PRODUCTIVITY, SIZE AND CAPITAL INTENSITY IN SELECTED PORTUGUESE MANUFACTURING SECTORS: A NON-PARAMETRIC ANALYSIS*

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This article adopts a non-parametric approach to explore the relation between size, capital intensity and productivity in a set of Portuguese manufacturing sectors. The article makes use of 2007 data from firm's balance sheets and income statements in sectors "food and beverages", "clothing", "manufactured non-metallic mineral products" and "metallic products, except machinery and equipment". In 2007, these four sectors represented almost half of the total number of manufacturing firms, more than one third of gross value added and sales and more than forty per cent of employment and capital stock in the Portuguese manufacturing sector. Firstly, the article presents basic descriptive statistics regarding the distribution of firms along the selected variables. Secondly, the analysis is enlarged by estimating robust conditional kernel distributions for the pairs of variables *capital intensity-productivity, size-productivity* and *size-capital intensity*. The unconditional distributions for the selected variables reveal some similarities between sectors. There is substantial heterogeneity within sectors but firms are concentrated in classes that correspond to small size, low capital-labour ratios and small number of workers. The conditional distributions reveal that the largest firms in terms of sales tend to be those with higher capital-labour ratios and these two characteristics tend to lead to higher levels of apparent labour productivity.

1. Introduction

Capital intensity, size, and productivity of firms are three key variables in empirical and theoretical industrial organization (IO) literature. The capital intensity, defined as capital stock over total employment, is an important component in the characterization of the production process as it reflects the combination of inputs in the production function. Nevertheless, empirical literature has not devoted much attention to this variable because data refering to sectoral capital stocks is typically non-available and existing aggregate data is plagued with statistical problems.[1] The recent availability of large longitudinal firm-level data sets, namely drawing on firms' balance sheets and income statements, has provided additional information on the capital stock. In this context, capital is defined as fixed plus intangible assets, as accounted in the balance sheet. Accounting methods and procedures affect this measure, though it is typically more robust than usual aggregate indicators. A limited number of articles focus on the impact of the capital stock on gross value added (GVA) or productivity. These articles usually estimate production functions or perform sectoral growth accounting exercises. In addition, some papers focus on the impact of financial

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1 Estimates of the aggregate capital stock typically rely on the perpetual inventory method. This method arrives at the level of capital stock by accumulating flows of gross fixed capital formation and assuming a constant depreciation rate. Assumptions on this latter rate and on the initial level of capital stock necessarily affect the path of the capital series.

markets or financing conditions on capital intensity (see, for example, Spalliara (2009)), while others relate capital intensity and wages (Arai (2003) and Leonardi (2007)).

Size is a classical variable in IO literature, usually defined as the total number of workers in the firm or total sales. This variable also links with the characteristics of the production process, namely in terms of returns to scale, either internal or external to the firm. As regards size, the literature mostly focuses on the evolution of the firm size distribution (see, for example, Cabral and Mata (2003) and Angelini and Generale (2008)) and on their determinants (Kumar *et al.* (1999) and Mata and Machado (1996)).

Productivity is usually measured as GVA per worker and it is interpreted as an outcome of the production process, affecting overall competitiveness. This ratio is sometimes defined as *apparent labour productivity* to distinguish from *total factor productivity*, which is obtained from a growth accounting exercise where capital and labour are explicitly considered as factors of production. The literature has also studied productivity issues, analyzing both the link between firm dynamics and productivity growth (see, for example, Bartelsman and Doms (2000) and Ahn (2001)) and the relation between productivity and size (Leung *et al.* (2008)).

This article takes data from balance sheets and income statements of Portuguese manufacturing firms in 2007 and adopts a non-parametric approach to relate size, capital-intensity and productivity. The paper presents some descriptive statistics and estimates conditional kernel distributions for the pairs of variables *capital intensity-productivity, size-productivity* and *size-capital intensity*. This analysis complements existing studies and it is relevant in terms of policy, especially in a context where Portuguese firms show comparatively low average productivity levels in international terms. For example, Cabral (2007) offers an in-depth analysis of Portuguese firms comprising entry and exit decisions, firm size, productivity and distortions to economic activity.

The non-parametric approach adopted in this article is basically descriptive and does not capture causal relations. Nevertheless, it has some advantages. Firstly, it imposes no prior structure on data. Secondly, it is robust to different distributions for the original data. The approach of this article is close to that of Huynh e Jacho-Chavez (2007), though this latter paper is mostly methodological, illustrating the estimation of conditional kernel densities.

The article analyses four manufacturing sectors: ``food and beverages'', ``clothing'', ``manufactured non-metallic mineral products'' and ``metallic products, except machinery and equipment''. In 2007, these four sectors represented almost half of the total number of manufacturing firms, more than one third of GVA and sales and more than forty per cent of employment and capital stock in the Portuguese manufacturing sector. Aggregate technological classifications typically consider the first two sectors as low-tech and the last two as medium low-tech.[2] Medium high-tech and high-tech categories represent about one third of total Portuguese GVA and about one fifth of total firms. In fact, the number of firms in the sectors that compose such technological categories is relatively low.[3] This fact limits the use of those sectors in the article, notably in the estimation of the robust kernel conditional densities.

The article is organized as follows. In the next section we present the database. In section 3 we present some descriptive statistics based on sectoral firm data and the results for the estimated conditional kernel distributions. Section 4 presents some concluding remarks.

2 The classification used is according to Loschky (2010) and it is very close to the OECD taxonomy based on manufacturing industries' technological intensity (see OCDE(2009)).

3 In our data, the shares of low-tech, medium low-tech, medium high-tech and high-tech in GVA are 42.6, 28.8, 25.3 and 3.3 per cent, respectively. The shares of firms in these categories are 51.9, 26.3, 19.8 and 2.0 per cent, respectively.

2. Database

The data used in this article draws on information about the annual accounts of corporations reported under the *Informação Empresarial Simplificada* (Simplified Corporate Information, Portuguese acronym: IES). The IES exists since 2006 and it covers virtually the universe of Portuguese non-financial corporations. The almost universal coverage of the IES emerges from its nature, as it is the system through which corporations report mandatory information to the tax administration and the statistical authorities. Under the IES, firms provide information about the balance sheet and the income account, as well as additional information on the number of employees, their categories and costs, and total exports and imports.

As it was previously said, the article considers sectors ``food and beverages'' (CAE 15), ``clothing'' (CAE 18), ``manufactured non-metallic mineral products'' (CAE 26) and ``metallic products, except machinery and equipment'' (CAE 28).[4] Table 1 reports the shares of the different sectors in terms of GVA, number workers, capital stock and sales and the total number of firms in the sample in 2007.[5] The four selected sectors represented 47.4 per cent of manufacturing firms, 37.2 per cent of GVA in the manufacturing sector, 34.6 per cent of sales, 44.5 per cent of employment and 42.8 per cent of capital stock. Therefore, the four sectors considered represent a significant share of the Portuguese manufacturing sector. The firms with zero workers, zero capital or with negative GVA were removed from the sample. Therefore, numbers presented do not necessarily coincide to IES aggregates.

Table 1

SHARE OF SECTORES AND NUMBER OF FIRMS IN MANUFACTURING (2007)

Sector	CAE 2.1	Shares				Number of firms
		GVA	Workers	Capital stock	Sales	
Food products and beverages	15	13.5	13.3	22.1	16.6	4615
Tobacco	16	1.1	0.1	0.5	0.6	3
Textiles	17	5.5	8.8	6.3	4.7	2295
Clothing	18	5.5	13.4	2.5	3.9	4038
Leather and footwear	19	3.1	6.1	1.5	2.6	1598
Wood and products of wood and cork, excep furniture	20	4.4	5.0	4.4	4.8	2649
Pulp, paper, paper products	21	4.5	1.6	7.6	3.5	348
Printing and publishing	22	4.9	4.2	4.1	3.1	2612
Coke, refined petroleum products and nuclear fuel	23	3.4	0.3	3.9	9.0	7
Chemicals and chemical products	24	5.7	2.7	6.0	5.8	630
Rubber and plastics products	25	4.3	3.3	3.5	3.8	813
Other non-metallic mineral products	26	9.2	7.4	11.5	6.9	2420
Basic metals	27	2.2	1.4	1.9	3.6	243
Fabricated metal products except machinery and equipment	28	9.0	10.4	6.6	7.3	5487
Machinery and equipment n.e.c	29	6.1	5.5	4.0	4.7	2174
Office, accounting and computing machinery	30	0.1	0.1	0.0	0.2	29
Electrical machinery and apparatus n.e.c	31	3.1	2.6	1.6	3.6	495
Radio, television and communication equipment	32	2.3	1.3	1.7	2.3	129
Medical, precision and optical instruments	33	0.8	0.8	0.4	0.6	524
Motor vehicles, trailers and semi-trailers	34	5.1	3.6	4.9	7.3	350
Other transport equipment	35	1.5	1.6	1.0	1.1	267
Furniture	36	3.7	6.1	3.1	3.2	3005
Manufacturing n.e.c; recycling	37	0.6	0.4	0.7	0.9	233
Sum		**100**	**100**	**100**	**100**	**34964**
Share of selected industries (CAE 15+18+26+28)		**37.2**	**44.5**	**42.8**	**34.6**	**47.4**

Source: Author's calculations based on a sample from IES.

4 CAE is the acronym for ``*Classificação das actividades económicas*'', the Portuguese classification of economic activities.

5 As a robustness test, all calculations presented in the article were repeated using 2008 data and the results are unaltered.

3. Productivity, size and capital intensity

As previously mentioned, the article focuses on the relations between three key variables: size (measured as total sales in euros), capital intensity (fixed plus intangible assets over total employment) and productivity (ratio between GVA and total employment). In conceptual terms, capital intensity and size of firms are important determinants of firms' productivity. In addition, the relation between size and capital intensity tells us whether larger firms are more capital intensive or if small firms are able to adopt such technologies. Nevertheless, as previously mentioned, the approach followed in this article is mostly descriptive, thus not establishing causal relations between the variables.

3.1. Unconditional distributions

One of the important results that has emerged from the empirical studies based on firm-level data is that there is a great deal of heterogeneity between firms, even within sectors, i.e., in a given sector firms with very different sizes, productivity levels and capital-labor ratios coexist. Part of this heterogeneity is associated with different types of goods produced. In fact, taking a two-digit CAE sector, there is still substantial diversity in terms of products and technologies within each cathegory. Nevertheless, even at more detailed levels of the classification, heterogeneity subsists.

Charts 1 and 2 present the relative densities of productivity, capital intensity, employment and sales across the four selected sectors. We begin by comparing the four sectors in terms of the shape of the relative distribution for the different variables and then comment separately on the characteristics of each sector. For comparative purposes, annex 1 presents some basic moments for the distributions of the selected variables across all Portuguese manufacturing sectors in the sample that is used.

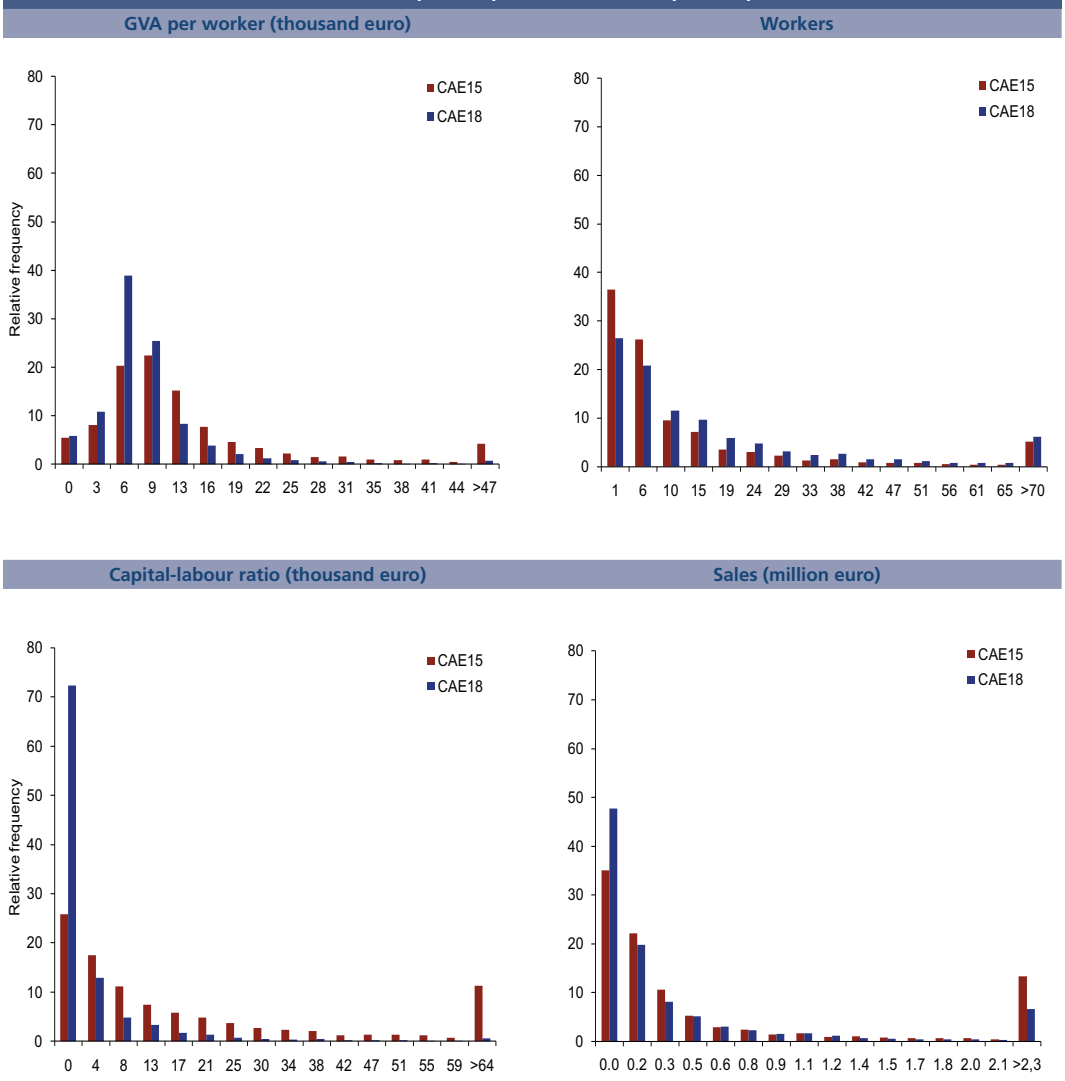
Charts 1 and 2 show that the relative frequencies of productivity (GVA per worker) in low-tech sectors ``food and beverages'' and, especially, ``clothing'' are significantly right-skewed, while medium-low-tech sectors ``manufactured non-metallic mineral products'' and ``metallic products, except machinery and equipment'' present distributions that are closer to the Gaussian shape. The differences between these distributions reflect a better performance in the medium-low-tech sectors but there are also firms in ``food and beverages'' and ``clothing'' that are very productive, probably operating with high-technologies. In addition, ``clothing'' stands out with a very high relative frequency in low capital-labour ratios, in a scenario where all the four sectors present distributions that are highly skewed to the right. This means that most Portuguese manufacturing firms in these four sectors use low capital-intensive technologies. This is compatible with previous aggregate studies where Portugal is identified as having low capital-labour ratios, when compared with other industrialized economies (see Amador and Coimbra (2007)). In a context where world technological progress is stronger in capital intensive sectors and technologies, this underlying situation is an important handicap in terms of productivity gains and GDP growth.[6] The distributions of sales and workers in the four sectors considered are also skewed to the right. Finally, sector ``metallic products except machinery and equipment'' shows a lighter right tail, meaning that relatively less firms present high employment levels.

As for the sector ``food products and beverages'', the capital-labour ratio is high in comparative terms, especially in a sector that is usually classified as low-tech. In addition, this sector shows a high relative frequency of firms with low levels of sales. Nevertheless, the median and mean productivity are slightly lower than in the whole set of manufacturing firms. On aggregate terms, the report "*Key figures in European business*" (Eurostat (2010)), which offers an overview of business activities in the EU-27, refers

6 It should be noted that investment rates were relatively high in the Portuguese economy, especially in the second half of the nineties. Nevertheless, it has been acknowledged that the starting levels of the capital stock were very low and much of this investment was directed towards non-tradable sectors, limiting the evolution of the overall competitiveness of manufacturing firms.

Chart 1

DESCRIPTIVES: FOOD AND BEVERAGES (CAE 15) AND CLOTHING (CAE 18)



Source: Author's calculations based on a sample from IES.

Note: Each frequency interval includes the observations with values larger than the one referred and lower or equal than what is referred for the next interval.

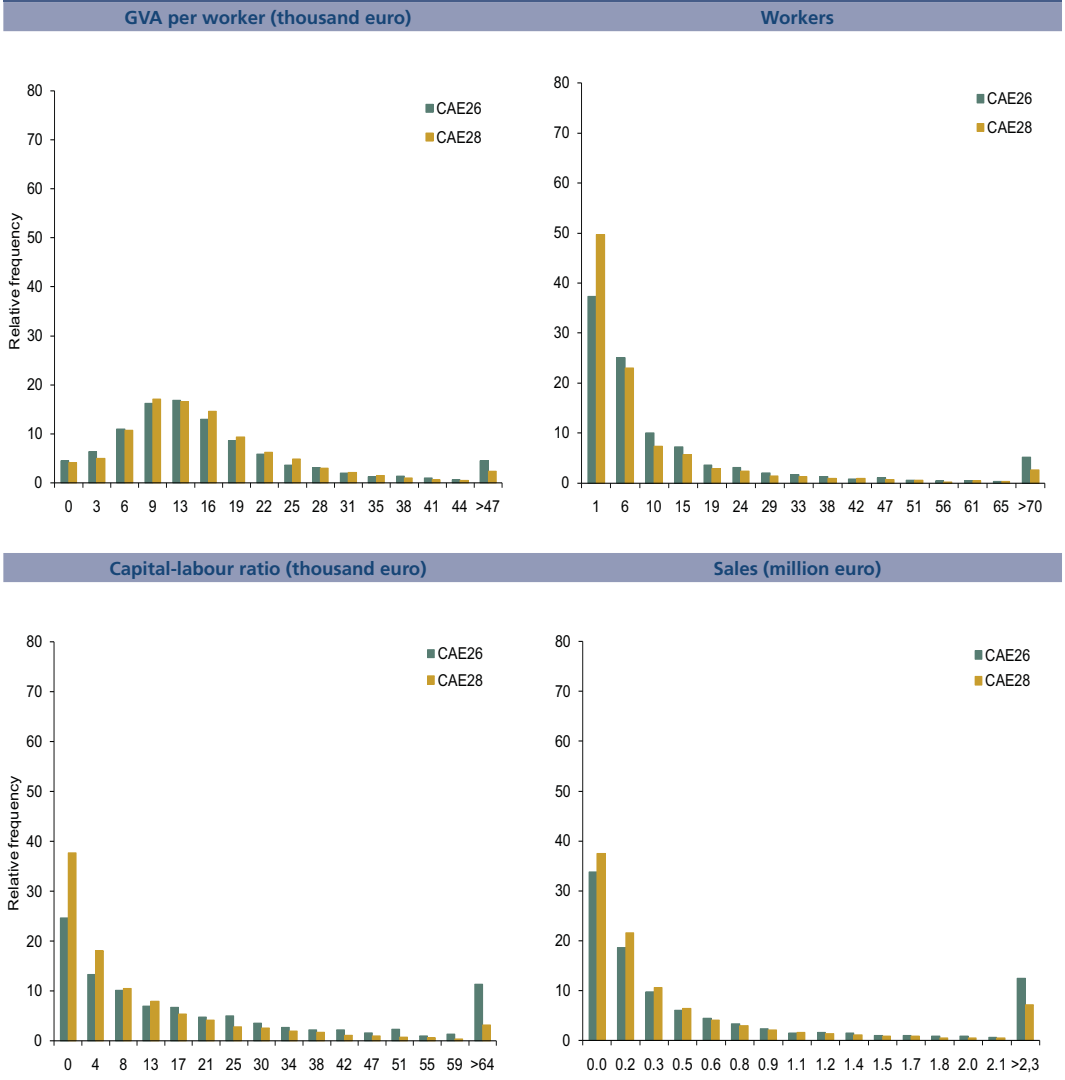
in that in 2007 this sector presented an apparent labour productivity that was close to that of the manufacturing sector. A similar result is obtained for Portugal, though the productivity level in ``food products and beverages'' in the EU-27 was almost 80 per cent higher than that observed in Portugal. Finally, it is relevant to remark that this is a very heterogeneous sector in terms of products, ranging from meat and fish products to dairy products, bread and beverages. Comparing with other EU-27 countries, Portugal presents a significant specialization in the processing and preserving of fish and fish products.[7]

When the ``clothing'' sector is analysed, we observe that the mean and the median of the distribution of the capital-labour ratio is the lowest of all manufacturing sectors (see annex 1). In addition, ``clothing'' is one of the sectors with the lowest mean for sales and productivity. Nevertheless, there are higher relative frequencies for larger numbers of workers, i.e., there are relatively more firms with many employees, when compared with the other three sectors studied. These features are consistent with the analysis

7 Specialization is here assessed by the share of the sub-sector in the non-financial business sectors' GVA.

Chart 2

DESCRIPTIVES: NON-METALLIC MINERAL PRODUCTS (CAE 26) AND METALLIC PRODUCTS, EXCEPT MACHINERY AND EQUIPMENT (CAE 28)



Source: Author's calculations based on a sample from IES.

Note: Each frequency interval includes the observations with values larger than the one referred and lower or equal than what is referred for the next interval.

made in Amador and Opromolla (2009), which focus on the Portuguese textile and clothing sectors. In particular, it is said that the structure of the Portuguese textiles and clothing sectors is based on small-medium firms and the analysis of firm-level data reveals some reduction in their average dimension from 1996 to 2005. This reduction is visible along several dimensions, namely sales. This was partly due to increased competition from new players in international trade, notably China.

The sector of ``other non-metallic mineral products'' is also quite heterogeneous, including glass manufacturing, the manufacture of ceramic and clay products, the manufacture of cement and concrete and the working of stone and miscellaneous non-metallic mineral products. This sector presents a relatively high capital-labour ratio, when compared with other manufacturing sectors. In addition, it shows slightly higher relative frequencies for higher levels of productivity and sales, when compared with the other three sectors considered. Furthermore, it is worth mentioning that there is a noticeable geographical concentration of these firms in Portugal. The Centro region stands as a regional cluster with relatively

high employment in this sector. According to Eurostat (2009), in 2006 this was one of only three regions across the EU-27, behind the Province of Namur (Belgium) and Swietokrzyskie (Poland), in which just over 5 per cent of the non-financial business economy workforce was engaged in the manufacturing of non-metallic mineral products.

Finally, sector of ``fabricated metal products except machinery and equipment'' shows a smaller median and, mostly, a smaller mean in terms of workers and capital-labour ratio, when compared with the overall set of manufacturing firms. Average productivity levels are close to the average of the manufacturing sector. Nevertheless, in aggregate terms, in 2006 this sector presented in Portugal productivity levels that were less than half of those recorded in the average of the EU-27 countries.

Overall, it is possible to identify some important differences across sectors, though Portuguese firms tend to be small in terms of sales and number of workers and with low levels of capital per worker. These features partly explain comparatively low firm-level and aggregate productivity in international terms. Nevertheless, the previous analysis neither informs on the distribution of productivity levels along the capital intensity or sales dimensions, nor on the relation between capital intensity and firm size. The next section moves in this direction by computing a set of conditional distributions in the four selected sectors.

3.2. Conditional distributions

In this section the nonparametric methods suggested by Hyndman *et al.* (1996) are used to analyze the conditional distributions across the pairs of variables *capital intensity-productivity, size-productivity* and *size-capital intensity*. The nonparametric methods allow for the analysis of different features of the data, without making *a priori* assumptions about the underlying causal relationships.[8] The choice of the optimal bandwidths to be used in the estimation of the conditional density is an important component of the estimation procedure, especially when the data does not come from gaussian or uniform distributions. The bandwidth selection method used in this article is the *maximum likelihood cross-validation* and the bandwidth type is *fixed*, as discussed in Hall *et al.* (2004). The np package, by Hayfield e Racine (2008), which runs in the R statistical environment, is used to compute the optimal (data dependent) bandwidth for each conditional density estimation. The continuous kernel type chosen by the package in the different sectors was a second-order Gaussian distribution. These parameters are plugged in the hdrcde package, by Hyndman e Einbeck (2009), in order to estimate and plot the conditional densities and the corresponding highest density regions (HDRs).

Charts 3, 4 and 5 report the estimated robust Kernel conditional distributions for the selected sectors. All variables are taken in natural logarithms. The left-hand side panels present the conditional distributions for the four sectors considered, while the right-hand side panels present the highest density regions (HDRs). The latter plots are computed from the conditional density estimates and show the smallest interval in the sample containing a given probability. This representation provides a clear two-dimensional picture of the information contained in the conditional distributions. The darker-shaded region corresponds to a 50% HDR and the lighter tone delimits the 95% HDR. The mode of each conditional density is shown as a bullet (•).

Chart 3 plots the conditional distributions for productivity relatively to different levels of capital intensity (capital-labour ratio). The figure shows that the conditional distribution of firm's productivity moves to slightly higher values when the conditioning capital-labour ratio increases, i.e., there is a higher probability of finding firms with higher productivity levels among those with higher capital intensity. This relation is stronger for high conditioning levels of capital intensity, especially in sector ``manufactured

8 See, for example, Huynh e Jacho-Chavez (2007) for an application of estimated kernel conditional densities to manufacturing firm-level data from Ecuador and Amador *et al.* (2010) for an application to international trade in Portugal, Spain Greece and Ireland.

non-metallic mineral products". In addition, the conditional distributions are concentrated in relatively narrow intervals, i.e., the amplitude of the HDRs is small. This means that firms within each interval of capital intensity do not show large variability in terms of productivity levels. Nevertheless, the amplitude of the HDRs somewhat increases in high conditioning levels of capital intensity in sector ``manufactured non-metallic mineral products".

As for the conditional distributions of productivity relatively to sales in the four selected sectors, chart 4 shows that there is an increase over higher conditioning values of sales. This positive relation is stronger than the one observed with the conditional distributions on capital-labour ratios in chart 3. However, conversely to the previous set of conditional distributions, the amplitudes of the HDRs are larger for lower values of the conditioning values of sales, i.e., there is a higher dispersion of productivity levels among those firms with lower levels of sales. This pattern is particularly strong in case of ``food and beverages", where some small firms are more productive than very large ones.

Finally, chart 5 presents the conditional distributions of capital-labour ratios along different firm sizes (sales). Firstly, it is possible to identify a positive relation between the conditioning values of sales and the interval of values where the corresponding distribution of capital-labour ratios is placed, i.e., the probability of finding firms with higher capital intensities increases among those of larger size. Secondly, the conditional distributions are dispersed along relatively broad intervals, i.e., the amplitude of the HDRs is large, though clearly decreasing for the largest firms. Therefore, firms with different sizes can present relatively close capital-labour ratios, especially those of medium dimension. Such broad intervals could be explained by the coexistence of firms in different stages of their life-cycle, i.e., different capital vintages. Nevertheless, there are some differences across the four sectors considered. The amplitude of the HDRs is comparatively small for low values of sales in sector ``food and beverages" but increases significantly for medium-size firms. In addition, in the sector ``manufactured non-metallic mineral products" the mode of the conditional distributions strongly increases with firm size, while in the sector ``metallic products, except machinery and equipment" this evolution is the lowest of the four sectors.

Overall, taking the set of four manufacturing sectors under analysis, there is a somewhat higher probability of finding high productivity firms in classes with higher capital-labour intensity and a clearly higher probability amongst those with larger sales. As for sales and capital intensity, there is also a positive relation as more capital intensive firms are found within classes of larger sales. Therefore, the largest firms in terms of sales tend to be those with higher capital-labour technological combinations and these two characteristics tend to lead to higher levels of apparent labour productivity.

4. Concluding remarks

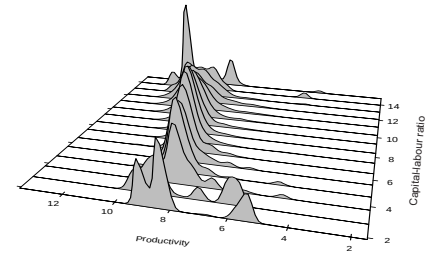
This article selects four representative Portuguese manufacturing sectors - ``food and beverages"; ``clothing"; ``manufactured non-metallic mineral products" and ``metallic products, except machinery and equipment" - and performs a non-parametric analysis using 2007 firm-level data. These sectors are a significant part of the Portuguese manufacturing sector, whose aggregate productivity level is much lower than that observed in the average of the EU-27 countries. The article focuses on the relation between size (sales), capital intensity (capital-labour ratio) and productivity (gross value added per worker) in the selected sectors.

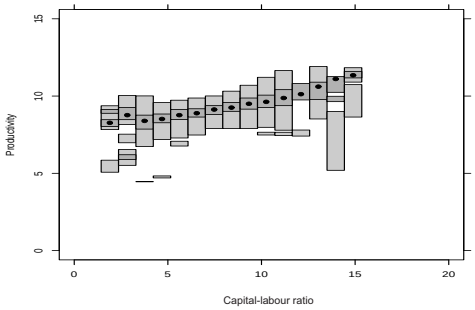
The unconditional distributions for the selected variables reveal some similarities between sectors. Firstly, there is substantial heterogeneity within sectors but firms are concentrated in classes that correspond to small size, low capital-labour ratios and small number of workers. This pattern is particularly strong in sector ``clothing". Secondly, the analysis shows that the relative frequencies of productivity in low-tech sectors ``food and beverages" and, especially, ``clothing" are significantly right-skewed, while medium-low tech sectors ``manufactured non-metallic mineral products" and ``metallic products, except machinery and equipment" have distributions that are closer to the Gaussian shape.

Gráfico 3

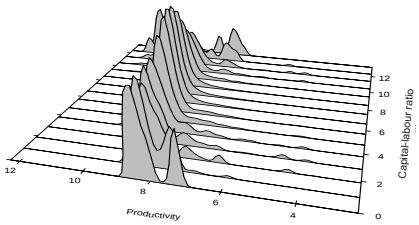
ESTIMATED CONDITIONAL DENSITIES: CAPITAL-LABOUR RATIO - PRODUCTIVITY

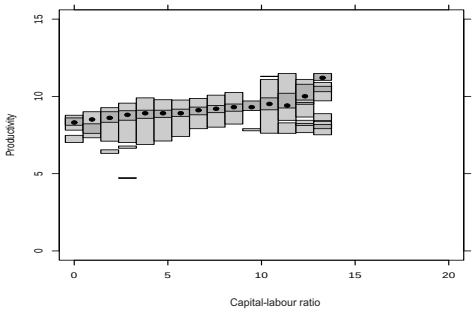
Food and beverages | **Food and beverages**



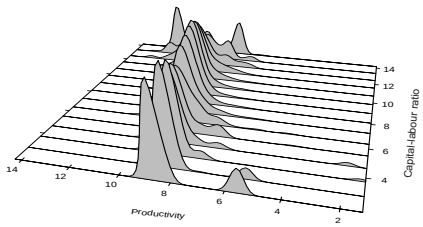


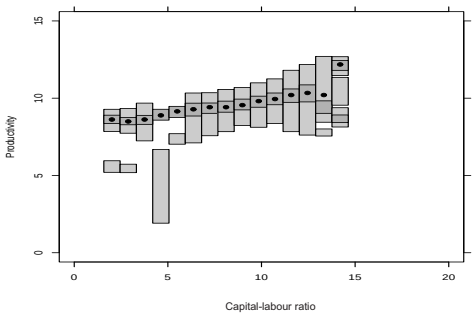
Clothing | **Clothing**



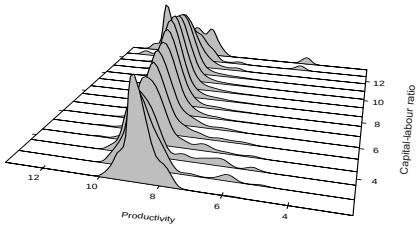


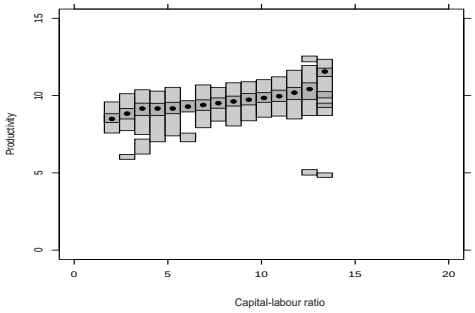
Non-metallic mineral products | **Non-metallic mineral products**





Metallic prod., except machinery and equip. | **Metallic prod., except machinery and equip.**





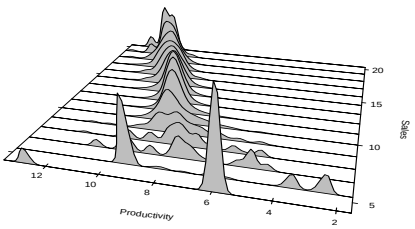
Source: Author's calculations based on a sample from IES.

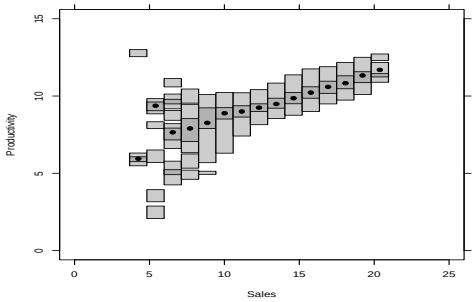
Note: Variables in natural logarithms.

Gráfico 4

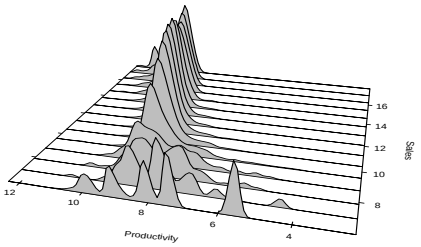
ESTIMATED CONDITIONAL DENSITIES: SALES - PRODUCTIVITY

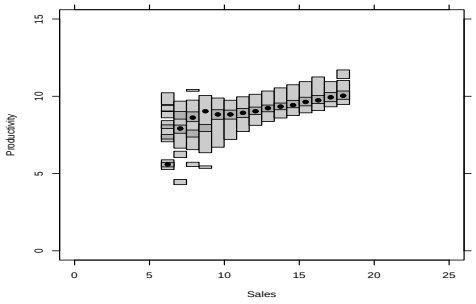
Food and beverages | **Food and beverages**



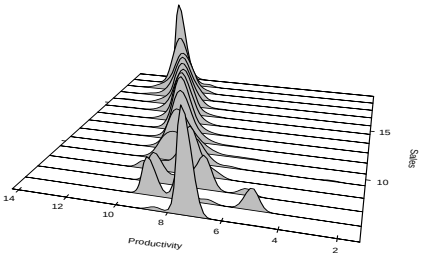


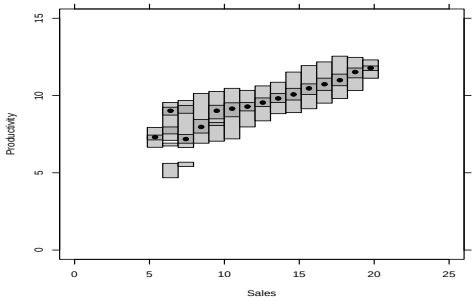
Clothing | **Clothing**



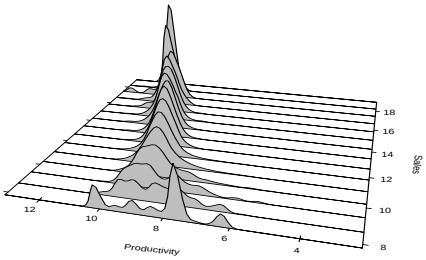


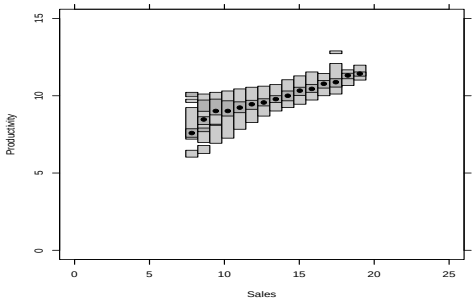
Non-metallic mineral products | **Non-metallic mineral products**





Metallic prod., except machinery and equip. | **Metallic prod., except machinery and equip.**



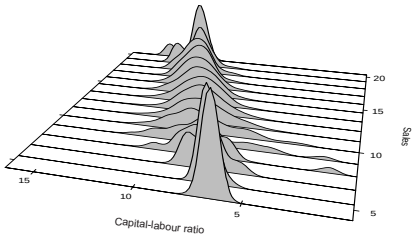


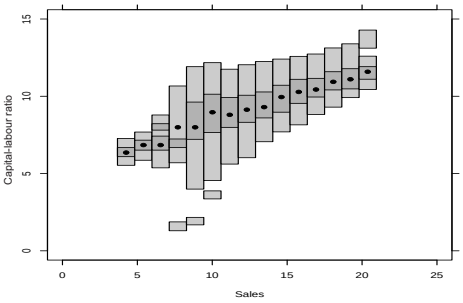
Source: Author's calculations based on a sample from IES.
Note: Variables in natural logarithms.

Chart 5

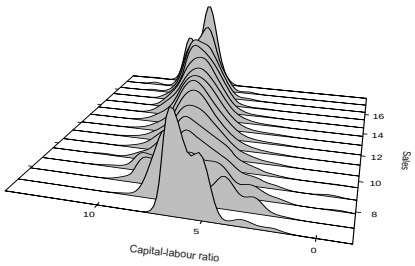
ESTIMATED CONDITIONAL DENSITIES: SALES - CAPITAL-LABOUR RATIO

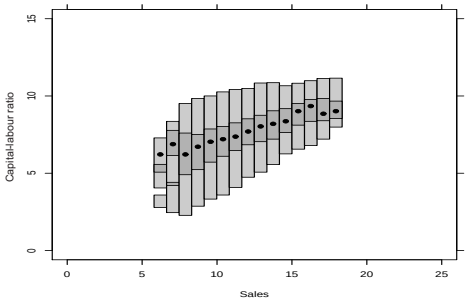
Food and beverages | **Food and beverages**



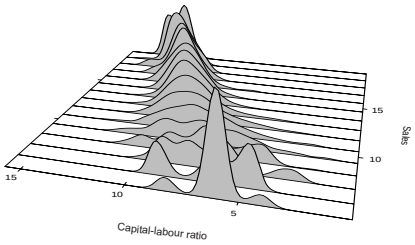


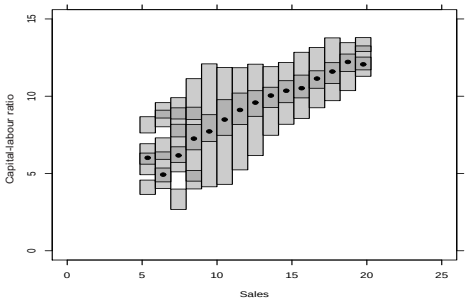
Clothing | **Clothing**



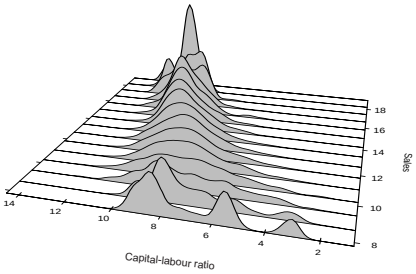


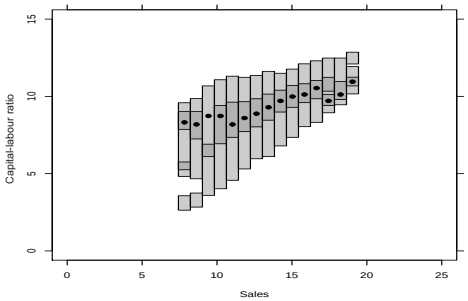
Non-metallic mineral products | **Non-metallic mineral products**





Metallic prod., except machinery and equip. | **Metallic prod., except machinery and equip.**





Source: Author's calculations based on a sample from IES.
Note: Variables in natural logarithms.

As for the conditional distributions, there is a somewhat higher probability of finding high productivity firms amongst those with higher capital intensity and a clearly higher probability amongst those with higher sales. These two latter variables are also positively related as more capital intensive firms are found amongst those that are larger. Nevertheless, some specificities emerge in particular sectors. For example, there is a higher dispersion of productivity levels among those firms with lower levels of sales and this pattern is particularly strong in case of ``food and beverages'', where some small firms are more productive than very large ones. In addition, in this sector, the dispersion of capital-labour ratios is relatively low amongst firms with low levels of sales but increases significantly for medium-size firms.

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Appendix A

DESCRIPTIVE STATISTICS ACCORDING TO CAE - FIRM-LEVEL DATA

		GVA (thousand euro)					Workers					Capital (thousand euro)				
	CAE	pcr 25	Median	pcr 75	Average	Std dev	pcr 25	Median	pcr 75	Average	Std dev	pcr 25	Median	pcr 75	Average	Std dev
Food products and beverages	15	39.6	87.0	227.8	541.3	3 497.8	4	8	16	20	55	24.5	79.9	298.0	1073.6	10295.5
Tobacco	16	6 211.4	9 729.7	103 683.7	70 020.2	110 576.1	93	105	440	320	394	13 385.9	22 096.4	50 668.3	35 337.3	39 005.9
Textiles	17	38.6	104.2	304.1	442.6	1 278.5	4	9	22	26	66	14.2	68.4	316.9	618.1	2 520.4
Clothing	18	44.1	100.6	231.4	252.8	560.9	5	12	24	23	39	6.1	20.9	70.3	136.3	540.3
Leather and footwear	19	55.5	132.5	315.1	361.7	830.2	6	12	27	26	55	11.8	36.1	121.0	204.6	721.3
Wood and products of wood and cork, excep furniture	20	31.7	74.9	186.1	311.0	1 832.2	3	6	11	13	40	11.0	42.8	148.1	371.3	2 068.5
Pulp, paper, paper products	21	64.5	148.7	472.2	2 396.2	16 598.6	5	10	23	31	82	23.8	122.8	582.8	4874.0	42 862.2
Printing and publishing	22	25.6	63.2	175.8	351.1	1 892.7	2	4	9	11	36	6.7	31.7	127.0	352.5	2 755.4
Coke, refined petroleum products and nuclear fuel	23	41.0	118.2	17 865.2	90 042.4	222 689.4	3	5	31	303	770	13.7	354.1	44 662.9	123 861.4	290 034.2
Chemicals and chemical products	24	52.5	191.1	822.3	1 688.0	4 846.4	3	9	25	29	59	22.6	148.5	785.4	2134.0	7 272.8
Rubber and plastics products	25	63.6	191.8	622.9	975.5	7 215.6	4	10	26	28	70	35.4	183.9	657.3	952.6	3 406.5
Other non-metallic mineral products	26	43.5	108.0	308.7	707.1	4 563.0	4	7	16	21	66	21.2	102.4	408.2	1 067.5	6 111.5
Basic metals	27	57.0	182.3	1 011.3	1 700.9	5 445.6	4	10	36	41	77	15.8	120.1	781.9	1 784.9	4 875.2
Fabricated metal products except machinery and equipment	28	34.4	80.8	211.4	304.5	1 130.1	3	6	11	13	32	9.4	37.0	140.4	270.5	1 413.3
Machinery and equipment n.e.c	29	43.7	122.3	388.1	516.7	1 986.5	2	6	17	18	45	10.1	52.9	275.4	407.4	1 333.3
Office, accounting and computing machinery	30	39.8	86.3	774.2	932.9	2 345.4	2	7	17	24	59	25.5	166.4	425.0	307.3	404.5
Electrical machinery and apparatus n.e.c	31	35.9	97.0	341.2	1 167.3	6 049.3	2	6	16	36	185	6.7	36.0	214.3	719.6	3 355.5
Radio, television and communication equipment	32	39.5	146.8	944.4	3 361.6	12 139.6	2	6	35	72	241	6.6	48.4	769.5	3 008.1	14 955.8
Medical, precision and optical instruments	33	25.6	56.2	138.5	298.7	1 596.4	2	3	6	10	39	5.4	22.4	64.2	172.0	1 057.9
Motor vehicles, trailers and semi-trailers	34	66.5	183.8	837.0	2 708.7	13 381.4	5	12	40	71	213	14.8	114.0	968.9	3 159.8	20 683.1
Other transport equipment	35	32.5	120.3	340.6	1 045.6	4 576.1	3	7	20	41	171	6.0	33.2	194.1	850.8	6 061.2
Furniture	36	27.1	68.4	170.7	228.9	938.6	3	6	13	14	48	7.1	35.8	148.8	234.5	890.5
Manufacturing n.e.c; recycling	37	22.9	78.7	333.1	502.0	1 307.1	2	5	11	10	16	18.2	68.2	494.9	705.8	1 760.6
Total		36.9	91.8	252.3	530.0	4829.4	3	7	16	20	63	10.8	46.4	203.4	640.0	7 856.5

Source: Author's calculations based on a sample from IES.

Appendix A

DESCRIPTIVE STATISTICS ACCORDING TO CAE - FIRM-LEVEL DATA

		Sales (thousand euro)					Capital-labour ratio (thousand euro)					Productuvity (thousand euro)				
	CAE	pcr 25	Median	pcr 75	Average	Std dev	pcr 25	Median	pcr 75	Average	Std dev	pcr 25	Median	pcr 75	Average	Std dev
Food products and beverages	15	112.6	243.5	688.0	2687.1	17 304.0	4.1	10.7	28.4	32.2	86.0	8.3	11.7	17.0	16.1	19.5
Tobacco	16	16 653.0	17 369.3	219 049.9	151 345.4	233 295.3	80.4	102.4	156.4	123.8	78.2	63.2	92.7	174.0	127.2	114.8
Textiles	17	82.5	243.8	873.6	1 524.3	4 852.5	2.5	8.8	21.2	17.4	29.7	8.2	12.0	17.1	14.2	12.0
Clothing	18	70.6	163.9	438.6	713.6	2 350.8	0.7	1.9	4.8	5.6	17.6	7.3	9.0	11.4	10.4	8.0
Leather and footwear	19	106.1	262.4	792.0	1 226.4	3 332.9	1.3	3.2	7.1	8.8	34.7	8.5	10.8	14.2	13.2	15.3
Wood and products of wood and cork, excep furniture	20	91.0	228.3	670.4	1 352.2	8 673.6	2.6	7.9	19.0	16.8	30.6	9.6	13.5	19.3	16.3	13.4
Pulp, paper, paper products	21	189.8	553.5	2 031.0	7 453.6	45 643.6	4.5	13.4	36.2	34.5	73.3	11.1	16.6	26.2	23.2	31.2
Printing and publishing	22	68.6	162.6	431.4	897.0	4 570.5	2.2	8.7	23.7	21.2	78.7	10.8	16.5	25.4	21.0	25.5
Coke, refined petroleum products and nuclear fuel	23	105.1	587.4	21 128.6	953 583.4	2 503 996.2	4.4	70.8	282.3	417.2	831.2	8.5	39.4	234.8	191.5	295.9
Chemicals and chemical products	24	175.5	689.2	2 956.4	6 887.0	19 353.4	5.3	16.3	43.0	43.4	88.9	13.1	22.4	40.4	37.4	72.1
Rubber and plastics products	25	206.9	656.2	1 943.0	3 463.2	18 037.5	6.2	17.4	35.8	35.1	82.5	12.8	18.7	28.1	23.3	17.9
Other non-metallic mineral products	26	113.5	275.6	856.9	2 116.2	12 693.5	4.4	13.8	33.6	31.5	67.9	10.1	14.8	21.4	19.2	25.0
Basic metals	27	161.6	566.0	3 827.8	11 013.7	42 810.3	2.7	12.4	36.2	52.2	423.4	12.2	19.0	29.7	28.9	67.6
Fabricated metal products except machinery and equipment	28	101.0	227.1	577.2	985.5	4 954.3	2.2	6.8	17.6	14.5	24.4	10.5	15.0	21.1	17.4	12.6
Machinery and equipment n.e.c	29	108.2	310.7	1 016.9	1 596.9	7 609.8	2.6	9.2	24.3	23.2	118.3	14.2	21.1	29.2	24.6	39.4
Office, accounting and computing machinery	30	119.5	298.6	2 144.4	5 347.4	12 535.0	5.8	18.5	31.3	31.8	57.3	12.3	25.0	36.5	34.4	38.7
Electrical machinery and apparatus n.e.c	31	95.6	260.0	990.7	5 463.4	30 662.5	1.9	6.5	17.7	15.7	34.5	11.7	17.9	26.6	25.2	81.0
Radio, television and communication equipment	32	84.2	351.0	2 315.2	13 406.9	53 004.7	1.5	8.4	25.8	65.1	452.4	12.6	21.2	38.0	30.4	47.7
Medical, precision and optical instruments	33	57.3	131.4	319.8	881.3	5 240.5	1.7	6.8	16.8	13.4	18.8	12.4	18.2	25.9	21.2	15.1
Motor vehicles, trailers and semi-trailers	34	181.5	508.6	2 868.4	15 604.5	95 724.5	3.2	9.9	25.6	22.5	48.3	12.5	18.0	26.0	22.2	27.1
Other transport equipment	35	89.6	280.6	1 112.8	3 008.2	13 952.8	1.3	5.4	13.8	16.3	39.1	10.6	16.7	25.6	19.2	13.3
Furniture	36	74.5	179.5	478.3	786.6	5 114.5	1.7	6.1	15.6	14.1	40.6	7.8	11.2	16.0	13.3	12.1
Manufacturing n.e.c; recycling	37	86.7	305.4	1 448.9	2 780.9	9 105.9	6.3	17.9	47.6	48.9	118.0	9.4	18.2	36.1	29.7	36.6
Total		92.9	230.4	699.4	2 132.1	3 880.0	2.0	7.0	19.9	20.1	76.4	8.9	13.2	20.3	17.5	25.1

Source: Author's calculations based on a sample from IES.