Structural Transformation of Portuguese Exports and the role of Foreign Direct Investment: some descriptive analysis for the period 1990-2005

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Abstract: in this paper we use a recent measure of the "income level of a country's exports" proposed by Hausmann et al. (2007) to characterize the structure of the Portuguese export basket, its recent evolution and the role of FDI in this process. We find that between 1990 and 2005 the improvement in the income content of the Portuguese export basket was achieved through a positive structural transformation effect that more than offset the negative effect of having a significant share of products which have experienced a decline in their income content. In particular, we find that the weight of exports with "high" and "very high" income content increased considerably, with these two classes explaining more than half of the export growth during the period. Analysing the presence of FDI in the different export products, we find that the share of foreign firms in 2005 was higher than average for products with "High" and "Very High" income content. Those two classes of products concentrated almost 2/3 of exports by foreign firms in Portugal in 2005. These and other pieces of evidence suggest that FDI has played a relevant role both in the growth of Portuguese exports and in the increase of their income content.

Key-Words: International trade, Foreign Direct Investment, The Portuguese Economy, Structural transformation.

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1. Introduction

In the current debate on the Portuguese economy, there is a view that the country's specialization pattern, traditionally dominated by low-skilled labour intensive products, is a major obstacle to convergence. According to this view, with the emergence of new trading partners with a comparative advantage in labour intensive goods, the future performance of the Portuguese economy will depend critically on its ability to shift its specialization pattern towards goods with higher productivity content. In this paper, we investigate the extent to which the Portuguese economy has indeed actually become increasingly specialized in goods with higher income content and whether such shift is more evident in sectors with a high presence of FDI.

The view that a country's economic growth is to a large extent linked to its external performance has a long tradition in economics, backing from Adam Smith and Ricardo. A number of theoretical models have emphasized the type and characteristics of the sectors wherein the country specializes (Prebisch 1950, Singer, 1950, Kaldor, 1966, Thirlwall, 1979, Pasinetti, 1981, Grossman and Helpman, 1991) [1]. Empirically, however, this proposition has been difficult to test, because a measure of a country specialization pattern that reflects the quality of the goods being exported is not easy to find. Dalum et al. (1999) test the relationship between the growth of value added in 11 manufacturing sectors in the OECD area for the period 1965-1988, and found that the characteristics of the specialization pattern are important to explain growth differentials. However, the impact seems to be gradually wearing off during the 1980s and their results are sensitive to alternative classifications of sectors into different technological categories that the authors consider. Feenstra and Rose (2000) develop a procedure to rank-order countries and commodities according to the "product-cycle" hypothesis, using desegregated data on

[1] A different question is whether the *identity* of the trade partners matters. The rationale is that a country that imports goods primarily from technological leaders receives more technology than a country that imports primarily from follower countries (Eaton an Kortum, 1996, 1999). The empirical evidence of this proposition remains, however, mixed (see Keller, 2004, for a survey).

US imports. They find a strong relation between what they dubbed “advanced export structure” and high productivity levels and fast growth rates.

More recently, Hausmann et al. (2007) proposed a quantitative index that ranks traded goods in terms of their implied productivity. This index (PRODY) is estimated as a weighted average of the per capita GDPs of the countries exporting a product, where the weights reflect the revealed comparative advantage of each country in that product. The authors then computed a measure of sophistication of a country export basket (EXPY) by calculating the export-weighted average of the PRODY for that country. The authors reported a strong correlation between EXPY and per capita GDPs and also found that EXPY is a strong and robust predictor of subsequent economic growth, controlling for standard covariates. The authors conclude that “poor countries export poor country goods and rich countries export rich country goods” and “you become what you export”.

In this paper, we compute a new vector of PRODY indexes using 1995 and 2005 COMTRADE data for 1235 products and 81 countries. We then use this index to characterise the Portuguese export basket and to assess how well it has moved towards goods with higher income content. We document that in the period from 1995 to 2005 Portugal has indeed become increasingly specialized in goods with higher income content. Next we investigate the extent to which foreign direct investment (FDI) has played key a role in this change. In particular, we assess the extent to which FDI has contributed to the upscale of the Portuguese specialization pattern.

The relation between FDI and economic performance has been a topic of controversy in the economic literature. At the theoretical level, FDI is expected to contribute to capital accumulation and to generate positive knowledge spillovers in host economies, either through labour training or through the provision of high-quality intermediate inputs (Fosfuri et. al, 2001, Rodriguez-Clare, 1996). However the empirical relationship

between FDI and knowledge spillovers has been found to be weak[2]. In the specific case of Portugal, there is anecdotic evidence of training spillovers and quality improvement effect on domestic supplier (OECD, 2008). However, estimates by Flores et al (2007) for the 1990s found no significant evidence of intra-sectoral spillover effects, as measured by the effect of FDI on domestic firm' labour productivity. Controlling for other variables, such as the technological gap, the authors found some evidence of spillovers, but the results were in general sensitive to the model specification.

This paper explores the impact of FDI through a different avenue: FDI may have a role in breaking up with the natural inertia underlying the existing specialization patterns. The idea that market forces alone may not be sufficient to shift the structure of exports towards goods of higher productivity has been stressed by different authors. The conventional theories of international trade emphasize the role of technology and factor endowments, such as physical capital, human capital and natural resources, in determining specialization patterns. Learning by doing theories stress the endogeneity of factor endowments and emphasize the role of productive experience in preparing a country to shift towards new goods. That is, as the stock of knowledge accumulates according to the industry-specific learning generated by the particular basket of goods in which a comparative advantage has been developed, a country becomes progressively more able to produce goods of higher quality (Young, 1991, Stokey, 1998, Jovanovic and Nyarko, 1996, Hausmann and Klinger, 1997). Hence, the opportunities facing a country in the process of structural transformation depend on how favourable the current specialization pattern is (an investigation for the case of Portugal in Lebre de Freitas and Salvado, 2008). In a different reasoning, Hausmann and Rodrik (2003) and Morris and Shin (2000) argued that the process of entering in a new market involves market failures,

[2] Recent evidence with micro-data is suggestive of important spillovers associated with FDI (Keller, 2004, Kugler, 2006). Still, many authors remain sceptical about the robustness of those results (e.g., Rodrik, 2007, pp.119-120). At the aggregate level there is some evidence that FDI has positive effects on the host economies (see Lim, 2001, for a survey). Some studies suggest that the main channel through which FDI contributes to economic growth is by stimulating technological progress (e.g., Borensztein et al., 1998). Empirical assessments face, however, a basic problem of endogeneity: because multinationals are attracted to high-performance countries, in the absence of adequate instrumental variables the direction of causality is difficult to identify.

such as information spillovers and coordination failures. Product-specific services and labour or managerial skills may never develop if there is no demand for them; however, if such inputs are not already in place it may be too costly (and/or too uncertain) to start new activities that depend on them. Also uncertainties regarding the true cost of entering a new market imply an information externality from first movers to late entrants. To the extent that these failures prevent first movers from fully recovering the costs of entering a new market, in a laissez faire economy there will be significant deviations between factor endowments and specialization patterns.

FDI can be viewed as a carrier of structural change in the export specialization of host countries. Not surprisingly, governments all over the world spend large amounts of resources to attract subsidiaries of multinational firms to their jurisdiction, on the basis that FDI can help to break up with the natural inertia underlying the existing specialization patterns. In Portugal, Governments have made significant efforts to support FDI inflows, either through financial incentives (EU funds and tax benefits) or by providing complementary infrastructures. Despite the high year-on-year volatility, FDI net flows to Portugal have a clear upward trend, from 0,43% of GDP in the 1970s to 1,03% in the 1980s, 1,085% in the 1990s and 3,65% in the period 2000-2006 (UNCTAD, 2007). Our evidence gives support to the idea that FDI has in fact played an important role in the process of transforming the Portuguese exporting sector. If the sophistication of a country export basket is correlated with its future income per capita – as Hausmann et al. (2007) sustain – then FDI seems to be having a positive impact on the growth prospects of the Portuguese economy.

The paper proceeds as follows. In Section 2, we analyse the relationship between RCA and PRODY at the product level from 1995 to 2005, in Portugal and in some other countries. In Section 3 we decompose the changes in the average income content of each country's exports into PRODY and structural transformation effects. In Section 4 we investigate how the composition of the Portuguese export basket has evolved in terms of classes of PRODY. In Section 5 we evaluate the extent to which the sectors that most

contributed to the Portuguese export growth have a large presence of FDI. Section 6 concludes.

2. Income content and comparative advantages

In this paper, we use the Hausmann et al. (2005) PRODY index to assess the sophistication level of products. Formally, the index is defined, for each product, as the weighted average of per capita incomes of countries exporting that product, where the weights are proportional to the country's index of Revealed Comparative Advantage in that good (Balassa, 1958). The mathematical details are in Appendix 1.

Products with high values of PRODY are, by construction, those where high income countries play a major role with respect to the other trading partners. The implied assumption is that the presence of higher wages is stronger where comparative advantages are determined by factors other than labour cost, such as know how, technology, public infrastructures, research centres and so on.

Our calculations use international trade data at the product level (SITC-4 rev 2), from the UN-COMTRADE database, as extracted in September 2007 and per capita GDP levels (in PPP) by the International Monetary Fund, World Economic Outlook Database, April 2008. Both variables refer to 1995 and 2005, and countries for which there was no consistent data for those two years were excluded. This leaves us with 81 countries and data for 1235 products. Table 1 displays the estimated PRODY values for some products, the corresponding PRODY rank and the share in World exports, in 2005. As expected, agricultural commodities and raw materials appear at the bottom of the table.

Table 1: PRODY values for a sample of products

Code	Commodity	PRODY 05	Rank	Share of World exports (per cent)
2933	Heterocyclic compounds with nitrogen hetero-atom(s) only.	33.408	4	0,47
8411	Turbo-jets, turbo-propellers and other gas turbines.	27.010	82	0,71
3004	Medicaments (excluding goods of heading 30.02, 30.05 or 30.06)	26.024	108	2,13
8525	Transmission apparatus for radio-telephony, radio-broadcasting	24.156	196	1,89
8542	Electronic integrated circuits and microassemblies.	24.047	201	2,81
9018	Instruments and appliances used in medical, surgical, dental or veterinary ...	23.486	229	0,61
8473	Parts and accessories for use with machines of heading 84.69 to 84.72	23.244	240	1,89
8703	Motor cars and other motor vehicles principally designed for the transport ...	22.951	255	5,15
8471	Automatic data processing machines and units thereof	22.355	292	2,78
8802	Other aircraft (for example, helicopters, aeroplanes); spacecraft	21.886	330	0,88
8414	Air or vacuum pumps, air or other gas compressors and fans	21.457	344	0,43
8708	Parts and accessories of the motor vehicles of headings 87.01 to 87.05.	20.802	382	2,34
8536	Electrical apparatus for switching or protecting electrical circuits, or fo ...	20.455	401	0,59
8541	Diodes, transistors and similar semiconductor devices	18.685	512	0,47
8901	Cruise ships, excursion boats, ferry-boats, cargo ships, barges and similar ...	17.586	584	0,48
2701	Coal; briquettes, ovoids and similar solid fuels manufactured from coal.	17.237	610	0,44
8704	Motor vehicles for the transport of goods.	16.900	624	0,87
8528	Reception apparatus for television	16.114	664	0,58
7102	Diamonds, whether or not worked, but not mounted or set.	15.347	702	0,85
2709	Petroleum oils, crude	11.549	914	5,05
6204	Women's or girls' suits, ensembles, jackets, blazers, dresses, skirts	7.977	1069	0,46
2401	Unmanufactured tobacco; tobacco refuse.	2.407	1235	0,07
801	Coconuts, Brazil nuts and cashew nuts, fresh or dried	2.230	1236	0,02
1801	Cocoa beans, whole or broken, raw or roasted.	2.097	1238	0,03
5203	Cotton, carded or combed.	1.414	1242	0,00
2612	Uranium or thorium ores and concentrates.	1.211	1243	0,01
5304	Sisal and other textile fibres of the genus Agave, raw or processed but not ...	1.146	1244	0,00
905	Vanilla	1.075	1245	0,00

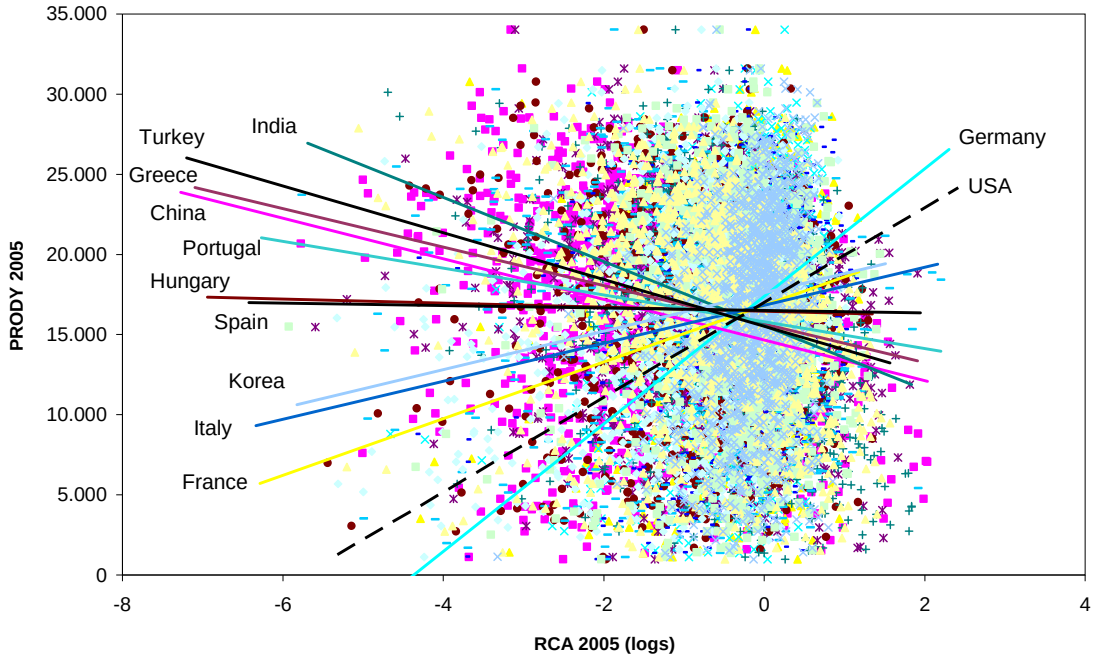
Sources: UN, COMTRADE database; IMF, World Economic Outlook Database

For illustrative purposes, Figure 1 assesses the linear relationship between our estimated 2005 PRODYs and the Balassa indexes of revealed comparative advantage (RCA) for 12 countries (China, France, Germany, Greece, Hungary, India, Italy, Korea, Portugal, Spain, Turkey and USA)[3]. Despite the high dispersion of the data, plotting a linear regression line helps in assessing the sign of the correlation between the two indexes. If significant, a negative correlation indicates a general tendency for a country to be specialized in goods with lower income content. A positive correlation, in turn, indicates a general tendency for a country to be increasingly specialized in goods with higher income content.

[3] The Balassa RCA index is in Logs. Null coefficients of RCA became missing values..

As can be expected from the construction of the PRODY index, richer countries tend to display a more positive relation between RCAs and PRODY values than developing countries.

Figure 1: PRODY and Revealed Comparative Advantage in 2005 (China, France, Germany, Greece, Hungary, India, Italy, Korea, Portugal, Spain, Turkey, USA)



According to the figure, by 2005 India was the country in this sub-sample with a more negative correlation between comparative advantage and PRODY values, followed by Turkey, Greece, and China. The Portuguese specialization pattern was more favourable than in these countries, but less than that of Hungary and Spain. On the other hand, Korea, Italy, France, USA and Germany exhibited positive correlations between RCA and PRODY values, suggesting a tendency to be more specialized in "rich country goods". Moving from a negative correlation towards a positive correlation involves the country becoming increasingly specialized in products with higher income content. This is what is meant by *structural transformation*.

The data in Figure 1 is silent in respect to sector sizes (the RCA index actually measures sizes, but relative to the world average). To account for a country total export mass, Hausmann et al. (2007) proposed the EXPY index. This is the average PRODY in a country export basket, where the weights are the share of each product in a country exports (details in Appendix 1).

Figure 2: EXPY and GDP per capita at PPP (2005, $US)

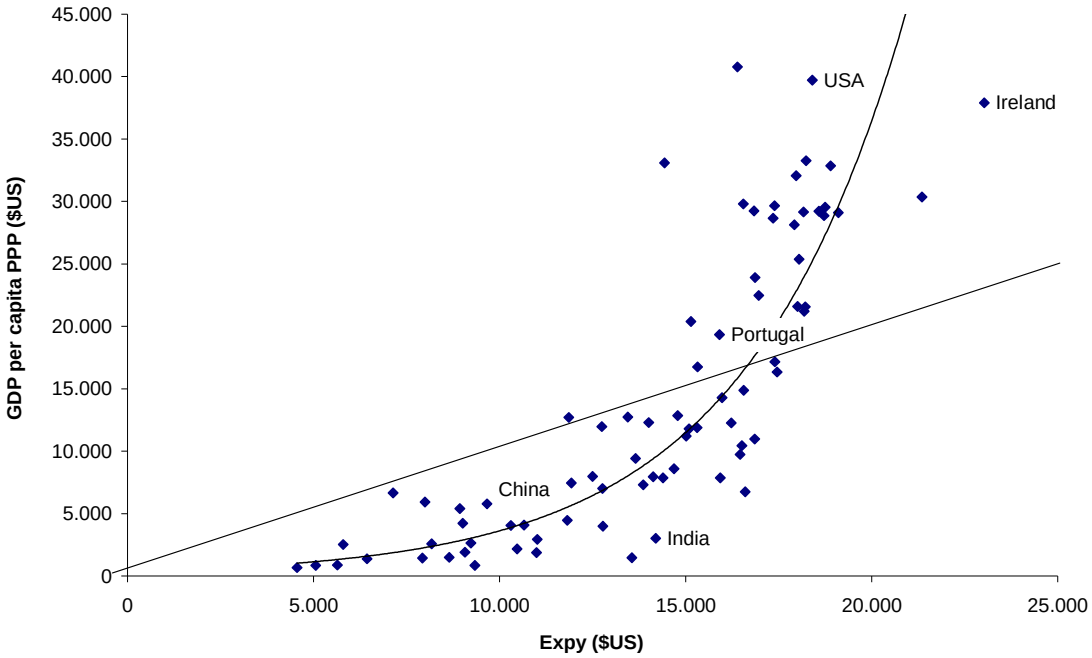


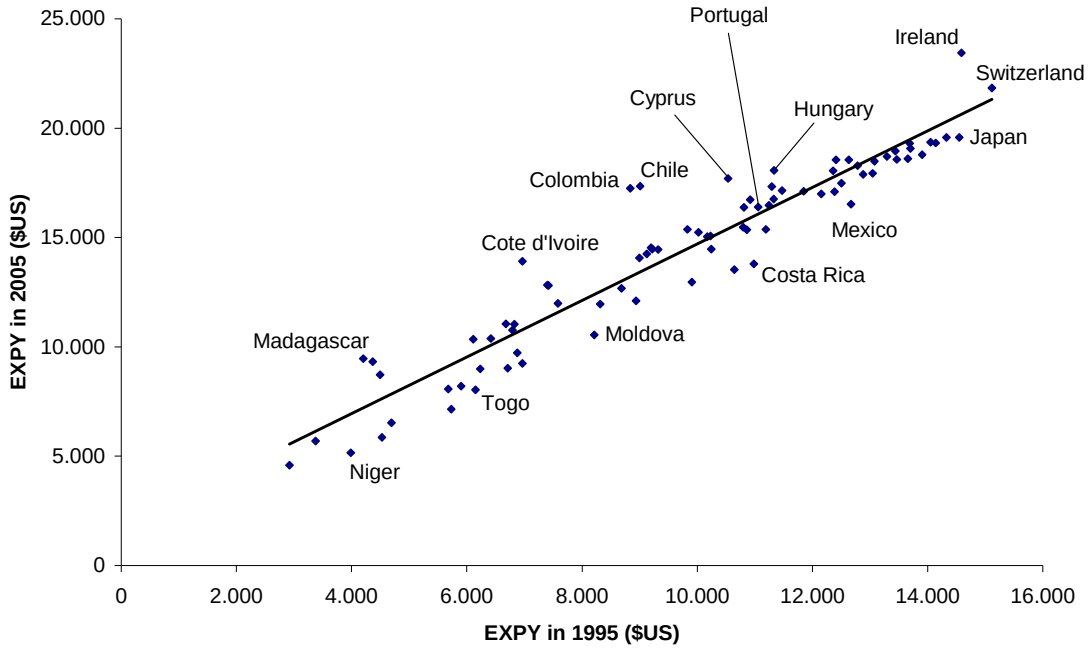
Figure 2 shows the relation between EXPY values and GDP per capita for the countries in our sample. The figure shows a positive relation between the two variables, with GDP per capita growing exponentially with EXPY[4]. Hausmann et al. (2007) found that EXPY is a strong and robust predictor of subsequent economic growth, controlling for standard covariates, leading them to conclude that "countries become what they export". This means that countries which have an EXPY value that is higher than their GDP per capita

[4] This figure mimics Hausmann et al. (2007). A similar pattern is found for 1995.

will tend to grow faster than countries in the reverse situation. In other words, countries which are placed below the 45º line in the figure above (e.g., China and India) will see their average income growing faster that countries located above the line (e.g., USA and Ireland). As can be seen, Portugal is an intermediate position, slightly above the 45º line.

Although the value of EXPY tends to grow over time (as a result of the general growth in GDP per capita in PPP worldwide), the ranking of countries' EXPYs tends to be relatively stable. Figure 3 compares the EXPY values in 1995 and in 2005 for the countries in our sample. Most countries are concentrated around the trend line, with the exceptions being more pronounced in those cases where EXPY has grown above the average (as was the case with Ireland, Cyprus, Chile, Colombia, and Madagascar, for example). These are countries which have seen the income content of their exports growing fast during the period.

Figure 3: Changes in EXPY between 1995 and 2005 ($US)

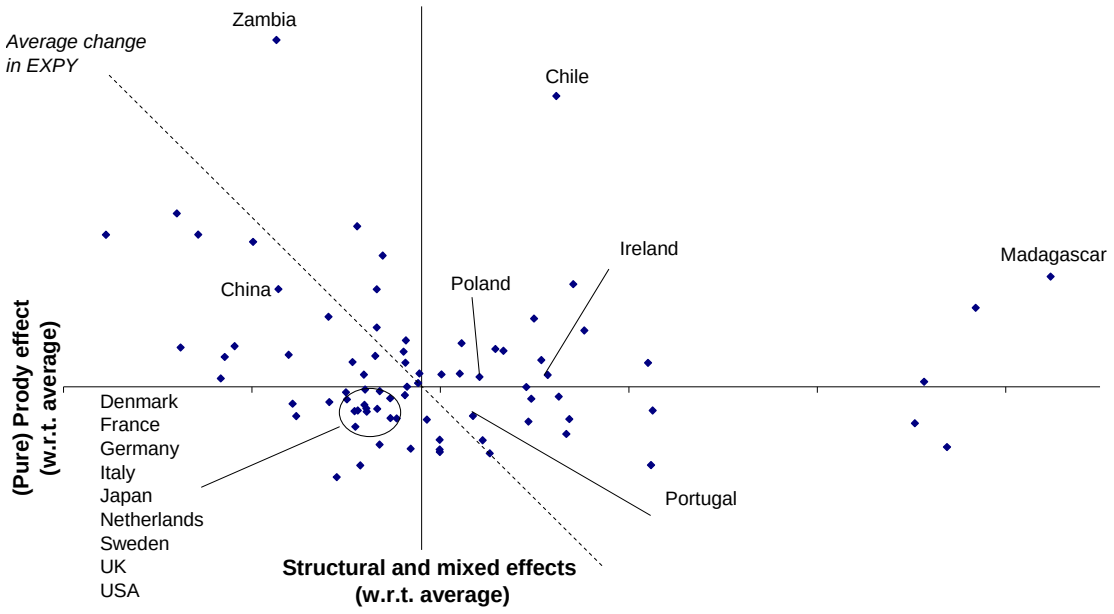


3. Decomposing the changes in EXPY: PRODY versus structural adjustment effects

Because PRODY indexes change over time – according to the changes in the world structure of trade and to changes in GDPs per capita at PPP – EXPY values can be computed at constant PRODY levels or at current PRODY levels. Changes in EXPY at *current* PRODYs reflect both changes in the structure of exports and changes in the implied value of exports.

Figure 4 below describes how the changes in EXPY at current PRODYs break down into a "pure PRODY effect" (i.e., the change in EXPY that would have been observed if the PRODY values of the different products had changed the way they did, while the export structure remained the same) and other effects (this includes a "pure structural transformation effect" – i.e., the value of EXPY which would be observed had the PRODY values remained the same while the structure of exports evolve the way they did – and a mixed effect). The technical details and the figures for 81 countries are in Appendix 4.

Figure 4: Decomposing the changes in EXPY at current PRODYs between 1995 and 2005



The horizontal and vertical axes in Figure 4 represent the sample average "pure PRODY effect" and the sample average "pure structural and mixed effects" (respectively) underlying the changes in EXPY values between 1995 and 2005. The dashed diagonal in the figure represents the average growth in EXPY across countries (weighted by GDP per capita in PPP in 2005). Dots to the right of this line represent countries whose EXPY value has increased above the average; dots to the left of the diagonal correspond to countries whose exports have experienced a decrease in income content in relative terms.

The figure reveals that the Portuguese EXPY level has increased above the average, while the reverse happen to most OECD countries (other exceptions include Australia, Canada, Czech Republic, Greece, Hungary, Ireland, Poland, and Slovakia). Portugal is located in the lower-right quarter of the graph, meaning that the change in the income content of its exports is accounted for by a positive structural transformation (plus mixed) effect, which was big enough to offset a negative PRODY effect. A negative PRODY effect means that, on average, the most important Portuguese exports in 1995 did not improve in terms of income content. In other words, had the Portuguese export basket remained stuck, its average income content would have grown less than the average. The reason is that a significant component of the Portuguese exports basket corresponds to traditional segments, where competition by emerging economies has been increasing. The positive structural transformation effect more than offsets this negative effect, allowing the EXPY level in Portugal to grow above the average.

The Portuguese pattern contrasts with what was observed in other OECD countries: most developed countries have registered both a (slightly) negative contribution of changes in PRODY values to the relative evolution of EXPY, and a negative contribution of the structural and mixed effects. In other words, not only their exports became on average less exclusive, but the change in the structure of exports has led to a less 'rich country goods' export profile[5]. In contrast, Chile and Madagascar, for example, have improved

[5] The analysis for Italy confirms Di Maio and Tamagni (2007). The authors found that the low performance of that country in the last two decades was mainly explained by the fact that Italy remained stuck in a number of products which PRODY values have declined, due to the entry emerging economies in these markets. In the

significantly their EXPY values, due to both positive structural adjustment and value effects.

4. Income content, export shares and export growth in Portugal

Having established the relative importance of the structural transformation effect in the case of Portugal, we now focus on this component, abstracting from changes in EXPY caused by changes in PRODY values. Hence, the analysis proceeds at constant PRODYs[6]. In this section and the following we use trade data from the Portuguese National Institute of Statistics (INE), which includes data on confidential positions, thus being more accurate than the COMTRADE database.[7]

The corresponding estimates of EXPY and export shares by classes of PRODY are displayed in Table 2. In the table, exports are split into 5 classes of PRODY. The 5 classes considered range from the 20% products with higher PRODY values to the 20% products with lower PRODY values (data for 81 countries are in Appendix 2).

figure, Italy is on the lower-left corner, meaning lack of structural adjustment and specialization in products of declining value.

[6] Because in the following we restrict attention to 2005 PRODY values, we are no longer constrained by the need to have a consistent sample of countries for the years 1995 and 2005. Therefore, from this point forward the PRODY values are computed using a larger sample of countries (93 instead of 81), allowing the PRODY index to reflect more accurately the income content of exports.

[7] A major drawback of COMTRADE is the presence of a sizeable category of miscellaneous products, "9999-Commodities not specified according to kind", which accounted for 2,9% of the world trade in 2005. This category cannot be ignored while computing RCA indexes, but there is no point in computing its PRODY value. Because this category differs significantly over time and across countries, its presence complicates international and inter-temporal comparisons. In the case of Portugal, a major change in the statistical treatment of confidentiality has occurred in 2005, causing a large number of products previously classified elsewhere to be moved to the class 9999. As a result, the share of exports in this category jumped from marginally positive to 8.7%.

Table 2 – The structure of Portuguese Exports by classes of PRODY

PRODY Class	1990		1995		2000		2005	
	Share on Exports	EXPY	Share on Exports	EXPY	Share on Exports	EXPY	Share on Exports	EXPY
Very High (top 20%)	6,2	1528	8,5	2118	9,4	2363	12,5	3097
High	21,6	4457	25,8	5392	32,8	6982	31,8	6727
Average	14,4	2390	14,2	2363	14,8	2460	16,3	2692
Low	32,1	3743	31,1	3673	27,0	3202	25,6	3049
Very low (20% lowest)	25,8	1923	20,4	1517	15,9	1195	13,9	1036
Total	**100**	**14041**	**100**	**15063**	**100**	**16202**	**100**	**16603**

Sources: own calculations, based on INE

The table shows that there has been a steady increase in the share of products with "High" and "Very High" income content (from a total weight of 27.8% in 1990 to 44.3% in 2005), at the cost of the classes "Low" and "Very Low" (from 57.9% to 39.5%). This move allowed the average income content of the Portuguese export basket (EXPY) to increase consistently over time, from 14.041 USD dollars in 1990 to 16.603 in 2005.

Table 3: Structure of exports by classes of PRODY – Portugal

PRODY Class	1990		2005		Growth of exports 1990-2005	
	Exports (10^6 Euros)	Share on Exports	Exports (10^6 Euros)	Share on Exports	% Change	Contribution (percentage points)
Very High (top 20%)	718,1	6,2	3688,8	12,5	413,7	16,7
High	2508,6	21,6	9358,7	31,8	273,1	38,4
Average	1670,4	14,4	4792,1	16,3	186,9	17,5
Low	3737,2	32,1	7534,2	25,6	101,6	21,3
Very low (20% lowest)	3001,0	25,8	4082,1	13,9	36,0	6,1
Total	**11635**	**100**	**29456**	**100**	**153,2**	**100**

Sources: own calculations, based on INE

Table 3 examines the contributions of the different classes of PRODY to the growth rate of Portuguese exports between 1990 and 2005. According to these data, the growth rate of exports (at current prices) between 1990 and 2005 was of 153%. Growth rates of exports are directly related with the value content of product classes, with the "Very High" class growing 413,7% and the class "High" 273,1%. Because the share of the

former in total exports is modest, however, its contribution to total growth is less impressive. Still more than half of the growth in Portuguese exports between 1990 and 2005 was due to products with "High" and "Very High" income content, which represented little more than ¼ of the exports in the beginning of the period. This confirms the trend of structural transformation in the Portuguese exports, already suggested in the previous section.

5. FDI, export growth and structural transformation in Portugal

In this section we assess the role of Foreign Direct Investment (FDI) in the process of structural transformation in Portugal between 1995 and 2005. For this purpose, we estimate the share of foreign firms in the Portuguese exports by product category, using data collected by the Portuguese Ministry of Labour and Social Solidarity on the composition of firms' capital by nationality of owners (details in Appendix 3).[8] Table 4 presents some basic data on the role of FDI in Portuguese exports by classes of PRODY.

Table 4: The role o FDI in Portuguese exports by classes of PRODY[9]

Prody Class in 2005	number of product classes	share of exports (%)		contribution to export growth (%)	share of FDI in total exports (%)		share of exports by foreign frims (%)	
		1995	2005		1995	2005	1995	2005
very high (20% highest)	217	8	10	13	34	43	9	13
high	235	25	31	40	50	56	40	50
median	216	14	16	19	33	33	14	16
low	215	30	25	17	25	17	23	12
very low (lowest 20%)	211	20	13	4	23	24	14	9
All products	1094	97	96	93	33	36	100	100

Sources: own calculations based on INE and GEP/MTSS, Quadros de Pessoal

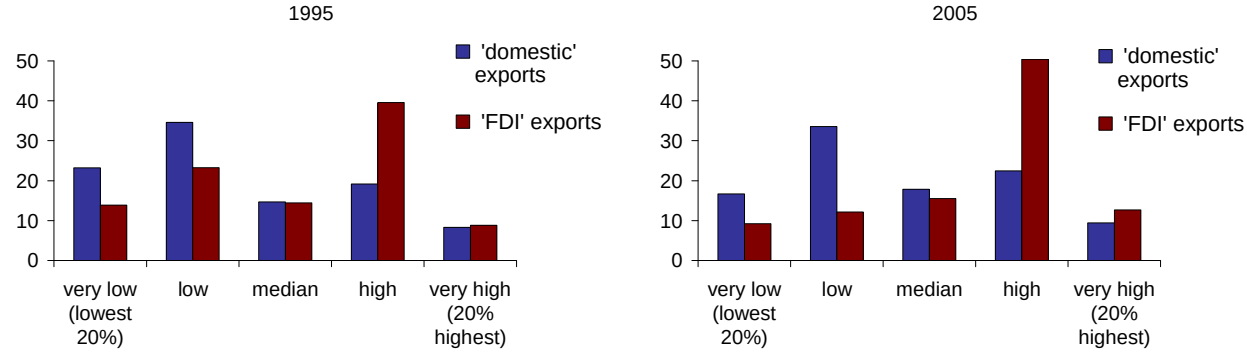
Notes: the table does not include data on 140 product classes, for which there is no data available on the presence of FDI; the share of FDI in each group is calculated as the weighted average of the FDI shares in the exports in each product, with the weights given by the share of each product in the exports of the group.

[8] Due to data limitations, in this section we restrict the analysis to 1.094 product categories (representing 96% of the exports in 2005) and to the evolution in the period 1995-2005.

[9] In this and in the following tables, the share of FDI in each group is calculated as the weighted average of the FDI shares in the exports in each product, with the weights given by the share of each product in the exports of the group (for further details see appendix 3).

These data point towards a number of facts worth noting. First, the share of FDI in total exports increased from 33% in 1995 to 36% in 2005, which means that FDI has made a clearly positive contribution to export growth in Portugal. Second, the income content of FDI-commanded exports is higher than average. This is immediately evident by plotting the distribution of export shares of different PRODY classes for exports commanded by domestic firms with that of FDI-commanded exports, as in Figure 5.

Figure 5: Share of exports of different PRODY classes



Source: own calculations based on INE and GEP/MTSS

We see that both in 1995 and in 2005 the distribution of FDI-led exports is biased towards products with higher content value, when compared with the distribution of 'domestic' exports (a simple Chi-square test leads us to reject the hypothesis of equal distributions, at a 1 % significance level). Furthermore, while in the case of 'domestic' exports the shape of the distribution is approximately the same in 1995 and in 2005 (notwithstanding the increase in the weight of products with higher income content), in the case of FDI exports there was a visible change in the shape of the distribution (confirmed once again by the Chi-square test), from a bi-modal to a one-modal distribution, in which the weight of product classes with high PRODY value concentrates half of the exports by foreign dominated firms in 2005.

In sum, FDI played a relevant role not only in the growth of Portuguese exports during the period, but also in increasing the income content of those exports.[10]

The coincidence between a high presence of FDI and the contribution to export growth is even clearer in Table 5. In this table, product categories are divided in 5 groups of similar dimensions, according to their contribution to the growth of exports in the period. Here we see that the top 20% products in terms of contribution to export growth concentrate 83% of the estimated exports by foreign firms in 2005.

Table 5: The role o FDI in Portuguese exports by contribution to export growth

Contribution to export growth between 1995 and 2005:	number of product classes	share of exports (%)		contribution to export growth (%)	share of FDI in total exports (%)		share of exports by foreign frims (%)	
		1995	2005		1995	2005	1995	2005
very high (20% highest)	218	49	72	106	35	40	53	83
high	219	5	5	6	23	27	4	4
median	219	1	1	1	22	28	1	1
low	219	0	0	0	18	34	0	0
very low (lowest 20%)	219	42	17	-20	32	25	43	12
All products	1094	97	96	93	33	36	100	100

Sources: own calculations based on INE and GEP/MTSS, Quadros de Pessoal

Notes: the table does not include data on 140 product classes, for which there is no data available on the presence of FDI; the share of FDI in each group is calculated as the weighted average of the FDI shares in the exports in each product, with the weights given by the share of each product in the exports of the group.

There are two different ways of interpreting these results: one is that foreign investment is inducing the growth in Portuguese exports; the other is that multinational enterprises invest in export products with higher performance. While one cannot disentangle this question on the basis of the available data, the information in Table 5 does not seem to support the second interpretation. True, the share of FDI in the exports of the top 20% contributors has increased over the period (from 35% to 40%). However, it was already the highest in 1995, when this group of products represented 49% of the total Portuguese

[10] This result somehow contrasts with the conclusions drawn by a recent study by the IMF (2008). The authors conclude that FDI was not likely to contribute to boosting export performance or to the upgrading of Portuguese exports, on the grounds that: (i) that the sectors which experienced an increase in the shares of FDI since the mid-1990s were typically those with a lower growth of international demand, and (ii) rising FDI flows to high-tech sectors were offset by increasing low-tech FDI. One should note, however, that data used in the IMF's study (FDI flows by sector) are very different from those used here (share of exports by foreign controlled firms, broken down by income content).

exports (72% in 2005). In other words, the presence of FDI in those products that contributed the most to the growth of Portuguese exports between 1995 and 2005 was already relevant in the beginning of the period suggesting that the causality was indeed from FDI to export growth.

Table 5 also shows that only 12% of the estimated FDI exports are related to products which have contributed negatively to the variation of nominal exports between 1995 and 2005. Coincidently, this is the only group of products in which the share of FDI in total exports as diminished (from 32% in 1995 to 25% in 2005). All in all, the evidence in Table 5 suggests a strong impact of foreign firms on the variation of Portuguese exports, either positive (when investment is involved) or negative (in case of divestment).[11]

The role of FDI in the structural transformation of Portuguese exports can also be analysed by organizing the export products according to their revealed comparative advantage (RCA) in 1995 and in 2005. In Table 6 we consider four types of products: the 'classics' (i.e., products in which Portugal had a revealed comparative advantage both 1995 and in 2005); the 'marginals' (products in which Portugal did not have a RCA in none of the years); the 'emerging' (products in which Portugal gained a RCA between 1995 and 2005); and finally the 'decaying' (products in which Portugal had a RCA in 1995 but not in 2005).[12]

[11] It should be note that these results are influenced by the bigger scale of foreign controlled firms with respect to the nationally controlled ones. To have an idea of the disproportion, in 2005 the average turnover of foreign-controlled firms in Portugal was about 24 times bigger than the average turnover of the remaining firms (source: Quadros de Pessoal database, GEP/MTSS). True, this figure considers all firms, independently of their involvement in international trade. If we were to consider only exporting firms, the contrast in the scales of foreign-dominated and other firms would surely be lower. Still, if we only consider firms with 50 employees or more, the average turnover of foreign-controlled firms in Portugal in 2005 was about 3.4 times higher than the average turnover of the remaining firms.

[12] We partially borrow these expression from Boccardo et al. (2007).

Table 6: The role o FDI in Portuguese exports by evolution of RCA

Types of products	number of product classes	share of exports (%)		contribution to export growth (%)	share of FDI in total exports (%)		share of exports by foreign frims (%)	
		1995	2005		1995	2005	1995	2005
classics	175	67	54	35	26	26	54	41
rarities	682	12	15	19	33	46	12	20
emerging	110	10	24	45	64	52	21	36
decaying	51	8	2	-5	52	46	13	3
All products	1094	97	96	93	33	36	100	100

Sources: own calculations based on INE and GEP/MTSS, Quadros de Pessoal

Notes: the table does not include data on 140 product classes, for which there is no data available on the presence of FDI; the share of FDI in each group is calculated as the weighted average of the FDI shares in the exports in each product, with the weights given by the share of each product in the exports of the group.

According to Table 6, the 'emerging' products was the group that contributed the most to the increase in exports (45%), reflecting the role of non-traditional products to the expansion of the Portuguese export sector. This is also the group of products in which the share of FDI in total exports was highest both in 1995 (64%) and in 2005 (52%). This reinforces once more the idea that FDI had an important role in bringing about some change in the specialization patterns of the Portuguese economy.

The last column on the right in Table 6 shows that the 'emerging' group of products concentrated 36% of the exports by foreign firms, while the 'classics' were responsible for 41% of those exports. While this suggests that FDI is still mostly directed to exports in which Portugal had a traditional comparative advantage, new products are gaining relevance: in fact, both the 'emerging' and the 'marginals' have increased their contribution to foreign-commanded exports (56%, jointly, in 2005, against 33% in 1995). This contrasts to what happened with the 'classics' and the 'decaying'. Furthermore, most of the FDI exports in non-traditional products (i.e., 'emerging' and 'marginals') is concentrated in products with "High" or "Very High" income content (see Table 7).

Table 7: FDI exports by evolution of RCA and PRODY class

Type of products	Prody Class in 2005					
	very low (lowest 20%)	low	median	high	very high (20% highest)	Total
classics	6	11	9	14	1	41
rarities	0	0	2	6	11	20
emerging	2	1	3	31	0	36
decaying	0	0	2	0	0	3
All products	9	12	16	50	13	100

Sources: own calculations based on INE and GEP/MTSS, Quadros de Pessoal

Notes: the table does not include data on 140 product classes, for which there is no data available on the presence of FDI; the share of FDI in each group is calculated as the weighted average of the FDI shares in the exports in each product, with the weights given by the share of each product in the exports of the group.

Table 8 illustrates the results discussed in this section by providing information on the 20 product categories that have contributed the most for the growth in Portuguese exports between 1995 and 2005 (these were responsible for 60% of the total increase in exports during this period). In the table we see that FDI accounted for at least 2/3 of the exports in 2005 in 8 out of those 20 product categories. With two exceptions the share of FDI in this FDI-dominated products was already significant in 1995. Only 3 of these 8 cases consist in 'classic' exports (the others being non-traditional products). And in all but two of these products (namely, cigarrets and rubber tyres), the income content is either "High" or "Very High".

This table also illustrates the relevance of the automotive and related industries in the processes discussed above – Motor cars and Parts and accessories of motor vehicles, both classified as products with high Prody values and with a significant presence of foreign firms, are responsible for 19% of the growth observed in exports.

Table 8: Top 20 products in terms of contribution to export growth

Code	Commodity	share of exports in 2005 (%)	contribution to export growth (%)	share of FDI in exports in 1995 (%)	share of FDI in exports in 2005 (%)	Prody value in 2005	RCA class
8.703	Motor cars and other motor vehicles principally designed for the transport ...	7	11	99	84	High	emerging champions
8.708	Parts and accessories of the motor vehicles of headings 87.01 to 87.05.	4	8	56	66	High	emerging champions
8.473	Parts and accessories for use with machines of heading 84.69 to 84.72	2	5	28	n.a.	Very High	emerging champions
2.710	Petroleum oils, other than crude	4	5	0	0	Low	classics
9.401	Seats (other than those of heading 94.02), whether or not convertible into ...	2	3	5	0	Median	classics
4.802	Uncoated paper and paperboard, of a kind used for writing	2	3	1	0	Very High	classics
8.527	Reception apparatus for radio-telephony, radio-telegraphy or radio-broadcas ...	3	3	93	98	High	classics
8.542	Electronic integrated circuits and microassemblies.	2	3	80	95	Very High	marginals
6.109	T-shirts, singlets and other vests, knitted or crocheted.	2	3	31	33	Very low	classics
4.011	New pneumatic tyres, of rubber.	1	3	75	93	Median	classics
7.601	Unwrought aluminium.	1	2	0	12	Median	emerging champions
2.402	Cigars, cheroots, cigarillos and cigarettes	1	2	4	85	Very low	emerging champions
3.004	Medicaments (excluding goods of heading 30.02, 30.05 or 30.06)	1	2	38	36	Very High	marginals
8.481	Taps, cocks, valves and similar appliances for pipes, boiler shells	1	1	14	78	High	emerging champions
7.214	Other bars and rods of iron or non-alloy steel, not further worked than for ...	1	1	0	0	Low	emerging champions
2.204	Wine of fresh grapes, including fortified wines	2	1	31	18	Low	classics
2.901	Acyclic hydrocarbons.	1	1	5	73	High	classics
4.504	Agglomerated cork (with or without a binding substance)	1	1	8	8	High	classics
8.480	Moulding boxes for metal foundry; mould bases; moulding patterns	1	1	4	6	High	classics
4.503	Articles of natural cork.	1	1	8	8	High	classics
Total of 20 products contributing most to export growth		**39**	**60**	**46**	**50**	**-**	**-**

6. Conclusions

We started by showing that the average income content of Portuguese exports (as reflected in the value of EXPY) has grown above the world average in recent years, and that this evolution was related to a structural transformation of the country's exports (and not to changes in the PRODY values of those products in which Portugal has a comparative advantage). This suggests that Portugal has been able to shift its specialization pattern toward products of higher productivity content - what confirms the recent findings of Caldeira Cabral (2008), who made a similar assessment using a classification of products based on technological intensity.

Analysing in greater detail the evolution in the Portuguese export structure, we find that such improvement was characterised by a fast increase in the classes of products with "High" and "Very High" income content. Between 1990 and 2005, the class of exports of "Very High" income content grew 413% between 1990 and 2005, followed by the class of "High" income content, which grew at 273%. In terms of contributions, these two classes explain 55% of total export growth.

Taking into account the presence of FDI in the different export products, we find that the share of foreign firms in 2005 was higher than average for products with "High" and "Very High" income content (56% and 43%, respectively). Those two classes of products concentrated almost 2/3 of exports by foreign firms in Portugal in 2005. About 5/6 of FDI-led exports were among the 20% of products that contributed the most to export growth between 1995 and 2005. Furthermore, we show that more than 1/2 of the FDI is related with non-traditional exports.

All these pieces of evidence suggest that FDI played a relevant role both in the growth of Portuguese exports during the period and in increasing their income content.

We mentioned in section 2 the results by Hausmann et al. (2007) showing that industrial upgrading (in terms of an increase in the average income content of exports) is a leading

indicator of economic performance. The results we reach in this paper suggest that FDI has contributed to the structural transformation of Portuguese exports towards higher sophisticated products. If both results hold, FDI will have made a positive contribution to the performance of Portuguese economy in the coming years.

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Appendix 1: Definitions of PRODY and EXPY

The PRODY index measures the "income content" of each product, as a weighted average of per capita incomes of the countries that export it. For each product i, the PRODY index is computed as: $PRODY_i = \sum_{c \in C} \sigma_{ci} Y_c$, where $\sigma_{ic} = \frac{RCA_{ic}}{\sum_{d \in C} RCA_{id}}$, $RCA_{ic} = \frac{X_{ic}/X_c}{X_i/X}$, $C = \{1,2,....,M\}$, where Y_C is real GDP per capita in the c-th country, M is the number of countries and the the weights σ_{ci} normalize the Balassa index of Revealed Comparative Advantage (RCA) of the c-country with respect to all the countries exporting in the same sector.

EXPY: measures the "sophistication level" of a country export basket, as an weighted average of the PRODYs of the products exported by that country. The income content of a country export basket, EXPY, is computed, for each country, as:

$$EXPY_c = \sum_i s_i PRODY_i ,$$

where $s_i = \frac{X_{ic}}{X_c}$ is the share of product i in the exports of country c.

Appendix 2 – Export shares by class of PRODY

	1990						1995						2000						2005					
	Very low	Low	Median	High	Very High	Total	Very low	Low	Median	High	Very High	Total	Very low	Low	Median	High	Very High	Total	Very low	Low	Median	High	Very High	Total
Argentina							39	25	20	12	4	100	35	27	20	13	4	100	36,8	26,1	22,7	10,7	3,8	100
Australia	26	20	33	14	7	100	24	18	33	15	11	100	20	22	33	13	13	100	17,5	18,6	42,4	11,7	9,8	100
Austria							6	16	20	34	24	100	5	14	18	37	24	100	4,3	17,1	18,6	35,3	24,7	100
Belize							69	27	2	3	1	100	62	36	1	1	0	100	67,8	29,4	1,3	0,7	0,7	100
Bolivia							64	23	11	2	0	100	61	11	14	12	1	100	42,3	18,1	37,9	1,1	0,5	100
Brazil	28	25	24	17	6	100	30	20	24	19	6	100	24	18	24	26	8	100	23,8	21,8	24,2	21,5	8,8	100
Cameroon							38	51	10	1	0	100	24	68	8	0	0	100	28,5	64,1	6,7	0,5	0,2	100
Canada	9	18	24	33	17	100	8	17	22	35	18	100	6	18	24	35	18	100	6,1	21,1	27,5	30,4	15,0	100
Chile	64	22	7	6	1	100	59	20	9	11	2	100	56	22	10	10	2	100	65,6	17,9	8,9	5,3	2,3	100
China							27	24	18	20	12	100	20	21	18	25	15	100	13,0	16,7	18,2	30,1	22,0	100
China Hong Kong SAR							15	17	18	25	24	100	13	15	17	27	29	100	9,7	11,0	13,4	25,0	40,9	100
Colombia							49	28	14	6	3	100	29	43	16	9	3	100	30,8	36,0	21,6	8,3	3,3	100
CostaRica							64	19	9	5	3	100	32	13	10	5	40	100	30,5	14,0	13,7	7,5	34,2	100
Cotedlvoire																			54,8	37,8	3,2	3,4	0,8	100
Croatia							20	29	27	16	8	100	17	29	32	14	9	100	12,5	31,3	29,7	17,3	9,2	100
Cyprus	32	32	21	10	6	100	42	21	21	6	10	100	40	23	16	12	9	100	7,7	27,2	13,6	13,6	37,9	100
Czech Rep.							9	21	27	30	12	100	6	16	26	40	12	100	4,5	14,5	24,1	44,3	12,7	100
Denmark	10	17	27	20	26	100	9	16	27	21	27	100	9	19	21	21	30	100	7,7	19,6	19,7	22,5	30,6	100
Dominica							81	10	6	2	1	100	59	25	14	2	1	100	53,3	28,6	16,2	1,0	1,0	100
Ecuador							54	41	2	2	1	100	38	56	3	2	1	100	30,8	64,4	2,3	1,7	0,9	100
Estonia							21	29	21	15	14	100	13	26	20	11	30	100	8,9	28,6	20,1	17,1	25,2	100
Finland	6	15	14	24	41	100	4	14	15	25	42	100	3	13	12	21	51	100	3,7	13,5	11,5	22,1	49,2	100
France							7	17	22	35	19	100	6	15	20	35	25	100	5,4	15,9	19,2	36,0	23,6	100
Germany *	5	11	20	41	23	100	5	10	19	41	24	100	4	9	18	43	26	100	3,8	9,4	17,3	42,7	26,8	100
Greece	35	39	17	7	3	100	32	37	18	9	4	100	25	37	18	11	10	100	19,8	32,7	20,8	13,6	13,1	100
Guatemala							66	17	10	3	4	100	56	24	13	3	4	100	59,7	20,6	11,5	3,8	4,3	100
Honduras							86	9	3	1	0	100	72	18	7	3	0	100	61,4	23,4	8,2	4,8	2,2	100
Hungary							16	23	29	21	11	100	7	13	19	43	18	100	4,6	12,4	19,0	42,3	21,7	100
Iceland	46	37	12	4	1	100	49	32	12	4	2	100	43	29	21	3	3	100	38,7	27,2	20,8	6,7	6,6	100
India	48	13	27	7	5	100	44	15	26	9	6	100	37	20	25	10	8	100	27,2	26,7	26,2	12,1	7,8	100
Ireland							4	11	17	25	43	100	2	6	8	21	63	100	1,8	6,1	6,7	17,8	67,6	100
Israel							8	11	41	14	26	100	5	7	37	15	35	100	4,1	7,0	51,6	12,6	24,7	100
Italy							9	21	24	28	19	100	8	20	23	28	20	100	6,9	20,2	23,1	28,4	21,4	100
Japan	2	5	18	46	29	100	1	5	18	42	33	100	1	5	16	42	36	100	1,5	6,1	16,9	42,1	33,3	100
Jordan							42	24	11	11	11	100	29	22	25	15	10	100	43,1	24,1	16,6	7,2	9,0	100
Kazakhstan							27	38	23	7	4	100	18	67	12	2	1	100	14,9	74,5	8,9	1,4	0,3	100
Kiribati							79	21	0	0	0	100							81,2	11,5	6,6	0,2	0,5	100
Kyrgyzstan							41	31	10	15	3	100	62	25	6	6	2	100	64,3	22,6	7,3	4,8	1,0	100
Latvia							19	44	17	11	9	100	18	48	19	7	7	100	12,5	46,0	19,9	12,9	8,7	100
Lithuania							15	40	26	12	7	100	18	43	22	12	5	100	10,9	44,9	23,6	15,2	5,4	100
Madagascar	86	9	3	1	1	100	85	10	4	2	0	100	64	29	3	3	1	100	70,7	20,8	3,9	2,4	2,1	100
Malawi	95	3	1	1	0	100	93	3	2	1	0	100	93	2	3	1	0	100	92,6	3,1	2,2	1,6	0,5	100
Malaysia	23	30	14	12	21	100	17	14	17	22	30	100	9	12	17	23	39	100	11,0	14,4	18,1	25,2	31,3	100
Maldives							61	39	0	0	0	100	65	35	0	0	0	100	19,3	75,2	2,5	2,3	0,8	100
Malta							13	6	42	9	31	100	7	8	7	10	68	100	5,4	4,2	56,4	20,3	13,7	100
Mauritius							72	17	5	2	4	100	74	15	4	3	3	100	60,0	13,1	5,9	4,2	16,9	100
Mexico	12	48	10	24	5	100	11	25	17	36	11	100	8	22	17	38	15	100	6,4	27,0	18,7	34,2	13,7	100
Morocco							64	26	6	4	1	100							51,6	32,5	11,0	3,5	1,3	100
Mozambique							79	12	4	4	1	100	52	27	19	1	1	100	75,8	13,5	8,3	2,1	0,3	100
Netherlands							11	18	22	26	23	100	9	17	16	28	30	100	8,7	18,5	18,1	25,0	29,7	100
New Zealand	9	28	25	28	10	100	11	26	27	26	10	100	10	25	28	26	12	100	8,5	24,4	29,8	24,9	12,4	100
Nicaragua							62	20	4	7	7	100	75	17	6	1	1	100	64,8	26,3	6,4	1,5	1,0	100
Niger							90	3	2	5	0	100	78	6	5	11	1	100	88,3	2,9	2,6	5,7	0,5	100
Norway							6	54	23	8	10	100	3	64	20	5	7	100	2,8	58,7	26,4	4,8	7,3	100
Oman	2	93	1	3	0	100	6	82	3	8	1	100	4	85	3	7	1	100	1,9	73,2	23,2	1,3	0,4	100
Panama							73	14	9	1	4	100	57	29	10	1	2	100	56,3	35,3	7,4	0,6	0,5	100
Paraguay	78	19	3	0	0	100	81	14	3	1	1	100	80	14	4	1	1	100	69,0	21,5	7,5	1,0	1,0	100
Peru							73	21	4	1	1	100	70	23	4	2	1	100	71,8	21,3	4,2	2,1	0,6	100
Poland							20	24	37	14	7	100	13	20	35	24	7	100	8,6	19,9	34,1	29,3	8,0	100
Portugal	26	32	15	21	6	100	20	31	15	25	8	100	16	27	15	32	9	100	14,4	26,5	16,9	31,5	10,7	100
Rep.of Korea	17	25	20	21	17	100	9	17	21	27	24	100	7	16	19	28	30	100	3,1	13,5	18,4	33,3	31,6	100
Rep.of Moldova							27	51	11	7	4	100	34	48	7	8	3	100	34,5	48,3	9,9	5,4	1,9	100
Romania	8	43	25	21	4	100	23	38	23	11	4	100	27	35	19	11	7	100	20,2	38,7	20,6	16,8	3,7	100
SaudiArabia							1	89	7	3	0	100	1	93	4	3	0	100	0,6	88,0	8,0	2,9	0,4	100
Singapore	10	24	13	31	22	100	6	12	12	36	34	100	4	12	10	29	44	100	2,7	15,2	10,2	23,0	48,9	100
Slovakia							11	30	28	23	8	100	8	25	23	37	7	100	5,3	26,9	23,1	36,4	8,3	100
Slovenia							9	13	31	32	15	100	6	11	32	36	16	100	4,6	11,5	28,7	38,2	17,0	100
Spain	8	26	20	37	9	100	8	20	19	41	11	100	8	20	20	40	12	100	7,4	20,1	20,8	37,4	14,3	100
Sweden							3	13	14	33	37	100	2	12	14	28	43	100	2,9	14,9	14,8	29,4	38,1	100
Switzerland	4	8	18	25	44	100	3	8	17	26	46	100	2	7	17	23	50	100	2,7	8,8	12,3	19,4	56,8	100
TFYR of Macedonia							39	33	14	11	3	100	38	47	7	6	2	100	42,7	43,2	6,1	5,3	2,7	100
Thailand	45	16	14	11	14	100	31	15	17	21	15	100	21	14	20	20	24	100	17,2	14,9	22,1	30,1	15,7	100
Togo							68	25	3	3	1	100	82	10	4	3	0	100	65,4	26,9	6,7	0,6	0,5	100
Trinidad and Tobago							6	67	24	2	1	100	3	62	33	1	0	100	1,6	52,1	44,6	0,9	0,8	100
Tunisia							53	32	6	6	2	100	48	36	6	9	2	100	38,6	38,7	7,5	12,7	2,5	100
Turkey	48	33	11	6	2	100	41	35	14	8	2	100	34	30	18	14	3	100	24,4	29,8	24,9	17,8	3,1	100
Uganda							94	3	2	1	0	100	75	10	12	1	2	100	80,0	12,6	2,5	2,2	2,7	100
United Kingdom							5	17	17	33	29	100	3	16	16	30	34	100	3,3	17,7	15,9	27,8	35,2	100
Uruguay							38	27	22	11	2	100	33	32	20	11	4	100	22,3	42,4	24,3	7,2	3,7	100
USA							10	10	16	35	30	100	7	9	15	36	34	100	6,5	9,3	16,3	35,8	32,1	100
Zambia							91	5	3	1	0	100	85	9	2	2	1	100	90,2	5,7	3,4	0,4	0,3	100

* Former Fed Rep. of Germany in 1990

Appendix 3 – Estimating the role of FDI in exports

Although we have access to the data on the exports for each product category (including confidential positions), we do not know how much of those exports are conducted by foreign-controlled firms. In order to estimate the share of FDI in the total exports of each product category, we used the «Quadros de Pessoal» database, which is compiled by the Portuguese Ministry of Labour and Social Solidarity. This database includes information on every firm with employed labour in Portugal, and contains a variable on the proportion of each firm's capital that is hold by non-nationals.

We start from the concordance tables between the Combined Nomenclature of goods (at the 4 digit level of desegregation) and NACE (the Classification of Economic Activities in the European Community, at the 4 digit level of desegregation) for 1995 and 2005. Although there is a bi-univocal relation for 84% of the CN codes, some of the product categories have more than on corresponding NACE code, as shown in the following table:

	CN codes	
Number of NACE codes for each CN code	**N.**	**%**
1	924	84
2	139	13
3 or more	24	3
Total	1094	100

Using the data from «Quadros de Pessoal, we computed the share of foreign-controlled firms (defined as those firms in which the proportion of capital owned by non-nationals is equal or greater than 50%) in the total turnover of each industry. Then, the share of FDI in the exports of each CN category was computed as the weighted average of FDI share of turnover in each relevant industry, with weights given by the turnover of each industry.

Formally,

$$FX_i = \sum_j a_{ij} FT_j$$

where FX_i is the share of FDI in the exports of product *i*; *FTj* is the proportion of foreign-dominated firms' turnover in the total turnover of industry *j;* and α_{ij} is the weight of industry *j* in the total turnover of industries associated with the product *i* (according the concordance tables), i.e.,

$$a_{ij} = \frac{T_{ij}}{\sum_j T_{ij}}$$

where,

$$T_{ij} = \begin{cases} \text{turnover of industry j} & \text{if j is associated with product i} \\ 0 & \text{otherwise} \end{cases}$$

Appendix 4 – Decomposing the growth of EXPY into pure structural effects, PRODY effects and mixed effects

Let E_i^t be the value of EXPY of country *i* in year *t*, s_{ij}^t the share of product *j* in the total exports of country *i* in year *t*, and Pj^t the PRODY value of product *j* in year *t*. Than, the change in EXPY from *t* to *t+n* can be decomposed as follows:

$$E_i^{t+n} - E_i^t = \sum_j s_{ij}^{t+n}.P_j^{t+n} - \sum_j s_{ij}^t.P_j^t$$

$$= \sum_j \left(s_{ij}^{t+n}.P_j^{t+n} - s_{ij}^t.P_j^t \right)$$

$$= \sum_j \left[\left(s_{ij}^{t+n} - s_j^t \right) P_j^{t+n} + s_{ij}^t.\left(P_j^{t+n} - P_j^t \right) \right]$$

$$= \sum_j \left(s_{ij}^{t+n} - s_{ij}^t \right) P_j^{t+n} + \sum_j s_{ij}^t.\left(P_j^{t+n} - P_j^t \right)$$

$$= \sum_j \left(s_{ij}^{t+n} - s_{ij}^t \right) P_j^t + \sum_j \left(s_{ij}^{t+n}.P_j^{t+n} + s_{ij}^t.P_j^t - s_{ij}^{t+n}.P_j^t - s_{ij}^t.P_j^{t+n} \right) + \sum_j s_{ij}^t.\left(P_j^{t+n} - P_j^t \right)$$

The first component of this expression is the pure structural effect (i.e., it tells us how the EXPY would have changed if the PRODY values of the different products did not change between 1995 and 2005), the last component gives us the pure PRODY effect (i.e., it shows how the EXPY of a country would have changed if there had been no transformation in its export structure), and the component in the middle is the mixed effect (which takes into account the fact that the impact of changes in PRODY values on the country's EXPY depend on changes in its export structure, and the other way round; e.g., the impact of changes in PRODY values are amplified when they refer to products which have gained weight in the country's export basket).

The following table displays the results of this decomposition for 81 countries.

	EXPY 1995	EXPY 2005	EXPY growth		Pure Prody effect	Mixed effect	Pure structural effect
			rate	rank			
Argentina	9.909	12.964	31%	73	29%	2%	-1%
Australia	11.328	16.762	48%	33	42%	4%	2%
Austria	13.656	18.599	36%	67	35%	2%	-1%
Belize	5.731	7.150	25%	81	42%	-7%	-10%
Bolivia	6.825	11.038	62%	13	29%	-1%	34%
Brazil	10.231	15.063	47%	35	39%	1%	6%
Cameroon	6.681	11.054	65%	12	46%	-7%	27%
Canada	9.200	14.537	58%	19	42%	6%	9%
Chile	9.012	17.340	92%	6	70%	-20%	42%
China	6.875	9.736	42%	47	49%	-3%	-4%
Colombia	8.835	17.240	95%	4	31%	12%	52%
Costa Rica	10.981	13.794	26%	80	39%	-3%	-10%
Cote d'Ivoire	6.963	13.918	100%	3	39%	5%	56%
Croatia	10.800	15.478	43%	44	37%	-1%	7%
Cyprus	10.540	17.699	68%	11	35%	7%	25%
Czech Rep.	12.360	18.053	46%	38	38%	0%	7%
Denmark	13.468	18.578	38%	61	36%	2%	0%
Dominica	5.680	8.071	42%	46	32%	-13%	23%
Ecuador	7.418	12.810	73%	8	41%	7%	25%
Estonia	10.810	16.380	52%	29	39%	-2%	14%
Finland	14.324	19.569	37%	66	35%	-1%	2%
France	13.077	18.493	41%	48	37%	3%	2%
Germany	14.054	19.363	38%	62	36%	1%	1%
Greece	9.828	15.363	56%	23	37%	9%	11%
Guatemala	6.419	10.376	62%	14	41%	-5%	26%
Honduras	4.365	9.321	114%	2	47%	-2%	69%
Hong Kong SAR	11.293	17.337	54%	26	34%	3%	16%
Hungary	11.332	18.071	59%	16	37%	0%	22%
Iceland	13.440	18.952	41%	52	31%	6%	4%
India	9.322	14.455	55%	25	43%	4%	8%
Ireland	14.585	23.438	61%	15	39%	16%	6%
Israel	12.411	18.550	49%	31	43%	6%	0%
Italy	12.880	17.886	39%	59	36%	2%	1%
Japan	14.547	19.575	35%	70	34%	1%	0%
Jordan	8.314	11.962	44%	43	46%	-12%	10%
Kazakhstan	9.216	14.460	57%	21	56%	-9%	11%
Kiribati	4.527	5.854	29%	77	55%	-60%	35%
Kyrgyzstan	6.968	9.237	33%	72	80%	-62%	14%
Latvia	10.023	15.236	52%	28	49%	-5%	8%
Lithuania	10.177	15.041	48%	34	45%	-2%	5%
Madagascar	4.205	9.458	125%	1	50%	-5%	80%
Malawi	2.921	4.589	57%	20	38%	-5%	24%
Malaysia	12.387	17.095	38%	60	31%	0%	7%
Maldives	7.396	12.827	73%	7	49%	-13%	37%
Malta	13.293	18.710	41%	53	31%	5%	5%
Mauritius	7.582	11.988	58%	18	34%	1%	23%
Mexico	12.152	16.998	40%	54	35%	0%	5%
Morocco	6.791	10.775	59%	17	42%	-6%	22%
Mozambique	4.692	6.528	39%	58	55%	-86%	70%
Netherlands	13.044	17.928	37%	63	35%	1%	1%
New Zealand	11.848	17.120	44%	40	41%	0%	3%
Nicaragua	5.901	8.213	39%	57	57%	-31%	13%
Niger	3.985	5.159	29%	76	35%	-22%	17%
Norway	12.673	16.532	30%	75	36%	-3%	-3%
Oman	11.195	15.379	37%	64	37%	-4%	4%
Panama	6.111	10.357	69%	9	44%	-14%	39%
Paraguay	6.713	9.031	35%	71	36%	-10%	8%
Peru	6.233	8.984	44%	42	54%	-12%	2%
Poland	10.916	16.730	53%	27	39%	1%	13%
Portugal	11.058	16.394	48%	32	35%	5%	9%
Rep. of Korea	12.787	18.280	43%	45	34%	0%	9%
Rep. of Moldova	8.213	10.547	28%	78	41%	-15%	2%
Romania	10.241	14.465	41%	50	39%	-2%	4%
Saudi Arabia	10.863	15.360	41%	49	41%	-1%	2%
Singapore	13.903	18.792	35%	69	32%	3%	1%
Slovakia	11.472	17.148	49%	30	39%	2%	8%
Slovenia	12.629	18.561	47%	36	41%	3%	4%
Spain	12.507	17.475	40%	55	38%	1%	1%
Sweden	14.143	19.332	37%	65	37%	1%	-1%
Switzerland	15.117	21.842	44%	41	38%	6%	0%
TFYR of Macedonia	8.939	12.107	35%	68	42%	-8%	2%
Thailand	11.246	16.484	47%	37	32%	3%	11%
Togo	6.153	8.039	31%	74	42%	-40%	28%
Trinidad and Tobago	8.994	14.064	56%	22	52%	-9%	13%
Tunisia	8.683	12.668	46%	39	31%	4%	12%
Turkey	9.124	14.247	56%	24	33%	6%	17%
Uganda	4.493	8.732	94%	5	34%	-8%	68%
United Kingdom	13.689	19.312	41%	51	38%	2%	2%
Uruguay	10.645	13.523	27%	79	28%	2%	-3%
USA	13.700	19.078	39%	56	35%	2%	2%
Zambia	3.376	5.701	69%	10	76%	-87%	80%