NOTASECONÓMICAS

Manufacturing Productivity in Portugal in a Comparative Perspective*

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resumo	résumé / abstract
O presente artigo apresenta e usa a técnica da "abordagem pela indústria de origem" desenvolvida pelo "International Comparisons of Output and Productivity" para comparar a produção real e a produtividade entre Portugal e Reino Unido para o ano de referência de 1987. Os resultados são depois extrapolados para trás até 1977 e para a frente até 1990 para se construir uma visão dinâmica da produtividade.	Cet article présente et utilise la technique de "l'approche par l'industrie d'origine" développée par le "International Comparisons of Output and Productivity" pour comparer la production réelle et la productivité entre Portugal et le Royaume-Uni en 1987. Les résultats sont ensuite extrapolés jusqu'en 1990 et de manière rétrospective jusqu'en 1977 pour obtenir une vision dynamique de la productivité.
	This article presents and uses the technique of the "industry of origin approach" developed by the "International Comparisons of Output and Productivity" for a benchmark comparison of real output and productivity in Portugal and in the UK in the year of 1987. It is further extrapolated backwards to 1977 and forwards to 1990 to get a dynamic view of the productivity performance.

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1. Introduction

After a period of remarkable increasing openness, due mainly to the economic growth after 1985 and to the entry into the European Economic Community, Portugal and their manufacturing sector suffered the impact of the world economic recession.

As a consequence, the debate about the future of the Portuguese manufacturing sector, and the pattern of industrial specialisation has been revived recently and a renewed interest was shown in Portugal. The options of the industrial policy, the productivity growth, the competitiveness and the competitive advantages of the Portuguese manufacturing branches have been the major topics under discussion.

So, the study of the past productivity growth, namely in a comparative perspective, may contribute to this debate and the main purpose of this article is to analyse the productivity of the Portuguese manufacturing sector relative to a base country, according to the industry-of-origin approach. This approach has been developed by the International Comparisons of Output and Productivity (ICOP) project at the University of Groningen and the present study was also carried out in co-operation and with the framework of the ICOP project without whose help and advice it would have been impossible.

The Portuguese manufacturing real output and the productivity were compared with a base country for a given benchmark year. These results were further extrapolated, backwards and forwards, to get a dynamic view of the relative Portuguese productivity level.

The United Kingdom (UK) was chosen as the base country. Firstly, because as a European country (the primary choice) it was also used as a base country in previous ICOP studies, and secondly, because of the facility to work with the data base. The benchmark year chosen was 1987, to allow country comparisons with other studies.

IIn section 2 the two approaches commonly used in country comparison are described. In section 3 the output and the input concepts used are defined. The main two basic data sources used are also described. Section 4 presents the results of the industry-of-origin method for the productivity comparison for the benchmark year between Portugal and the UK. These results are extrapolated in section 5 allowing a tentative ranking with other countries.

2. How to do cross-country comparisons

To make international comparisons of economic performance, namely the real output and productivity growth, all the concepts have to be converted into a single currency. Comparisons based on the official nominal exchange rates can lead to misleading conclusions because they do not reflect the purchasing power of a currency in terms of all the goods and services produced in an economy and because the short term fluctuations are essentially caused by speculative movements in the foreign exchange markets, and capital movements.

To solve this problem, two approaches are commonly used: the "expenditure approach" and the "industry of origin approach".

2.1 The ICPs PPP and the Expenditure Approach

In the expenditure approach the exchange rate[1] is replaced by the "purchasing power parity" (PPP)[2], to convert and to make comparisons at a macro-economic level, that "is to make the comparison in terms of expenditures on GDP and its major subdivisions (consumption, government, and capital formation) and minor subdivisions (food, clothing and the like)" (Kravis et al., 1975: 19).

The PPPs are weighted averages of the price relation of a standard basket of goods and services

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1 The term "exchange rate" signifies the official nominal exchange rate.
2 Defined as the "number of currency units required to by goods equivalent to what can be bought with one unit of the currency of a base country" (Kravis et al., 1975:288)

that belong to the same final expenditure category of Gross Domestic Product (GDP) in two countries. They are, for that reason, essentially used to compare the GDP of the whole national economy, or its final expenditure components.

However, this approach it is not suitable for the comparison of real output or productivity at an industry level because the prices of the final expenditure components reflect the cost of different industry inputs and the effects of import and indirect taxes rather than the real product of one industry.

The wide use of the PPPs is essentially due to the work of the International Comparison Project (ICP) of the United Nations that, since 1975, has provided the PPPs for a large and growing number of countries (see Kravis et al., 1975; 1978; 1982; and Summers and Heston, 1988; 1991). This work is now being developed by the European Community and its statistical office, Eurostat and the OECD.

2.2 The UVR and the Industry of Origin Approach
The industry of origin approach focuses on the study of output and productivity on the production side, in a sectoral perspective, rather than on the demand side. Original studies with this approach were made by Rostas (1948) and Paige and Bombach (1959). Nevertheless, the original method, focusing on comparison of physical output quantities, has been changed and refined by the ICOP project, in order to develop and standardise its application to all the sectors of the economy and to other countries[3].

The basic methodology uses relative unit values (derived from the division of output sales at producer prices by quantities for each country) to calculate "unit value ratios (or industry-of-origin 'purchasing power parities')" (Ark, 1993: 14) for a product or a group of products, which are further aggregated to convert gross value added by sector of an economy to a common currency and thus to make real output and productivity comparisons.

3. Concepts and sources
3.1 The output and input concept
It was necessary to chose a standard output concept that would enable one to make output and productivity comparisons between countries. For that purpose there are two output concepts generally used: the gross value added (GVA), and the gross value of output (GVO).

The GVA concept is defined as the "actual contribution of an industry to the value added generated in the economy as a whole" (Pilat and Rao, 1991: 5), i.e., the value added by the labour and the capital input. The GVO concept is a broader concept than the GVA, because it also includes the intermediate inputs. This poses a problem of duplication, because an intermediate input of an industry is simultaneously an output of another one.

To calculate the productivity it will be necessary to deduct all the intermediate inputs to avoid the problems of duplication of output and productivity[4]. These problems are circumvented with the use of the GVA concept which was the output concept chosen. All the concepts chosen are also expressed at factor cost.

To make accurate comparisons of real labour productivity in the manufacturing sector it is necessary to work with reliable estimates on the output and also on the labour input. Those estimates should also be standardised and well defined, to allow comparisons between countries. In that sense, as labour input the paid employees and the hours actually worked were used, including overtime and excluding the time for vacations, sickness, industrial disputes, work stoppages and strikes.

In Portugal only paid employees are reported in the production census and in the national accounts. The number of hours worked was obtained from a secondary source[5]. However, it is

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3   In Maddison and Ark (1988) and Szirmai and Pilat (1990) one can find a full description of this method applied to the manufacturing sector. A full overview of all the comparisons studies is given by Ark (1993).
4   There are, however, authors (as explained in Ark and Pilat, 1993) to whom the intermediate inputs are as important as the labour and capital input to measure the competitiveness of an industry, or of a sector.
5   See Appendix 5 for references of the sources.

not clear how the paid hours not worked were estimated and how much was deducted to calculate the number of hours actually worked. In spite of the problems mentioned, it was assumed that the statistics were reliable and trustworthy.

In table 1 the annually hours worked per employee in Portugal and in the UK are presented. Because Portuguese employees work more hours than British employees, the Portuguese relative productivity on a per hour basis will be lower than on a per employee basis.

Table 1. Hours worked annually per employee in manufacturing, 1987

Branch	UK	Portugal (a)
Food, Beverages & Tobacco	1.705	2.028
Textiles, Wearing Apparel, Leather & Footwear	1.560	2.064
Wood Products	1.840	2.043
Paper Products	1.646	1.993
Chemical Products	1.742	1.900
Rubber & Plastic Products	1.716	1.945
Non-Metallic Mineral Products	1.861	2.033
Basic & Fabricated Metal Products	1.792	2.051
Machinery & Transport Equipment	1.823	2.041
Electrical Appliances	1.754	1.929
Other	1.704	2.030
Total manufacturing	1.763	2.037

Source: For Portugal see appendix 5. For the UK the source was Ark (1993).
Note: (a) To estimate average number of hours actually worked per employee in Portugal in 1987, the ratio of the total number of hours actually worked and the total number of employees in March was used. This ratio was further multiplied by eleven (the number of working months, i.e. excluding vacations).

3.2 The reconciliation of the production census and the national accounts
There are two basic data sources that can be used to make the productivity comparisons: the production census and the national accounts. The main differences between those two data sources, for Portugal, are presented in table 2.

Table 2. GVA and employment by manufacturing branches, Portugal, 1987

Branch	GVA			Employment		
	National Accounts (mln.)(1)	Production Census (mln.)(2)	(2)/(1) (%)	National Accounts (thous.)(3)	Production Census (thous.)(4)	(3)/(4) (%)
Food Manufacturing	172.791	115.490	66,8	98,2	69,1	70,3
Beverages	59.158	30.265	51,2	10,2	8,4	82,7
Tobacco (a)	6.874	21.332	310,3	1,5	1,9	127,7
Textiles & Wearing Apparel	375.974	212.709	56,6	265,3	191,0	72,0
Leather & Footwear	46.138	32.373	70,2	35,1	30,9	88,1
Wood Products	65.774	45.663	69,4	63,8	48,5	76,1
Paper Products	113.931	120.520	105,8	37,2	39,3	105,7
Chemicals	96.858	109.233	112,8	35,0	34,2	97,6
Rubber & Plastic Products	27.670	33.207	120,0	19,3	20,0	103,8
Non-Metallic Mineral Products	110.981	91.200	82,2	58,1	49,8	85,7
Basic & Fabricated Mineral Prod.	123.616	80.652	65,2	72,6	50,2	69,1
Machinery & Transport Equipment	128.697	85.576	66,5	63,9	57,8	90,5
Electrical Appliances	58.613	49.388	84,3	27,4	22,5	82,1
Other	13.385	5.918	44,2	14,7	5,1	34,7
Total Manufacturing	1.400.460	1.033.525	73,8	802,3	628,9	78,4

Source: see appendix 5.
Note (a) There is a wide discrepancy in the tobacco industry between the census and the national accounts GVA. A possible explanation is that it is highly probable that the culture of tobacco is also considered in the production census (it should not be included) which is not the case of the national accounts. It might also be that some taxes (it was impossible to know to what degree) are included in the GVA of the production census.
Those errors are probably derived from the answers given to the questionnaire by the firm that has the monopoly control of tobacco production which obviously were not correct on those items.

It is possible to see that in Portugal and for the year of 1987, the production census estimates of GVA and employment, for manufacturing, were generally lower than national accounts estimates. The GVA and the employment in the production census were, respectively, 73,8% and 78,4% of the national accounts estimates. This can be explained by several reasons, such as:

1. The economic activity is more widely covered by national accounts. The production census was still based, for this year, on questionnaires that cover all "estabelecimentos", but leaving out the informal activities that are not covered at all. The informal activities are estimated, in the national accounts, with the use of coefficients which are applied to the surveyed activities. Those coefficients are a good approximate measure of the relation between the researched activities and the actual economic activity.

2. The census does not achieve a full coverage of the economic activity, because it is based on questionnaires that are not all returned and are not sent to all the firms.

3. The coverage of the economic activity is not the same. Mining activities are part of non-metallic mineral products and of basic and fabricated mineral products in the national accounts, whereas this activity is excluded from the census.

4. The geographical coverage is also not the same. Production census includes continental Portugal, and the islands of Azores and Madeira whereas the national accounts only include continental Portugal. However, the contribution of the islands to the employment is about 1,5% and to the GVA about 1,4% of total in the census.

5. Different statistical units are used. National accounts are based on the "product approach" that allows one to estimate an Input-Output table. Because of that the statistic unit used is the "unidade de produção homogénea" identical to the concept of "activity unit" (Ark, 1993: 56), which represents a specific manufacturing activity with the production of a homogeneous product. The production census uses the concept of "estabelecimento", corresponding to the "local unit" (Ark, 1993: 56) which represents a manufacturing unit located at a single postal address able to produce heterogeneous products. With this concept it is difficult to know all the product transactions between the "local units", and therefore it is difficult to estimate the exact production and intermediate input by product. However, this problem is not entirely solved with the use of the "product approach" in the national accounts.

6. The national accounts for 1987 are only provisional.

A further observation has to be made. 1987 is not a base year for the calculation of national accounts. The Portuguese national accounts are based on a quinquennial system. Every five years the "Matriz de Produção Nacional[6] is estimated, on the production and on the employment side, which gives a fairly good estimate of the economic activity. The national accounts are further calculated with the use of the latter. For the years in between the full coverage of the economic activity is estimated with the use of the last matrix known (in this case, 1986) and the information provided by other sources, like the production census.

In spite of the techniques used, the calculation of national accounts is still affected by the underestimation of the informal activities, and because of that, the underestimation of the actual economic activity.

Nevertheless the differences found in those statistical sources, the calculation of the Portuguese productivity in manufacturing sector will not be highly influenced by the one chosen. The GVA and the employment in the production census expressed as a percentage of the national accounts is highly similar (73,8% and 78,4% respectively). This means that the productivity will also be very similar in both sources.

To make the cross-country comparison of output and productivity, for the chosen benchmark

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6 National Production Matrix.

year, this study uses as a main source the production census[7]. Firstly because the production census provides the detailed information required for the cross-country comparison: the output and the labour input by industry level; and secondly, because the information being reported from a single source is more consistent.

To do the extrapolation of the benchmark results the national accounts[8] series were used which is much more useful for the following reasons:

1. The base, i.e. the number of covered "local units", in the production census is more unstable in a time series. The questionnaires, as mentioned above, are not all returned, and do not achieve a full coverage, or at least a constant coverage throughout the period. There are probably some firms that are created and not included in the base, and therefore not researched. With the national accounts techniques, it is possible to have almost a constant coverage of the real economic activity throughout the years.

2. Whereas national accounts are based on a "product approach" that is not the case of the production census based on an "local unit approach". Therefore a change in a product might re-allocate the "local unit" to another activity, whereas this would not happen in the national accounts.

3. To reduce the costs of research, a sampling technique has been used (also in Portugal, after 1988) for the production census. Probably the base will change each year. This is not the case for the national accounts.

4. To construct output series at constant prices from the production census it would be necessary to use deflators from other sources, while national accounts provide the needed deflators to rebuild the series at constant prices.

The technique of extrapolation is used because the benchmark studies are time consuming and the necessary data besides the fact that they are published with some delay, sometimes are not available for every year.

4. The estimation of the UVRs

4.1 The matching procedure
The conversion of the output of both countries to a single currency is made with the use of unit value ratios (UVRs). To estimate them it was necessary to find products, or groups of products, in the production census of both countries, to be matched according to their characteristics, which should be as similar as possible, in a given benchmark year. Afterwards the UVRs, resulting from the matchings, are aggregated to obtain, consecutively, a UVR for the industry, for the branch and finally for the manufacturing sector[9].

However, matching products was not always easy because:

1. The unit of measurement is not always the same in each country. For example, some textile products, like cotton, were measured in terms of tonnes in Portugal and in terms of square meters in the UK. However, for some products, like tobacco, it was possible to convert the different units used, to a common unit with the use of expert information.

2. In some cases the census does not give information on quantities produced or sales value, because the information was generally confidential.

3. Some products are produced only in one country, like Port Wine.

4. There are products, or groups of products, that are similar between countries, in their characteristics, like vehicles in general, but because they have different qualities in terms of

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7 See Appendix 5 for references of the sources.
8 See Appendix 5 for references of the sources.
9 See Appendix 1 for a more detailed description of the aggregation method of the UVRs.

"product-mix" they cannot be matched, at least not with the "normal technique". The matching procedure of these products will be later discussed.

5. The UVR is an average price ratio, and therefore the unit values of the matched products that seem to distort the UVRs for the aggregates were not used.

It is also important to have a high percentage of the matched output to the total production, so that the UVRs could be reliable, acceptable and trustworthy.

4.2 The quality problem

As explained above, the estimated UVRs are highly dependent on the product matches and from the assumption that the matched products have similar qualities. However, the problem is that it is always possible to match products of the same categories which can result in UVRs not representative for the aggregates because of a quality difference.

Therefore, to calculate reliable UVRs, the differences of the products in terms of their characteristics and in terms of their main functions and qualities or even consumer tastes, not listed in the census, should be considered and if possible, quality adjustments must be made. The quality problem is discussed in Ark (1993) where he describes the problem of the "product-mix", related with the degree of homogeneity of its characteristics (e.g., for passenger cars it is possible to specify the cylinder capacity, etc.), and the "product content", related to the way that the products can perform certain functions (the quality of the construction, etc.), which are more difficult to describe.

Because of the lack of information, quality adjustments for this study were only made for passenger cars. To do the adjustments two categories of passenger cars were conceived, accordingly to cylinder capacity (under 1.250 c.c.. and between 1.300 and 1.450 c.c.). Afterwards, a method[10] to adjust the obtained average unit value for all passenger cars was used, in order to calculate the unit values for the two categories, but maintaining constant the total physical quantities and the total ex-factory sales.

Table 3. Main results of estimates of UVRs for passenger cars, 1987

Class	Passenger cars in units (share of total)		Unit value in national currency (ratio to the total)		Unit Value Ratio (a) (GBP/PTE[11]) (ratio of total)
	Portugal	UK	Portugal	UK	
Category one-Small cars (cars below 1.250 c.c.)	56.123 (82,1)	32.520 (6,2)	623.620 (0,95)	2.902,3 (0,69)	214,88 (1,38)
Category two-Medium cars (cars 1.300 c.c. - 1.450 c.c.)	12.223 (17,9)	493.180 (93,8)	819.447 (1,24)	4.327,1 (1,02)	189,38 (1,22)
Total cars produced unadjusted quality	68.346 (100,0)	525.700 (100,0)	658.641 (1,00)	4.238,9 (1,00)	155,38 (1,00)
Weighted unit value of Portugues cars adjusted for qualitye			658.641	3.157,1(b)	208,62
Weighted unit value of British cars adjusted for quality			807.300(c)	4.238,9	190,46
Geometric average UVR for cars adjusted for quality					199,33
Official nominal exchange rate					230,69

Notes: (a) The UVR is the ratio of the Portuguese unit value to the British one in national currency.
(b) Calculated using Portuguese quantity weights.
(c) Calculated using British quantity weights.

10 The method is fully described in Appendix 2. The same method was used e.g. in Ark (1990).
11 GBP/PTE is the quantity of Portuguese Escudos per Great Britain Pound.

Table 3 shows the main results derived from this method. Only the unit value for medium cars in the UK is almost similar to the total unit value. The table also shows that the UVR derived when quality adjustments are not made (155,38) is substantially lower than the UVR derived for each category of car produced when adjustments for quality are made (214,88 for category one and 189,38 for category two) and lower than the geometric average UVR for cars adjusted for quality (199,33).

The geometric average UVR of passenger cars adjusted for quality, is simultaneously the UVR for the industry motor vehicles and their engines because no more matches were made inside this industry. The UVR found for this industry is also identical to the UVR found for the branch machinery and transport equipment, were it belongs, because no more matches were made inside this branch. The UVR found for the branch was therefore derived from two product matches: two categories of passenger cars.

Besides the low number of matched products a low matching percentage in this branch was also achieved: 17,2% and 4,1% in the UK and Portugal respectively (table 5).

Since in this branch the products are very heterogeneous and consequently with different UVRs, and because a low matching percentage was obtained, it is difficult to assume that the UVR derived for the passenger cars is reliable and representative for the branch.

Another method was therefore used to derive the UVR for the branch. With the ICP PPPs, the ratio of the transport equipment PPP to that for total equipment PPP[12] was calculated. This ratio was then applied to the UVR of the motor vehicle industry to derive the UVR for the machinery and transport equipment branch. To use this method it is necessary to assume that the differences between the UVRs and the PPPs are proportionately the same across-countries. The results of this procedure are described in table 4.

Table 4. Main results of the estimation of UVR and PPPs for the machinery and transport equipment branch, 1987 (GBP/PTE)

Equipment ICP PPP	(1)	231,45
Transport Equipment ICP PPP	(2)	258,03
Transport Equipment/Equipment	(3)=(2)/(1)	1,1149
UVR for Motor Vehicles and their Engines	(4)	199,33
UVR derived for Machinery and Transport Equipment	(4)/(3)	178,80

Note: all the UVR were derived on a Fisher basis.

The UVR, for machinery and transport equipment obtained from the above procedure (199,33) is not very different from the one directly obtained by the matching procedure (178,80), i.e. the former is 11,49% higher than the latter (as it is shown in line 3). For that reason, for the rest of this study the UVR derived from the matching procedure was used.

4.3 Comments on the results

In table 5 the UVRs for each branch[13], the matching percentages and the number of UVRs are presented. As no product matches were made for the residual branch "other manufacturing products", it was assumed that the corresponding UVR was equal to the total manufacturing UVR.

12 The ICP PPPs were only available for the year of 1990. With the use of index number of producer prices obtained from CSO (1992) for the UK and index prices of GVA at factor cost obtained from INE (various issues) the PPPs were backdated to 1987.
The ICP PPPs are from Eurostat and are not published. The former information and the statistics from CSO were kindly provided by Prof. Bart van Ark.
13 Petroleum refining was not included because the UVR derived from the matching technique distorted the UVR for the industry and for the branch, and consequently all the subsequent results.

For Portugal 29,7% of the GVO was covered by product matches, whereas for the UK the matching percentage in terms of sales of goods produced (including receipts for work done and services rendered) was 14,4%. For a total of 130 product matches, this coverage can be considered satisfactory, although there is a high variation shown among industries. A high matching percentage was achieved in wearing apparel, leather and footwear, whereas in wood, paper, machinery and transport equipment, and electrical appliances the matching percentage was rather low. The main reason for this is that the products of those branches are heterogeneous and therefore much more difficult to match. The high matching percentage found for the tobacco and beverages is biased by the probable inclusion of excise duties in the Portuguese production census.

Table 5. UVR by manufacturing branch, matching percentages and number of UVRs, 1987

| Branch | Unit Value Ratio (GBP/PTE) | | | | | | |
| | Quantity Weights | | Geometric average | Relative Price Level(a) | Matching Percentages (%) | | Number of UVRs |
	British	Portg.		(UK=100)	UK	Portg.	
Food Manufacturing	212,64	209,04	210,83	91,4	18,2	31,1	18
Beverages	109,76	104,97	107,34	46,5	45,0	49,6	2
Tobacco	145,87	129,06	137,21	59,5	100,0	88,9	3
Textiles	175,56	194,91	184,98	80,2	26,8	28,5	22
Wearing Apparel	191,19	197,91	194,52	84,3	63,3	60,8	12
Leather & Footwear	181,33	173,80	177,53	77,0	35,5	79,9	10
Wood Products	113,36	114,19	113,78	49,3	8,3	29,9	2
Paper Products	147,39	154,73	151,02	65,5	7,2	16,8	3
Chemicals	204,95	195,44	200,14	86,8	15,6	30,6	27
Rubber & Plastic Products	204,59	189,80	197,06	85,4	21,1	44,3	11
Non-Metallic Mineral Products	247,48	231,38	239,30	103,7	10,6	33,7	3
Basic & Fabricated Metal Prod.	206,30	242,31	223,58	96,9	35,1	29,9	8
Machinery & Transport Equip.	190,46	208,62	199,33	86,4	17,2	4,1	2
Electrical Appliances	200,52	212,73	206,53	89,5	5,3	15,6	7
Other	189,82	184,75	187,27	81,2			
Total Manufacturing	189,82	184,75	187,27	81,2	14,4	29,7	130
Official Nominal Exchange Rate	230,69	230,69	230,69				

Note: (a) The relative price level is the ratio of the geometric average UVR to the official nominal exchange rate.

One can see that the UVRs are different from the exchange rate, and that there is a discrepancy in the UVRs among the industries covered. Generally, the UVRs are lower (with the exception of the non-metallic mineral products) than the exchange rate. And if one takes as a reference for the long run equilibrium exchange rate the UVR, or the industry of origin Purchasing PPPs, derived for the total manufacturing, i.e. 1 GBP=187,27 PTE, then the actual value of the Portuguese escudo 1 GBP=230,69 PTE is undervalued in 18,8%. Or, in other worths, the Portuguese escudo must appreciate against to the Great Britain Pound in 18,8% to equate the long run equilibrium exchange rate or the rate that would equate the prices of the manufacturing products produced in the respective countries.

As a consequence the relative price level, that is the ratio of the UVR to the exchange rate, is generally under 100. The price level of al the branches, excluding non-metallic mineral products and of manufacturing sector in Portugal, are below that in the UK. The price level of the manufacturing sector in Portugal is 81,2% of the UK.

The low relative price level generally found is mainly due to the value of the exchange rate, and to the devaluation policy used by the Portuguese government in the 1980s to give a competitive position to Portuguese exports.

The lowest UVRs are found for the branches of beverages, tobacco, wood and paper products and for textiles, leather and footwear. The highest UVR, although with a UVR similar to the exchange rate, is found for non-metallic mineral products. This implies that the use of the UVRs to convert the GVA into a single currency will result in higher estimates of output and productivity in Portugal relative to the UK than the use of the exchange rate.

With the UVRs it was possible to convert the GVA in national currency to the other country currency[14] and thus calculate the productivity in each of the two countries and the relative productivity level which are presented in table 6.

It shows that the relative Portuguese productivity level is around 48,3% of the British one, and that there is not a wide discrepancy among branches, with the exception of beverages, tobacco and of the paper products.

The high Portuguese relative productivity in beverages and in tobacco is probably upward biased by the inclusion of some taxes (like excise duties[15]) in the GVA. The Portuguese high relative productivity in paper products (95,1%) can be explained by the technology used in Portugal (capital intensive), as in most other countries, which was absorbed from the technological best-practice countries. Therefore, the technology used in Portugal and in the UK is very similar.

The lowest relative productivity is found for non-metallic minerals, basic and fabricated metal products and machinery and transport equipment. For the largest Portuguese manufacturing branch, i.e. textiles (which is also the branch with the highest relative GVA level: 31,2% of the British GVA, with 6,2% for the manufacturing sector) a relative productivity level of 50,7% was found, similar to the manufacturing average. Therefore, Portugal has not benefited from the fact of having an important relative textile branch because the latter is not producing relatively better than the total manufacturing.

It is also possible to see that there is not a wide discrepancy between the Portuguese relative productivity level with British prices (48,9% for total manufacturing) and with Portuguese prices (47,6% also for total manufacturing).

Table 6. GVA per employee by manufacturing branches, Portugal and UK, 1987						
	at British prices			at Portuguese prices		geom. average
Branch	UK (in GBP)	Port.	Port./UK (%)	UK (in PTE)	Port.	Port./UK (%)	Port./UK (%)
Food Manufacturing	18.971	7.998	42,2	4.033.978	1.671.896	41,4	41,8
Beverages	27.792	34.186	123,0	3.050.337	3.588.477	117,6	120,3
Tobacco	45.113	86.314	191,3	6.580.794	11.139.589	169,3	180,0
Textiles	12.702	6.112	48,1	2.229.992	1.191.275	53,4	50,7
Wearing Apparel	8.423	4.559	54,1	1.610.303	902.380	56,0	55,1
Leather & Footwear	11.304	6.025	53,3	2.049.751	1.047.204	51,1	52,2
Wood Products	15.178	8.238	54,3	1.720.636	940.674	54,7	54,5
Paper Products	21.343	19.802	92,8	3.145.733	3.064.018	97,4	95,1
Chemicals	34.172	16.364	47,9	7.003.407	3.198.054	45,7	46,8
Rubber & Plastic Prod.	18.171	8.730	48,0	3.717.502	1.656.932	44,6	46,3
Non-Metal. Mineral Prod.	21.754	7.919	36,4	5.383.703	1.832.312	34,0	35,2
Basic & Fab. Metal Prod.	17.894	6.630	37,1	3.691.605	1.606.605	43,5	40,2
Mach. & Transp. Equip.	18.730	7.066	37,7	3.567.294	1.474.089	41,3	39,5
Electrical Appliances	16.442	10.368	63,1	3.296.919	2.205.546	66,9	64,9
Other	7.335	6.234	85,0	1.392.334	1.151.778	82,7	83,8
Total Manufacturing	18.173	8.895	48,9	3.449.569	1.643.446	47,6	48,3

14 The method is described in Appendix 3.
15 See also note of table 2.

The overall results are not different from what could be expected, showing a relative productivity gap between the two countries.

Table 7. GVA per hour worked, Portugal and UK, 1987

Branch	at British prices			at Portuguese prices			geom. average
	UK	Port.	Port./UK	UK	Port.	Port./UK	Port./UK
	(in GBP)		%	(in PTE)		(%)	(%)
Food, Beverages & Tobacco	12,5	6,2	50,0	2.323,1	1.037,1	44,6	47,3
Text, Wear. App., Leat., Foot.	6,8	2,8	40,7	1.242,5	535,1	43,1	41,9
Wood Products	8,2	4,0	48,9	935,1	460,5	49,2	49,1
Paper Products	13,0	9,9	76,6	1.911,1	1.537,2	80,4	78,5
Chemicals	19,6	8,6	43,9	4.020,3	1.683,1	41,9	42,9
Rubber & Plastic Products	10,6	4,5	42,4	2.166,4	852,1	39,3	40,8
Non-Metallic Mineral Products	11,7	3,9	33,3	2.892,9	901,1	31,1	32,2
Basic & Fabricated Metal Prod.	10,0	3,2	32,4	2.059,7	783,2	38,0	35,1
Machinery & Transport Equip.	10,3	3,5	33,7	1.956,4	722,3	36,9	35,3
Electrical Appliances	9,4	5,4	57,3	1.879,7	1.143,4	60,8	59,1
Other	4,3	3,1	71,3	817,1	567,3	69,4	70,4
Total Manufacturing	10,4	4,4	41,8	1.981,6	807,0	40,7	41,3

The relative productivity measured in terms of hours worked is lower than the productivity measured in terms of employees, because working hours in Portugal are greater than in the UK (table 1). While the Portuguese productivity, on a per employee basis, relative to the UK is 48,3%, the relative productivity on a per hour basis is only 41,3%, total manufacturing (minus 7%).

5. The extrapolation of the results

5.1 The use of time series
The benchmark results for 1987 were extrapolated, backwards and forwards, with the time series taken from national accounts[16].

Graph 1 shows Portuguese GVA per employee expressed as a percentage of the British one[17]. From the graph it is possible to see that, in the period under analysis, the relative Portuguese productivity for total manufacturing did not improve (Portugal started with a relative productivity level of 49,8% in 1977 and finished with 48,4% in 1990).
The dynamics of the comparative productivity performance were not the same, in this period:

1. There is a partial recovery in the Portuguese manufacturing productivity, reaching its peak in 1980, with a relative productivity level of approximately 54,7%.

2. After 1980, the relative productivity level started to deteriorate and in 1985 it reaches the lowest level (about 44%).

3. After 1986, the relative productivity level remained approximately constant.

The dynamics of the comparative productivity performance were also not the same in all major branches.

1. There is a catch-up[18] process in the branches that observed the lowest relative productivity levels in 1977 (under the levels of the total manufacturing relative productivity), i.e. basic and fabricated mineral products, engineering and others. The catch-up was rapid in the residual

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16 The extrapolation method is described in Appendix 4. The British and the Portuguese time series were taken respectively from Ark (1993) and from INE (various issues).
17 All the results are derived on a Fisher basis.
18 Catch-up is defined by Abramovitz (1986) as a reduction in the productivity gap compared to the leading country (in this study, the UK).

Graph 1. GVA per Employee, UK=100, 1977-1990
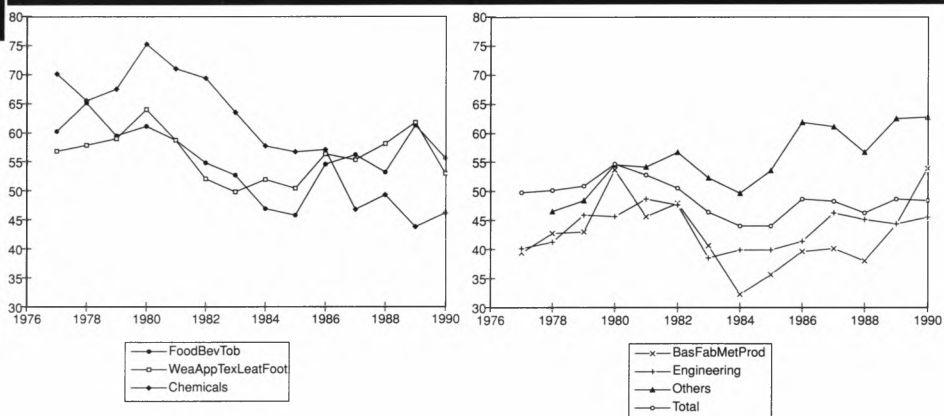
branch "other manufacturing products" and basic and fabricated mineral products, whereas in engineering it was slow and remained under the level of total manufacturing.

2. Secondly, in branches with the higher relative productivity levels in 1977, i.e. in food, beverages and tobacco, textiles, wearing apparel, leather and footwear and in chemicals, the initial gap to the UK had widened. The situation in chemicals worsened relatively more than the others. The most important branch in Portugal, textiles, wearing apparel, leather and footwear, shows only a small decline in the relative productivity level: it decreases approximately 5% in the covered period.

It appears that generally the branch by branch analysis follows the same evolution pattern as that registered for total manufacturing. A period of catching-up (1977-1980), was followed by a period of deterioration (1981-1985), with a further stabilisation (1986-1990). The performance of basic and fabricated mineral products is, however, peculiar because after 1982 it starts to deteriorate rapidly followed by a rapid recovery after 1984, reaching its peak in 1990. There is also a striking performance of food, beverages, tobacco and chemicals in the last period. After a year of recovery (1986) there is not a stabilisation of the relative productivity level in the years in between. In this last period there was a small recovery of the food, beverages and tobacco whereas the situation in chemicals followed a decreasing trend that began in 1980.

Graph 2. Manufacturing GVA per Employee, 1977=100, 1977-1990
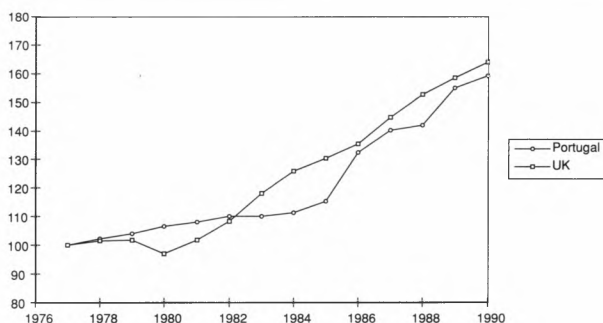
Graph 2 shows the time series on real output in each country and helps to give a clear view of the dynamics of the comparative productivity performance of both countries. It shows that the catch-up process observed in Portugal, until 1980, in the manufacturing sector is due not only to the Portuguese productivity growth but also to the decrease in British productivity. After 1980, British productivity started to increase rapidly, whereas in Portugal the productivity started to grow at lower rates.

After the second oil crisis Portugal was forced to implement expansive measures and external counter cyclical policies to decrease inflation and to increase investment, production and employment in order to avoid the possible pernicious effects of the decrease in foreign demand. In 1983 the balance of payments deficit and the external debt were out of control and as a result Portugal was forced to sign in 1983 with IMF a new programme of economic stabilisation in order to control those variables. 1983-1985 was therefore a period of economic depression as a result of the above mentioned policies and agreement and was caracterized by lower productivity growth rates.

The widening of the Portuguese relative productivity levels between 1980 and 1985 is also explained by the British acceleration of productivity growth, essentially due to the adjustment policies adopted by the Thatcher government after the second oil crisis. In this period the goal was the decrease of the inflation rate independently of the costs in the growth rates of the British economy and especially in the decrease in employment mostly in the manufacturing sector. The reduction in employment raised the British productivity levels although there was a fall in the manufacturing production.

At the end of the 1980s there is a similar evolution of the productivity growth in both countries, and because of that there is a stabilisation in comparative productivity levels. The beginning of stabilisation in the comparative productivity levels is coincident with the entrance of Portugal in the European Economic Community, in January 1986, and shows the positive effects of economic integration of a small country like Portugal. One should remember that the year of 1985 marks the beginning of the economic recovery in the UK (which goes until 1990) as well as in Portugal.

Graphs 3 and 4 can be used to investigate and to explain the striking performance of Portuguese productivity in this period.

If one looks to the time series of the GVA in the manufacturing sector in each country it is possible to see that the Portuguese manufacturing GVA has been increasing at a faster growth rate than the British one. After 1980 there is a widening gap of the manufacturing GVA, although this is the period where the Portuguese relative productivity levels did not show signs of recovering.

Graph 3. Manufacturing GVA,1977=100, 1977-1990	Graph 4. Manufacturing Employment, 1977=100, 1977-1990
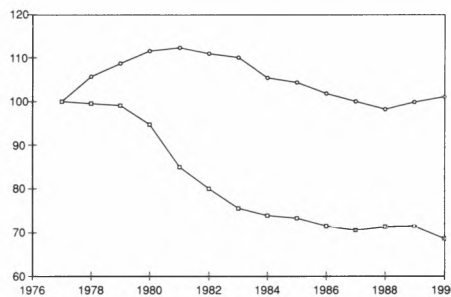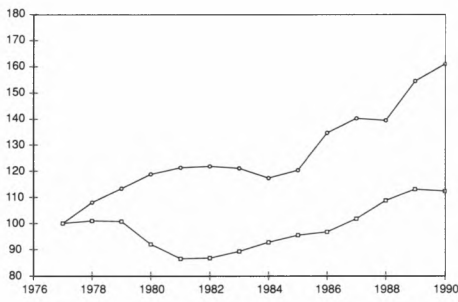
Portugal
UK

So, if the relative productivity Portuguese manufacturing GVA is increasing at a faster growth rate than in the UK, the explanation for the productivity performance must be found in the employment evolution. As it is possible to see in Graph 4, manufacturing employment, between 1977 and 1980, has grown in Portugal, whereas in the UK it has decreased. Despite the relative employment growth in Portugal, the relative manufacturing GVA has also increased. The Portuguese catch-up process in this period is therefore explained by the higher productivity growth rates in Portugal. It is also clear that employment between 1981 and 1985 decreased in both countries, but more rapidly in the UK, whereas the GVA started to increase rapidly in the UK. This evolution explains the deterioration of Portuguese relative productivity in the years between 1980 and 1985. After 1986, employment remained practically the same in both countries, and there was stability in the comparative productivity performance.

5.2 Comparisons with other countries

There are several binary comparisons, in the ICOP project, with the UK as the base country. The main results of those binary comparisons are described in table 8.

Table 8. Comparisons of UVRs, relative price levels and productivity levels for manufacturing

Benchmark year and binary comparison with UK	UVR (Geometric Average)	Official Nominal Exchange Rate	Relative Price Level (UK=100)	GVA per Employee (UK=100)	GVA per Hour Worked (UK=100)
1984					
France (GBP/FRF) (a)	10,99	11,68	94,1	116,1	126,2
Netherlands (GBP/NLG)	4,01	4,29	93,5	143,1	155,4
1987					
Germany (GBP/DEM) (b)	3,50	2,94	119,1	112,7	121,8
Portugal (GBP/PTE)	187,27	230,69	81,2	48,3	41,8
USA (GBP/USD) (c)	1,42	1,63	86,4	186,6	172,4

Source: For binary comparisons. other than Portugal/UK. the source was Ark (1993).
Notes: (a) Excludes tobacco and pretoleum refining.
            (b) Excludes petroleum refining and publishing.
            (c) The base country was the USA. Includes petroleum refining. It was used as an output concept the "net output", which is a much broader concept than the GVA concept, because it also includes the non-industrial services rendered.

Ark (1990, updated) compares the French labour productivity in terms of per-employee hour worked relative to the UK for the benchmark year of 1984, and discovers that the French productivity is about 26% above that of the UK in that year. It also shows that there is a recovery of the British productivity in the 1980s relative to 1970s, which contributed reducing the productivity gap, although the productivity level in 1988 still remained below the one registered in 1973. This recovery is mainly due to the faster growth rates of the British manufacturing productivity in the 1980s.

For the Dutch/UK comparison the productivity differentials were even higher: 55,4% above the productivity level of the UK on a per hour basis and 43,1% on a per employee basis.

The UK is compared with the United States, the leading country, with the same benchmark year as this study. The productivity level of the UK relative to the US, on a per employee basis ("net output" per worker), found was 53,6%. The figures are not very different on a per hour basis: 58% for the manufacturing. It is also concluded that there is a recovery in the productivity measured on a per hour basis: from 51,6% in 1977 to 58,8% in 1990.

The Germany/UK comparison shows also that German productivity in manufacturing is superior to the UK one.

Although it is difficult to multilateralise those major findings in order to calculate the relative productivity levels between Portugal and each of the other countries (see Ark, 1993: 42ff for the

explanation of the reasons), one can easily see that Portuguese manufacturing productivity is still far from the countries with the higher productivity levels. Much has to be done to allow the possibility of the productivity growth in Portugal and thus the possibility of catching-up.

Table 9. GVA per employee, UK = 100

	France	Germany	USA	Portugal
1977	123,3	145,4	203,6	49,8
1980	139,1	154,1	205,6	54,7
1985	115,9	127,7	186,8	44,1
1990		109,9	186,5	48,4

Source: For France, Germany and USA was Ark (1993).

Table 9 strengthens the above analysis. There is a partial recovery of British manufacturing productivity relatively to the leading countries (USA, Germany and France) in the period after 1977 and a small recovery relative to Portugal. This means that the comparative productivity in Portugal decreased less than in the other countries, relative to the UK.

6. Conclusions

The results can be summarised as follows:

1. Portuguese real output and productivity relatively to the UK underestimated when the exchange rate is used, because it is generally higher than the UVRs. The UVR for total manufacturing was 1 GBP=187,27 PTE and the exchange rate in the same period was 1 GBP=230,69 PTE, i.e. the Portuguese escudo is undervalued relative to the Great Britain Pound in 18,8%.

2. The productivity level for Portugal relatively to the UK was 48,3% on a per employee basis and 41,3% on a per worked hour basis in 1987. The higher relative productivity levels were obtained in beverages and tobacco and for the so-called traditional sectors, on which Portugal is specialised like textiles, wearing apparel, leather and footwear, wood products, and for paper and electrical appliances.

3. The study of the evolution of the relative productivity levels shows that in the end of the 1980s they are still below the level registered in 1977. They decreased especially after the economic crisis and depression in Portugal in 1980-1985. The economic recovery after 1985, mainly as a result of the dynamic effects of the higher openness of Portugal to the international trade, was not enough to reach the initial levels.

4. Two evolution patterns were found. The branches with the higher relative productivity levels in 1977, the traditional branches, had deteriorated their levels. Instead the branches with the lower relative productivity levels in 1977 have registered a catch-up process.

5. Portugal is still far away from the productivity leaders in the world economy like the USA, The Netherlands, France or Germany. The period under analysis is not also a good example of a process of catching-up because Portugal was not able to reduce the productivity gap compared to the above mentioned leading cuntries.

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Appendices

Appendix 1 — Aggregation of the UVR

The estimation of the UVRs was carried out in a number of steps. In the first step: the aggregation of unit values, for matched products, to calculate an average UVR for the industry level (which roughly corresponds to the 4-digit industry level of "Classificação das Actividades Económicas", CAE)[19]. Second, the aggregation of the UVRs for the branch level (which roughly corresponds to the 3-digit industry level). Third, the aggregation of the UVR for the manufacturing level.

The production census reports provided the necessary information to calculate the prices (i.e., unit values) for the products in each country, by dividing the sales value by the produced quantities. With the unit values and the produced quantities of the products that could be matched it was possible to calculate the UVR for individual products, as a ratio between the Portuguese unit value and the correspondent British unit value. The obtained UVR expresses, like the PPP, a price relation of products between two countries, although the UVR refers to producer prices and not consumer prices like the PPPs.

The UVRs of the matched products belonging to a matched industry (j(m)) were than weighted by the quantities of one of the countries to calculate an average UVR for the industry. Using the two country's quantities as weights two UVRs were calculated: the Laspeyres price index (with the quantity weights of the base country, UK) and the Paasche price index (with the quantities of Portugal). A third price index was also calculated, Fisher's, as a geometric average of the previous.

$$UVR_{j\,(m)}^{XU(U)} = \frac{\sum_{i=1}^{s} P_{ij}^{X} \cdot Q_{ij}^{U}}{\sum_{i=1}^{s} P_{ij}^{U} \cdot Q_{ij}^{U}} \quad \text{Laspeyres index, and} \qquad UVR_{j\,(m)}^{XU(X)} = \frac{\sum_{i=1}^{s} P_{ij}^{X} \cdot Q_{ij}^{X}}{\sum_{i=1}^{s} P_{ij}^{U} \cdot Q_{ij}^{X}} \quad \text{Paasche index}$$

where $UVR_{j\,(m)}^{XU(U)}$ is the unit value ratio of the currency of country X (Portugal) versus the currency of the base country U (UK) in the matched industry j(m), at quantity weights of country U.

$UVR_{j\,(m)}^{XU(X)}$ is the unit value ratio of the currency of country X (Portugal) versus the currency of the base country U (UK) in matched industry j(m), at quantity weights of country X.

$i=1...s$ is the sample of matched items in matched industry j(m).

Because of the fact that in some industries the coverage percentage of output is very low, it is difficult to assume that the UVR of the matched products found for the industry was reliable, and because of that representative for the industry. These industries, where the matched output was inferior to 25%[20], in at least one of the countries, were considered to be in the non-matched industries (j(n)) of the branch. In these conditions 14 industries were found, which represent about 14,3% of the manufacturing GVA in the UK, and 26,5% in Portugal. It was assumed that the UVR, that should represent the unknown UVR of the non-matched industries, was equal to the quantity weighted UVR for all matched products in the branch to which they belong.

$$UVR_{j(n)}^{XU(U)} = \frac{\sum_{i=1}^{s} P_{ik}^{X} \cdot Q_{ik}^{U}}{\sum_{i=1}^{s} P_{ik}^{U} \cdot Q_{ik}^{U}} \quad \text{Laspeyres index, and} \qquad UVR_{j(n)}^{XU(X)} = \frac{\sum_{i=1}^{s} P_{ik}^{X} \cdot Q_{ik}^{X}}{\sum_{i=1}^{s} P_{ik}^{U} \cdot Q_{ik}^{X}} \quad \text{Paasche index}$$

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19 Economic Activity Classification.
20 In some other studies, this limit was considered to be 30%, like Ark, 1990.

The second step is the reweighting of the UVRs for GVO (UVR $_{(go)}$) for each industry (j) by the corresponding GVA, to calculate the representative UVR for the branch (k).

$$JVR_k^{XU(U)} = \frac{\sum_{j=1}^{r}(UVR_{j(go)}^{XU(U)} \cdot VA_j^U)}{VA_k^U} \quad \text{and} \quad UVR_k^{XU(X)} = \frac{VA_k^X}{\sum_{j=1}^{r}(VA_j^X / UVR_{j(go)}^{XU(X)})}$$

where $UVR_k^{XU(U)}$ is the UVR of branch k at quantity weights of country U.

$UVR_k^{XU(X)}$ is the UVR of branch k at quantity weights of country X.

Finally, the UVR for total manufacturing was calculated with the later procedure, i.e., the reweighting of the average branches UVRs by the corresponding GVA.

This process of constant reweighting, firstly by quantities and then by the value added, has the advantage that each UVR is weighted according to its relative importance in the aggregate and avoids the risk of a UVRs high weight caused by the over-representation of a product or group of products, or even an industry, in the aggregation technique.

Appendix 2 — Quality adjustments for passenger cars

The total sales value for all the passenger cars was conceived as the sum of the two categories of sales value:

$$Q_t P_t = Q_1 P_1 + Q_2 P_2$$

With the prices for the two categories, the relative price for category two in terms of category one was calculated (in this study, the standard category). Afterwards, the total number of cars produced in terms of the standard category was calculated.

$$Q_1^{\cdot} = Q_1 + \frac{P_2}{P_1} Q_2$$

The ratio of total sales to the quantity of cars produced of the standard category gives the price (i.e. unit value) for category one. The price for category two was then obtained by multiplying this price by the relative price of category two expressed in terms of the standard category.

$$P_1^{\cdot} = \frac{Q_t P_t}{Q_1^{\cdot}} \quad ; \qquad P_2^{\cdot} = \frac{P_2}{P_1} P_1^{\cdot}$$

The UVR was than estimated as the ratio of the Portuguese to the British unit values for each category.

The method requires information on unit values and physical quantities for each category. As production censuses in both countries only supply information for total physical quantities and total ex-factory sales value of passenger cars, the physical quantities and the unit values (or prices) for each one of the categories had to be obtained from secondary sources[21].

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21 The physical quantities for the British cars produced were taken from *The World Automotive Statistics 1989*, and for Portugal the source was the "Associação dos Industriais de Montagem de Automóveis". The prices, obtained from the trade sources in the UK and in Spain, for each category of car produced were calculated as an average of the base prices (i.e., excluding national taxes) for two "typical" models, domestically manufactured.
There is no available information of the prices of passenger cars from the Portuguese producers. As a relative price between the two categories of cars produced was needed, the relative prices of the Spanish producers were used, assuming that this relative price was equal to the Portuguese one.
The source of the data base on prices was from Jato Dynamics, London, and was kindly provided by Prof. Bart van Ark.

Another adjustment had to be made. In Portugal, the total quantity of cars produced was different, according to the sources used (the production census or the trade source). Therefore, the structure of passenger cars produced from the trade source statistics was applied to the production census.

After these adjustments it was possible to calculate unit values and quantities for each category, and for each country, without making changes in the total quantity and ex-factory sales value as reported in the production census. The UVR for each category and for the total of cars produced was further calculated with the previous unit values.

Appendix 3 — Conversion of the GVA to the other country currency

To convert the GVA of a country, in its own currency, to the other country currency the UVR calculated with the own country quantity weights was used:

$$VA^{X(U)} = VA^{X(X)}/UVR^{XU(X)} \quad \text{and} \quad VA^{U(X)} = VA^{U(U)} * UVR^{XU(U)}$$

where superscripts refer to the country X (Portugal) and U (UK) and the country prices used to express the value added are between brackets.

Appendix 4 — Method to extrapolate the benchmark results

There are two methods to extrapolate the benchmark results. One is to extrapolate the comparative value added figure for the benchmark year by time series on real output:

$$\frac{VA_{t+1}^{X(U)}}{VA_{t+1}^{U(U)}} = \frac{VA_t^{X(U)} \cdot (VA_{t+1}^{X(X)}/VA_t^{X(X)})}{VA_t^{U(U)} \cdot (VA_{t+1}^{U(U)}/VA_t^{U(U)})} \quad \text{and} \quad \frac{VA_{t+1}^{X(X)}}{VA_{t+1}^{U(X)}} = \frac{VA_t^{X(X)} \cdot (VA_{t+1}^{X(X)}/VA_t^{X(X)})}{VA_t^{U(X)} \cdot (VA_{t+1}^{U(U)}/VA_t^{U(U)})}$$

where subscripts refer to the year.

The second possible method is the updating or backdating of the UVR initially derived for the benchmark year with the use of index national prices derived from the national accounts:

$$UVR_{t+1}^{XU(X)} = UVR_t^{XU(X)} \cdot \frac{P_{t+1}^{X(X)}/P_t^{X(X)}}{P_{t+1}^{U(U)}/P_t^{U(U)}} \quad \text{and} \quad UVR_{t+1}^{XU(U)} = UVR_t^{XU(U)} \cdot \frac{P_{t+1}^{X(X)}/P_t^{X(X)}}{P_{t+1}^{U(U)}/P_t^{U(U)}}$$

The following stage is the conversion of the GVA in both countries expressed in its own currency with the UVR derived from this method.

Both methods will lead exactly to the same results if both series are consistent. This would be the case if the time series on real output, for the first method, and the deflators for the output, for the second, are directly taken from the national accounts.

Appendix 5 — Statistical Sources

For the benchmark comparison, in the case of Portugal, the "Estatísticas Industriais", 1987 (INE, 1989) was used which gives the series of output and input in a 6-digit industry level and the annual sales of major products belonging to each industry. The industrial classification is based on CAE, which is derived from the International Standard Industrial Classification (ISIC), although adapted for the Portuguese case. For the UK this information was taken from Quarterly Sales Inquiry (BSO, various issues) and Report on the Census of Production (BSO, 1989) on a 4-digit industry level (that roughly corresponds to the 6-digit industry level of the Portuguese CAE) classified by Standard Industrial Classification.

The time series, for Portugal, of GVA and employment were obtained from Contas Nacionais (INE, various issues). For the UK the GVA was obtained from National Income and Expenditure

Accounts (CSO, various issues). The employment statistics are deriven from the "Department of Employment"[22].

The hours actually worked in Portugal were taken from the statistics of the "DEMESS"[23]. They give information on the total number of employees and number of hours actually worked (excluding vacations), in the period of March 1987, on a 6-digit industry level of CAE.

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22 The UK statistics were kindly provided by Prof. Bart van Ark.
23 They were kindly provided by Prof. Augusto Mateus and Prof. Mário Bairrada.