

THE IMPORT CONTENT OF GLOBAL DEMAND IN PORTUGAL*

Fátima Cardoso** | Paulo Soares Esteves*** | António Rua**

ABSTRACT

The analysis of the importance of imports in global demand is crucial for a better understanding of the behaviour of the main macroeconomic variables. In this article we assess the import content of global demand over the last three decades, highlighting the heterogeneity across demand components and across products.

1. Introduction

The analysis of the role of imports in global demand is relevant for a better understanding of the economic evolution, namely to assess the impact of changes in the demand components on other variables, such as GDP or trade balance. A typical example concerns the impact of exports growth on GDP as this impact depends on the use of imports in the production oriented to the foreign market. That is, the effect on domestic production resulting from an increase of the Portuguese exports is certainly lower if it is driven by a product such as fuels (which have a high import content) than tourism (since services related with hotels and restaurants present a low import content). Therefore, the monitoring of the evolution of exports should take into account not only its aggregate behaviour but also its sectoral decomposition.

For an analysis of the import content of exports and corresponding implications in the economic activity see, for example, Cross (2002) for Canada, Loschky and Ritter (2006) for Germany, Koopman *et al.* (2008) for China and di Mauro *et al.* (2005), Breda *et al.* (2008) and European Commission (2012) for several European countries. For a more comprehensive analysis of the import content of the several components of global demand see, for example, Herzberg *et al.* (2002) for the United Kingdom, Heitz and Rini (2006) for the French case and Claus and Li (2003), Kranendonk and Verbruggen (2008) and Bravo and Álvarez (2012) for a set of countries.

In this article, we focus on the analysis of the import content of global demand in Portugal over the last three decades. In particular, we characterize its temporal evolution and assess how the role of imports to cope with global demand behaviour has changed throughout time in the period post 25th April.

In Chart 1, it is presented the import penetration in global demand for the longest period for which there is available data (1953 - 2012), resorting to the Historical Series for the Portuguese Economy [Pinheiro *et al.* (1997, 1999)] for the period before 1995.

Since 1953 up to the end of the 70's, it was not recorded an increase of the import penetration, in real terms. It was only after joining the European Economic Community that there was a significant increase of this indicator.

* The opinions expressed in this article are those of the authors and do not necessarily coincide with those of Banco de Portugal or the Eurosystem. Any errors and omissions are the sole responsibility of the authors.

** Economics and Research Department, Banco de Portugal.

*** Office of the Governor, Banco de Portugal.

Note that, in nominal terms, the weight of imports in the global demand recorded an increase after the end of the first half of the 70's, reflecting the oil shocks, and a decrease in periods where the oil price declined substantially, as for example in 1986. Therefore, the nominal indicator did not present a sustained increase as the one recorded by the indicator at constant prices. Nevertheless, it should be noted that since the end of the 90's the import penetration has been similar in nominal and real terms, while presenting an upward trend although interrupted during the low phases of the business cycle. Additionally, the import penetration presents a pro-cyclical behaviour recording an elasticity higher than one *vis-à-vis* the global demand (Chart 2). In general, the increase of the import content of global demand over the last decades as well as the pro-cyclical feature have been observed in most advanced economies.

In this article, we address the evolution of the import content providing detail, in terms of the main components of global demand as well as its decomposition at a more elementary level, highlighting the heterogeneity across the several economic activity branches. Besides contributing to a better understanding of the aggregate evolution of the import content of demand, the results obtained also allow improving the assessment of the impact of such differentiated behaviour on GDP and trade balance.

The article is organized as follows. The data is presented in the next section. In section 3, the main results are discussed whereas in section 4 such results are used to estimate an econometric model for the Portuguese imports. Finally, in the last section, a summary of the main findings is provided.

2. Data

In this article, we intend to analyze in a systematic way the evolution of the import content of global demand for a period of time as long as possible, considering a breakdown by product comparable over time and as detailed as possible. The calculation of the import content was based on symmetric matrices of domestic output (at basic prices) and imports containing information both of intermediate consumption (by product and homogeneous branch of production) and of final uses by product. These matrices correspond to a breakdown of the data of national accounts (input-output tables), but not available with the same regularity. In recent years, the compilation of these matrices, designated integrated system of input-output matrices was provided by the Department of Prospective and Planning (DPP) and is planned to be updated every five years, approximately.

Chart 1

IMPORT PENETRATION

Weight of imports in global demand

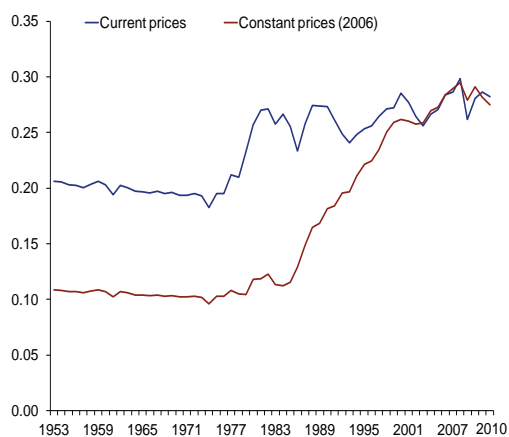
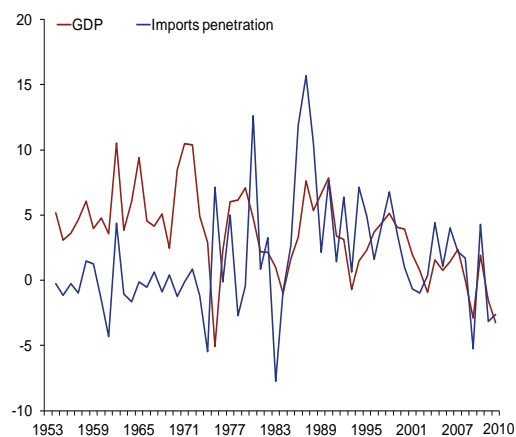


Chart 2

EVOLUTION OF IMPORT PENETRATION AND ECONOMIC ACTIVITY

Annual growth rates in volume



Source: INE and a Historical Series for the Portuguese Economy [Pinheiro et al.(1997) and (1999)].

Therefore, the sampling period considered in the analysis includes all years for which information is available, that is, 1980, 1986, 1992, 1995, 1999, 2005 and 2008. Matrices for 1980, 1992 and 1995 were provided by the INE, while from 1995 onwards the compilation of these matrices was done by the DPP (based on data from INE).¹ Based on this information it is possible to calculate the content of primary inputs to satisfy demand and in this study we focus on the input associated with imports.²

Note that the data for 1980, 1986 and 1992 are according to ESA 79 while the remaining years are according to ESA 95, which should be taken into account and justifies some caution in the analysis over time. In particular, we highlight the following points. Firstly, in ESA 79, the concept of private consumption concerns to the territory (includes expenses of non-residents in the country but does not include the expenditure of residents outside the national territory) while in SEC 95 private consumption concerns to residents (that is, it includes imports and excludes exports of tourism). Secondly, the FISIM (Financial Intermediation Services Indirectly Measured, called Imputed Production of Banking Services in ESA 79) was previously registered exclusively as intermediate consumption of a fictitious branch while from the base 2000 in ESA95 the FISIM became allocated to intermediate consumption (imputed to the respective branch) and final uses.³ To ease the comparison, the FISIM was allocated to branches/products as done in Reis and Rua (2009).

Additionally, one should note that over the period considered there were three nomenclatures of products (one in ESA79 and two in ESA95). Thus, for comparability over time an aggregation was performed by keeping as far as possible the most detailed level, resulting in 29 products similarly to Reis and Rua (2009).⁴ This resulted in matrices of imported and domestically produced intermediate consumption for 29 products and 29 homogeneous branches, as well as the final uses of these 29 products (for each component of final demand) from imports and domestic production.

Note that the calculations are performed based on the matrices at basic prices, so the import contents obtained are not affected by taxes, and trade margins are not allocated to each product.

3. Results

Table 1 presents the total import content of the different components of global demand in Portugal over the last three decades (see the Appendix for a description of the methodology). Note that the total import content reflects both the direct import content (which arises from the final demand of imported goods) and the indirect import content (resulting from the use of imported goods in domestic production). Chart 3 shows this decomposition for each of the components of global demand.

Analyzing the results obtained at basic prices, we conclude that the import content of global demand has been relatively stable over time and stood at around 30 per cent, although it has increased slightly since 1986 after joining the EEC.

The component that typically presents a higher import content is GFCF, recording a value of around 40 per cent. However, exports registered a significant increase since 1995 attaining values similar to those of GFCF at the end of the period considered. This increase is associated with the start of production of

¹ The matrices from 1999 onwards were published in Martins (2004a), Martins (2004b), Dias (2008) and Dias and Domingos (2011).

² For example, an analysis of the content of primary inputs for the various components of final demand in 2005 and detailed by product can be found in Dias (2010).

³ The FISIM was considered as a whole as intermediate consumption of a fictitious sector/branch, which, since it had no production, registered a negative value added in the same amount. This negative value added was fully deducted from the value added of all institutional sectors and branches of activity, wherefore the level of GDP was not affected by the figure registered as FISIM production (see, for example, "Box 3.1: *The Base 2000 of Portuguese National Accounts*", Banco de Portugal, *Annual Report 2005*).

⁴ The correspondence between ESA79 and ESA95 first nomenclature is provided in Reis and Rua (2006) and the correspondence with the current nomenclature can be obtained from the authors.

Table 1

TOTAL IMPORT CONTENT							
	1980	1986	1992	1995	1999	2005	2008
<i>(at basic prices)</i>							
Private consumption	0.26	0.24	0.25	0.26	0.29	0.28	0.30
Public consumption	0.09	0.09	0.06	0.08	0.09	0.09	0.11
GFCF	0.41	0.39	0.45	0.36	0.39	0.37	0.41
Exports	0.38	0.33	0.31	0.36	0.37	0.40	0.42
Global demand	0.30	0.27	0.28	0.28	0.30	0.29	0.32
<i>(at purchasers' prices)</i>							
Private consumption	0.24	0.22	0.23	0.23	0.25	0.25	0.26
Public consumption	0.09	0.09	0.06	0.08	0.09	0.09	0.11
GFCF	0.39	0.38	0.44	0.34	0.37	0.35	0.39
Exports	0.38	0.33	0.31	0.36	0.37	0.40	0.42
Global demand	0.29	0.26	0.26	0.26	0.28	0.27	0.29

Source: Author's calculations.

Autoeuropa, a large company of auto industry with significant impact on exports. It is worth noting, more recently, the growing importance of fuel exports, characterized by a high import content. In the case of exports, the total import content reflects essentially the indirect import content. This reflects the phenomenon of fragmentation of the supply chain at the international level (see, for example, Amador and Cabral (2008)).

In turn, private consumption presents an import content slightly below global demand and increased gradually since 1986 standing at 30 per cent in 2008. The evolution of the import content of private consumption reflects distinct behaviors in terms of the direct and indirect import content. In fact, the direct import content of private consumption presented a significant increase over time (14 per cent in the 2000s compared to 4 per cent in 1980) while the indirect component showed a declining trend. This indicates that private consumption has been increasingly satisfied by direct recourse to imported consumer products.

Additionally, we should mention that the component of global demand with lower import content is public consumption, registering a value close to 10 per cent.

Naturally, when considering the components of demand at purchasers' prices, the import content is reduced. This is particularly visible in the case of private consumption given the level of taxation on this component of global demand (notably tobacco, fuels and motor vehicles).

The following subsections present a more detailed analysis of the import content of the main aggregates of global demand, particularly private consumption, gross fixed capital formation and exports.

3.1 Private Consumption

Table 2 presents the import content for private consumption breakdown by product. As can be seen, the products which have higher import content are durable goods (especially machinery and transport equipment) and fuel (see Chart 4). Note that in the case of transport equipment and machinery the very high import content reflects mainly imports addressed directly to private consumption. On the contrary, in the case of fuel, the high import content stems largely from the indirect effect, reflecting the fact

Chart 3

TOTAL, DIRECT AND INDIRECT IMPORT CONTENT | PER UNIT



Source: Author's calculations.

Table 2

IMPORT CONTENT OF PRIVATE CONSUMPTION BY PRODUCTS								
	Weights in 2008	1980	1986	1992	1995	1999	2005	2008
Private consumption	100.0	0.26	0.24	0.25	0.26	0.29	0.28	0.30
Agriculture	1.7	0.21	0.19	0.22	0.25	0.33	0.42	0.50
Fishing	0.5	0.26	0.27	0.46	0.20	0.29	0.36	0.44
Fuel and mining	2.1	0.83	0.69	0.66	0.73	0.73	0.86	0.85
Food and beverages	9.3	0.34	0.30	0.31	0.41	0.44	0.49	0.59
Tobacco	0.2	0.38	0.07	0.06	0.38	0.32	0.44	0.44
Textiles and clothing	2.6	0.34	0.33	0.54	0.58	0.64	0.62	0.72
Leather	0.7	0.35	0.53	0.43	0.60	0.71	0.65	0.78
Wood and cork	0.1	0.23	0.25	0.34	0.38	0.43	0.45	0.54
Paper	0.3	0.30	0.59	0.43	0.47	0.53	0.45	0.57
Chemicals	1.9	0.65	0.61	0.60	0.75	0.83	0.82	0.84
Rubber and plastics	0.4	0.58	0.76	0.84	0.71	0.75	0.70	0.75
Other minerals	0.2	0.42	0.68	0.59	0.68	0.77	0.47	0.56
Metals	0.2	0.47	0.50	0.62	0.74	0.79	0.69	0.80
Machinery	1.4	0.61	0.75	0.85	0.90	0.95	0.93	0.94
Transport equipment	3.2	0.62	0.69	0.84	0.96	0.99	0.99	0.99
Other manufacturing	1.6	0.83	0.84	0.70	0.51	0.60	0.60	0.71
Electricity, gas and water	3.6	0.33	0.21	0.12	0.14	0.18	0.34	0.36
Construction	0.1	0.24	0.21	0.23	0.20	0.21	0.22	0.24
Trade	19.2	0.14	0.11	0.10	0.12	0.14	0.12	0.15
Hotels and restaurants	10.9	0.14	0.13	0.12	0.20	0.20	0.20	0.18
Transportation	3.2	0.32	0.19	0.17	0.16	0.18	0.31	0.37
Communications	3.2	0.05	0.05	0.11	0.13	0.11	0.18	0.19
Financial Intermediation	6.9	0.04	0.08	0.07	0.07	0.06	0.10	0.06
Real estate	10.6	0.05	0.11	0.04	0.05	0.05	0.04	0.03
Renting and business activities	2.4	0.07	0.06	0.10	0.13	0.14	0.15	0.19
Education	2.0	0.03	0.02	0.02	0.04	0.04	0.03	0.04
Health and social work	6.1	0.11	0.13	0.08	0.13	0.14	0.14	0.16
Public administration	0.2	0.11	0.11	0.08	0.05	0.05	0.07	0.07
Other services	5.3	0.12	0.10	0.12	0.11	0.10	0.14	0.12
<i>Memo</i>								
Food consumption	11.5	0.31	0.28	0.30	0.38	0.42	0.48	0.57
Durables consumption	6.6	0.61	0.70	0.80	0.83	0.89	0.86	0.90
Non-food non-durable consumption	82.0	0.22	0.19	0.18	0.18	0.19	0.20	0.21

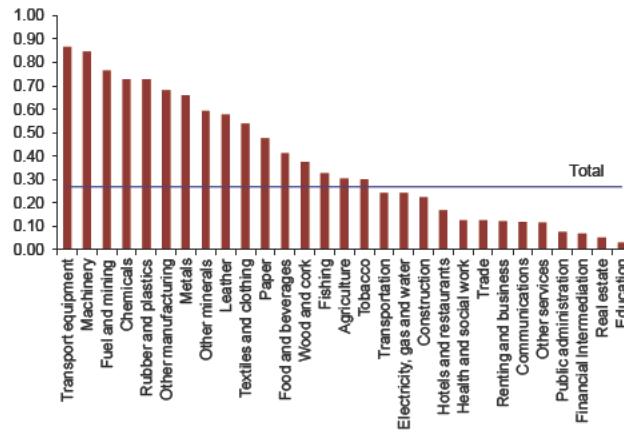
Source: Author's calculations.

that this sector includes the activity of domestically refining the associated raw materials. In turn, the consumption expenditures concerning services are those that have a lower import content.

Concerning the temporal evolution of the import content in the last 30 years, one should note that food consumption has been increasingly satisfied by imported goods, resulting in a substantial increase in the direct import content (see Chart 5). There was also a significant increase in the share of imports (via the direct component) in the consumption of goods associated with so-called traditional sectors such as textiles, clothing and footwear. This phenomenon of reorientation of private consumption to external production implies a less favorable impact in GDP of increased demand for these goods.

Chart 4

IMPORT CONTENT OF PRIVATE CONSUMPTION BY PRODUCTS | AVERAGE IN THE YEARS CONSIDERED



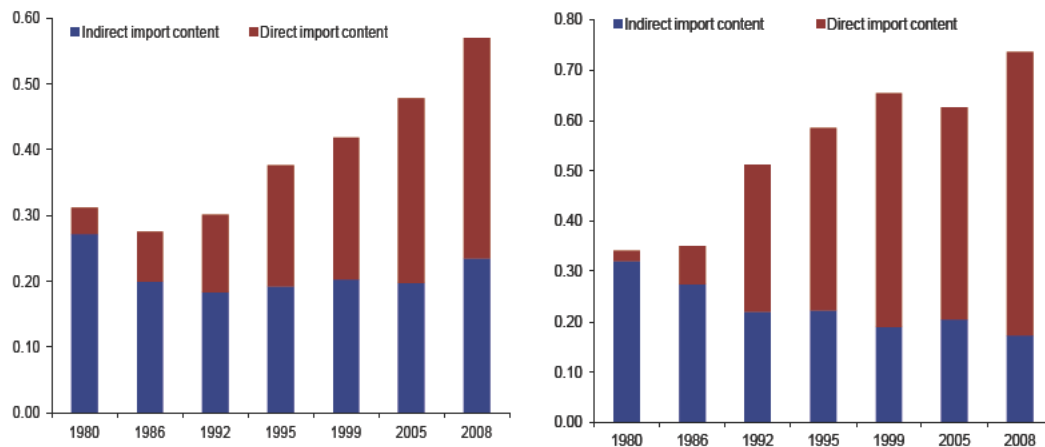
Source: Author's calculations.

3.2 GFCF

As mentioned before, the weight of the imported component in GFCF has been relatively stable at around 40 per cent. Considering the main components of GFCF, one should note that transport equipment and machinery and equipments are those with the highest import content, having registered in 2008 a value of 97 and 83 per cent, respectively (see Table 3). Note that this type of investment is largely satisfied directly by imports which translates into a high direct import content (see Chart 6). In turn, GFCF in construction shows a relatively low import content (slightly more than 20 per cent) reflecting only the indirect import content.

Chart 5

IMPORT CONTENT OF PRIVATE CONSUMPTION



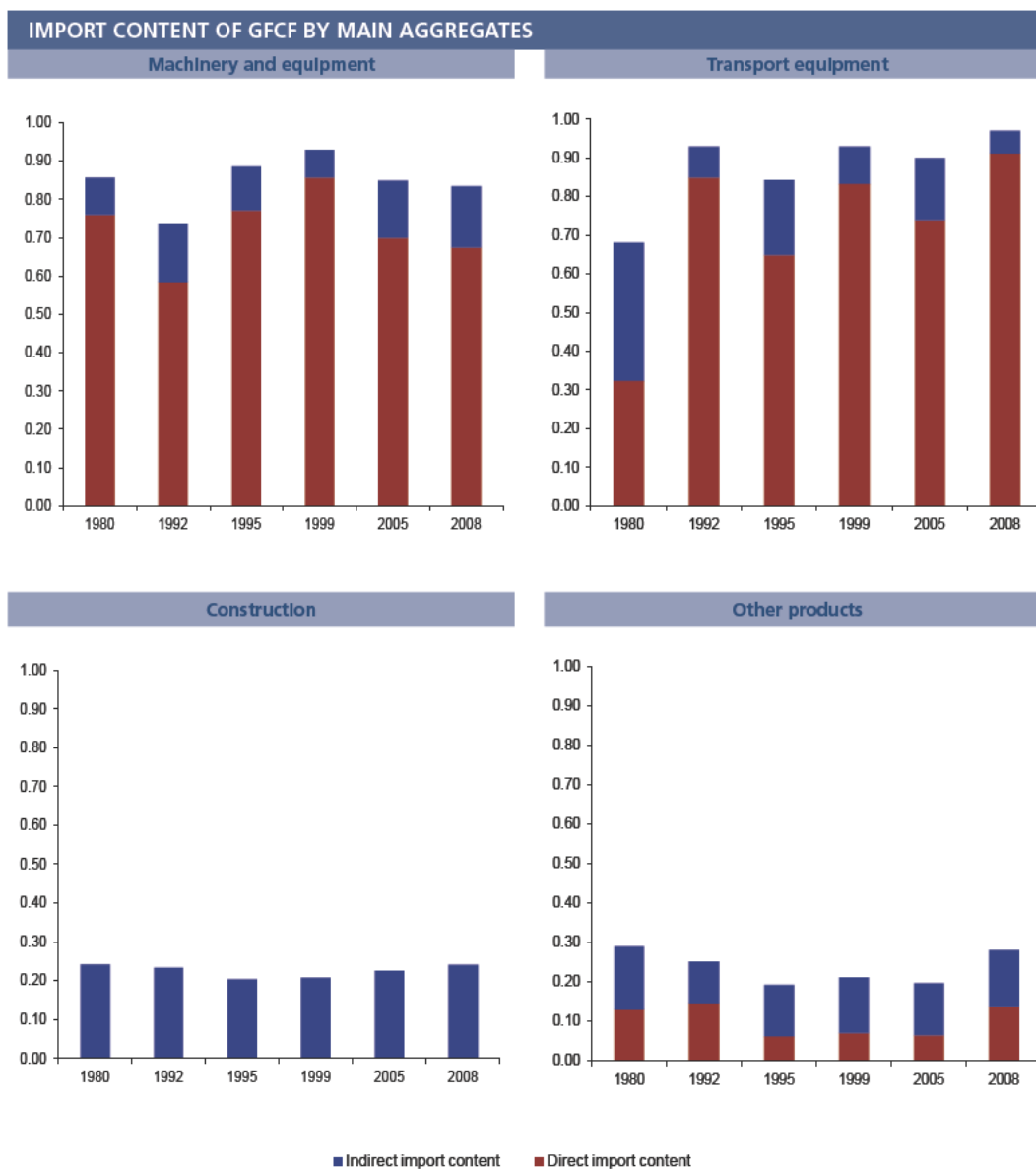
Source: Author's calculations.

Table 3

IMPORT CONTENT OF GFCF BY PRODUCTS								
	Weights In 2008	1980	1986	1992	1995	1999	2005	2008
GFCF	100.0	0.41	0.39	0.45	0.36	0.39	0.37	0.41
Machinery and equipment	22.0	0.86	0.89	0.74	0.89	0.93	0.85	0.83
Transport equipment	6.5	0.68	0.80	0.93	0.84	0.93	0.90	0.97
Construction	50.4	0.24	0.21	0.23	0.20	0.21	0.22	0.24
Other products	21.0	0.29	0.19	0.26	0.19	0.21	0.20	0.28

Source: Author's calculations.

Chart 6



Source: Author's calculations.

3.3 Exports

Regarding exports, the goods component presents a substantially higher import content than the services component (about 50 and 20 per cent in 2008, respectively) (see Table 4). It should be noted that, since Portugal joined the European Community in 1986, exports of goods have presented an increase in terms of import content, in line with international evidence. Naturally, the higher the import content the lower the positive impact of an increase in exports in the economy.

Exports of goods that incorporate a higher import content include fuels and transport equipment (see Chart 7). In the first case, it reflects the fact that Portugal is not an oil producing country by which the raw material has to be imported to enable refining and subsequent export. It should be noted that the importance of these exports has been increasing in the most recent period, amounting to about 8 per cent of the total nominal exports of goods in 2012 compared to 2 per cent in the early 2000s. In the case of vehicles, despite the positive externalities arising from the AutoEuropa in Portugal, whose production is intended primarily for export, this activity implies a significant imported component. In turn, not surprisingly, agricultural products and fisheries are those with lower import content.

4. An econometric model for the Portuguese imports

Besides improving the understanding of the aggregate evolution of the import content of demand and its implications, namely in terms of GDP and trade balance, the assessment of the import content of the several components of the global demand is relevant for the econometric modelling of imports (see, for example, Bussière *et al.* (2011), Laxton *et al.* (1998) and Herzberg *et al.* (2002)).

In this section, we provide an illustration for the Portuguese case. In particular, we consider the main determinants of the behaviour of imports of goods and services, in real terms, namely the global demand

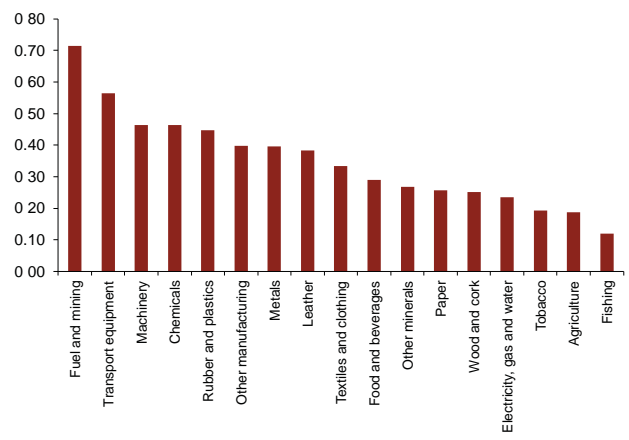
Table 4

IMPORT CONTENT OF EXPORTS BY PRODUCTS								
	Weights in 2008	1980	1986	1992	1995	1999	2005	2008
Exports of goods and services	100.0	0.38	0.33	0.31	0.36	0.37	0.40	0.42
Exports of goods	76.5	0.41	0.35	0.34	0.40	0.41	0.45	0.49
Agriculture	1.3	0.17	0.15	0.15	0.12	0.14	0.27	0.30
Fishing	0.3	0.19	0.14	0.14	0.07	0.06	0.11	0.14
Fuel and mining	5.1	0.79	0.63	0.58	0.68	0.68	0.82	0.82
Food and beverages	5.9	0.32	0.24	0.22	0.27	0.29	0.30	0.38
Tobacco	0.5	0.36	0.07	0.06	0.17	0.20	0.29	0.22
Textiles and clothing	7.9	0.32	0.28	0.31	0.34	0.35	0.35	0.38
Leather	2.9	0.34	0.42	0.32	0.39	0.39	0.38	0.44
Wood and cork	2.6	0.22	0.21	0.25	0.22	0.24	0.28	0.34
Paper	3.2	0.25	0.22	0.20	0.24	0.26	0.28	0.35
Chemicals	5.2	0.57	0.51	0.39	0.42	0.43	0.45	0.47
Rubber and plastics	3.4	0.51	0.44	0.43	0.42	0.42	0.44	0.46
Other minerals	3.2	0.32	0.23	0.19	0.23	0.23	0.31	0.36
Metals	7.5	0.38	0.35	0.32	0.39	0.39	0.48	0.45
Machinery	14.0	0.42	0.39	0.39	0.50	0.50	0.51	0.53
Transport equipment	11.1	0.53	0.47	0.53	0.56	0.58	0.62	0.67
Other manufacturing	1.7	0.56	0.47	0.38	0.33	0.33	0.37	0.35
Electricity, gas and water	0.7	0.29	0.21	0.12	0.14	0.18	0.34	0.36
Exports of services	23.5	0.27	0.17	0.12	0.11	0.12	0.15	0.20

Source: Author's calculations.

Chart 7

IMPORT CONTENT OF EXPORTS OF GOODS | AVERAGE IN THE YEARS CONSIDERED



Source: Author's calculations.

(weighted by the import content) and the relative price of imports. Regarding the global demand, each component is weighted by the corresponding import content, that is,

$$PG^* = c_C C + c_G G + c_I I + c_X X$$

where PG^* denotes the global demand weighted by the import content, C corresponds to private consumption, G is public consumption, I denotes investment, X refers to exports of goods and services and c_C , c_G , c_I and c_X are the corresponding import contents (at market prices). By its turn and in line with the literature, the competitiveness price indicator for imports is defined as the ratio between the deflator of imports of goods and services and GDP deflator (see, for example, Fagan *et al.* (2001, 2005)).

The estimation of a macroeconomic model of the type ECM (Error Correction Mechanism), for the period running from the first quarter of 1980 up to the fourth quarter of 2012, resulted in the following specification:

$$\Delta \ln M_t = 0.39 + 1.48 \Delta \ln PG_t^* - 0.15 \Delta \ln Def_t - 0.13 (\ln M_{t-1} - \ln PG_{t-1}^*) - 0.08 \ln Def_{t-1}$$

(4.48) (14.5)
(-3.68)
(-4.92)
(-4.50)

$$\hat{\sigma} = 0.015 \qquad R^2 = 0.75 \qquad F(4, 126) = 94.55 [0.000]$$

where M denotes the imports of goods and services, in real terms, Def is the relative price between imports and GDP. For the estimated coefficients, we report in brackets the HACSE t-ratios (based on standard errors robust to heteroscedasticity and autocorrelation). Additionally, we report the standard error, the R^2 and the F statistic for testing the overall fit of the model along the corresponding p -value.

Concerning the estimated model one should highlight the following. Firstly, the relative price of imports affects negatively the behaviour of real imports, both in the short-run (with a coefficient of -0.15) and in the long-run (with an elasticity of -0.65). Likewise in other countries (see Laxton *et al.* (1998)), the long-run elasticity is higher than the short-run one. Regarding the global demand weighted by the import content, it was imposed a unitary elasticity in the long-run as usual in the literature that addresses the estimation of this kind of models (see, for example, Laxton *et al.* (1998), Herzberg *et al.* (2002) and Fagan *et al.* (2001, 2005)). Note that this assumption is not rejected when one takes into account the fact that the

import content has changed throughout time.⁵ However, it is rejected if one uses the historical average of the import content. This finding highlights the sensitivity of the long-run relationship to structural changes, which are potentially more relevant as the sample period used for estimation purposes increases.

In what concerns the short-run elasticity *vis-à-vis* the global demand weighted by the import content, the estimated value is around 1.5, which is in line with previous literature. The finding of an elasticity higher than one goes back to the seminal work of Houthakker e Magee (1969) (see, for example, more recently Bussière *et al.* (2011)).

There are some arguments that can support a short-run elasticity higher than one. On the one hand, in line with Herzberg *et al.* (2002), imports are more cyclical than global demand because national firms, due to adjustment costs, are not able to change instantaneously the production capacity and therefore imports accommodate the demand fluctuations. On the other hand, the components of global demand that present typically a more pronounced cyclical behaviour are also the ones that have higher import content. Therefore, the fact that the weighting is not performed at the most elementary level results in measurement errors which can explain a short-run elasticity above one. For example, in the above equation, if one had used the global demand (weighted directly by its import content, that is, $c_{PG}PG$) as the short-run indicator it would result in an elasticity close to 1.8. In contrast, considering a higher level of disaggregation of the several components of global demand would result in an elasticity closer to one.

5. Conclusions

In this article we assess the evolution of the import content of the different components of global demand over the last three decades.

In particular, the import content of the global demand recorded an increase after Portugal joined the European Community. The component that presents the highest import content is GFCF, although exports have registered a noteworthy increase since 1995 attaining similar figures to GFCF at the end of the sample period. By its turn, private consumption presents an import content slightly below global demand despite the gradual increase since 1986. Public consumption is the component of global demand that records the lowest import content.

The results obtained allow for a better understanding of the aggregate behaviour of the import content of global demand and its implications, namely in terms of the evolution of GDP and trade balance. Additionally, resorting to the import content results, it was estimated a model for the Portuguese imports so as to illustrate its usefulness in terms of macroeconomic modelling.

⁵ In practice, for the years where data is available (namely 1980, 1986, 1992, 1995, 1999, 2005 and 2008) the corresponding import content have been used whereas for the remaining years it was considered a linear interpolation between two known years so as to smooth the evolution of the import content (see, for example, Bussière *et al.* (2011)).

References

- Amador, J. and Cabral, S. (2008), "Vertical specialization in Portuguese international trade", *Economic Bulletin Summer*, Banco de Portugal, 97-114.
- Bussière, M. G. Callegari, F. Ghironi, G. Sestieri and N. Yamano (2011), "Estimating Trade Elasticities: Demand Composition and the Trade Collapse of 2008-09", *NBER Working Paper No. 17712*.
- Bravo, A. C. and Álvarez, M. T. (2012), "The import content of the industrial sectors in Spain", *Banco de España Economic Bulletin*, April, 81-92.
- Breda, E., Cappariello, R. and Zizza, R. (2008), "Vertical specialisation in Europe: evidence from the import content of exports", Working Paper no. 682, Banca d'Italia.
- Claus, I. and Li, K. (2003), "New Zealand's Production Structure: An International Comparison", *Working Paper 03/16*, New Zealand Treasury.
- Cross, P. (2002) "Cyclical implications of the rising import content in exports", *Canadian Economic Observer*, December, Statistics Canada.
- Dias, A. (2008), "Sistema integrado de matrizes input-output para Portugal, 2005", *Documento de trabalho no. 8*, Departamento de Prospetiva e Planeamento.
- Dias, A. (2010), "Conteúdos de inputs primários da procura final – Portugal 2005", *Documento de trabalho no. 1*, Departamento de Prospetiva e Planeamento.
- Dias, A. and Domingos, E. (2011), "Sistemas integrados de matrizes input-output para Portugal, 2008", *Documento de trabalho no. 7*, Departamento de Prospetiva e Planeamento.
- di Mauro, F. et al. (2005), "Competitiveness and the Export Performance of the Euro Area", *Occasional Paper no. 30*, European Central Bank.
- European Commission (2012), "A closer look at some drivers of the trade performance at Member State level", *Quarterly report on the euro area*, vol. 11, no. 2, 29-39.
- Fagan, G., Henry, J. and Mestre, R. (2001), "An Area-Wide Model for the euro area", *Working Paper no. 42*, European Central Bank.
- Fagan, G., Henry, J. and Mestre, R. (2005), "An Area-Wide Model for the euro area", *Economic Modelling*, 22(1), 39-59.
- Heitz, B. and Rini, G. (2006), "Reinterpreting the contribution of foreign trade to growth", *Trésor-Economics Letter no. 6*.
- Herzberg, V., Sebastia-Barriel, M. and Whitaker, S. (2002), "Why are imports so cyclical", *Quarterly Bulletin Summer 2002*, Bank of England.
- Houthakker, H. S., and S. P. Magee (1969), "Income and Price Elasticities in World Trade," *Review of Economics and Statistics*, 51, 111-125.
- Koopman, R., Wang, Z. and Wei, S. (2008), "How Much of Chinese Exports Is Really Made in China? Assessing Domestic Value-Added when Processing Trade Is Pervasive", *Working Paper no. 14109*, National Bureau of Economic Research.
- Kranendonk, H. C. and Verbruggen, J. P. (2008), "Decomposition of GDP Growth in Some European Countries and the United States", *De Economist*, vol. 156, no. 3, 295-306.
- Laxton, D., Isard, P., Faruquee, H., Prasad, E. and Turtelboom, B. (1998), "MULTIMOD Mark III: The Core Dynamic and Steady-State Models", *IMF Occasional Paper no. 164*, International Monetary Fund.
- Loschky, A. and Ritter, L. (2006), "Import content of exports", paper apresentado na 7th OCDE Interna-

tional Trade Statistics Expert Meeting, Paris.

Martins. N. (2004a), "Sistema integrado de matrizes de input-output para Portugal de 1995, a preços correntes e a preços de 1999", *Documento de trabalho*, DPP.

Martins. N. (2004b), "Sistema integrado de matrizes de input-output para Portugal, 1999", *Documento de trabalho*, DPP.

Reis, H. and Rua, A. (2006), "An input-output analysis: linkages vs. leakages", *Working Paper no. 17/06*, 2006, Banco de Portugal.

Reis, H. and Rua, A. (2009), "An input-output analysis: linkages vs. leakages", *International Economic Journal*, vol. 23, no. 4, 527-544.

Pinheiro, M (coord.) et al. (1997), *Historical series for the Portuguese economy post II World War*, Vol. II – methodological notes, Banco de Portugal.

Pinheiro, M. (coord.) et al. (1999), *Historical series for the Portuguese economy post II World War*, Vol. I – statistical series, revised and enlarged version for 1994 and 1955, Banco de Portugal.

Appendix

Let us assume that there are n sectors in the economy and consider the equilibrium between total supply and total demand for each good

$$x_i + m_i = z_{i1} + z_{i2} + \dots + z_{in} + y_{i1} + y_{i2} + \dots + y_{ik} \quad (1)$$

where x_i is the domestic output of good i ($i=1, \dots, n$), m_i denotes imports of good i , z_{ij} is sector i 's product absorbed by sector j , that is, the intermediate consumption, and y_{il} is final demand l ($l=1, \dots, k$). In national accounts, final demand encompasses the different components of global demand such as private consumption, public consumption, investment and exports. Note that intermediate consumption includes both domestic output and imports ($z_{ij} = z_{ij}^d + z_{ij}^m$) and the same applies to each of the components of global demand ($y_{il} = y_{il}^d + y_{il}^m$).

Since

$$m_i = \sum_{j=1}^n z_{ij}^m + \sum_{l=1}^k y_{il}^m \quad (2)$$

substituting (2) into (1) we obtain

$$x_i = z_{i1}^d + z_{i2}^d + \dots + z_{in}^d + y_{i1}^d + y_{i2}^d + \dots + y_{ik}^d \quad (3)$$

For the n products we get a set of n equations

$$\begin{aligned} x_1 &= z_{11}^d + z_{12}^d + \dots + z_{1n}^d + y_{11}^d + y_{12}^d + \dots + y_{1k}^d \\ x_2 &= z_{21}^d + z_{22}^d + \dots + z_{2n}^d + y_{21}^d + y_{22}^d + \dots + y_{2k}^d \\ &\vdots \\ x_n &= z_{n1}^d + z_{n2}^d + \dots + z_{nn}^d + y_{n1}^d + y_{n2}^d + \dots + y_{nk}^d \end{aligned} \quad (4)$$

Define a_{ij}^d as

$$a_{ij}^d = \frac{z_{ij}^d}{x_j} \quad (5)$$

that is, the domestic output of product i used to produce a unit of product j . Substituting (5) into (4) we obtain

$$\begin{aligned} x_1 &= a_{11}^d x_1 + a_{12}^d x_2 + \dots + a_{1n}^d x_n + y_{11}^d + y_{12}^d + \dots + y_{1k}^d \\ x_2 &= a_{21}^d x_1 + a_{22}^d x_2 + \dots + a_{2n}^d x_n + y_{21}^d + y_{22}^d + \dots + y_{2k}^d \\ &\vdots \\ x_n &= a_{n1}^d x_1 + a_{n2}^d x_2 + \dots + a_{nn}^d x_n + y_{n1}^d + y_{n2}^d + \dots + y_{nk}^d \end{aligned} \tag{6}$$

which can be written, in matrix terms, as

$$X = A^d X + Y^d \mathbf{1} \tag{7}$$

where

$$A^d = \begin{bmatrix} a_{11}^d & a_{12}^d & \dots & a_{1n}^d \\ a_{21}^d & a_{22}^d & \dots & a_{2n}^d \\ \vdots & \vdots & & \vdots \\ a_{n1}^d & a_{n2}^d & \dots & a_{nn}^d \end{bmatrix} \quad X = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \quad Y^d = \begin{bmatrix} y_{11}^d & y_{12}^d & \dots & y_{1k}^d \\ y_{21}^d & y_{22}^d & \dots & y_{2k}^d \\ \vdots & \vdots & & \vdots \\ y_{n1}^d & y_{n2}^d & \dots & y_{nk}^d \end{bmatrix} \quad \mathbf{1} = \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix} \tag{8}$$

Let I be an identity matrix $n \times n$. Solving (7) for X , we get

$$X = (I - A^d)^{-1} Y^d \mathbf{1} \tag{9}$$

where $(I - A^d)^{-1}$ is the well known Leontief matrix. The element (i, j) of the Leontief matrix allows to assess the increase in domestic output of product i if there is an unitary increase of final demand of the domestic output of product j .

Now define a_{ij}^m as the imports of product i used in the production of one unit of product j , that is

$$a_{ij}^m = \frac{z_{ij}^m}{x_j} \tag{10}$$

Therefore, resorting to equation (2), it is possible to write for each product i the following

$$m_i = \sum_{j=1}^n a_{ij}^m x_j + \sum_{l=1}^k y_{il}^m \tag{11}$$

By considering the n products, one obtains in matrix form

$$M = A^m X + Y^m \mathbf{1} \tag{12}$$

where

$$A^m = \begin{bmatrix} a_{11}^m & a_{12}^m & \dots & a_{1n}^m \\ a_{21}^m & a_{22}^m & \dots & a_{2n}^m \\ \vdots & \vdots & & \vdots \\ a_{n1}^m & a_{n2}^m & \dots & a_{nn}^m \end{bmatrix} \quad Y^m = \begin{bmatrix} y_{11}^m & y_{12}^m & \dots & y_{1k}^m \\ y_{21}^m & y_{22}^m & \dots & y_{2k}^m \\ \vdots & \vdots & & \vdots \\ y_{n1}^m & y_{n2}^m & \dots & y_{nk}^m \end{bmatrix} \tag{13}$$

Define $c_{il}^m = \frac{y_{il}^m}{y_{il}}$ as the direct import content of final demand l of product i and $c_{il}^d = \frac{y_{il}^d}{y_{il}}$ as the final demand of type l satisfied directly through domestic output, where the corresponding diagonal matrices are given by

$$C^m = \begin{bmatrix} c_{1l}^m & 0 & \dots & 0 \\ 0 & c_{2l}^m & \dots & 0 \\ \vdots & \vdots & \dots & \vdots \\ 0 & 0 & \dots & c_{nl}^m \end{bmatrix} \quad C^d = \begin{bmatrix} c_{1l}^d & 0 & \dots & 0 \\ 0 & c_{2l}^d & \dots & 0 \\ \vdots & \vdots & \dots & \vdots \\ 0 & 0 & \dots & c_{nl}^d \end{bmatrix} \quad (14)$$

Substituting (9) into (12) and taking into account that $Y^m = C^m Y$ and $Y^d = C^d Y$ we obtain

$$M = \left[A^m (I - A^d)^{-1} C^d + C^m \right] Y1 \quad (15)$$

where $A^m (I - A^d)^{-1} C^d$ and C^m denote the indirect and the direct import content, respectively. Hence, for each component of the global demand (private consumption, public consumption, GFCF and exports) we obtain a vector of import contents which corresponds to the amount of imports required to fulfil one unit of final demand of each product j . The total import content of a given component of the global demand includes both the direct import content (final demand of imported goods) and the indirect component, that is, the imports of intermediate goods used to produce the domestic output. Additionally, the total import content of each component reflects the underlying composition in terms of products.