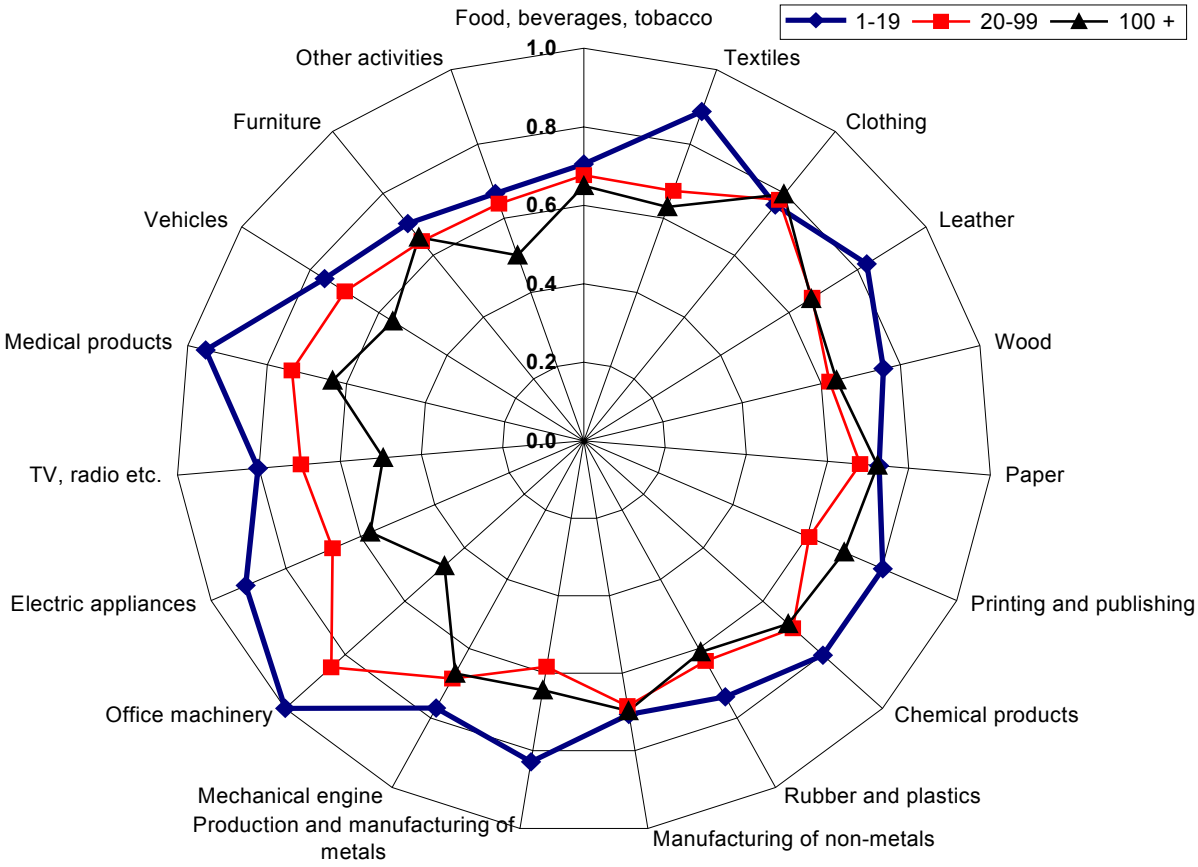


Table 4 – Performances(*) in 2000. Size class '1-19' employers (Istat, 2002)

Economic activity (industry)	*VA/SA (%)*	*OM/VA (%)*	*CL/D (1000€)*	*FI/N (1000€)*	*FI/CL (%)*
Food, beverages, tobacco	20.5	55.7	20.014	6.247	58.9
Textiles	30.5	55.5	19.243	3.168	25.6
Clothing	33.4	42.8	15.460	1.328	13.7
Leather	26.1	50.5	17.673	2.603	21.2
Wood	34.2	57.8	19.139	5.295	55.1
Paper	21.6	50.3	20.919	5.696	37.5
Printing and publishing	33.5	52.5	23.875	4.508	30.2
Chemical products	24.5	60.5	24.439	9.916	56.8
Rubber and plastics	32.2	53.3	21.672	6.835	43.8
Manufacturing of non-metals	31.8	51.0	20.909	5.737	43.1
Production and manufacturing of metals	38.4	53.7	21.214	4.108	29.2
Mechanical eng.	31.7	52.8	23.422	5.707	36.2
Office machinery	11.6	57.6	27.165	2.833	16.9
Electric appliances	33.4	55.4	20.058	3.059	22.5
TV, radio etc.	34.7	54.9	21.900	4.153	37.2
Medical products	41.8	61.9	21.367	3.720	36.2
Vehicles	28.2	49.9	20.961	4.395	30.6
Furniture	32.3	56.3	19.161	6.470	61.6
Other activities	26.2	64.6	23.252	15.074	110.6
Total	**30.9**	**53.9**	**20.356**	**4.670**	**37.1**

(*) *VA:* value added; *SA:* sales; *OM:* operating margin; *CL:* labour costs; *FI:* fixed investment; *N:* number of employers; *D:* number of dependents.

Table 5 – Performances(*) in 2000. Size class '20-99' employers (Istat, 2002)

Economic activity	*VA/SA (%)*	*OM/VA (%)*	*CL/D (1000€)*	*FI/N (1000€)*	*FI/CL (%)*
Food, beverages, tobacco	18.4	49.9	25.688	11.272	46.5
Textiles	29.0	39.1	23.727	4.747	20.9
Clothing	24.2	43.4	19.155	2.315	12.7
Leather	22.0	36.7	20.351	3.330	17.5
Wood	25.7	38.3	21.494	5.968	29.5
Paper	25.7	44.9	27.489	8.531	32.5
Printing and publishing	33.3	35.7	30.065	7.751	27.5
Chemical products	24.7	50.2	35.646	14.486	42.0
Rubber and plastics	29.2	42.5	26.944	9.207	35.9
Manufacturing of non-metals	32.0	45.3	27.154	8.482	32.5
Production and manufacturing of metals	30.8	41.1	27.559	11.636	44.3
Mechanical eng.	32.1	39.1	30.546	5.449	18.6
Office machinery	20.1	47.5	27.054	2.957	11.5
Electric appliances	31.3	37.0	26.069	4.120	16.6
TV, radio etc.	30.0	41.8	27.369	5.888	22.4
Medical products	36.0	42.5	30.999	5.055	17.0
Vehicles	34.1	38.6	25.838	3.914	15.7
Furniture	23.3	39.6	22.477	5.787	27.1
Other activities	31.5	42.4	30.752	10.214	34.7
Total	**27.7**	**41.6**	**26.283**	**7.345**	**29.3**

(*) *VA:* value added; *SA:* sales; *OM:* operating margin; *CL:* labour costs; *FI:* fixed investment; *N:* number of employers; *D:* number of dependents.

Table 6 – Performances(*) in 2000. Size class '100 +' employers (Istat, 2002)

Economic activity	*VA/SA (%)*	*OM/VA (%)*	*CL/D (1000€)*	*FI/N (1000€)*	*FI/CL (%)*
Food, beverages, tobacco	19.0	41.9	35.224	11.003	31.4
Textiles	28.6	37.0	28.572	7.101	25.0
Clothing	23.7	45.4	26.872	3.698	13.8
Leather	19.6	41.5	25.488	6.976	27.6
Wood	24.4	43.9	27.793	10.617	38.5
Paper	23.2	47.9	37.213	11.757	31.7
Printing and publishing	33.5	39.7	51.514	9.080	17.7
Chemical products	24.3	43.6	48.530	13.758	28.4
Rubber and plastics	27.5	36.6	33.755	9.556	28.4
Manufacturing of non-metals	34.5	45.1	36.932	10.831	29.4
Production and manufacturing of metals	24.0	38.6	34.656	8.812	25.6
Mechanical eng.	28.0	35.8	36.120	5.436	15.1
Office machinery	14.5	2.3	41.954	3.598	8.6
Electric appliances	26.3	28.5	35.749	7.498	21.0
TV, radio etc.	24.4	42.9	41.366	31.364	76.0
Medical products	34.4	34.9	37.539	7.468	20.0
Vehicles	17.4	26.5	35.056	7.306	20.9
Furniture	22.2	38.8	28.477	6.556	23.2
Other activities	40.1	27.3	39.683	14.506	36.7
Total	**24.2**	**38.1**	**36.208**	**9.350**	**25.9**

(*) *VA:* value added; *SA:* sales; *OM:* operating margin; *CL:* labour costs; *FI:* fixed investment; *N:* number of employers; *D:* number of dependents.

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