THE PORTUGUESE MANUFACTURING INDUSTRY (1996-2004): WHICH CAPACITY FOR STRUCTURAL CHANGES? [1]

Natércia Godinho Mira - Universidade de Évora - E-mail: nmira@uevora.pt

Resumo:

As decisões de investimento das empresas, quer em investimento físico ou tangível, quer em intangíveis ou capital humano, constituem importantes determinantes do padrão estrutural. Neste contexto, o nosso objectivo consiste em avaliar a habilidade desenvolvida pelas empresas da indústria transformadora Portuguesa, para promover as necessárias alterações no padrão de especialização. Como os investimentos intangíveis são, por natureza, de difícil medição e avaliação, utilizámos taxonomias WIFO aplicadas à indústria transformadora, as quais nos permitem reduzir essa intangibilidade em análises quantitativas. Sem grandes alterações durante o período analisado, os resultados apontam para uma especialização em indústrias intensivas em trabalho e reduzidas competências, o que, sendo revelador de uma reduzida capacidade de adaptação, pode afectar o processo competitivo no seio de um mercado alargado.

Palavras-chave: adaptabilidade, competitividade, decisões de investimento, alteração estrutural, padrão de especialização.

Códigos JEL: L60

Abstract:

The investment decisions of firms in relation to both, physical or intangible investments and to human capital are important determinants of any structural pattern. In this context, our objective is to evaluate the ability developed by firms' Portuguese manufacturing, to make the necessary changes on the specialisation pattern. Because intangible investments are, by nature, difficult to measure and evaluate, we use WIFO taxonomies applied to the manufacturing industry. These taxonomies allow to makes at least some of the intangibles a bit more tangible for quantitative analysis. The results point towards a specialisation in labour-intensive and low-skill manufacturing with no great changes during the period, revealing all the while a reduced capacity to adapt, which could affect the competitive process within an enlarged market.

Keywords: adaptability, competitiveness, investment decisions, structural change, specialisation pattern.

JEL Codes: L60

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1. Introduction

Since Portugal joined the European Economic Community in 1986 and went on to participate in monetary union, as a result of the ratification by Parliament of the Treaty on European Union (EU) in 1992, until the planned establishment of Economic and Monetary Union on 1 January 1999, complete integration within the present European Union has been considered a priority. This integration, as well as Portugal's participation in relation to the euro, was recognised as essential. However, at the same time, it was seen as a challenge because of the competition that would be felt both at the global and at the EU level, and also because of the implications this would have for the competition among firms in the internal market. This challenge became far greater, as the pressure of the process of economic restructuring was increasingly felt, considering the difficulties firms generally came to experience. While new firms were set up and entered the market, there were others which, as they were basically inefficient, were forced out of the market, because they could not deal with the greater competition, whether in the broader sphere or in the domestic market itself.

The question of the firms' competitiveness and of the Portuguese economy in general, is seen as fundamental to the whole process of integration, since it is an economy that is very open to the outside and, as such, is very exposed to international competition. Only by being competitive does an economy have the capacity to, on the one hand, maintain its position in those markets where it does business and, on the other, win new markets. The key aspect of this competitiveness is the adaptability of economies (European Commission, 1999), which is essentially the ability to pursue new opportunities through the accumulation and reuse of resources, as well as through an aptitude to exploit already-existing competitive strengths. This adaptability, fundamental not only to the growth of a country but also to the reduction of the vulnerability of its economy through the development of its capacity to resist unforeseen external economic shocks, is equally important for firms, so that the capacity to adapt is seen as a key element in entrepreneurial competitiveness.

Twenty years after joining and after approximately fourteen consecutive years of financial support from the EU had elapsed, Portugal, in 2004, had one of the lowest levels of productivity among the 15 EU members. In terms of average percentage of the EU 15, for the year productivity was 62.6 and the per capita GDP in PPP[2] was 67.4 (Banco de Portugal, Annual Report, 2004). The use made of structural funds channelled into manufacturing, with the objective of promoting investment and contributing to an increase in levels of productivity in such a way as to guarantee competitiveness among firms within the Single Market, did not appear by then to have ensured that the necessary modifications had been achieved.

In the face of empirical evidence in the mid-1990s indicating that there was a need for a profound restructuring at the industrial level, the objective of this paper is to evaluate the ability developed by manufacturing firms during the period under analysis (1996-2004), to alter the structure of Portuguese industry while it was adapting to new competitive forces[3]. In which way, the firms' investment decisions were as a stimulating force to make the necessary changes in the specialisation pattern of manufacturing industry? Taking the Portuguese manufacturing industry as the basis for this study, it clearly being the dominant industrial sector[4] and the one where transactional goods were concentrated on an international scale, our objective is to evaluate the adaptability of the Portuguese economy to the more aggressive competitive conditions.

This paper is structured as follows. In section 2 a brief overview of theoretical framework around the concepts to be used is given. In section 3, an attempt is made to evaluate the extent of the structural changes that occurred during the period under analysis, since the greater or lesser degree of ability to adapt to the new competitive constraints depends on the pattern of specialisation and on the rhythm of the changes occurring in the structure of the manufacturing industry. In section 4, first of all we analyse the firms' physical investment decisions at the sectoral level, while a potential stimulating force for some of the structural changes, as determinants

[2] Purchasing power parity.

[3] After 2004, these underwent yet further change due to the fact that the EU had expanded, with 10 new countries joining that year.

[4] This refers to industry in its broadest sense which, as well as the Manufacturing Industry, includes mining, electricity, gas, water and construction.

of the capacity for accumulation and the adaptability of the economy. Then, intangible and human capital investments are also taken into consideration, and using the WIFO industrial taxonomies we seek to analyse the specialisation pattern of Portuguese manufacturing industry, with reference either to other studies that apply the same methodology, or that has analysed the evolution of Portuguese manufacturing. Finally, in section 5, some conclusions are drawn from the empirical work carried out.

2. Sctrutural Change, Adaptability and Competitiveness

Depending on the accumulation of human and physical capital, above all the economic growth depends on efficiency with which they are used. So, productivity growth given by the ability to obtain more output from given inputs of labour and capital, depends on the quality of those factors as well as the way of their combination on production – more or less efficiently.

Because productivity growth is determined by a variety of factors, it is difficult to attribute the poor performance of productivity growth to any particular factor. But, in a certain way there is consensus that in certain Member States of the European Union and in the United States too, the information and communication technologies (ICT) and innovation have been determinants in the acceleration of productivity growth (European Commission, 2002).

An essential insight of classical development economics was that economic growth depends on changes in the structure of production, with the industrialization being the driver of technical change and the reallocation of labour from low to high-productivity activities having a positive effect on overall productivity increase (United Nations, 2006).

Despite the several uses of the concepts of structure and structural change in economics, the most common use of structure has to do with the relative importance of sectors in the economy, either in terms of production or factor use, being the industrialization the central process of structural change (Syrquin, 1988).

Discussing the role of what they called “leading sectors”, Freeman and Soete (1997) identified the term “structural change” to the Schumpeterian term of “creative destruction”. In Schumpeter’s theory, the introduction of innovations lead to a process of “creative destruction” with the emergence and growth of new sectors, and the decline of the old technologies. So, creative destruction and structural change have the same meaning, i.e., changes measured by variations in the shares of sectors in output or employment. Freeman and Soete (1997) show how since the First Industrial Revolution both technological change and creative destruction had mainly taking place within the manufacturing sector.

Either Kaldor (1966), considering the manufacturing sector as a driving force for economic growth, or Cornwall (1976) referring the importance of technological changes on manufacturing sectors to productivity improvement in a whole of sectors, concluded that manufacturing is the prime sector leading to economic growth.

The manufacturing industry is the most exposed sector to international competition, because manufactured goods are more tradable than other goods or services. Besides is a sector more intensive in Research and Development (R&D). Therefore, the evolution in manufacturing is a good indicator for capturing the capacity of the economy to react and adjust to globalization challenges.

According to Abramovitz (1986), the notion of adaptability supposes the existence of an interaction between the social capability and the technological opportunity. The level of education and firms, commercial, and financial organizations and other institutional arrangements, are important constrains in its choice and adaptation of technology. “The combination of technological gap and social capability defines a country’s potentiality for productivity advance by way of catch-up” (Abramovitz, 1986, p: 389). So, technological catch-up is much more than replacing an outdated technological set up with a more modern one, implying continuous transformations on technological, economic and institutional structures[5].

[5] In a seminal paper about convergence, Abramovitz (1986) pointed out for the first time the link between structural change and convergence.

While early growth models emphasized the role of capital accumulation without recognize the role of innovation and diffusion of technology in global economic growth, modern growth theories suggest the innovation as a crucial determinant of growth. Technological change and innovations are essential sources of structural change.

Despite several doubts persistence about the relative importance for overall economic and productivity growth, on the one hand of the contribution of productivity growth within the ICT sector and, on the other, of the spillovers from the ICT sector to other industries, an important characteristic of the US economy and some EU Member States that registered a good economic performance, is the intensive use of information and communication technologies (ICT) (European Commission, 2001). ICT is considered a core element of the knowledge society and an important complement to R&D activities.

According to the European Commission (2002), "a key determinant of Europe's recent under–performance in productivity growth is insufficient innovative activity as well as under–investment in, and weak diffusion of, information and communication technologies (ICT)" (European Commission, 2002: p.4).

Although productivity growth in developed countries mainly relies on technological innovation, there is no doubt that changes in the structure of production towards activities with higher levels of productivity, is a crucial determinant of economic growth, where the human capital is crucial[6]. Technology diffusion can only be efficient if the level of human resources is high enough. The human capital contributes to productivity, both at the level of individual workers and at the macroeconomic level, in an intimate relationship between skills and productivity. Only with a labour force of high quality, new technologies, innovation and research and development can be readily exploited.

3. Structural Changes in The Manufacturing Industry

Being the dominant industrial sector, manufacturing it is made up of fairly heterogeneous sub-sectors, with the particularity of having evolved in a differentiated way during the 20th century. In an analysis carried out on nine sub-sectors and with a breakdown to 2 digits of the CAE-Rev 1, Aguiar and Martins (2004) identified a progressive diversification in the Portuguese manufacturing industry up to the 1960s. With the Food, drink and tobacco, Textiles, clothing and footwear and Wood and cork sectors clearly dominant in the first decades of the century, they suffered a reduction in importance, whether in terms of production or of labour force, when the Paper, publishing and printing, Non-metallic minerals, Metallic products, machinery and transport materials sectors came to be of greater importance in manufacturing.

For the period between 1970 and 1996, with the same sub-sectors and similar breakdown, Lança (2000) concluded that the evolution of Portuguese manufacturing was characterized by a great structural immobility, with an accentuated international specialisation on the cluster textil/ leather. With the increasing foreign investment on the automobile industry, at the end of the period the situation changed, with the Metallic products in 1996 being the first sector in terms of exports (37% of total manufacturing), against a significant reduction on the Food, drink and tobacco sector (thirteen percentage points since 1970).

The analysis undertaken by the European Commission in relation to specialisation in European manufacturing between 1986 and 1998 at two levels of breakdown (sector and industry) in fourteen countries, indicates for Portugal, a decrease in specialisation (in terms of production and exports), which is contrary to what was the general trend in the remaining countries (European Commission, 1999). During this period, the greatly reduced specialisation reflected reductions in sectors such as textiles, food production and wood production, with the manufacture of Machinery and equipment and Electrical machinery, together with Vehicle manufacturing, taking their place.

In a breakdown to 3 digits of the CAE for the period 1996 to 2004, we have sought to evaluate how the 101 industries evolved and whether the trend towards a decreasing specialisation identified by the European Commission report was maintained. In terms of the production, export and employment variables, two indicators were used in our analysis,

[6] For details about the relationship between human capital and productivity growth, see for example, Mankiw et al (1992), Barro and Sala-i-Martin (1995) and Vandenbussche et al. (2006) .

namely the Herfindahl Index and the Concentration Ratio. Both indices were used according to the suggestion made by the European Commission (European Commission, 1999) for an analysis of the degree of manufacturing specialisation in determined industries. There are others specialisation indicators, each one with advantages and disadvantages and highlighting different aspects. Not all of them are easy to calculate or interpret, and someone not very intuitive quantitatively. The generalised use of Herfindahl Index and Concentration Ratio in studies about specialisation dictates our choice. Comparing with the Herfindahl Index and others indicators, Concentration Ratio has the advantage of to be most intuitive. This is the reason why it is considered a good complement in all studies of specialisation allowing by simple comparison in two different years, to assess how evolve the degree of specialisation.

Thus, manufacturing is "highly specialised" in production, if a reduced number of sectors or industries (consonant with the breakdown) is responsible for a significant part of production. All changes that occur in specialisation level are a reflexion of how resources are reused within manufacturing industry.

The Herfindahl Index is defined as the sum of the square of the shares of all sectors/industries in the whole manufacturing industry. This makes it very susceptible to influence by the market share of the largest sector or industry. In spite of this disadvantage it is easy to calculate. Its formula is given as:

$$H = \sum (s_i)^2 ,$$

where *i* represents each sector or industry appertaining to manufacturing, and s_i relates to the sector share *i* (or industry) within the total manufacturing industry. The greater the value of *H*, the greater is the degree of specialisation. Over time, increases in the Herfindahl Index are indicative of a greater degree of industrial specialisation and, consequently, of an increase in concentration in a limited number of sectors/industries. On the other hand, decreases in the index point to reductions in specialisation and concentration, which signifiers a greater dispersal of production over a greater number of sectors/industries.

All of the statistical information used was provided by the Instituto Nacional de Estatística - INE (National Institute for Statistics) from the database of the Inquérito às Empresas Harmonizado - IEH (Harmonised Survey of Enterprises). The data were properly weighted by INE in a breakdown of the manufacturing industry into 3 digits of the Classificação das Actividades Económicas - CAE (Classification of Economic Activities) for the period 1996 to 2004.

Relative to the behaviour of this index (based on industries share) and in respect of variable production, it can be seen from Figure 1 that the trend was towards the maintenance of the index in relation to the first year of the period, with no significant fluctuations during the nine years studied. The specialisation of production, relatively stable and with an *H* in the order of 0.025, indicates a high degree of inter-industrial dispersal of production and a reduced mobility. The trend of the index relative to the specialisation of exports and the specialisation of employment was different, with more marked fluctuations and a decreasing trend in the former, in particular from 1999. By then, a reduction in specialisation and in the concentration of exports begins to be seen and thus a dispersal of exports among a greater number of industries. In the case of the index relating to specialisation in employment, the slightly decreasing trend up to the middle of the period is reversed, representing from that point an increase in the degree of specialisation and concentration of employment in a smaller number of industries. Exports and employment, from 2001, revealed diverging trends.

Despite some fluctuations in the index of specialisation of exports and of employment and relative stability in the index of specialisation of production, we can see that, for most of the period, this last index reached values of almost half of the other two, representing a lower concentration in respect of production.

The other indicator, Concentration Ratio (CR_n), provided by the part of the *n* largest industries/sectors in the total manufacturing industry (in production, exports and employment), was used as a secondary indicator. As a Concentration Ratio disadvantage,

is that it only uses information about the largest industries/sectors; besides there is no good guide about the dimension of *n* that should be considered. Its formula is given as:

$$CR_n = \sum_{i=1}^{n} s_i \ ,$$

where *i* represents each sector or industry appertaining to manufacturing, and s_i relates to the sector share *i* (or industry) within the total manufacturing industry.

Such as for the Herfindahl Index, the CR_5 was calculated for each of the variables, based on industries share (Figure 2). During the three years analysed, 1996, 2000 and 2004, the ratio revealed itself to be relatively stable whether for production or for employment. However, the ratio relative to production was far lower, with 25.7% in 1996 and 24.05% in 2004, while for employment the ratio for these years was around 35% to 36%. In relation to the stability of the ratio relative to production, there is also a corresponding relative stability with respect to the five industries which continued as the five largest during the period. They are: Manufacture of petroleum products (CAE 232), Manufacture of other clothing and fashion accessories (CAE 182), Manufacture of motor vehicle (CAE 341), Manufacture of footwear (CAE 193), and Manufacture of other food products (CAE 158). The fluctuations that occurred during the period are slight, indicating an inter-industrial mobility which was reduced in terms of variable production. The industry that falls into fifth place, CAE 193 – the Footwear industry, maintaining a certain degree of regularity until about 2002, became part of the group of the following five in 2003, with 2.9% of the manufactured product in 2004, while in 1996 it had 4%, accentuating the loss of importance in the industrial structure of an industry that had always been considered "traditional" in Portuguese manufacturing[7].

With a greater fluctuation in exports, the five largest industries held on to about 41% of total manufacturing exports in 1996, a concentration which was significantly reduced in 2004, when the CR_5 was 29.94%. In spite of this reduction, which confirms the decreasing specialisation seen in the previous decade, the composition of the group of the five largest industries underwent no major changes: Motor vehicle manufacture (CAE 341) – always on the top during the period[8] (essentiality due to the high foreign investment), Manufacture of other clothing and fashion accessories (CAE 182), the Footwear industry (CAE 193), the Manufacture of pulp, paper and cardboard (CAE 211) and the Manufacture of other work in wood and of work in straw and plaiting materials; the Cork industry (CAE 205). The final year of the period was an exception, with the last of these industries giving place to the Manufacture of electronic components (CAE 321), with 5.3% of the total of manufactured exports although in 1996 this percentage was only 3.2%, with an evident substitution by exports incorporating a higher level of technology.

In addition to the stability of the ratio relative to employment, should be emphasize that the five premier industries were practically the same throughout the period, each of them with relatively stable shares and only one or two changes in their position relative to each other, confirming in this group a reduced inter-industrial mobility in terms of employment.

As important as the structural changes, is the speed of those changes. So, the indicators of the speed of change of production, of exports and of employment were calculated (European Commission, 1999; Aiginger 2000; Aiginger 2001), based on the absolute differences between the shares of the first and of the last years, which were added for all of the industries (3 digits).

$$\text{Speed of Change} = \sum_i \left| s_{i,t} - s_{i,t-n} \right| ,$$

where $s_{i,t}$ and $s_{i,t-n}$ represent the shares in the last year of the period and in the first year, respectively.

Aiginger (2000) drew attention to some of the problems to be taken into consideration when the index is applied, given the difficulty of the measurement of the speed of change through one simple indicator. The fact that the speed of change of shares distinguishes

[7] According to Lança (2000), this industry was part of the main specialisation pole of the Portuguese manufacturing industry, the cluster textil/leather, which was responsible in 1996, for 31% of the exports, 21% of the value added and 32% of the industrial employment.

[8] This confirms the continuity of the good performance in terms of exports of the automobile industry (particularly the motor vehicle sector) founded by Lança (2000).

only one aspect of structural modifications, whose origin could even be varied when adaptability is a complex process with many facets, is among the identified problems.

Varying between a minimum of 0 (in case of maximum similarity between the shares) and a maximum of 200 (when the similarity is minimal), on its own, the structural change expressed by the speed of change indicator is not an objective, though it does represent the capacity for change of an economy or industry, reflecting levels of competitiveness.

The index produces values very different for each of the variables: 26.07 for production, 42.78 for exports, and 20.03 for employment. In the last case, this comprises a fairly moderate structural change and represents some rigidity, which could affect growth.

Aiginger (2001) calculated the speed of change for the manufacturing of 14 EU countries for the period 1985 to 1998. In a breakdown to 3 digits, the results for Portugal point to changes in the order of 49.57 in the case of value added (this was the variable that was used and not production), 44.48 in the case of exports and 40.46 for the speed of change in relation to employment. The correspondent values of the speed of change in the 14 EU countries were 19.27 for value added, 21.33 for exports and 17.48 for employment. Portugal was one of the countries with the fastest structural changes during the period under analysis, ranking, for any of the variables, between first and third of the fourteen countries analysed. Comparing with our results, we can say that there was a significant reduction on structural changes since the middle of 1990's (only results of exports and employment can be comparable).

Calculating the speed of change at sector level and for production, exports and employment with a breakdown to 2 digits of CAE, the sectors considered "winners" and "losers" in terms of their respective shares were identified (Tables 1, 2 and 3).

For every variable, sectors intensive in R&D[9] and with high level labour skills[10] were found among the winners and losers to the same degree as were labour-intensive sectors with low skills in terms of human resources used. Having as its basis those sectors which, from the beginning to the end of the period, registered major changes in respect of shares of production and exports, from 1996 to 2004, we can say that at the first glance, there is no clear trend pointing to huge structural changes, in the sense of a greater weight being given to sectors intensive in R&D and with a greater use of more highly qualified human resources. However, we must refer a positive aspect: there is a slight trend to a decrease in shares (for all variables) of low-technology sectors, such as Food and drinks industries, Tobacco industry, Manufacture of textiles, Clothing industry, preparation, dyeing and manufacture of articles made from fur and Cutting and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear.

4. The Importance of Investment as an Impulse for Change

4.1 The physical investment and the adaptability and capacity for accumulation

As is recognised by neoclassical models (Solow 1957, Barro 1998), gross fixed capital formation and tangible productive investment are determinants in the capacity for accumulation of an economy and, consequently, of its development. In this way, and based on neoclassical theory, we acknowledge the relevance that the variable of physical investment has in the economy in general and in Portuguese manufacturing industry in particular, as a moving force for its development. This is because, apart from contributing to improvements in work productivity itself, it is also through tangible investment that access is provided to new technologies incorporated in the equipment that is acquired.

In relation to this point, the analysis made of the behaviour of Portuguese manufacturing during the period 1996 to 2004 has to do with the way in which the firms' decisions of physical investment evolve at the industry level, while being a potential stimulating

[9] To classify the sectors according their intensity in R&D, we use the OECD Classification which divides the manufacturing industry into high-technology, medium-high-technology, medium-low-technology and low-technology groups. This classification is based on analysis of R&D expenditure and output of 12 OECD countries according to ISIC Rev. 3 (NACE Rev. 1 in Europe). For details see Hatzichronoglou (1997).

[10] Landesmann et al. (2007), in a study about skills and industrial competitiveness, identified industry groups by average skill intensity, classifying in the high-skill intensive, industries such as machinery, electrical and optical equipment and transport equipment, and in the low-skill intensive, industries such as textiles, wood, other manufacturing and recycling.

force for some of the structural changes. Although not corresponding exactly to the value of firms' investment, the variable used, Increase in Material Fixed Assets, is the one which can identify it most closely and which could be obtained from the accounts' details, to become part of the questionnaires undertaken within the ambit of IEH. It corresponds to the total variation of the fixed material assets occurring during the exercise – acquisitions less disinvestments. It includes the work that the enterprise carried out for itself and which is destined for capital assets and corresponds in terms of the variables examined by IEH, to the algebraic sum of three aspects: Increases in Material Fixed Assets, Divestitures, Transfers and Discounts.

For the whole period and at 1996 prices[11], the calculation was made of rates of growth of the variable Increase in Material Fixed Assets, which we will from now on designate Investment. Because of an "unusual" negative value of that variable in 1996 in the industry (CAE 265) motivated by a great value of property transfers, which distort our analysis by the influence on the rates of growth of manufacturing, we take the option of neutralize the effect of that CAE in the total investment and, of course, we excluded its value in the growth rate of manufacturing[12]. For all period, the importance of the investment of that industry in total manufacturing is not very high and relatively stable (around 1 or 2%).

It was concluded that there is some irregularity in this type of expenditure, either in relation to the length of the period under analysis or between the various industries. Despite this, the choice was made to divide the period under analysis into two sub-periods. This was due to the fact that, on average, in the first four years of the period (1996-2000), the number of sectors with negative growth rates in investment was lower, with an average annual growth rate for this period of 6.75% for manufacturing as a whole, while for the following four years (2000-2004) this rate was negative (-15.9%) (see Table 4). As a rule, no clearly defined trends exist in investment' decisions, whether in global terms throughout the period or even at the level of the various industries. This agrees with the findings of the European Commission in relation to the decade 1985 – 1995 by recognizing the volatility of the variable investment, and according to which, because the factors explaining the pattern of investment in European manufacturing are varied, rates of investment were registered which varied as much between the various industries in a given country as between countries (for a given industry). Since this is to do with changes of a technological nature and the reaction to demand, it is an aspect that is also influenced by macroeconomic policies and by the regulatory structure of each country (European Commission 1999).

In spite of the investment irregularity, two sub-periods of analysis were defined and the average annual growth rate was calculated. Throughout all period, the average annual growth in manufacturing was of -4.58%, 36 industries registered negative growth and 75 had higher rates of growth than that of manufacturing as a whole. Taken as a whole, the first sub-period shows an average annual growth higher than the second, which is in fact negative. The average annual growth in manufacturing during this first sub-period was 6.75%, 26 industries having negative growth rates and 62 growing more than manufacturing as a whole. In the second sub-period, a reduction in investment was verified in around 42% of the industries although 77 of the 100 analysed had registered rates of growth of investment higher than that of manufacturing as a whole, which in this period grew by -15.90%.

During the period, the year showing the worst performance in investment was 2002, with the rate of growth in manufacturing at -24.93%; it was the year in which 66 of the 100 industries saw their investment expenditure reduced, compared to the previous year. This deceleration of business investment could be quite naturally related to the slowdown in economic activity which was confirmed for this year, as well as to the heightened levels of firms' debt, which occasioned

[11] Because of the unavailability of a price index at industry level, the variable was deflated by a price index constructed with annual growth prices for Portuguese economy (Banco de Portugal, Annual Reports).

[12] CAE 265 refers to the Cement, lime and plaster industry. In 1996, it was an industry with 46 firms, three of them of a great dimension. For such negative value, a probable explanation could be the restructure of one of those firms, with the consequent distribution of its inheritance, without registration on 1996 of the acquisitions counterparts.

a reduction in the credit that was sought (Banco de Portugal, Annual Report, 2004).

There are many industries in which, although they have overall positive values in the conjunction of the three variables (Increase in Material Fixed Assets, Divestitures, Transfers and Discounts), frequent fluctuations from one year to the next end up bringing in negative rates of growth, a situation which is much more frequent in the second sub-period than in the first. In global terms, comparing both sub-periods, we can talk about a reduction in investment performance.

As our objective is to group industries on the basis of rates of growth in investment, the following criteria for classification were adopted:

Rate of Variation in Investment	Growth/Reduction
Over 100%	Strong growth
Between 50 and 100%	Very high growth
Between 25 and 50%	High growth
Between 10 and 25%	Moderate growth
Between 0 and 10%	Reduced growth
Negative up to -10%	Slight reduction
Between -10 and - 25%	Moderate reduction
Between -25 and - 50%	Strong reduction
Lower than - 50%	Very strong reduction

The different investment performances in the two sub-periods led us to consider an ordination of industries according to the average rates of growth of investment during the first (1996-2000). From among them, we selected and took as our basis for comparison those which registered rates of growth of investment higher than 25%. In total there were 35 industries, whose behaviour during the second sub-period was analysed. This led to a regrouping on the basis of the dynamics of their investment during the period 2000 to 2004 and the formation of three groups with distinct patterns of behaviour with regard to investment (Table 5):

- Group I - those varying between strong growth and high growth;

- Group II - those varying between moderate growth and reduced growth;

- Group III - industries where there was a reduction in investment, moving from a slight reduction to a very strong reduction.

We can verify distinct dynamics of investment in the two sub-periods, with all those industries which in the first were assumed to be strong investors displaying in the second diverse behaviour, moving from the maintenance of their position (Group I and some cases from Group II) to situations of a drastic reduction in investment (Group III), where some industries moved from a situation of strong growth to one of very strong reduction. This is the case of industries of Manufacture of electric motors, generators and transformers (CAE 311) and of Manufacture of aircraft and space vehicles (CAE 353), where the reduction was highest. This clearly means a reduction of expenditure in investment in an industry investing strongly in R&D and with high levels of skills in the workforce.

Out of the total of the 35 industries used as the basis for comparison, only 14 maintained rates of high growth in the second sub-period and, as such, were included in Group I. In general, we could say that the irregularity of investment decisions in each industry throughout the period did not allow us to establish any relationship between the physical investment realised and the structural changes which occurred. However, we must highlight a particular industry, namely, the Manufacture of electronic components (CAE 321) whose behaviour in terms of exports we have emphasize in the structural analysis. Increasing their exports during the period, this industry was one out of the 35 industries with a great performance in terms of investment expenditures in the first sub-period. Besides, belonging to the group I, it has registered a very high growth in the last sub-period. This good performance could be understands as a stake on industries driven by technology, with an evident substitution by exports incorporating a higher level of technology, denoting a capacity to adapt, even if insufficient.

4.2 The investment in intangibles factors of production and the specialisation pattern

The industries' decisions that they will invest in what is frequently called physical (tangible) investment or in intangible and in human capital investments strongly condition and determine the structural pattern and consequently the competitiveness of an economy. The use made of existing technology, as well as of current labour skills in the methods of production utilised, determine its structural pattern, reflecting the strengths and weaknesses underlying them and affecting work productivity and levels of competitiveness.

For this reason, investment in intangible assets in their varied components is taken as fundamental in order to guarantee that the firms' competitiveness is based on their capacity to innovate at the level of products or of processes, with the utilisation of new technologies and new methods and forms of management and organisation. Among them are included, for example, investment in R&D, design, patents and know-how, in marketing, in human resource training, in entrepreneurial organisation, etc. Young (1998) presented a list of possible intangible investments, designating "six core components" divided into: those connected with computers; production and technology; human resources; organisation of the enterprise; an external component: marketing and sales; and a final group related to specific intangibles of determined industries.

According to Hunter et al (2005), from an economic perspective, intangible investments constitute any expenditure which, because it cannot be included as a physical investment, is destined to generate benefits in the long term. Whether in terms of accounting or on the part of economists and managers, there is some uniformity in terms of the identification of intangible investments in non-monetary assets, with no physical manifestation. Nevertheless, the problem is essentially located in the way that these are evaluated. All of them are intangibles, difficult to measure and evaluate. The same authors draw attention to the need for classification and measurement of this type of asset, not only to understand the level of return on investment already made but also so that future investments can be planned and forecasts made.

To what extent this type of investment influences competitive performance at the level of industries and conditions respective structures, has been a question that for a number of years has preoccupied the European Commission.

Recognising the importance of intangible factors of production, the objective of making empirical analyses that take them into consideration viable, has led to an approach towards intangibles, on the one hand centred on the distinction between tangible and intangible factors of production, and on the other based on the skills of human resources (Peneder, 1999). Using as its information base statistics from the manufacturing industry in the Unites States of America[13], the author used cluster statistical techniques with the objective of revealing typical patterns of factors through the classification of observations based on their relative similarities in respect of a multi-dimensional conjunction of variables. The central idea was that of segmenting the data in a way that creates maximum homogeneity within each group and with the maximum distance between groups. This approach gave rise to two new typologies of industry, known as WIFO I and II[14]. Both classifications (presented in Annexes identified as WIFO taxonomies) correspond to Eurostat's revisited NACE system (Statistical Classification of Economic Activities in the European Community) at the three-digit level. There is a direct correspondence between the CAE Rev.2 and the NACE Rev.1.1 until the four digit level.

Considering the importance of intangibles assets, as well as its difficulty of being measurable which is a great barrier for empirical analysis, the European Commission (European Commission, 1999), found in those taxonomies a very useful tool, and use them to analyse the structural pattern of European manufacturing industry. Later we'll made reference to the results founded for Portugal in that report.

[13] At the European Union level, no data exist with identical breakdown in relation to all the variables used.

[14] WIFO – Austrian Institute of Economic Research.

We used those typologies or taxonomies, WIFO I and II, in determining the specialisation pattern of Portuguese manufacturing industry.

The first taxonomy of the industrial structure (WIFO I), it is based on the comparative exogenous advantages dependent on the localisation and, as such, a function of the relative endowments of capital and labour factors (tangible investment) and on the specific endogenous advantages created by the firms, resulting from intangible investments in marketing or in innovation. Its application brought about the grouping of industries into five distinct, mutually exclusive blocks, each of them reflecting typical combinations of productive factors:

- I - Labour-intensive industries;
- II - Capital-intensive industries;
- III - Industries driven by marketing and publicity (publicity-intensive);
- IV - Industries driven by technology (R&D intensive);
- V - Residual industries – The choice of this name is by our owned, and is to do with the fact that, in contrast to the other groups, it is a grouping of industries which are not defined by any productive factor in particular.

Based on taxonomy WIFO I and with a breakdown into 3 digits of CAE, the shares of production, export and employment of the 101 industries which comprise Portuguese manufacturing are in Table 6. Sector 37 – Recycling, encompassing industries 371 and 372, forms part of class D of CAE (manufacturing industries); these did not, however, form part of either of the two taxonomies. We opted to include them in the Group of Residual Industries in the case of taxonomy I and in the Group of low-level skills in the case of taxonomy II.

Although there were few significant alterations in respect of the evolution of any of the groups throughout the period, it is worth highlighting the reduced shares of production and employment with respect to Group IV, the R&D intensive industries (11.06% and 4.83 %, respectively, in 2004), which expresses the lower importance in manufacturing of industries driven by technology, the group where innovation and investment in R&D are important. In terms of export share, the importance of this group is clearly higher (around 20.65% in the same year), denoting a better performance of manufacturing in respect of the composition of its exports. This is so, despite the fact that labour-intensive industries continued to be those which, throughout the whole period, represented the greatest values in terms of exports and employment. Clearly, the data point to a specialisation of manufacturing production in labour-intensive industries (Group I), together with Groups II, III and V, to the detriment of industries that are R&D intensive.

The second taxonomy (WIFO II), it captures another aspect, that of the qualifications and training of human resources, in discriminating between industries according to the use they make of different labour skills. According to this taxonomy, the industries were placed into four distinct groups:

- I - High level of skills;
- II - Medium level of skills (white collar);
- III - Medium level of skills (blue collar);
- IV - Low level of skills.

The application of this second taxonomy, whose results are found in Table 7, allows us to conclude that for every variable, Portuguese manufacturing is clearly deficient in high-level skills, being, on the contrary, specialised in industries which utilise resources with lower qualifications. In terms of production, its pattern of specialisation has not undergone large changes, the only fact registered being that the greatest variation occurred in industries with the lowest levels of skills, which is verified from 1996 to 2000. To be registered as a positive point, there was an increase in the share relative to industries with medium-level skills (white collar). This trend is also verified in relation to export share, with exports in 2004 involving the same type of skills, being around seven percentage points above its value in 1996. Of note is the fact that a reduction in the relative share was verified in the group of industries utilising low-level skills, which, although not very significant, indicates a positive evolution in industrial structure, that is, greater utilisation of more highly qualified human resources.

In 1997 as a result of the WIFO taxonomies application among 14 EU countries, and in contrast with the others, Portugal had among resources used and in terms of Value Added, the lowest share in industries with high levels of competence (5.79%) and the highest share in industries with low levels of competence (52.52%) (European Commission,

1999). The correspondent shares in the EU-15 were 30.43% and 16.75%. There are great differences in the industrial structure across those countries in terms of both tangible versus intangible inputs and skill intensities. This denotes completely different structural patterns, which reflect differences in the use made of technology and in the use of different labour skills.

Zielinska-Glebocka (2005) analyses the specialisation pattern of Polish manufacturing in the period 1993 to 2000, employing those taxonomies. Based on WIFO I, she found that Poland still remains more specialised in labour-intensive, capital intensive and some residual (called of mainstream) industries, and less specialised in R&D industries. With the WIFO II, Polish data show a country more specialised in low-skill and blue collar industries and less specialised in high-skill industries.

Relative to the aspect of the qualifications of human resources (one of the principal non-material resources), one of the indicators pointed out as relevant in this domain is concerned with the percentage of workers with a higher education diploma. In Portuguese manufacturing in the period 1996 to 1999, this percentage was only 13%, equivalent to a little more than a half of the European average (Marques, 2002). These figures, although relating to a decade ago, express very well what has to be done from the point of view of training and qualifications for the manpower that is used on which, to a large degree, the levels of productivity and competitiveness of manufacturing depend.

Measuring growth and the speed of structural change of manufacturing for fourteen EU countries between 1985 and 1998, Aiginger (2001), concluded that Portugal and Ireland share high growth and rapid structural change according to all indicators. Portugal, successful in catching up, with rapid growth and speed of change was classified near the top of the ranking.

In an analysis of the performance in the nineties of the three southern peripheral countries, Spain, Portugal and Greece, Aiginger (2003) concluded that those countries (since 1970) grew faster than the EU, with Portugal reducing its gap per capita at purchasing power parity from 50% to 31%. However, with a low tertiary education, the least educated work force and a research considerably below the EU average, for Portugal were prospected the major difficulties with toughest competition from EU enlargement to take place in 2004.

In a study about the convergence and structural change of the cohesion countries Godinho and Mamede (2004), concluded that: i) in all countries, the standards of living convergence vis-à-vis the EU average were associated with changes in the productive structure; ii) although the good performance of the Portuguese manufacturing industry between 1985 and 1994, when compared with the others cohesion countries, their productivity remains on a lower level; iii) in terms of convergence, the relative success of the Portuguese manufacturing industry has to do with a positive evolution on the subsector of low-tech industries (comprising about 59% of the manufacturing employment), the main sector in all cohesion countries. According our own data, the positive evolution was maintained, because in 1996, low-tech industries[15] accounted for 65% of total manufacturing employment.

In their study, Godinho and Mamede (2004), made use of a similar period of the paper of Aiginger (2001), which, as we saw, presented for Portugal the fastest structural changes of the fourteen countries analysed.

As for the application of these two taxonomies, the following should be noted. As happens in any classification with this range, care has to be taken in any interpretations that are made, in so far as 101 industries were grouped together into five or four different groups (depending on the taxonomy used), since there were naturally within each group industries with a high level of heterogeneity.

5. Conclusions

The empirical analysis undertaken to evaluate the ability developed by manufacturing firms during the period between 1996 and 2004, through the necessary changes to modify the structure of Portuguese manufacturing industry, allows us to draw certain conclusions.

In first place, and from the analysis which was made based on indicators of specialisation, we can conclude that the most significant changes are in respect of exports, with a greater speed of structural change, although with a reduction

[15] According to the OECD Classification mentioned on footnote 9.

in specialisation and concentration and, thus, a dispersal of exports between a greater number of industries. This trend, demonstrated by the Herfindahl Index, was corroborated by a significant reduction of the respective $CR_{5,}$ thus pointing to a continuing decrease in specialisation, a factor which had already manifested itself in the previous decade. Throughout the period and having as its base those sectors which registered the greatest changes in respect of share of production, exports and employment, and so considered "winners" or "losers", there is no clear trend pointing to a huge structural changes, in the sense of a greater weight being given to sectors intensive in R&D and with a greater use of human resources holding a higher level of qualifications.

In relation to the analysis made about the capacity for accumulation and adaptation through the realisation of expenditure on physical investment, we were no able to conclude much more than the existence of a great irregularity in this type of expenditure and a better performance in the first half of the period under analysis, with no clear direct relation with the structural changes which occurred. As an exception, we have highlighted a particular industry included in the high-technology group, namely, the Manufacture of electronic components (CAE 321) by its great performance in terms of both export capacity and investment expenditures. Moreover, we must emphasize the behaviour of the Motor vehicle manufacture (CAE 341), belonging to the medium-high-technology group – always on the top of the five largest industries in terms of exports. Mainly supported by foreign investment, this could be understands as a stake on industries driven by technology, denoting a better performance of manufacturing in respect of the composition of its exports, even if slight.

In respect of the investment in intangibles factors of production and their effects on the structural pattern, the application of WIFO I and II taxonomies led us to conclude that, on the one hand there continues to be a strong stake in labour-intensive industries to the detriment of industries in R&D, reflecting the less important role in Portuguese manufacturing of industries driven by technology. On the other hand, despite a slight improvement in respect of the use of more qualified human resources, Portuguese manufacturing continues to be somewhat deficient in high level skills, remaining, on the contrary, specialised in industries which use resources with lower levels of qualifications. As far as we are concerned, this constitutes a serious obstacle to the development of the industrial sector and strongly conditions the competitive process in an enlarged market, in which, from the point of view of skills, we are presently confronted in a UE-27 with much better qualified partners. Learning and skills development should be priorities whose importance mustn't be forgotten, considering that we have to compete with partners, someone of them that for sure have completely different structural patterns.

In our opinion, the adaptation of Portuguese manufacturing to strong international competition, which has been felt for some time, has been greatly conditioned, not only by displacement in terms of time but also by displacement in terms of the intensity of R&D[16]. The structure of manufacturing in more developed countries, which have rapidly evolved in the direction of there being ever greater incorporation of activities involving a high level of technology, in particular in the realm of ICT (information and communication technologies), requires on the part of Portuguese manufacturing a capacity for adaptation, where innovation has to be a constant concern. This goes beyond the physical investments that have already been made and should be extended to the role of intangible investments, with precise objectives for ever-increasing skills and capacities and an efficient use of ICT. ICT are a key element of the emerging information and knowledge society and an important complement of all R&D activities, playing a crucial role in the modernisation of any economy and in the promotion of innovation, without forget that technology diffusion can only be efficient if the level of human resources is high enough. As we saw, modern

[16] In Lança (2000), chapter 4 about a technological view of the Portuguese manufacturing, was stressed the modest effort of their firms in R&D, innovation and other technological expenses, which constitute an obstacle to their competitive performance. According to the same author (p.2), besides a reduced immaterial investment particularly in R&D, there are other two main structural fragilities in the Portuguese manufacturing industry, namely, the low level of education and qualification of the human resources and a deficient management of a lot of their firms. All of them constitute a serious obstacle to a transition for a more competitive economy based on innovation and quality.

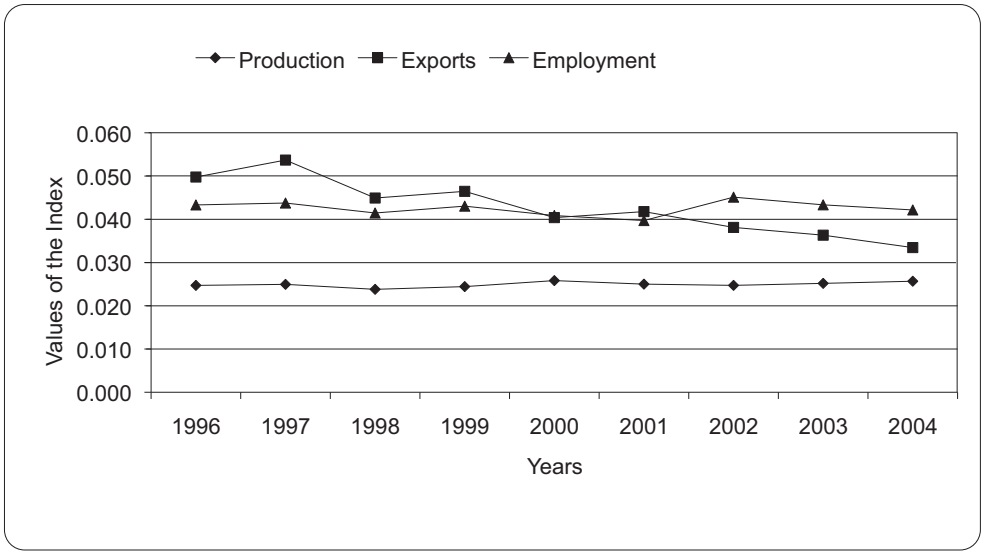
growth theories suggest the innovation is a crucial determinant of growth, with technological change and innovations being essential sources of structural change.

The existing industrial structure, characterised by a low intensity of R&D and human resources and where lower levels of qualifications predominate, denotes a completely different structural pattern when comparing with other countries our competitors, which reflect differences in the use made of technology and at the level of different labour skills, showing that much still has to be done, so that Portuguese firms could compete, under the same conditions, with their European congeners.

6. Annexes

FIGURE 1

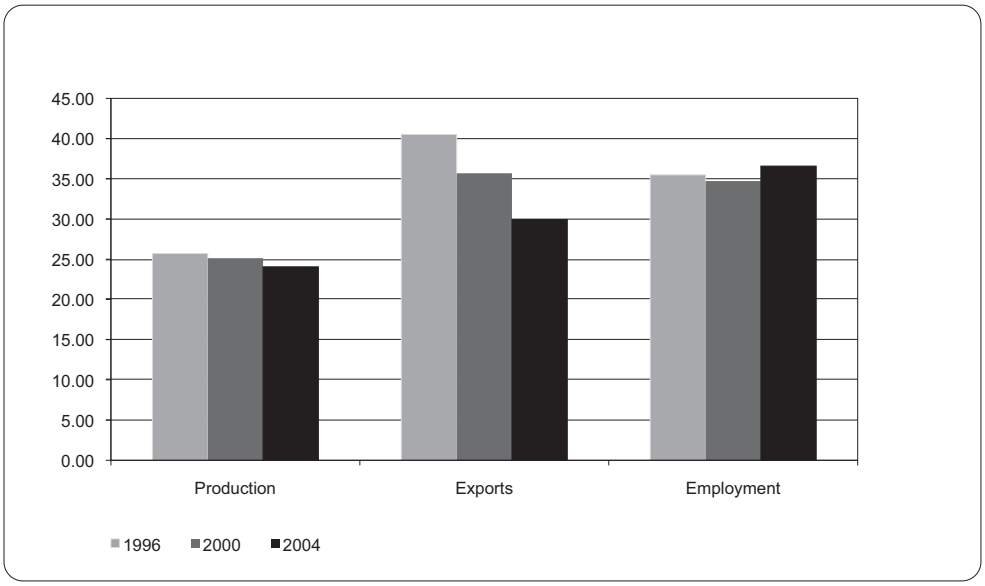
Herfindahl Index (H)



Source: Own processing of data from INE.

FIGURE 2

Market share of the five largest industries (CR5)



Source: Own processing of data from INE.

TABLE 1

Speed of change in production in the Manufacturing Industry (1996-2004)

	CAE – Rev.2 (2 digits)	1996 (%)	2004 (%)	Speed of Change
Sectors with greatest growth in the share of production	Manufacture of equipment and of radio, television and communication appliances	2.97	4.74	1.77
	Manufacture of coke, refined petroleum products and treatment of nuclear fuel	7.31	9.04	1.73
	Manufacture of metallic products, except machines and equipment	5.09	6.32	1.23
	Manufacture of rubber articles and plastic materials	2.23	3.30	1.07
	Base metals industries	2.02	2.82	0.80
Sectors with greatest decrease in the share of production	Tobacco industry	1.29	0.60	0.69
	Food and drinks industries	16.35	15.46	0.89
	Cutting and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	4.69	3.24	1.45
	Manufacture of motor vehicles, trailers and semi-trailers	7.25	5.77	1.48
	Manufacture of textiles	7.94	5.77	2.17

Source: Own processing of data from INE.

TABLE 2

Speed of change in exports in the Manufacturing Industry (1996-2004)

	CAE – Rev.2 (2 digits)	1996 (%)	2004 (%)	Speed of Change
Sectors with greatest growth in the share of exports	Manufacture of equipment and of radio, television and communication appliances	6.04	10.26	4.22
	Manufacture of rubber articles and plastic materials	1.77	4.27	2.50
	Manufacture of metallic products, except machines and equipment	2.45	4.30	1.85
	Manufacture of furniture, other manufacturing industries, non-specified	1.57	3.24	1.67
	Manufacture of electrical equipment and machinery, non-specified	4.35	5.59	1.24
Sectors with greatest decrease in the share of exports	Manufacture of other transport material	2.52	1.46	1.06
	Clothing industry, preparation, dyeing and manufacture of articles made from fur	10.02	7.11	2.91
	Manufacture of textiles	11.01	7.25	3.76
	Cutting and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	8.42	4.47	3.95
	Manufacture of motor vehicles, trailers and semi-trailers	16.59	12.10	4.49

Source: Own processing of data from INE.

TABLE 3

Speed of change in employment in the Manufacturing Industry (1996-2004)

	CAE – Rev.2 (2 digits)	1996 (%)	2004 (%)	Speed of Change
Sectors with greatest growth in the share of employment	Manufacture of metallic products, except machines and equipment	8.05	9.66	1.61
	Manufacture of furniture, other manufacturing industries, non-specified	6.50	7.51	1.01
	Manufacture of rubber articles and plastic materials	1.92	2.90	0.98
	Manufacture of other mineral, non-metallic products	6.70	7.09	0.39
	Food and drinks industries	11.51	11.90	0.39
Sectors with greatest decrease in the share of employment	Manufacture of equipment and of radio, television and communication appliances	1.69	1.45	0.24
	Manufacture of other transport material	1.68	1.17	0.51
	Clothing industry, preparation, dyeing and manufacture of articles made from fur	15.58	14.67	0.91
	Cutting and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	7.99	6.60	1.39
	Manufacture of textiles	11.84	9.55	2.29

Source: Own processing of data from INE.

TABLE 4

Investment trends for the manufacturing industry during the period 1996 to 2004

	1996-2000	2000-2004	2001-2002	1996-2004
Average annual growth in the manufacturing industry (%)	6.75	-15.90	-24.93	-4.58
Nº. of industries with reduction in the growth rate of investment	26	42	66	36
Nº. of industries with growth rates higher than the manufacturing industry in general	62	77	56	75

Source: Own calculations based on data from INE.

TABLE 5

Industries with rates of growth of investment higher than 25% for the period 1996-2000: ordering based on growth during the following sub-period

	CAE - Portuguese Classification of Economic Activities - Rev. 2	Average annual growth 1996-2000 (%)	Average annual growth 2000-2004 (%)
Group I	247 – Manufacture of synthetic or artificial fibres	239.78	Strong growth (487.55)
	263 – Manufacture of tiles, floor tiles, mosaics and ceramic plaques	73.08	Strong growth (359.19)
	268 – Manufacture of other mineral, non-metallic products	284.55	Strong growth (353.08)
	283 – Manufacture of steam generators	157.85	Strong growth (216.45)
	246 – Manufacture of other chemical products	39.97	Strong growth (210.64)
	291 – Man. mach. equip. for prod. and use of mechanical energy	167.73	Strong growth (199.29)
	312 – Manuf. of distrib. and control material for electrical installations	37.86	Strong growth (167.06)
	355 – Manufacture of other transport material, non-specific	54.09	Strong growth (133.36)
	282 – Manufacture of tanks and containers for central heating	72.97	Strong growth (103.64)
	221 – Publishing	125.70	Very high growth (80.94)
	365 – Manufacture of games and toys	351.97	Very high growth (69.47)
	321 – Manufacture of electronic components	251.31	Very high growth (68.87)
	371 – Recycling of scrap iron and metallic waste	2 079.02	Very high growth (67.05)
	341 – Manufacture of motor vehicles	73.77	High growth (43.30)
Group II	156 – Processing of cereals and pulses; manuf. of starches, flours, etc.	267.01	Moderate growth (18.57)
	372 – Recycling of non-metallic waste	32.96	Moderate growth (14.78)
	251 – Manufacture of rubber goods	32.96	Moderate growth (11.37)
	157 – Manufacture of animal feed	28.02	Reduced growth (9.50)
	154 – Production of oils and vegetable and animal fats	155.36	Reduced growth (5.07)
	266 – Manuf.of concrete, plaster, cement and granolithic conc. products	25.48	Reduced growth (1.38)
Group III	300 – Manuf.of office machinery and automatic information equipment	77.86	Slight reduction (-0.36)
	211 – Manufacture of pulp, paper and cardboard (except corrugated)	65.52	Slight reduction (-0.39)
	285 – Treating and coating of metals; general mechanical activities	73.30	Slight reduction (-6.95)
	223 – Reproduction of recording supports	42.95	Slight reduction (-9.47)
	244 – Manufacture of pharmaceutical products	48.23	Slight reduction (-9.76)
	175 – Other textile industries	180.34	Slight reduction (-11.83)
	352 – Manufacture and repair of railway rolling stock	63.27	Moderate reduction (-21.65)
	241 – Manufacture of base chemical products	151.82	Very strong reduction (-51.48)
	275 – Founding of ferrous and non-ferrous metals	41.24	Very strong reduction (-59.06)
	191 – Cutting and dressing of leather	33.91	Very strong reduction (-72.42)
	313 – Manufacture of wires and insulated cable	31.80	Very strong reduction (-83.23)
	202 – Manuf. of veneers, plywood, panels, fibres and other panels	66.54	Very strong reduction (-118.74)
	171 – Preparation and spinning of textile fibres	65.05	Very strong reduction (-242.49)
	311 – Manufacture of electric motors, generators and transformers	138.59	Very strong reduction (-517.46)
	353 – Manufacture of aircraft and space vehicles	98.35	Very strong reduction (-2067.37)

Source: Own calculations based on data from INE.

TABLE 6

Share of Production, Exports and Employment in Total Manufacturing: Application of the Industrial Taxonomy WIFO I (by tangible and intangible factors)

Grouping of Industries	1996	2000	2004
	Share (%)		
Group I – Labour-intensive industries			
Production	24.82	24.47	24.30
Exports	27.84	27.11	26.84
Employment	43.42	43.63	44.64
Group II – Capital-intensive industries			
Production	18.11	20.50	20.86
Exports	16.94	19.17	20.26
Employment	6.18	5.67	5.12
Group III – Publicity-intensive industries			
Production	28.85	24.83	25.06
Exports	16.71	13.94	13.09
Employment	26.38	25.11	25.52
Group IV – R&D-intensive industries			
Production	10.66	11.51	11.06
Exports	21.45	21.56	20.65
Employment	4.90	5.10	4.83
Group V – Residual industries			
Production	17.56	18.70	18.72
Exports	17.05	18.21	19.16
Employment	19.13	20.47	19.85

Source: Own processing of data from INE.

TABLE 7

Share of Production, Exports and Employment in Total Manufacturing: Application of the Industrial Taxonomy WIFO II (by qualifications of human resources)

Grouping of industries	1996	2000	2004
	Share (%)		
Group I – High-level skills			
Production	5.87	5.74	5.68
Exports	5.68	5.80	5.99
Employment	6.19	5.98	6.08
Group II – Medium-level skills (white collar)			
Production	25.59	28.83	29.65
Exports	25.27	29.66	32.62
Employment	13.11	14.00	13.52
Group III – Medium-level skills (blue collar)			
Production	19.77	20.74	20.31
Exports	25.56	24.37	24.65
Employment	21.80	23.51	24.91
Group IV – Low-level skills			
Production	48.76	44.69	44.36
Exports	43.48	40.17	36.73
Employment	58.90	56.51	55.49

Source: Own processing of data from INE.

WIFO TAXONOMY I

industries (CAE Rev. 2) clustered by input combinations

Residual industries	Industries driven by marketing and publicity
1730 Finishing of textiles	1510 Meat products
1770 Knitted and crocheted articles	1520 Fish and fish products
1750 Other textiles	1530 Fruits and vegetables
1760 Knitted and crocheted fabrics	1540 Vegetable and animal oils and fats
2120 Articles of paper and paperboard	1550 Dairy products; ice cream
2430 Paints, coatings, printing ink	1560 Grain mill products and starches
2510 Rubber products	1570 Prepared animal feeds
2520 Plastic products	1580 Other food products
2610 Glass and glass products	1590 Beverages
2660 Articles of concret, plaster and cement	1600 Tobacco products
2680 Other non-metallic mineral products	1910 Tanning and dressing of leather
2720 Tubes	1920 Luggage, handbags, saddlery and harness
2870 Other fabricated metal products	1930 Footwear
2910 Machinery for production, use of mech. power	2210 Publishing
2920 Other general purpose machinery	2220 Printing
2930 Agricultural and forestry machinery	2230 Reproduction of recorded media
2950 Other special purpose machinery	2450 Detergents, cleaning and polishing, perfumes
2960 Weapons and ammunition	2820 Tanks, reservoirs, central heating radiators and boilers
2970 Domestic appliances n. e. c.	2860 Cutlery, tools and general hardware
3110 Electric motors, generators and transformers	3350 Watches and clocks
3130 Isolated wire and cable	3630 Musical instruments
3140 Accumulators, primary cells and primary batteries	3640 Sports goods
3150 Lighting equipment and electric lamps	3650 Games and toys
3540 Motorcycles and bicycles	3660 Miscellaneous manufacturing n. e. c.
3550 Other transport equipment n. e. c.	
3700 Recycling (*)	**Capital intensive industries**
	1710 Textile fibres
Labour intensive industries	2110 Pulp, paper and paperboard
1720 Textile weaving	2310 Coke oven products
1740 Made-up textile articles	2320 Refined petroleum products
1810 Leather clothes	2410 Basic chemicals
1820 Other wearing apparel and accessories	2470 Man-made fibres
1830 Dressing and dyeing of fur; articles of fur	2630 Ceramic tiles and flags
2010 Sawmilling, planing and impregnation of wood	2650 Cement, lime and plaster
2020 Panels and boards of wood	2710 Basic iron and steel, ferro-alloys (ECSC)
2030 Builders' carpentry and joinery	2730 Other first processing of iron and steel
2040 Wooden containers	2740 Basic precious and non-ferrous metals
2050 Other products of wood; articles of cork, etc.	3430 Parts and accessories for motor vehicles
2620 Ceramic goods	
2640 Bricks, tiles and construction products	**Industries driven by technology (R&D intensive)**
2670 Cutting, shaping, finishing of stone	2420 Pesticides, other agro-chemical products
2810 Structural metal products	2440 Pharmaceuticals
2830 Steam generators	2460 Other chemical products
2840 Forging, pressing, stamping and roll forming of metal	3000 Office machinery and computers
2750 Casting of metals	3120 Electricity distribution and control apparatus
2850 Treatment and coating of metals	3210 Electronic valves and tubes, other electronic comp.
2940 Machine-tools	3220 TV, and radio transmitters, apparatus for line telephony
3160 Electrical equipment n. e. c.	3230 TV, radio and recording apparatus
3420 Bodies for motor vehicles, trailers	3310 Medical equipment
3510 Ships and boats	3320 Instruments for measuring, checking, testing, navigating
3520 Railway locomotives and rolling stock	3330 Industrial process control equipment
3610 Furniture	3340 Optical instruments and photographic equipment
3620 Jewellery and related articles	3410 Motor vehicles
	3530 Aircraft and spacecraft

Source: Adapted from European Commission, 1999. (*) This inclusion is of our own responsibility.

WIFO TAXONOMY II

industries (CAE Rev. 2) clustered by qualifications of human resources

High skills
2440 Pharmaceuticals
2910 Machinery for production, use of mech. power
2920 Other general purpose machinery
2930 Agricultural and forestry machinery
2940 Machine-tools
2950 Other special purpose machinery
2960 Weapons and ammunition
3000 Office machinery and computers
3510 Ships and boats
3530 Aircraft and spacecraft
Medium/white collar skills
2110 Pulp, paper and paperboard
2120 Articles of paper and paperboard
2210 Publishing
2220 Printing
2230 Reproduction of recorded media
2310 Coke oven products
2320 Refined petroleum products
2410 Basic chemicals
2420 Pesticides, other agro-chemical products
2430 Paints, coatings, printing ink
2450 Detergents, cleaning and polishing, perfumes
2460 Other chemical products
2470 Man-made fibres
2970 Domestic appliances n. e. c.
3110 Electric motors, generators and transformers
3120 Electricity distribution and control apparatus
3130 Isolated wire and cable
3140 Accumulators, primary cells and primary batteries
3150 Lighting equipment and electric lamps
3160 Electrical equipment n. e. c.
3210 Electronic valves and tubes, other electronic comp.
3220 TV, and radio transmitters, apparatus for line telephony
3230 TV, radio and recording apparatus
3310 Medical equipment
3320 Instruments for measuring, checking, testing, navigating
3330 Industrial process control equipment
3340 Optical instruments and photographic equipment
3350 Watches and clocks
Medium/blue collar skills
2010 Sawmilling, planing and impregnation of wood
2020 Panels and boards of wood
2030 Builders' carpentry and joinery
2040 Wooden containers
2050 Other products of wood; articles of cork, etc.
2810 Structural metal products
2820 Tanks, reservoirs, central heating radiators and boilers
2830 Steam generators
2840 Forging, pressing, stamping and roll forming of metal
2850 Treatment and coating of metals
2860 Cutlery, tools and general hardware

2870 Other fabricated metal products
3410 Motor vehicles
3420 Bodies for motor vehicles, trailers
3430 Parts and accessories for motor vehicles
3520 Railway locomotives and rolling stock
3540 Motorcycles and bicycles
3550 Other transport equipment n. e. c.
3610 Furniture
Low skills
1510 Meat products
1520 Fish and fish products
1530 Fruits and vegetables
1540 Vegetable and animal oils and fats
1550 Dairy products; ice cream
1560 Grain mill products and starches
1570 Prepared animal feeds
1580 Other food products
1590 Beverages
1600 Tobacco products
1710 Textile fibres
1720 Textile weaving
1730 Finishing of textiles
1740 Made-up textile articles
1750 Other textiles
1760 Knitted and crocheted fabrics
1770 Knitted and crocheted articles
1810 Leather clothes
1820 Other wearing apparel and accessories
1830 Dressing and dyeing of fur; articles of fur
1910 Tanning and dressing of leather
1920 Luggage, handbags, saddlery and harness
1930 Footwear
2510 Rubber products
2520 Plastic products
2610 Glass and glass products
2620 Ceramic goods
2630 Ceramic tiles and flags
2640 Bricks, tiles and construction products
2650 Cement, lime and plaster
2660 Articles of concret, plaster and cement
2670 Cutting, shaping, finishing of stone
2680 Other non-metallic mineral products
2710 Basic iron and steel, ferro-alloys (ECSC)
2720 Tubes
2730 Other first processing of iron and steel
2740 Basic precious and non-ferrous metals
2750 Casting of metals
3620 Jewellery and related articles
3630 Musical instruments
3640 Sports goods
3650 Games and toys
3660 Miscellaneous manufacturing n. e. c.
3700 Recycling (*)

Source: Adapted from European Commission, 1999. (*) This inclusion is of our own responsibility.

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