GAINS FROM IMPORT VARIETY: THE CASE OF PORTUGAL*

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1. INTRODUCTION

Several models were developed in the eighties to provide a theoretical basis for trade of different varieties of the same good, *i.e.*, horizontal intra-industry trade. In these models, goods are distinct due to certain attributes, but they are basically the same in terms of quality, cost and technology employed in their production. Trade between countries with similar endowments is basically driven by consumers' preferences for diversified consumption bundles ("love for variety") and by the existence of monopolistic competition with economies of scale in the production of each variety of the good (see, for instance, Dixit and Stiglitz (1977), Krugman (1979, 1980, 1981), Lancaster (1980) and Helpman (1981)). Even if the gains from trade through the import of new varieties have long been established in international trade theory, the empirical estimates of the impact of increased variety on aggregate welfare have appeared only recently. Within a monopolistic competition setting, consumers value additional varieties depending on their substitutability, which is captured by the elasticity of substitution. So the computation of the gains from imported variety requires the estimation of the elasticities of substitution between the varieties of each good, which is done using panel data methods. The statistical technique was first proposed by Feenstra (1994), which deals with the empirical methods needed to analyse the gains from trade due to expanding variety for an individual good, and was afterwards extended by Broda and Weinstein (2006) to a multi-good framework and implemented with data for the US.

Broda and Weinstein (2006) show that the growth in product variety was an important source of gains from trade in the US over the 1972-2001 period. The main idea is that conventional import price indices are mismeasured because they take as given the basket of imported varieties. New varieties lower aggregate prices, depending on their substitutability with other varieties and their expenditure share, with varieties being defined as goods originating from different countries. They find that the upward bias in the conventional import price index reached 28 per cent over the above mentioned period or 1.2 per cent per year and estimate the value to US consumers of the increased import varieties to amount to 2.6 per cent of GDP. Gaulier and Méjean (2006) used the same methodology to study the aggregate price effect of newly imported varieties for a sample of 28 advanced and emerging market economies and confirm the downward impact of changes in imported variety on import price

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levels. On average between 1994 and 2003, the appearance of new varieties leads to an unrecorded 0.2 per cent annual drop in import prices. However, their results vary strongly across countries, with the measurement bias being much higher in some emerging countries.

Following the methodology proposed by Feenstra (1994) and extended by Broda and Weinstein (2006), we estimate the gains from import variety growth for Portugal and other euro area countries in the period from 1995 to 2007. We use the BACI-CEPII database, which provides reconciled bilateral trade values (in US dollars) and quantities at the 6-digit of the 1992 Harmonized System (HS) classification.

The article is organized as follows. Section 2 reviews the methodology used to obtain the gains from imported variety, referring to Feenstra (1994) and Broda and Weinstein (2006), and describes the database used. Section 3 starts by describing the growth of variety in Portuguese imports. Then, the gains from new imported varieties in Portugal are examined in comparison with those obtained for other euro area countries. The remaining of the section details the results obtained for Portugal, examining the product dimension of the measurement bias of import prices. Section 4 presents some concluding remarks.

2. METHODOLOGY AND DATA

The growth of international trade has significantly broadened consumers' choice of goods in recent decades. As international trade expands, domestic consumers are able to acquire varieties of goods not available from domestic producers and this wider choice of goods increases consumers' welfare. The seminal work of Feenstra (1994) and its extension by Broda and Weinstein (2006) propose a methodology to quantify the gains from an increase in imported varieties using highly disaggregated trade data in a framework where consumers value variety. The main idea is that an increase in imports of new varieties of a given good results in a fall in aggregate import prices and this effect is stronger if new varieties are not close substitutes of existing ones. This effect is not captured by traditional import price indices, which are based on a fixed set of varieties, leading to a measurement bias. Using this bias, we can estimate what consumers would be willing to pay to access the wider range of varieties available in the most recent period. The empirical methodology to quantify the measurement bias of import prices due to the new imported varieties and its welfare gains can be decomposed into several steps that are described below.

The results of this methodology should be viewed with some caution, since they depend heavily on the assumptions adopted in the empirical strategy. The Broda and Weinstein (2006) methodology assumes that the number of domestic varieties is unaffected by the increase in imported varieties, so there are no dynamic and input-output effects resulting from increases in the number of imported varieties. This caveat is a direct consequence of using only trade data to evaluate the variety gains from trade, thus ignoring the domestic supply of differentiated varieties. This fact introduces an error in the estimated gains from imported variety (see Arkolakis *et al.* (2008) and Feenstra (2006) for a discussion). Ardelean and Lugovskyy (2010) extended Broda and Weinstein (2006) methodology by allowing domestic and foreign varieties to be imperfect substitutes within each sector. They found that domestic productivity is an important factor in evaluating the variety gains from trade when foreign and domestic varieties are substitutes.[1]

2.1. Empirical strategy

Feenstra (1994) developed a methodology for measuring the impact of new varieties on an exact price index of a single imported good and Broda and Weinstein (2006) extended this methodology to the case of multiple goods obtaining an exact aggregate import price index that takes into account variety change. In this section, we follow closely Feenstra (1994) and Broda and Weinstein (2006) and briefly describe the empirical strategy. The first step is to precise the empirical definition of a "variety". We define a good as a 6-digit Harmonized System (HS6) category and a variety is defined as a good imported from a particular country, using Armington (1969)'s formulation of product differentiation by country. As discussed in Broda and Weinstein (2006), there are several definitions of variety in different theoretical and empirical frameworks, for instance, a brand produced by a firm, the output of a firm or the output of a country. The choice on the definition of variety used empirically is often determined by the availability of information. In our case, as in several international trade papers, variety is defined as specific good produced by a particular country, since it is not possible to obtain information on all individual firms exporting to Portugal.

As in Broda and Weinstein (2006), the preferences of the representative consumer can be described by a three-level utility function that aggregates imported varieties into imported goods, then aggregates these imported goods into a composite imported good and finally combines this imported good with a composite domestic good to generate utility. The specification of the bottom level subutility function derived from the consumption of an imported good g at time t, M_{gt}, is written as a nonsymmetric constant elasticity of substitution (CES) utility function over varieties of this good, with a variety defined as a good g imported from a country c:

$$M_{gt} = \left(\sum_{c \in C} d_{gct}^{1/\sigma_g} m_{gct}^{(\sigma_g - 1)/\sigma_g} \right)^{\sigma_g/(\sigma_g - 1)}, \tag{1}$$

where m_{gct} is the subutility derived from the imported variety c of good g in period t, $d_{gct} > 0$ is the corresponding taste or quality parameter describing the consumer's preference for the differentiated variety c, and C denotes the set of available countries and hence potentially available varieties in period t. The elasticity of substitution among varieties of good g is given by σ_g, which is assumed to exceed unity.

The minimum unit-cost functions derived from this utility function can be used to obtain an exact price

(1) The authors found that in some US manufacturing sectors, such as electronics, variety gains are underestimated by more than 90 per cent with the standard methodology, that is, trade leads to larger gains from variety if the domestic sector is taken into account. In contrast, for other sectors, like machinery and transportation and wood and paper, variety gains are overestimated by around 40 per cent when neglecting the response of domestic variety. On average, the bias in variety gains from ignoring domestic varieties is relatively small, leading to an overestimation of 8 per cent between 1991 and 2001.

index for good g as shown in Diewert (1976). In the case of a CES function, Sato (1976) and Vartia (1976) show that the exact price index P_g can be written as a geometric mean of individual price changes using ideal log-change weights:

$$P_g = \prod_{c \in I_g} \left(\frac{p_{gct}}{p_{gct-1}} \right)^{\omega_{gct}}, \tag{2}$$

where p_{gct} is the price of variety c of good g in period t, $I_{gt} \subset C$ is the subset of all varieties of good g consumed in period t, $I_g = I_{gt} \cap I_{gt-1}$ is the set of common varieties consumed in both periods t and t-1 and ω_{gct} are ideal log-change weights computed using expenditure shares in the two periods (see appendix for a detailed definition).

The exact price index P_g in equation 2 accounts only for a fixed set of varieties I_g available in both periods. The idea of the index proposed initially by Feenstra (1994) is to correct this conventional price index P_g by multiplying it with an additional term which measures the influence of new and disappearing varieties of good g. As explained in Feenstra (1994), a useful way to interpret this effect of new and disappearing varieties is by treating the price of a variety before it is available as equal to its reservation price, *i.e.*, a price so high that demand equals zero.[2] Once the variety appears on the market, it has a lower price determined by supply and demand. As the price of new varieties falls from its reservation level to its actual price, this lowers the overall price index. In contrast, in the case of disappearing varieties, it is as if their price increases from its observed level to its reservation price, which implies a rise in the aggregated index.

The variety-adjusted import price index π_g is defined as:

$$\pi_g = P_g \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{1/(\sigma_g - 1)}, \tag{3}$$

where

$$\lambda_{gt} = \frac{\sum_{c \in I_g} s_{gct}}{\sum_{c \in I_{gt}} s_{gct}}, \tag{4}$$

$$\lambda_{gt-1} = \frac{\sum_{c \in I_g} s_{gct-1}}{\sum_{c \in I_{gt-1}} s_{gct-1}} \tag{5}$$

(2) In the case of a CES utility function, the reservation price tends to infinity.

λ_{gt} equals the fraction of expenditure in varieties that are available in both periods relative to the entire set of varieties in period t and hence it decreases when new varieties appear. If the new varieties have a substantial share of expenditure, then λ_{gt} will be small, and this will make the exact index π_g much lower than the index P_g. Symmetrically, λ_{gt-1} captures the impact of disappearing varieties. These dropped varieties lower λ_{gt-1} and increase the exact price π_g relative to the conventional price index P_g. Thus, the lambda ratio in equation 3 tends to get smaller if there are many new varieties and it tends to get larger if there are many disappearing varieties. The magnitude of the lambda ratio is determined entirely by the relative expenditure shares of new and disappearing varieties.

The exact price index π_g also depends on the elasticity of substitution between varieties of good g. If σ_g is high, the term $1/(\sigma_g-1)$ approaches zero and the bias term becomes close to unity, *i.e.*, the influence of variety change is less pronounced if varieties are close substitutes. On the contrary, when varieties are highly differentiated, new varieties are very valuable and disappearing varieties very costly, so changes in variety have a large effect on the exact price index.

In sum, this methodology assumes that there are only two determinants of how new import varieties affect the import price of a given good: the degree of similarity among varieties and the magnitude of the increase in varieties. The main intuition is that increasing the number of varieties of a good does not imply much gain if new varieties are close substitutes to existing ones or if the expenditure share of new varieties is small relative to existing ones. While the elasticities give us information on the former, the lambda ratios provide information on the magnitude of net variety creation in any given market. The upward bias in import prices from ignoring changes in variety increases with lower elasticities and lower lambda ratios.

After deriving the exact price index with variety change for each good g, the aggregate exact import price index for all goods can be obtained following Broda and Weinstein (2006):

$$\Pi^M = \prod_{g\in G}\left[P_g\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{1/(\sigma_g-1)}\right]^{\omega_{gt}} = CIPI\prod_{g\in G}\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\omega_{gt}/(\sigma_g-1)}, \tag{6}$$

where G is the set of goods that is assumed constant over time, ω_{gt} are ideal log-change weights for each good g, $CIPI=\prod_{g\in G}P_g^{\omega_{gt}}$ is the conventional import price index that does not account for the change in varieties.

The ratio of the corrected import price index and the conventional price index reflects the impact of variety growth on the exact aggregate import price index:

$$Bias=\frac{\Pi^M}{CIPI}=\prod_{g\in G}\left(\frac{\lambda_{gt}}{\lambda_{gt-1}}\right)^{\omega_{gt}/(\sigma_g-1)}. \tag{7}$$

Broda and Weinstein (2006) named this geometric weighted average of the λ ratios as the aggregate import bias that results from ignoring new varieties in all product categories. If the $Bias$ is smaller than one, it means that the change of variety over time has lowered the exact import price index.

Assuming that the upper utility function is separable into a domestic good and the composite imported good, the overall price index of the economy can be written as:

$$\Pi = \left(\frac{p_t^D}{p_{t-1}^D} \right)^{\omega_t^D} \left(\Pi^M \right)^{\omega_t^M}, \tag{8}$$

where p_t^D is the price of a composite domestic good in period t, ω_t^M is computed as the logarithmic mean of the ratio of imports to Gross Domestic Product (GDP) in the two periods and ω_t^D is the corresponding weight of the domestic sector (see appendix).

Since there is no substitutability between domestic and imported varieties, the gains from variety (GFV) can be expressed as:

$$GFV = \frac{\Pi^{conv} - \Pi^{corr}}{\Pi^{corr}} = \left(\frac{1}{Bias} \right)^{\omega_t^M} - 1, \tag{9}$$

where Π^{conv} is the conventional overall price index of the economy assuming that the set of varieties is constant and Π^{corr} is the overall price index of the economy taking into account gains from imported variety, as defined in equation (8). So, the welfare effect of a fall in the exact import price can be computed by weighting the inverse of the aggregate lambda ratios with the fraction of imported goods relative to total economic activity. GFV represents the compensating variation required for consumers to be indifferent between the set of varieties available at the final and starting periods, that is, how much consumers are willing to pay to access the larger set of varieties available at the end of the period.

2.2. Data

The international trade data used in this article comes from the BACI - CEPII database, which provides reconciled bilateral values (in US dollars) and quantities at the 6-digit of the 1992 Harmonized System (HS) classification, including over 5000 products and 200 trading partners in each year.[3] The sample period starts in 1995 and ends in 2007. We make all computations at the HS 6-digit level in bilateral terms and then aggregate data at the industry level to allow sectoral analysis, using the 2-digits of the International Standard Industrial Classification (ISIC), rev.3. In addition, we also used the CEPII classification by transformation level based on the Broad Economic Categories of the United Nations, which includes five different stages of production: primary goods, processed goods,

(3) See Gaulier and Zignago (2009) for a detailed description of this database.

parts and components, investment goods and consumption goods. We restricted the analysis to non-energy imports by excluding all HS6 goods classified under chapter 27 of the HS “Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes”. The reason was that trade in these sectors frequently accounts for a large share of a country’s imports but it is very specific and its import values are frequently distorted due to highly volatile oil prices.

We obtain estimates for the elasticity of substitution from Broda *et al*. (2006) who report Portugal’s elasticities of substitution at the 3-digit HS level estimated using the Generalized Method of Moments (GMM) of Hansen (1982). The use of these elasticities has some caveats. On the one hand, the elasticities of substitution estimated at a more aggregated level are likely to be smaller - implying less substitutability - and this can potentially bias upwards the estimated gains from variety. On the other hand, these elasticities are assumed constant at the level estimated using import data from 1994 to 2003, not considering changes in the differentiation of goods over time. Broda and Weinstein (2006) report a slight decrease in the median elasticities of substitution from the 1972-1988 period to the 1990-2001 period, indicating that goods imported by the US have become more differentiated. In our case, this shortcoming could be limited by the shorter time-span of our analysis.

3. MAIN RESULTS

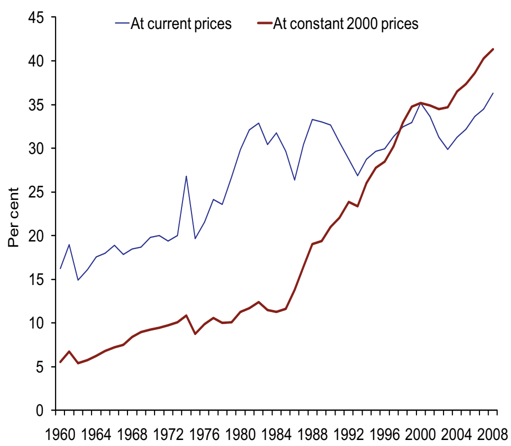
3.1. The growth of variety in Portuguese imports

The economic integration of Portugal increased substantially in the last decades, notably through the participation in trade arrangements like the European Free Trade Agreement (EFTA) in 1960, the European Economic Community (EEC) in 1986, and the European single market with the dismantlement of intra-EEC trade barriers and the adoption of a common trade policy in 1993, as well as through the participation in the euro area since its creation in 1999. The degree of openness of the Portuguese economy increased strongly over the last decades, with both imports and exports increasing their share in GDP, especially when measured at constant prices. The ratio of Portuguese imports of goods to GDP increased from 26.4 per cent in 1986 to 36.3 per cent in 2008 at current prices and from 13.8 per cent in 1986 to 41.3 per cent in 2008 at 2000 prices (Chart 1). The increase in imports to GDP ratio is visible in most economies over the last decades and results from several factors, including progressive trade liberalization, lower transport and communication costs, a greater variety of goods and services demanded by consumers and an increasing role of vertical specialization activities.

The growth of Portuguese imports was accompanied by an increase in the product varieties imported. Table 1 includes some preliminary evidence on the evolution of variety in Portuguese non-energy imports over the 1995-2007 period. Recall that, as mentioned in section 2, we define a good as a 6-digit HS category and a variety is defined as the import of a particular good from a specific country. The increase in the number of good-country pairs, *i.e.*, the number of varieties, in Portugal was driven by the increase in the number of supplying countries and not in the number of goods. This, to a large extent, reflects the fact that the number of goods is constrained by the product classification

Chart 1

PORTUGUESE IMPORTS OF GOODS
AS a percentage of GDP



Sources: European Commission (AMECO) and authors' calculations.

used. Given that Portugal already imported in 1995 almost all non-energy goods defined at the 6-digit HS category (4773 out of 4977 categories), the possibility of an increase in the number of varieties through the new goods dimension was fairly small. In fact, there was even a decline in the number of measured goods in Portuguese imports from 1995 to 2007 (from 4773 to 4492). This reduction was also observed in the other euro area countries considered. However, the number of imported varieties in Portugal increased by more than 16 per cent from 49557 in 1995 to 57560 in 2007. This growth of net variety resulted from an increase in the number of countries supplying each individual good, as reflected in the evolution of the median and the average number of countries exporting a good to Portugal from 1995 to 2007. In 1995 each good was imported from an average of 14.9 countries and in 2007 the average number of supplying countries rose to 18.8. These results contrast with those obtained by Broda and Weinstein (2006) for the US that show that the growth in the number of varieties from 1972 to 2001 reflected roughly in the same proportion the increase in the number of goods and in the number of countries supplying each good. Broda and Weinstein (2006) used a more detailed

Table 1

VARIETY IN PORTUGUESE IMPORTS OF GOODS
Excluding energy; 1995-2007 period

	Number of goods	Average number of varieties	Median number of varieties	Total number of varieties	Share in total imports
All goods 1995	4773	14.9	14	49557	100
All goods 2007	4492	18.8	17	57560	100
Common goods 1995	4433	15.1	14	47890	97.9
Common goods 2007	4433	18.9	17	57399	99.9
1995 not in 2007	340	8.1	7	1667	2.1
2007 not in 1995	59	4.4	4	161	0.1

Sources: CEPII (BACI) and authors' calculations.

classification defined at 8 or 10 digit categories, depending on the period. Our product classification at the 6-digit level may thus be underestimating the new goods expansion channel for variety growth in Portugal. However, given that the method proposed by Broda and Weinstein (2006) is designed to quantify the gains from new varieties within existing goods, but it is unable to quantify the introduction of entirely new goods, our level of disaggregation seems adequate.

Table 2 shows the thirty main origins of Portuguese non-energy imports in 2007, with the countries ranked both by the number of goods and by the value of goods exported to Portugal. The importance of European Union (EU) markets in Portuguese international trade over this period is clear from this table, as EU countries occupy the highest ranks in Portuguese imports. The countries ranked in the top 3, Spain, Germany and France, are the same in both years and according to both criteria. The EU countries ranked in the top 7 positions in 2007 are also the same in both criteria, although with some relative changes over the period. However, there were also significant changes in the relative importance of various countries as exporters to Portugal over this period. The emergence of new

Table 2

COUNTRIES RANKED BY THE NUMBER OF GOODS AND VALUE OF GOODS EXPORTED TO PORTUGAL

Excluding energy; 1995-2007 period

	Ranking by number of goods			Ranking by value of imports	
Country	1995	2007	Country	1995	2007
Spain	1	1	Spain	1	1
Germany	2	2	Germany	2	2
France	3	3	France	3	3
Italy	5	4	Italy	4	4
Netherlands	6	5	Netherlands	6	5
United Kingdom	4	6	Belgium-Luxembourg	7	6
Belgium-Luxembourg	7	7	United Kingdom	5	7
China	14	8	China	19	8
USA	8	9	Russian Federation	21	9
Switzerland	9	10	USA	8	10
Austria	12	11	Brazil	10	11
Sweden	10	12	Sweden	13	12
Denmark	11	13	Japan	9	13
Brazil	15	14	Austria	16	14
India	19	15	Norway	15	15
Turkey	27	16	Ireland	17	16
Japan	13	17	Turkey	29	17
Czech Rep.	28	18	Switzerland	11	18
Poland	35	19	India	20	19
Asia, nes	16	20	Czech Rep.	47	20
Canada	22	21	Rep. of Korea	12	21
Rep. of Korea	23	22	Denmark	14	22
Finland	17	23	Poland	43	23
Ireland	20	24	Finland	18	24
Hong Kong	18	25	Hungary	75	25
Thailand	25	26	South African Customs Union	30	26
Greece	29	27	Morocco	27	27
Israel	26	28	Argentina	25	28
Norway	21	29	Thailand	22	29
Morocco	33	30	Pakistan	28	30

Sources: CEPII (BACI) and authors' calculations.
Notas: The table reports rankings for the 30 countries that exported the highest number and the highest value of goods to Portugal in 2007. We define a good as a 6-digit Harmonized System (HS) category.

players in world trade in Central and Eastern Europe and in Asia is also visible in the ranks of the main countries of origin of Portuguese imports. Table 2 shows the strong emergence of China, which moved from the14th position to the 8th in terms of the number of goods and from 19th to 8th in terms of values of exports to Portugal, and the good performance of Turkey and, to a lesser extent, India. Some Central and Eastern European countries, like the Russian Federation, the Czech Republic, Poland and Hungary, also have advanced strongly as exporters to Portugal. On the contrary, developed countries like Japan, the USA and Switzerland, experienced declines in their ranks both in terms of the number of goods and the value of the goods they export to Portugal.

Counting new and disappearing varieties as in Table 1 offers clear evidence on the variety growth phenomenon. However, the measurement of the impact of net variety growth on import prices comprises two factors: the elasticity of substitution among different varieties of a good and shifts in expenditure shares among new, remaining, and disappearing varieties (the lambda ratios). The lambda ratio for a given good is only defined if at least one common variety is available at the start and the end of the period (that is, $I_g = I_{gt} \cap I_{gt-1} \neq 0$ in equations 4 and 5). That implies that one cannot calculate lambda ratios for a good for which only new and disappearing varieties exist. Other authors have solved the problem by defining goods at a more aggregated level whenever this happens. We opted for keeping only the common goods for which lambda ratios can be computed at the HS 6-digit level, since the loss of information is not significant. The number of goods dropped represents 3.4 per cent of common goods in both years and accounts for 1.2 per cent of the value of total Portuguese imports of common goods in 1995 and 0.2 per cent in 2007.

3.2. Gains from new imported varieties

Table 3 displays the main results for Portugal and other euro area countries of the aggregated price measurement bias due to the omission of net changes in variety and its resulting welfare gains, computed using the methodology described in section 2. The bias index described in equation 7 is below one for all countries analysed, meaning that not accounting for the net change in imported varieties leads to an overestimation of import prices over the period considered.[4]

In the Portuguese case, net changes in the variety of non-energy imported goods had a negative impact on import price indices of 2.3 per cent in cumulative terms over the 1995-2007 period. This corresponds to an average annual bias of 0.2 per cent, which is not captured by conventional import price measures based on a constant basket of varieties. Weighting the inverse of the index bias with the ratio of imports to GDP, as shown in equation 9, produces an estimate of the welfare gains due to variety increase as a ratio to GDP as depicted in the last column of Table 3. For Portugal, the value to consumers of import variety growth in the 1995-2007 period amounted to 0.7 per cent of GDP, which means that consumers in Portugal would be willing to spend 0.7 per cent of GDP in 2007 to have access to the larger set of imported varieties of 2007 instead of the 1995's set.

In our calculations, we have assumed that all HS 6-digit level goods within the same HS 3-digit cate-

(4) Belgium and Luxembourg are excluded from the analysis since Broda *et al*. (2006) do not report the elasticities of substitution for these two countries.

Table 3

IMPORT PRICE INDEX BIAS AND THE GAINS FROM VARIETY
Excluding energy; 1995-2007 period

	Number of observations	Median lambda	Median sigma	Bias			Import share on GDP	Welfare gains
				Index	In percentage	Annual average		
Portugal	4281	0.986	3.6	0.9772	2.3	0.2	28.3	0.7
France	4606	0.988	4.1	0.9962	0.4	0.0	23.9	0.1
Germany	4614	0.993	3.8	0.9976	0.2	0.0	20.5	0.0
Netherlands	4535	0.986	3.3	0.9999	0.0	0.0	41.8	0.0
Spain	4514	0.965	2.8	0.9681	3.2	0.2	19.8	0.6
Italy	4547	0.973	3.9	0.9928	0.7	0.1	17.7	0.1
Austria	4403	0.984	4.1	0.9902	1.0	0.1	31.6	0.3
Finland	4120	0.961	2.9	0.9627	3.7	0.3	23.9	0.9
Greece	4213	0.930	2.7	0.9358	6.4	0.5	19.4	1.3
Ireland	4259	0.957	4.2	0.9619	3.8	0.3	37.3	1.5

Sources: CEPII (BACI) and authors' calculations.
Note: The median sigmas presented above were computed from the 3-digit HS import demand elasticities of Broda *et al.* (2006).

gory share a common elasticity of substitution taken from Broda *et al.* (2006). A potential problem is that these 3-digit level elasticities may underestimate elasticities between varieties of goods defined at 6-digit level, because varieties of goods defined at a more disaggregated level will tend to be closer substitutes. Alternatively, we aggregated all HS6 data to the HS3 level and computed the import price bias for Portugal using only data at the 3-digit level. In this case, the results point to a cumulative fall of 1.1 per cent of the variety-adjusted import price index relative to the standard import price index over the 1995-2007 period. However, as using aggregated data may hide significant growth along the extensive margin of the variety dimension, the results of this alternative exercise may in turn lead to an underestimation of the actual bias.[5]

One reason for smaller import price bias estimated for Portugal compared to the one obtained by Broda and Weinstein (2006) for the US (respectively, 0.2 and 1.2 per cent per year) may be related with the time-period examined. For Portugal, the analysis covers only the period 1995-2007, thus missing earlier years of considerable structural change in Portuguese external trade, like the accession to the EEC in 1986. For the US, the analysis extends from 1972 to 2001, but the authors highlight that the gains are much higher between 1972 and 1988 than during the nineties (annual bias of 1.4 and 0.8 per cent, respectively), which they see as suggesting that much of the gains from globalization may have been realized prior to 1990. Our results are broadly in line with the ones obtained by Gaulier and Méjean (2006), which report that on average between 1994 and 2003, the appearance of new varieties lead to an unrecorded 0.2 per cent annual drop in import prices in a sample of 28 advanced and emerging market economies.

The measurement bias of import prices resulting from variety is higher in Portugal than in most euro area countries, with only Greece, Ireland, Finland and Spain displaying larger bias. For Greece, igno-

(5) In fact, all gains from import variety computed from international trade data tend to be underestimated as even highly disaggregated trade data hides some variety growth. For instance, Blonigen and Soderbery (2009) use very detailed market data of the US automobile sector and show that the gains from variety are 50 per cent higher if this more disaggregated data is used instead of standard international trade data.

ring new imported varieties leads to overestimation of the import price level of 6.4 per cent in cumulative terms, while neglecting the change in the set of imported varieties leads to an upward bias of the import price index of 3.8, 3.7 and 3.2 per cent in Ireland, Finland and Spain, respectively. Netherlands displays the lowest price measurement bias, with Germany and France also showing small bias. The stronger welfare gains from variety are also found in Ireland, Greece and Finland, with Netherlands and Germany showing basically no gains over this period.

The next subsection analyses in more detail the measurement bias of import prices in the Portuguese economy over the 1995-2007 period, identifying the individual industries for which this type of bias was more relevant.[6]

3.2.1. Product breakdown

This section examines the evolution of the bias from new varieties in Portuguese import prices in different sectors, using two distinct classifications: an industrial classification and a broader classification by economic categories. In addition, to complement the analysis, Table 4 includes the fifteen main positive and negative contributions to the measurement bias of Portuguese import prices from 1995 to 2007 at the product level, *i.e.*, at the HS6 level. The detailed results at the HS6 level can be easily aggregated to get different sectoral breakdowns. For every sector k the bias can be computed as:

$$Bias_k = \prod_{g \in K} \left(\frac{\lambda_{gt}}{\lambda_{gt-1}} \right)^{\omega_{gt}/(\sigma_g - 1)}, \qquad (10)$$

where K is the set of all g goods of sector k and $Bias = \prod_k Bias_k$.

Using the 2-digits of the ISIC rev.3, the measurement bias of import prices appears to be especially relevant in one industry, in the sense that it represents almost 45 per cent of the total bias over the 1995-2007 period (Table 5). This industry is the “Manufacture of basic metals” (ISIC 27). The substantial contribution of this sector reflected mainly the import bias estimated for several products of iron and steel comprised in chapter 72 of HS and, to a much lesser extent, for aluminium unwrought not alloyed (HS 760110). The second most important contribution at this breakdown level comes from the “Manufacture of textiles” (ISIC 17), mainly from products of cotton (chapter 52 of HS), in particular cotton yarn (HS 5205). Other industries also gave a significant contribution to the measurement bias of Portuguese import prices over this period, namely the “Manufacture of chemicals and chemical products” (ISIC 24), the “Manufacture of food products and beverages” (ISIC 15) and the “Manufacture of machinery and equipment, n.e.c.” (ISIC 29).

We also use the CEPII classification by transformation level based on the Broad Economic Categories of the United Nations to examine the groups of products where the bias is more relevant (Chart

(6) See Mohler (2009) for a similar breakdown.

Table 4

PRODUCT BREAKDOWN OF THE IMPORT BIAS FROM NEW VARIETIES IN PORTUGAL
Excluding energy; 1995-2007 period; as a percentage of total bias

15 main positive contributions

HS6 code and name		ISIC rev3	Stage of production	
880240	Fixed wing aircraft, unladen weight > 15,000 kg	3530	Investment goods	12.9
760110	Aluminium unwrought, not alloyed	2720	Processed goods	6.4
721420	Bar/rod, iron or non-alloy steel, indented or twisted, nes	2710	Processed goods	6.4
720441	Waste from the mechanical working of iron or steel ne	2710	Primary goods	5.1
170111	Raw sugar, cane	1542	Processed goods	4.6
100590	Maize except seed corn	0111	Primary goods	4.3
720824	Hot rolled iron or non-alloy steel, coil, width >600mm, t <3mm thick, ne	2710	Processed goods	3.6
520513	Cotton yarn >85% single uncombed 232-192 dtex, not retail	1711	Processed goods	2.8
720429	Waste or scrap, of alloy steel, other than stainless	2710	Primary goods	2.6
440399	Logs, non-coniferous nes	0200	Primary goods	2.5
721070	Flat rolled iron or non-alloy steel, painted/plastic coated,width>600mm	2710	Processed goods	2.4
520512	Cotton yarn >85% single uncombed 714-232 dtex,not ret	1711	Processed goods	2.4
292610	Acrylonitrile	2411	Processed goods	2.3
852810	Colour television receivers/monitors/projectors	3230	Consumption goods	2.1
721331	Hot rolled bar/rod, iron or non-alloy steel, coiled width <14mm, C<0.25%	2710	Processed goods	2.0
	Total of these 15 products			62.4

15 main positive contributions

HS6 code and name		ISIC rev3	Stage of production	
440810	Veneer or ply sheet, coniferous (softwood) <6 mm thic	2021	Processed goods	-0.7
852790	Radio reception apparatus nes	3230	Investment goods	-0.7
721913	Hot rolled stainless steel coil, w >600mm, t 3-4.75mm	2710	Processed goods	-0.7
251612	Granite, merely cut into blocks etc	1410	Primary goods	-0.7
100630	Rice, semi-milled or wholly milled	1531	Consumption goods	-0.8
710812	Gold in unwrought forms non-monetary	2720	Processed goods	-0.8
480529	Paper, multi-ply, uncoated, nes	2101	Processed goods	-0.9
810890	Titanium, articles thereof, nes	2720	Processed goods	-1.2
841121	Turbo-propeller engines of a power < 1100 kW	3530	Parts and components	-1.2
520100	Cotton, not carded or combed	0111	Primary goods	-1.5
251020	Natural calcium phosphates, ground	1421	Primary goods	-1.9
470429	Chemical wood pulp, sulphite, non-coniferous, bleached	2101	Processed goods	-1.9
290321	Vinyl chloride (chloroethylene)	2411	Processed goods	-2.2
440121	Wood in chips, coniferous	2010	Primary goods	-2.8
890190	Cargo vessels other than tanker or refrigerated	3511	Investment goods	-23.3
	Total of these 15 products			-41.2

Sources: CEPII (BACI) and authors' calculations.
Note: Contribution of each product relative to the total import bias from increased variety over the 1995-2007 period, expressed as a percentage.

Table 5

SECTORAL BREAKDOWN OF THE IMPORT BIAS FROM NEW VARIETIES IN PORTUGAL
Excluding energy; 1995-2007 period; as a percentage of total bias

ISIC rev.3		
01	Agriculture, hunting and related service activities	4.3
02	Forestry, logging and related service activities	4.0
05	Fishing, aquaculture and service activities incidental to fishing	0.3
13	Mining of metal ores	-0.3
14	Other mining and quarrying	-2.2
15	Manufacture of food products and beverages	7.8
16	Manufacture of tobacco products	1.2
17	Manufacture of textiles	13.3
18	Manufacture of wearing apparel; dressing and dyeing of fur	0.1
19	Tanning and dressing of leather; manufacture of luggage, handbags and footwear	1.9
20	Manufacture of wood and cork; manufacture of articles of straw and plaiting	-1.8
21	Manufacture of paper and paper products	-3.4
22	Publishing, printing and reproduction of recorded media	-0.1
23	Manufacture of coke, refined petroleum products and nuclear fuel	0.0
24	Manufacture of chemicals and chemical products	9.7
25	Manufacture of rubber and plastics products	0.6
26	Manufacture of other non-metallic mineral products	2.5
27	Manufacture of basic metals	44.9
28	Manufacture of fabricated metal products, except machinery and equipment	3.1
29	Manufacture of machinery and equipment n.e.c.	7.2
30	Manufacture of office, accounting and computing machinery	1.3
31	Manufacture of electrical machinery and apparatus n.e.c.	1.9
32	Manufacture of radio, television and communication equipment and apparatus	5.3
33	Manufacture of medical, precision and optical instruments, watches and clocks	2.1
34	Manufacture of motor vehicles, trailers and semi-trailers	3.9
35	Manufacture of other transport equipment	-8.4
36	Manufacture of furniture; manufacturing n.e.c.	1.2
37	Recycling	-0.4
74	Other business activities	0.0
92	Recreational, cultural and sporting activities	0.0
	Total	100

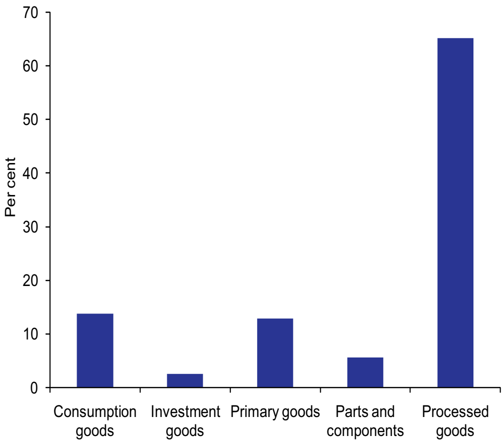
Sources: CEPII (BACI) and authors' calculations.
Note: Contribution of each sector relative to the total import bias from increased variety over the 1995-2007 period, expressed as a percentage.

2). Imports of processed goods, where several of the metal and textiles products described above are included, gave the highest contribution to the measurement bias of Portuguese import prices over the 1995-2007 period, corresponding to 65.2 per cent of the total. Consumption goods represented 13.7 per cent of the total measurement bias and its major individual contribution resulted from imports of colour television receivers/monitors/projectors (HS 852810). The contribution of primary goods amounted to 12.9 per cent, reflecting some of the metal products mentioned above and also imports of products of agriculture, forestry and logging. The very small contribution of investment goods masks a very heterogeneous behaviour of its components. The most substantial positive contribution at the product level came from fixed wing aircraft (HS6 880240), but the most negative contribution to the total bias also resulted from an investment good, namely cargo vessels other than tanker or refrigerated (HS6 890190), as can be seen in Table 4.

Chart 2

BREAKDOWN BY MAIN STAGES OF PRODUCTION OF THE IMPORT BIAS FROM NEW VARIETIES IN PORTUGAL

Excluding energy; 1995-2007 period; as a percentage of total bias



Sources: CEPII (BACI) and authors' calculations.
Note: Contribution of each stage relative to the total import bias from increased variety over the 1995-2007 period, expressed as a percentage.

4. CONCLUSIONS

The gains from trade through the import of new varieties have long been established in international trade theory. However, structural empirical estimates of the impact of this increased variety on welfare have appeared more recently. The methodology proposed by Feenstra (1994) and extended by Broda and Weinstein (2006) allows to quantify the effect that newly imported varieties have on import prices and, hence, on aggregate welfare. The main idea is that imports of new varieties of a good lead to a decline in import prices and this effect is not captured by conventional import price indices based on a fixed set of varieties, leading to a measurement bias. This methodology assumes that there are two determinants of how new import varieties affect the price index: the magnitude of the increase in varieties and the degree of substitutability among varieties. The methodology does not take into account the impact of new imported varieties on domestic variety, since the number of domestic varieties is assumed to be unaffected by the new foreign varieties. Therefore, the interpretation of the results should be made with caution, as changing domestic varieties have also an impact on aggregate welfare that is not accounted for in this analysis.

The degree of openness of the Portuguese economy increased strongly over the last decades, with both imports and exports increasing their ratio to GDP. The growth of Portuguese imports was accompanied by an increase in the number of varieties imported. The increase in variety of Portuguese imports resulted from the rise in the number of trading partners supplying a specific good, as the number of imported goods decreased slightly from 1995 to 2007.

Following the methodology proposed by Feenstra (1994) and extended by Broda and Weinstein (2006), this article estimates the gains from import variety for Portugal and other euro area countries in the period from 1995 to 2007. Our results show that for all euro area countries the import price index is biased upwards due to the omission of newly imported varieties. Ignoring the net change of imported varieties led to an upward bias of the Portuguese import price index of 2.3 per cent in cumulative terms, an average annual bias of 0.2 per cent. The value to Portuguese consumers of the increased set of imported varieties between 1995 and 2007 is estimated to reach 0.7 per cent of GDP. The gains from import variety in Portugal are among the highest in the euro area, with Ireland, Greece, Finland and Spain displaying also large gains.

In Portugal, the measurement bias of import prices is especially relevant in the "Manufacture of basic metals", which represents almost 45 per cent of the total bias over the 1995-2007 period. The second most significant contribution comes from the sector "Manufacture of textiles", accounting for more than 13 per cent of the total. Important contributions are also found in other industries, namely "Manufacture of chemicals and chemical products", "Manufacture of food products and beverages" and "Manufacture of machinery and equipment, n.e.c.". Investment goods as a whole give a very small contribution to the total bias but have a rather heterogeneous behaviour of its components.

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APPENDIX

Log-Change Ideal Weights

The weights ω_{gct} used in equation 2 to compute the exact price index P_g as a geometric mean of individual price changes are ideal log-change weights. These weights are computed using expenditure shares in the two periods as follows:

$$\omega_{gct} = \frac{\dfrac{s_{gct} - s_{gct-1}}{\ln s_{gct} - \ln s_{gct-1}}}{\sum_{c \in I_g} \left(\dfrac{s_{gct} - s_{gct-1}}{\ln s_{gct} - \ln s_{gct-1}} \right)}, \qquad \text{(A.1)}$$

$$s_{gct} = \frac{p_{gct} x_{gct}}{\sum_{c \in I_g} p_{gct} x_{gct}}, \qquad \text{(A.2)}$$

where p_{gct} is the price of variety c of good g in period t, x_{gct} is the quantity of variety c of good g imported in period t, $I_{gt} \subset C$ is the subset of all varieties of good g consumed in period t and $I_g = I_{gt} \cap I_{gt-1}$ is the set of common varieties consumed in both periods t and $t\text{-}1$.

The numerator in equation A.1 is the logarithmic mean of the shares s_{gct} and s_{gct-1} and lies between them. Then, the weights ω_{gct} are normalized versions of logarithmic means and add up to unity.

The ideal import share ω_t^M used to calculate the welfare gains in equation 8 is computed as the logarithmic mean of the ratio of imports to Gross Domestic Product (GDP) in the two periods:

$$\omega_t^M = \frac{s_{Mt} - s_{Mt-1}}{\ln s_{Mt} - \ln s_{Mt-1}}, \qquad \text{(A.3)}$$

where

$$s_{Mt} = \frac{\sum_{g \in G} \sum_{c \in I_{gt}} p_{gct} x_{gct}}{GDP_t}. \qquad \text{(A.4)}$$

The numerator in equation A.4 represents the value of total goods imported in year t and the denominator is the nominal GDP in year t, both in current US dollars.