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ECONOMIC PERFORMANCE OF PORTUGUESE COMPANIES 1989-1999: A DEA STUDY

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Abstract

The magazine *Exame 500* publishes each year a listing of the top 500 companies by sales volume, along with accompanying financial indicators. This rich data set is underutilized in the analysis performed by *Exame 500*, rankings and relative performance being assessed in a naïve fashion. This study seeks to provide an enhanced view of the sectoral performance of the Portuguese economy in the period 1989-1999 using the Data Envelopment Analysis (DEA) technique. Additionally, the relative performance of national to foreign-owned companies and public to private companies is assessed. An analysis of the results seeks to understand why certain sectors perform better than others, and how national/ foreign ownership and public/ private objectives matter. The results are interpreted with particular reference to the economic background of the period. Some final comments are presented discussing the usefulness of DEA and possible revisions of the technique as well as other limitations of the study.

Keywords: data envelopment analysis, economic performance, Portuguese companies

1. INTRODUCTION

The Portuguese economy underwent significant development in the period 1989-1999. Notwithstanding the recession around 1993, the economy grew in real terms around 4% per year. Much of this growth can be attributed to Portugal

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playing catch-up with respect to the rest of the European economies, and in particular the euro-zone. The external rigor put on the Portuguese economy by the Maastricht Treaty and generous financial subsidies from the European Commission contributed to this healthy growth rate, along with a continuing liberalization of internal markets. This study seeks to uncover the relative competitiveness of the different sectors in the economy in this period. In other words, which sectors of the economy are most efficient in their utilization of workers and capital in terms of producing profits? This study employs a data set produced by Dun and Bradstreet and published yearly in the magazine *Exame 500, Melhores e Maiores*[1] which publishes eight financial indicators relating to the five hundred largest firms by sales volume. The dataset also includes data relating to ownership: public or private, national or foreign. This allows the study to uncover whether public or private ownership implies an efficiency advantage and also whether foreign owners achieve better efficiency from their companies than national owners.

The results show a spread of different efficiencies between the sectors of the economy, which can be explained by the different cost structures and competitive environment for each area of activity. In addition, the changing economic climate can also be seen to have an impact on sectoral performance. In general, retailing activities are found to perform better and industrial activities less well. Public companies are found to be less efficient than their private counterparts. This result is to be anticipated given the different objectives between public and private companies. Nationally owned companies are found to be better performers than foreign owned companies. This is explained partly as a sectoral issue; foreign companies are concentrated in manufacturing, which is less profitable than services. Other factors such as culture, the investment cycle and exchange rates can also be used to explain the difference between national and foreign owned companies.

This study is divided into the four following sections. Firstly, a discussion of the data set and additional data requirements will be presented. There follows, in the second section, a discussion of the methodology and brief review of the DEA technique. The third section discusses the results obtained from the models that were applied. The fourth section concludes with a reflection on the usefulness of the technique, shortcomings of the particular application and areas for improvement and further research.

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[1] *Exame 500, Melhores e Maiores* is a special edition published annually by the magazine EXAME. Its main purpose is to publicly award a prize to the best performing firms in each economic sector. Only the largest 500 firms in Portugal are analysed. For simplicity reasons, in this study this magazine will be referred as EXAME 500.

2. DATA

Data from the study comprises eight financial indicators for the five hundred largest companies by sales volume in Portugal. The data is published yearly in the magazine Exame (1989-1999), the original source being Dun and Bradstreet, Portugal. The Exame 500 magazine uses the eight financial indicators (see Table 1) to rank the companies on financial performance, each variable given an equal weighting.

The ranking has changed over time: for instance, from 1989 to 1992 six indicators were used. While in 1993 the number of indicators was reduced to five in 1996 it increased to eight, which is the present number of indicators used to rank the financial performance of firms in the Exame 500 list. No justification is given for creating the ranking in such a way. Obvious questions would include why these eight indicators are used, and why equal weights are applied. Additional data is available on the number of workers, the sector of the economy, the nationality of ownership (national or foreign) and if the firm lies within the private or public sector.

TABLE 1

Financial indicators used in Exame 500 to rank firms on financial performance

Indicator	Name
1	Sales growth
2	Net results growth
3	Return on investment (ROI)
4	Return on equity (ROE)
5	Return on sales
6	Gross value added
7	Solvability
8	Liquidity

Supplementary data was sought to be able to fully utilize the base dataset provided by Exame 500. The methodology, described in the next section, requires that labour costs are used as an input, whilst the base dataset contains only information on the number of employees. To translate the number of employees into total labour costs, data was procured to indicate the relative wage levels between the different sectors in Portugal during the period. No consistent data set could be found that would map wage data for all the sectors across the whole period. Data from the International Labour Organization (ILO) was obtained that provided wages by economic activity (see ILO Table 5A in www.ilo.org). Economic activity for this data is defined by the International Standard Industrial Classification

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of all Economic Activities (ISIC) codes, in this case ISIC-Rev. 3. A mapping was made between the sectoral divisions used by Exame 500 and the ISIC codes – often it was necessary to refer to the particular activities of the constituent companies in the Exame 500 sample to fully ascertain the economic sector in question. This mapping allowed the inclusion of wage costs per sector, although the data collected was incomplete for the period. To overcome the problem of incompleteness, it was decided to choose a base year (1998) with complete data and apply this wage data to the whole time period. For the purposes of the model, it is necessary relative values for the wage data between different areas of economic activity. Using this transformation, ISIC Sector H having the lowest wages is fixed at a relative value of 100. Fixing the relative wage values with data from just one year implies that these relative values do not change over time. Thus, our model cannot account for changes in the labour market during this period and notably if productivity gains for different sectors were absorbed into the labour costs or not. Whilst the analysis presented here makes this assumption, it is recognized that labour markets within the different sectors of the economy have barriers which do not permit the free movement of workers to amortize divergent wage rates. Data available for the time period 1995-1998 from OECD National Accounts show that labour compensation per full time equivalent employee rose 6.7% for workers in the aggregate major ISIC sectors G, H and I while in comparison this value rose only 2.5% for major ISIC sector F. Table 2 below provides the relative wage data retrieved from the ILO based on 1998 data and the mapping to the Exame 500 sectors.

3. THE MODEL AND METHODOLOGY

The Exame 500 magazine ranks companies based on a set of performance indicators, most of which are ratios of output to input. Performance evaluation based on this type of performance indicators is a traditional method. In a context where only one input and one output exist, a ratio indicator makes sense, and it is easy to use as a measure of performance. However, that is not the case when multiple inputs and/ or outputs are involved. Each ratio, in that case, only reflects the level of one input and one output, which makes it difficult to understand the global performance of a decision making unit, when not all ratios point to the same level of performance.

When ratios are used to evaluate performance, given their number, it is common to adopt a summary measure of their values, as in the case of the Exame 500 ranking. This aggregation is done to reduce the complexity of the frequently conflicting information given by the performance indicators. The method to aggregate indicators is normally subjective, as the decision maker has to adopt some weighting scheme.

TABLE 2

ILO relative wage data mapped to Exame 500 sectors

Exame Sector	Description		ISIC Rev-3 Major Sector	ISIC Rev-3 Sub-Sector	Relative Wage Index
A1	Agro-food Industry		D	D15	132
A2	Commerce		G	G52	145
A3	Distribution of Foodstuffs		G	G52	145
A4	Sale of Automotive Vehicles		G	G50	145
A5	Construction		F	F45	126
A6	Chemicals		D	D24	132
A7	Precision electrical goods		D	D28 to D32	132
A8	Textiles		D	D17	132
A9	Sale of electrical and electronic goods		G	G52	145
A10	Editorial, information and graphical arts		D	D22	132
A11	Non-metallic minerals		D	D26	132
A12	Transportation equipment		D	D34 to D35	132
A13	Distribution and transportation		I	I60 to I63	257
A14	Wood, cork and furniture		D	D20	132
A15	Fuel distribution		G	G50	145
A16	Services		K	K70 to K71	259
A17	Clothing and leather goods		D	D18 to D19	132
A18	Hotels and restaurants		H	H55	100
A19	Communications		I	I64	257
A20	Pharmaceutical products		D	D24	132
A21	Paper and cellulose products		D	D21	132
A22	Hygiene and cleaning		D	D24	132
A23	Metal work and metallurgy		D	D27 to D31	132
A25	Water, electricity and gas		E	E40 to E41	210
A26	Telecommunications		I	I64	257
A27	Mining		C	C10 to C14	154
A28	Real estate		K	K70	259

Thanassoulis et al. (1996) discuss the advantages of using DEA, rather than performance indicators based on ratios, to assess the performance of decision-making units. DEA is a mathematical programming method to determine the relative efficiencies of a set of organisational units when there are multiple inputs and outputs. The basic DEA model was developed by Charnes et al. (1978), which was followed by many methodological and practical developments (for a good introduction to DEA, see Boussofiane et al., 1991). DEA, unlike ratio analysis, does not require a subjective weighting scheme, as it allows for flexibility in the weights used in determining an aggregate measure of performance.

The approach taken in this study relies on standard production function theory where our inputs to the system are the capital invested and labour costs and the output is net results (see Table 3). Although no comparable studies using mathematical programming techniques in other countries were found in the literature, a similar approach is followed by Lovell (1995) to compare the macroeconomic performance of 10 Asian countries during the period 1970-1988.

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TABLE 3

DEA Model Factors

Inputs	Output
Labour cost Shareholders funds Liabilities	Net results

Labour cost was calculated by multiplying the number of workers by the relative wage index presented in Table 2. *Shareholders funds* and *liabilities* were derived directly from the data available. *Net results* were one of the items in the data available. A small number of companies had negative net results, and the data was transformed by adding a constant to net results so that no negative numbers were present in the data (see for example Lovell, 1995). It is recognised that this transformation has limitations, since the CCR model used is not translation invariant, and it is acknowledged that recent advances in the theory (see Portela et al., 2004) offer other solutions to the problem of handling negative data in DEA. The companies being compared include private and public companies, which may be pursuing different objectives. Public companies are those belonging to the *Sector Empresarial do Estado* or the Business Sector of the State. These companies are in areas deemed to be related to fundamental public infrastructures, the supply of essential services of public interest as well other areas of importance to the economic and social policies. The political and public service element of these companies will necessarily imply a different ex-ante valuation.

A very small number of companies were removed due to data inconsistencies, which would invalidate the model. Additionally, a few sectors were removed for lack of sufficient units (for more on the number o decision-making units, see Pitfall 4.1 in Dyson et al., 2001).

It is to be noted that efficiency in this model is at odds with the traditional definition of allocative efficiency used in economics. In particular, a sector which is able to extract high profits from its productive factors relative to other sectors will appear efficient in the DEA model. In terms of allocative efficiency the picture is reversed; extracting high profit levels from productive factors is symptomatic of reduced competition, insufficient output, prices set too high and poor allocative efficiency (the sector is under allocating resources to production).

The Charnes, Cooper and Rhode's (CCR) model of DEA (Charnes et al., 1978), which assumes constant returns to scale (CRS), with an output orientation, is used in this study. CRS is used, as the set of decision-making units under analysis are of the same order of grandeur, being the 500 biggest companies operating in Portugal. Output orientation is used since the objective of most companies will be to maximise profit, given its inputs.

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In order to compare the performance of different sectors of the Portuguese economy, the original method, by Charnes et al. (1981), to compare different technologies is used. In its first application the method was used to compare the performance of schools under Program Follow Through, a federal program to improve school performance, and schools not under the program.

As the objective is not to assess the performance of individual companies, but the performance of some «policy» or «program» under which they operate, it is necessary to disentangle the managerial efficiency of individual companies from the policy effectiveness of the group.

Initially, each company is assessed within its own economic sector, using the CCR model. The DEA efficiency of each company, within its sector group, is its managerial efficiency. In a second stage, the observed input-output levels of each unit are replaced by its radial targets. The thus transformed units are pooled into one single group, and assessed again. Any inefficiency now detected can then be attributed to the weaknesses of the sector of activity within which the units operate rather than its management. The effectiveness of those sectors' policy or programme can then be estimated.

The same procedure is applied by ownership: separating state and private companies, and separating Portuguese and foreign companies. The Warwick Windows DEA software was used to run the models.

4. DISCUSSION OF RESULTS

4.1. Performance by sector

Having run a DEA model for each of the sectors, and then a model for all the pooled companies together, the evolution of the efficiency scores for each sector over the years can be traced (see Table 4, Figure 1 and Figure 2).

During the period it can be seen that the best performing sectors are in retailing activities, namely those related to commerce (A2), distribution of foodstuffs (A3), fuel distribution (A15), agricultural industry (A1), selling of automotive vehicles (A4), and selling of electronic goods (A9).

It can be noted that all of these sectors are related to commercial activities, as opposed to manufacturing sectors, which this study shows to be poor performers. This result can be justified by noting that typically retailing activities have high profit margins in relation to manufacturing activities.

Some of these sectors have a somewhat countercyclical beha-viour, showing better performance in the recession period (e.g. A1, A13 and A15). This can be understood by noting that it is relative performance being measured and these sectors are essential industries relatively invariant to the

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economic cycle, whereas commerce (A2) receives a negative impact in a recession.

FIGURE 1

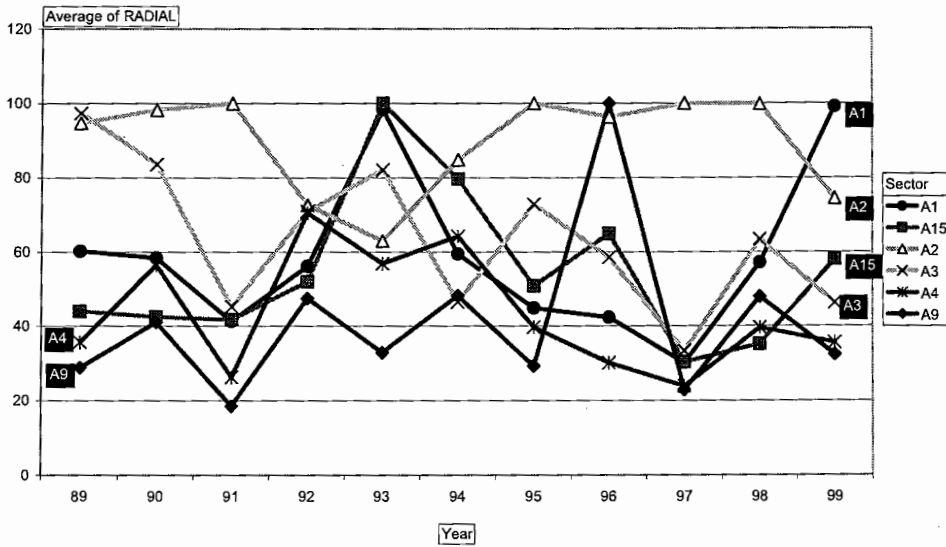Evolution of efficiency scores for sectors of the economy with best average performance

FIGURE 2

Evolution of efficiency scores for selected other sectors of the economy
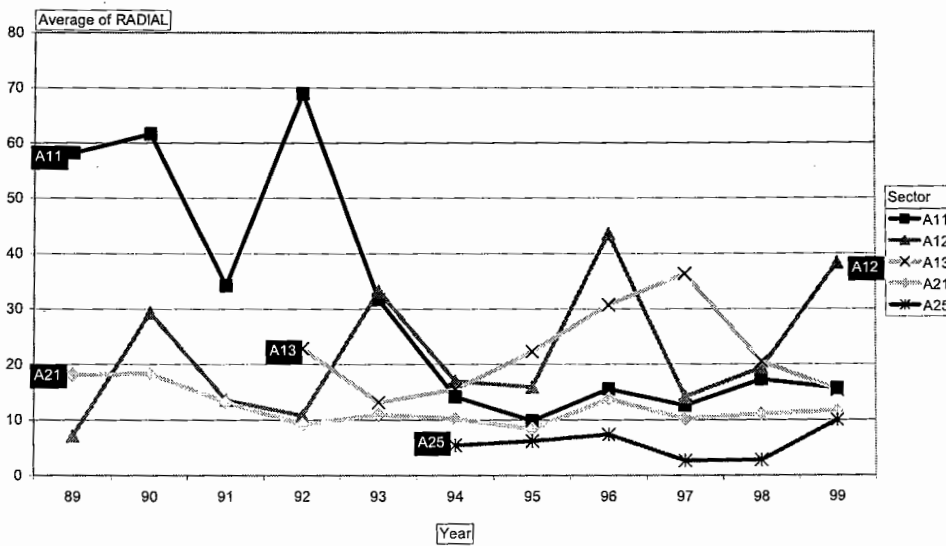

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TABLE 4

Average efficiency scores for each sector of the economy for the period 1989-1999

Year	A1	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A2	A20	A21	A22	A23	A25	A26	A3	A4	A5	A6	A7	A8	A9	Average
89	60	14	58	7	n/a	15	44	19	12	21	28	95	24	18	n/a	11	n/a	n/a	97	36	20	40	26	16	29	45
90	58	21	62	29	n/a	52	43	29	29	14	40	98	24	18	40	15	n/a	n/a	84	56	33	28	34	20	41	51
91	41	25	34	14	n/a	18	42	12	12	23	19	100	16	13	26	12	n/a	n/a	45	26	17	25	15	27	19	34
92	56	26	69	11	23	46	52	44	14	n/a	24	73	34	9	68	13	n/a	n/a	71	70	19	35	25	16	47	47
93	98	33	32	33	13	41	100	50	20	n/a	32	63	48	11	n/a	16	n/a	n/a	82	57	26	35	27	23	33	52
94	59	39	14	17	16	21	80	21	18	15	n/a	85	26	10	n/a	17	5	n/a	47	64	25	31	28	42	48	44
95	45	31	10	16	22	30	51	23	14	15	n/a	100	16	8	n/a	10	6	n/a	73	40	18	24	13	46	29	42
96	42	22	16	44	31	35	65	36	32	n/a	n/a	96	35	14	n/a	19	7	n/a	58	30	11	27	19	54	100	46
97	30	14	13	14	36	29	30	24	46	n/a	n/a	100	18	10	20	16	3	n/a	33	24	17	19	16	19	23	33
98	57	21	17	19	21	57	35	30	31	29	n/a	100	22	11	28	27	3	43	63	40	15	21	26	27	48	43
99	99	21	16	38	15	12	58	100	25	25	n/a	74	24	12	n/a	14	10	18	46	36	11	16	17	23	32	43
Avg.	58	26	30	23	23	31	54	41	23	20	28	90	26	12	37	16	6	29	65	44	19	28	22	28	41	44

Note: n/a – not available because of insufficient data.

TABLE 5

Average number of units for each sector over the time period (where sector/year included)

	A1	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A2	A20	A21	A22	A23	A25	A26	A3	A4	A5	A6	A7	A8	A9	Total
Avg.	61	12	16	16	13	13	13	12	9	7	17	56	13	10	6	12	6	7	43	41	32	23	21	20	20	473

In the first half of the time period, 1989-1993, the non-metallic mineral sector (A11) performed well whilst the sector comprising the sale of electrical and electronic goods (A9) performed poorly. The second half of the time period, 1994-1999, saw a reversal of this trend, with sector A9 and A16 (services) performing strongly, with the non-metallic minerals sector becoming less efficient.

The appearance of retail sales of electrical and electronic goods (A9) as a strong performer in the second half of the period can be explained by the mobile telecommunications boom and the rise of internet technologies. Telecommunications (A26) saw a large amount of growth in this period but huge investment in infrastructures and technologies saw a poor return in the short term. Services also gained in this period with the continual restructuring of the financial industry and liberalization of financial markets and also with Foreign Direct Investment (FDI) in services which overtook that of manufacturing between 1990 and 1995. The presence of the non-metallic mineral sector as a strong performer at the beginning of the period and a weak performer at the end of the period can be explained by the decreasing profitability of this area of activity exemplified by the closure of many mines towards the end of the time period (sector A27, mining, had insufficient units to use in the study). In addition, Secil, a cement manufacturer and the second largest firm in the sector, was privatized in 1994/5 with some restructuring costs.

Amongst the poorest performers are three sectors with clear specificities, namely those related to water, electricity and gas (A25), metal and metallurgy (A23) and construction activities (A5).

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The subsector A25 is particularly heterogeneous. Although the water subsector increased steadily in the first part of the decade and the electricity supplier, EDP, tried to achieve a universal coverage in the same period their market action remained closely linked to the municipalities and as public companies it is difficult to judge them on their profitability.

The metalwork and metallurgy sector (A23) faced a huge transformation due to the flexibilization of the production in order to face both the environmental demands and the restructuring of the European metallurgic industry during the nineties. As the demand shrank and stiffed during the last decade only those firms that remained competitive managed to increase their efficiency in the final part of the decade.

Aside from analysing the efficiency results on the basis of economic factors and market conditions, reference should be made to the varying number of units in each sector. It is acknowledged in the literature regarding the DEA technique that the size of the sample will have a significant effect on the average efficiency of the decision making units (Simpson, 2005). As the sample size increases the probability of uncovering units close to the 'true production' frontier increases. In this case, it is to be expected that a comparison of companies by sector will tend to show that the sectors with more companies are better performers. Indeed, this assertion is given some credence by the data through a comparison of Table 4 and Table 5. The three sectors that have the largest average number of units over the period (A1, A2 and A3) also have above average efficiency scores.

As noted above, limitations of the data prohibit a full analysis taking into account relative variations in compensation per employee over the period. The observation made that between 1995 and 1998 compensation per employee in major ISIC sectors G, H and I rose substantially more than in major ISIC sector F may explain some of the observed average efficiency advantage of sectors such as A2, A3 and A4 over sector A5.

4.2 Performance by ownership type

In comparing the performance of public and private firms the first conclusion that comes to light is the superiority of private firms in relation to public firms with the exception of the year 1994 (see Figure 3). The economic cycle is largely responsible for this inversion as the economy hit a recession in 1993-1994 (see Figure 4). Whilst the recession, as traditionally measured by GDP growth, hit the bottom of the cycle in 1993, companies' profitability is dependent upon capacity utilization which will lag demand in the business cycle. As the economy enters a decline in economic activity, companies have difficulties in reducing productive capacity to match. Capital assets are long term investments that take years to

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adjust to production needs and firms are reluctant and often unable to lay-off workers to match changing conditions. Hence capacity utilization lags the business cycle and with it company efficiency. In Figure 4 it is notable that the output gap is most negative in 1994, the year in which private companies ceded efficiency to public companies. The output gap represents deviations of actual GDP from potential GDP as a percentage of potential GDP – potential GDP being the maximum production possible for the economy without accelerating prices. In addition, the unemployment rate can be seen to be peaking long after the recession has bottomed out – peak level of unemployment in the cycle occurred in 1996 at 7.3%. Firms were unable to adjust their labour usage at the necessary pace to match the reality of the economic conditions – a common malaise of European economies. Private companies are more affected by recessions than state owned areas of activity, which are concentrated in areas of basic services (mainly utilities) and products. Private companies dominate the supply of luxury goods/services which have a high income elasticity of demand. As income falls, demand falls swiftly causing an imbalance between productive capacity and demand which necessitates some adaptation period. Hence, the significant recession of 1993-1994 caused a temporary period of inefficiency for private (relative to public) companies.

The fact that public firms are normally less efficient than private firms is to be expected. Private firms are driven by the overriding necessity to maximize profits. They are thus orientated by the need to maximize the financial return from the productive factors employed, which is the output measure of the model in this paper. Public firms, however, are not necessarily judged solely on their profitability. The objectives of public firms are diverse, including universal coverage (e.g. postal services, train services), equality of access (e.g. TAP, the national air carrier providing discounted flights for residents of the islands) and maintaining a stakeholder position in industries of 'national interest' (e.g. cement, petrol). These benefits are not measured by the financial performance of the company – for these companies the emphasis is on minimizing costs whilst achieving a given service level as opposed to private companies which look to maximize return from the factors employed. In addition, the state has companies in industries which are natural monopolies (e.g. EDP, the electricity supplier). Regulation of natural monopolies implies setting price as close to average cost as possible to maximize allocative efficiency. When this occurs, the measure of efficiency as defined by the model will be close to zero. In reality, sector A25 (Water, electricity and gas) was the poorest performer of the group.

The number of private companies over the period is, on average, 5.5 times larger than that of state companies. As discussed previously, Simpson (2005) has shown that a significant difference in the size of the sample can have the effect of underestimating the efficiency scores of the smaller sample. In this case, the underperformance of state companies will be aggravated relative to private ones.

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FIGURE 3

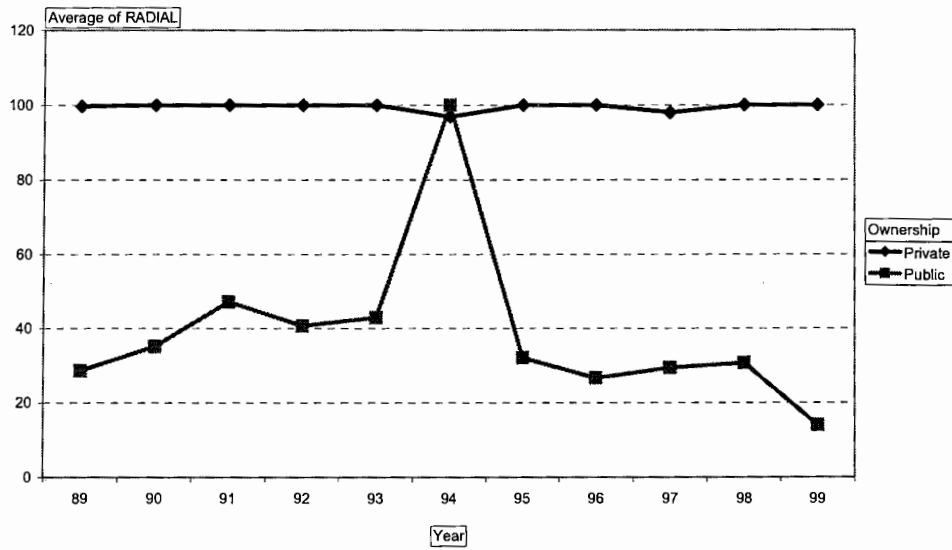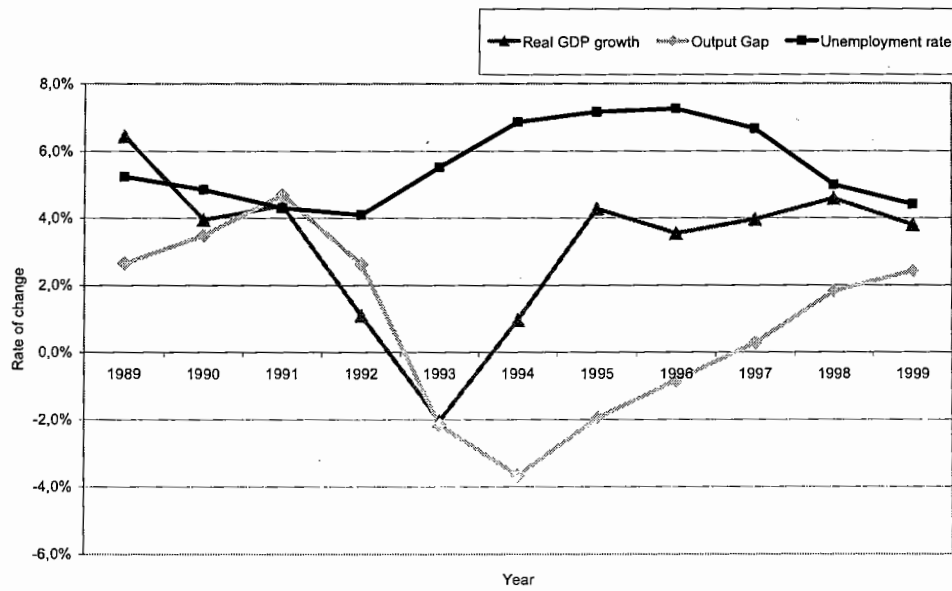**Evolution of efficiency scores by ownership type 1989-1999**

FIGURE 4

**The economic cycle 1989-1999 (source: OECD, www.oecd.org)**

4.3. Performance by nationality

Following on from the discussion at the end of the previous section, comparing the performance of Portuguese to foreign-owned companies should be more robust as Portuguese firms outstrip foreign-owned firms by only 1.5 times.

FIGURE 5

Evolution of efficiency scores for Portuguese and foreign owned companies 1989-1999
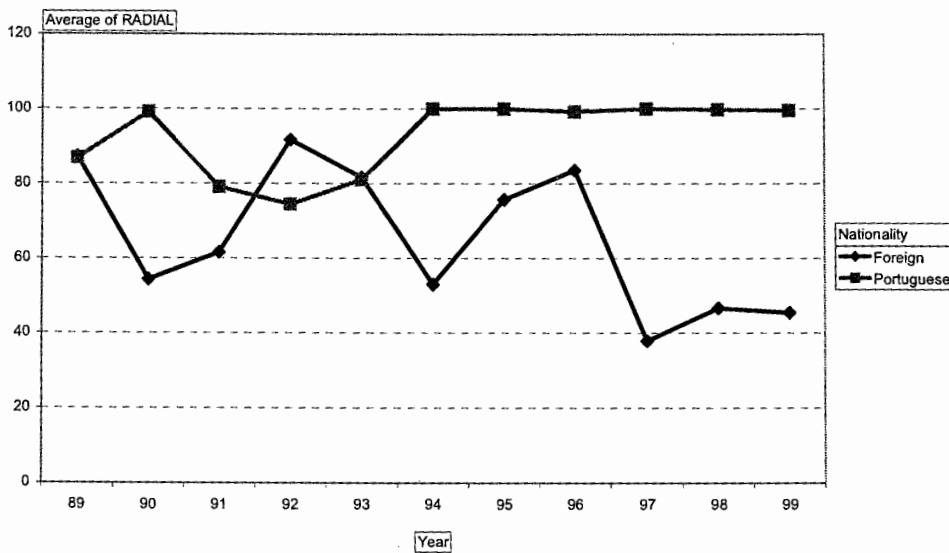
Foreign-owned firms are found to have an advantage in three years – 1989, 1992 and 1993 – with the other years being dominated by the national firms (see Figure 5). It can be further noted that from 1994 foreign owned firms not only have an inferior performance but that the tendency is for performance of foreign owned firms to deteriorate. The explanation of this result is not straightforward but related to many factors impinging on the economy at this time.

There is no evidence to suggest that better performing sectors are dominated by Portuguese owned firms. A test of the correlation between performance efficiency per sector and the percentage of firms under Portuguese ownership per sector reports a value of just 0.12. A different explanation can be sought by looking at the foreign owned firms operating in Portugal. Although many firms relocated their activities to Portugal to benefit from low wages in particular after the entry of Portugal into the European Union in 1986 the decade of the 1990s brought many changes to the business environment. The liberalization of movements of goods and factors worldwide, in conjunction with the growing importance of

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telecommunications and information technology, which reduced the traditional importance of national frontiers, made business a more global activity. Production plants became more integrated into the operations of the business, moving from being mere platforms for export of finished goods to strategic elements in the activity of the business in a global environment. As a consequence of the relative dimension and the international division of labour, multinationals sought to take advantage of the new international perspectives, which led many multinationals to tune their international plants to new global and transnational strategies. The practice of firms moving part of their production to less costly foreign locations is known as offshore outsourcing or just offshoring. Here, production of intermediate goods and services, mainly requiring low-skilled labour, are farmed out to countries with a comparative advantage in their production. This can also extend to finished goods in unskilled sectors, such as for instance, textiles. (IMF World Economic Outlook, April 2007)

This globalisation of the business environment brought consequences for international companies operating in Portugal. The cost of labour increased steadily over the period, outstripping average inflation in Portugal (and more importantly the EU) plus productivity gains. Heavy investment was taking place to reorient the productive operations to be more fully integrated with the business activities. Some companies chose disinvestment and run-down of operations, with subsequent exit costs due to two factors. Firstly, the Portuguese market became inefficient as a local operation. Secondly, with new opportunities opening up in the East of Europe (and elsewhere) the Portuguese operations were not considered viable for continued investment in favour of new start-up operations elsewhere. Portugal lost significant competitive ground against its major trading partners during the period. Seventy-five percent of all external trade occurs within the European community and during the period unit labour costs in ISIC sectors C through K rose some 25% for the euro-zone but 92% in Portugal. (Data from OECD Stat.) The viability of Portugal as a cheap cost base was lost in this period. Whilst the model used assumes that wages levels are fixed over time, this assumption is only limiting in that relative wage levels between sectors are held constant. Given that there is no direct correlation between ownership and sector this will not alter the interpretation of the results given here.

A further explanation of the relative profitability of foreign owned firms can be sought by looking at the international trade environment of the period. Over the period the Portuguese Escudo climbed in value by 20% in trade-weighted terms (Data from OECD). From 1st January 1999 the exchange rate was fixed under the European Monetary Unit (EMU). This adjustment, although over a period of some eight years, was significant and undoubtedly changed the profitability of many industries which produce in Portugal and export into the world economy. Portugal is a small economy and is as such highly dependent upon international (mainly

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EU) economic conditions. The appreciation of a country's currency causes a change in the relative costs of imports and exports, reducing the cost of imports in the local currency and making exports more expensive for foreigners, who have to pay an ever higher price in foreign currency. Many foreign owned firms used Portugal as a production base, exporting the production home or to other target markets. As the exchange rate appreciates, production costs escalate reducing profitability. This exchange rate movement can be seen as a contributing factor towards the decline in the efficiency of foreign owned companies in relation to national companies that are not, in principle, so reliant on exports.

5. CONCLUDING REMARKS

This article has sought to uncover the relative efficiencies of the different sectors of the Portuguese economy during the period 1989-1999 using the DEA methodology. In addition, the data set also allowed for comparisons of performance across ownership testing national against foreign owned firms and public against private owned firms. Performance is defined as profit return on factor inputs employed. In terms of the different sectors of the economy, retailing and commercial activities are seen to be better performers compared to manufacturing. National firms are found to have a performance advantage in comparison to foreign-owned firms, but this is only consistently true towards the end of the period. Publicly owned firms are less efficient than privately owned firms, except for the anomalous period of the 1993-1994 recession in Portugal.

Some of these results can be justified by looking at the innate factors which condition the different firms under analysis. The different orientations of the public and private firms are seen to condition their profit objectives. The different market structures and cost conditions of the sectors of the economy are seen to condition their relative performance. National and foreign firms also operate with different objectives, and are seen to be especially influenced by the international commerce environment of the time. The composite effect of the economic environment (and in particular the business cycle) is responsible for much of the variations in performance behaviour over time. Recessions are shown to affect different firms in different ways, benefiting some (publicly-owned) and hurting others (privately-owned). Exchange rate movements are put forward to justify the falling efficiency of foreign based firms.

There are several limitations that must be made explicit. The first one is that the model cannot account for changes in the labour market during this period and notably if productivity gains for different sectors were absorbed into the labour costs or not. As a consequence the use of better wage data to reflect true labour cost is mandatory to have a better wage cost per sector for the whole period under analysis.

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A second limitation is the time period under analysis. Although one decade is a very short time period for a sound economic analysis it is not yet known how representative this period is.

The CCR model of DEA used throughout the study assumes constant returns to scale, which in certain situations might be arguable. If one compares for example distribution and transportation (A13), fuel distribution (A15) and services (A16) the CRS might be considered a limiting assumption as there might be substantial differences in scale and returns to scale might not be constant. Furthermore an understanding of the results requires that the reader recognize that the study compares sectors of the economy which are not, a priori, homogeneous.

Increasing the time period for another decade would complement the study and permit a better understanding of the evolution of performance over time. Improvements in the availability of statistics mean that more accurate wage data could be employed for a study of the last ten years (1997-2007) allowing the inclusion of changing labour market conditions. Although it is speculative to put forward some possible outcomes it is expected that services and retailing activities would remain better performers than manufacturing activities and national firms would outperform their foreign counterparts due to the liberalization of trade and the global shift of economic activities form Western countries to Asia. On the other side, publicly owned firms are expected to improve their performance vis-à-vis privately owned companies due to the recession period Portugal is going through in the beginning of this new millennium.

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Resumo:

A revista *Exame 500* publica cada ano uma listagem das 500 maiores empresas em Portugal a nível de volume de vendas, bem como um conjunto de indicadores financeiros das mesmas. Este conjunto de dados é sub-analisado pela *Exame 500*, sendo os rankings e o desempenho avaliados de forma *naive*. Este estudo procura fornecer uma visão alargada do desempenho sectorial da economia portuguesa durante o período 1989-1999, utilizando a metodologia da *Data Envelopment Analysis* (DEA). Adicionalmente, também é analisado o desempenho relativo das empresas nacionais face às estrangeiras e das empresas públicas face às privadas. Uma análise dos resultados procura perceber, por um lado, porque certos sectores têm melhor desempenho do que outros e, por outro, o porquê das diferenças entre o sector público e privado e entre as empresas nacionais e estrangeiras. Os resultados são interpretados tendo em consideração o *background* económico do período em causa. Finalmente, são apresentados alguns comentários sobre a utilidade do DEA e sobre possíveis revisões da metodologia utilizada, bem como as limitações do estudo.

Palavras-chave: data envelopment analysis, desempenho económico, empresas portuguesas