PRODUCT SWITCHING OR RE-CLASSIFICATION? AN APPLICATION TO PORTUGUESE INTERNATIONAL TRADE*

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ABSTRACT

Empirical researchers increasingly use highly disaggregated product-level data to study trends in exports, imports, and domestic production. However, frequent updates of the classification systems make it difficult to distinguish true product-switching behavior from spurious changes to the product mix. In this paper, we present and discuss Van Beveren, Bernard and Vandenbussche (2012)'s methodology (based on the algorithms developed by Pierce and Schott, 2012) for creating consistent product codes for EU trade data over time and apply it to the study of Portuguese international trade trends.

1. Introduction

Empirical researchers increasingly use highly disaggregated product-level or firm-product-level data to study trends in exports, imports, and domestic production. Three prominent examples are Schott (2004), Hummels and Klenow (2005), and Bernard *et al*. (2009).

Schott (2004) shows that although the United States source the same products from both high- and low-wage countries, unit values within products vary systematically with exporter relative factor endowments and production techniques. Thanks to the availability of finely classified product data, Schott (2004) can conclude that factor-proportions specialization is rejected across products but not within products.[1]

Hummels and Klenow (2005) use data on shipments by 126 exporting countries to 59 importing countries in 5,000 product categories to study how large economies export more (in absolute terms) than do small economies. They find that a wider set of goods accounts for around 60 percent of the greater exports of larger economies. Moreover, within categories, richer countries export higher quantities at modestly higher prices.[2]

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1 Imports are classified according to seven-digit Tariff Schedule of the United States (TS7) codes from 1972 through 1988 and according to the ten-digit Harmonized System (HS10) codes from 1989 through 1994.

2 They use two sources of export data. Worldwide data come from the United Nations Conference on Trade and Development (UNCTAD) Trade and Analysis Information System (TRAINS) CD-ROM for 1995. The data are reported in the Harmonized System classification code at the six-digit level. They also use data with more product detail from the "U.S. Imports of Merchandise" CD-ROM for 1995, published by the U.S. Bureau of the Census.

Firm-product-level data have been particularly useful for examining the extent to which firms' growth in output, exports or imports occurs at the "extensive margin" versus the "intensive margin", *i.e.* the degree to which growth takes place via product-adding and dropping or within surviving products. Bernard *et al*. (2009) find that most of the year-to-year changes in U.S. trade values occurred along the intensive margin associated with surviving products, rather than the extensive margin associated with product-adding and dropping.[3]

While finely disaggregated product-level data become more and more accessible, studies using them have to deal with the fact that government authorities frequently update product classification systems. As a result, underlying physical goods may be classified in different categories over time and it might be difficult for researchers to properly distinguish true product-switching behavior from spurious changes to the product mix.[4] Pierce and Schott (2012) address these concerns for U.S. data and provide a methodology for creating consistent product codes for trade data over time. Van Beveren, Bernard and Vandenbussche (2012) adapt Pierce and Schott (2012)'s methodology for use with European Union (EU) production and trade data, and examine the implications of changing product classifications on measured product adding and dropping at Belgian firms.

In this paper, we present and discuss Van Beveren, Bernard and Vandenbussche (2012)'s methodology and apply it to the study of Portuguese international trade trends.

2. Data and methodology

In the first part of this section, we describe the product classification system used to record trade flows by every member state of the EU, and the concordance methodology used to make the product classification consistent over time. In the second part of the section, we describe the database of trade flows of all firms located in Portugal used in this study.

2.1. Combined nomenclature and concordance methodology

EU statistics register the value and quantity of internationally traded goods (i) between Member States of the EU (intra-EU trade) and (ii) by EU Member states with non-EU countries (extra-EU trade). Data on extra-EU trade are collected from customs, while data on intra-EU trade are collected through the Intrastat system, which, in 1993, replaced customs declarations as the source of trade statistics within the EU. When declared to customs in the European Community, goods must be classified according to the Combined Nomenclature (CN). This determines which rate of customs duty applies and how the goods are treated for statistical purposes. The CN is a method for designating goods and merchandise, established to meet, at one and the same time, the requirements both of the Common Customs Tariff and of the external trade statistics of the Community.[5] The CN is also used in intra-Community trade statistics and is comprised of the Harmonized System (HS) nomenclature, run by the World Customs

3 They use the United States Linked/Longitudinal Firm Trade Transaction Database (LFTTD), which links individual U.S. trade transactions to U.S. firms. Trade transactions are recorded at the same level of disaggregation as in Schott (2004). They use a time-consistent set of HS codes developed by Pierce and Schott (2012) to eliminate spurious product-country adding and dropping due to change in HS classification over time. This issue is the main subject of our article.

4 Amador and Opromolla (2013) study the joint destination-product strategies of manufacturing firms located in Portugal in the period 1995–2005, and find that surviving destination-product pairs are crucial in driving the year-to-year variation in exports of surviving exporters. They use a coarse level of product aggregation (HS 4-digits) in order to minimize the problems associated with changes in the HS classification over time.

5 The basic regulation underlying the CN system is Council Regulation (EEC) No 2658/87 on the tariff and statistical nomenclature and on the Common Customs Tariff. An updated version of the Annex I to the Combined Nomenclature Regulation is published as a Commission Regulation every year in the L-series of the Official Journal of the European Communities.

Organisation (WCO), with further Community subdivisions. The Harmonized System forms the basis for international trade negotiations, and is applied by most trading nations. Each CN subdivision has an eight-digit code number, the CN8 code. The first six digits of the CN code correspond to the HS nomenclature. The European CN8 classification system is therefore an (8-digit) extension of the HS6 classification system, analogous to the ten-digit extensions (HS10) employed by the United States.

The coverage of the CN, *i.e.* the type of goods that are considered, has not changed over time. However, the CN classification is updated every year, so that each particular physical good may receive different CN8 codes over time. Such updates may be motivated by changes internationally agreed upon, either at the WCO with regard to the HS6 classification, or at the World Trade Organization (WTO) with regard to conventional rates of duty. Other changes may occur to reflect the evolution of commercial policy, technology or statistical requirements.

Table 1 reports the structure of the CN classification over time.[6] The number of CN8 products goes from a minimum of 10,096 in 2005 to a maximum of 10,606 in 1997. The table further shows the number of codes associated with each version of the HS6 classification. Our sample period spans three different HS6 classifications since this was updated in 1996 and 2002.

The concordance methodology that we apply to make the CN8 classification consistent over time was introduced by Van Beveren, Bernard and Vandenbussche (2012), and is based on Pierce and Schott (2012). In this section we provide the intuition underlying the concordance methodology, and relegate technical details to the Annex. We refer to the "effective year" as the year in which a particular change in the CN8 classification becomes effective. "Obsolete" refers to codes that are totally or partially replaced starting in the effective year and "new" refers to the codes that replace them.

Building a product classification that is consistent over time requires the use of concordance files. Eurostat provides these files every time the CN classification is updated. Concordance files are lists of "mappings" between obsolete and new codes. Mappings can be "simple" or "complex". Simple changes make no adjustments to the actual items covered by a particular code; they just swap one eight-digit

Table 1

STRUCTURE OF THE COMBINED NOMENCLATURE CLASSIFICATION

Combined Nomenclature 8-digit (CN8)		Harmonized System 6-digit (HS6)
Year	# of CN8 codes	
1995	10,448	HS6 1992 (5,018 codes)
1996	10,495	
1997	10,606	
1998	10,587	
1999	10,428	HS6 1996 (5,113 codes)
2000	10,314	
2001	10,274	
2002	10,400	
2003	10,404	
2004	10,174	HS6 2002 (5,224 codes)
2005	10,096	

Source: Eurostat (Classification files from Ramon server).

Notes: This table shows the number of CN8 and HS6 codes for each year in the period 1995-2005. HS6 codes have been revised in 1996 and 2002, while CN8 codes are revised every year.

6 Most classifications and concordance tables are available for download on the European Union's classification metadata server, *i.e.* the Ramon server (http://ec.europa.eu/eurostat/ramon/).

code for another. In contrast to simple changes, complex changes alter the mix of items captured by a particular code. For these changes, the items formerly encompassed by one or more obsolete codes are distributed to one or more "new" codes. The development of an over-time consistent concordance starts with the assignment of a unique identifier – a "synthetic" code – to all codes (new and obsolete) involved in a same mapping present in a concordance file. Specifically, if obsolete codes a and b from t-1 map into new code c in t, the two obsolete codes and the new code need to be "grouped" in a synthetic code. It is then necessary to search for chains of code changes over time. Suppose now, that code c in turn maps into codes d, e, and f in $t+3$. Codes a, b, c, d, e, and f then need to be assigned to the same synthetic code, in all years. In other words, consecutive changes in codes (new codes in some year becoming obsolete in a later year) need to be chained together in "family trees".

2.2. Trade data

The "European Statistical System" (ESS) collects and disseminates statistics in the European Union. The ESS is the partnership between the Community statistical authority, which is the Commission (Eurostat), and the national statistical institutes (NSIs) and other national authorities responsible in each Member State for the development, production and dissemination of European statistics. This Partnership also includes the EEA and EFTA countries.[7] Statistics Portugal (*INE*) collects, on a monthly basis, data on export and import transactions by firms that are located in Portugal.

For the purpose of this research, we were able to gain access to data from 1995 to 2005. The same information employed in this article is used for official statistics and, besides small adjustments, aggregates to the official total exports and imports of Portugal. Each transaction record includes, among others, the firm's tax identifier, a CN8 product code, the destination/origin country, the value of the transaction in euros, the quantity (in kilos and, in some cases, in additional product-specific measuring units) of transacted goods, and the relevant international commercial term (FOB, CIF, FAS, etc.). For extra-EU trade, all transactions whose value is higher than €1,000 or whose weight is greater than 1,000kg have to be reported. In the case of intra-EU trade, and in the period under study, firms are required to provide information on their trade transactions if the volume of exports or imports in the current year or in one of the previous two years was higher than about 60,000 euros and 85,000 euros, respectively.[8]

In this article, we use data on all export and import transactions of firms located in continental Portugal and that imply a transfer of ownership.[9] In the analysis, we aggregate data at the product-year or country-product-year level. At the country-year-level, our data aggregate, on average, to within 2 percent of the data reported by *INE*.

3. Results

This section divides into two parts. First, we illustrate the importance of controlling for CN code reclassifications when measuring product adding and dropping in Portuguese export and import data. Second, we use the post-concordance data to show trends in the number of exported (imported) products to (from) several key groups of countries.

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7 See http://epp.eurostat.ec.europa.eu/portal/page/portal/pgp_ess/about_ess for a description of ESS and the list of NSIs and other authorities.

8 In the case of intra-EU trade, firms have the option of "adding up" multiple transactions only when they refer to the same month, product, destination/origin country, Portuguese region and port/airport where the transaction originates/starts, international commercial term, type of transaction (sale, resale,... etc.), and transportation mode. Intra-EU trade reporting thresholds are substantially stable over the period 1995–2005. More information can be found at: http://webinq.ine.pt/public/files/inqueritos/pubintrastat.aspx?Id=168.

9 As such, we include both manufacturing and non-manufacturing firms in the analysis. It should be emphasized that trade data only refer to traded goods and not traded services.

In both parts, we define a product as added if it is exported (imported) in *t* but not in *t-1*. Conversely, the product is dropped if it is exported (imported) in *t-1* but not in *t*. Finally, a product is continuing if it is exported (imported) both in *t-1* and in *t*.

3.1. The effect of the concordance on the measurement of product adding and dropping

Tables 2 and 4 show the number of added, dropped, and continuing – exported or imported – products, before and after applying the concordance. After applying the concordance, (i) a subset of products originally classified as added or dropped are re-classified as continuing; (ii) the total number of exported or imported products declines due to the grouping of codes into families.[10]

The concordance procedure heavily affects the pattern and net impact of product adding and dropping along the sample period. First, the application of the concordance methodology substantially reduces the importance of the product margin in driving year-to-year exports and imports. Tables 2 and 4 show that added products represent, on average across the sample period, 12.4 (6.3) percent of the products exported (imported) in the previous year, before the concordance, and only 9.0 (2.9) percent after the concordance. The number of dropped products also declines from 11.9 (6.4) percent of the number of exported (imported) products to 8.2 (2.6) percent. Tables 3 and 5 show that the change in added and dropped products as a percentage of exports or imports (in the beginning year) is even bigger. Before applying the concordance, added and dropped products represent, on average, 2.9 (3.9) and 3.0 (3.8)

Table 2

ADDED, DROPPED, AND CONTINUING EXPORTED PRODUCTS–BEFORE AND AFTER THE CONCORDANCE, 1995–2005

	(t-1–t)	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average 95-05
Added (*t*)	w/o	1,408	954	801	824	843	753	1,126	628	880	747	896.4
		(19.9)	(13.2)	(10.9)	(11.6)	(11.9)	(10.6)	(15.7)	(8.5)	(12.0)	(10.1)	(12.4)
	w/	635	637	450	565	611	584	565	492	548	532	561.0
		(10.4)	(10.3)	(7.2)	(9.2)	(10.0)	(9.4)	(9.0)	(7.7)	(8.6)	(8.2)	(9.0)
Dropped (*t-1*)	w/o	1,288	792.0	1,057	879	787	677	953	633	812	684	856.2
		(18.2)	(11.0)	(14.3)	(12.4)	(11.1)	(9.5)	(13.2)	(8.6)	(11.0)	(9.2)	(11.9)
	w/	565	549	626	554	495	517	476	493	433	428	513.0
		(9.2)	(8.9)	(10.0)	(9.1)	(8.1)	(8.3)	(7.6)	(7.7)	(6.8)	(6.6)	(8.2)
Continuing	w/o	5,802	6,418	6,315	6,237	6,274	6,440	6,240	6,733	6,549	6,745	6,375.3
		(81.8)	(89.0)	(85.7)	(87.6)	(88.9)	(90.5)	(86.8)	(91.4)	(89.0)	(90.8)	(88.1)
	w/	5,563	5,649	5,660	5,556	5,626	5,720	5,828	5,900	5,959	6,079	5,754.0
		(90.8)	(91.1)	(90.0)	(90.9)	(91.9)	(91.7)	(92.4)	(92.3)	(93.2)	(93.4)	(91.8)
All (*t-1*)	w/o	7,090	7,210	7,372	7,116	7,061	7,117	7,193	7,366	7,361	7,429	7,231.5
		(1.7)	(2.2)	(-3.5)	(-0.8)	(0.8)	(1.1)	(2.4)	(-0.1)	(0.9)	(0.8)	(0.6)
	w/	6,128	6,198	6,286	6,110	6,121	6,237	6,304	6,393	6,392	6,507	6,267.6
		(1.1)	(1.4)	(-2.8)	(0.2)	(1.9)	(1.1)	(1.4)	(0.0)	(1.8)	(1.6)	(0.8)

Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data)) and authors' calculations.

Notes: The top part of this table shows the number of added/dropped/continuing products (and, in parenthesis, the relative frequency with respect to the number of products in *t-1*) exported by Portugal, for each pair of subsequent years between 1995 and 2005. Added, dropped, and continuing products are defined in section 3. The bottom part of the table shows the total number of products exported in year *t-1*, and, in parenthesis, its growth rate between *t-1* and *t*. Rows marked with (w/o) and (w/) refer to pre- and post-concordance figures, respectively.

10 Based on tables 2 and 4, we find that the number of added products declines by, on average, 37 percent (62 percent) in the case of exports (imports). Similarly, the number of dropped products declines by 40 percent (66 percent) in the case of exports (imports). The total number of exported (imported) products declines by 13 percent (16 percent). The number of continuing products also declines, but by less than the total number of exported (imported) products.

Table 3

CONTRIBUTION OF ADDED, DROPPED AND CONTINUING PRODUCTS TO THE PERCENTAGE CHANGE IN TOTAL EXPORTS – BEFORE AND AFTER THE CONCORDANCE, 1995–2005

	(t-1–t)	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average 95-05
Added	w/o	8.3	1.7	3.2	1.2	1.4	0.9	8.0	0.2	3.0	1.4	2.9
	w/	0.5	0.2	0.1	0.3	0.1	0.4	0.2	0.2	0.4	0.1	0.2
Dropped	w/o	8.4	2.3	3.3	1.4	1.4	0.9	8.1	0.2	2.3	1.9	3.0
	w/	0.1	0.8	0.3	0.2	0.2	0.3	0.1	0.2	0.2	0.4	0.3
Continuing	w/o	9.3	11.4	6.8	3.3	14.7	2.0	2.2	1.8	3.6	1.1	5.6
		8.8	11.3	7.0	3.0	14.8	1.9	2.0	1.8	4.0	0.9	5.6
Exports		9.2	10.8	6.8	3.2	14.7	1.9	2.0	1.8	4.3	0.6	5.5

Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The top part of this table shows exports associated with added/dropped products and the change in exports associated with continuing products, between year *t-1* and *t* relative to total exports in *t-1*. Added, dropped, and continuing products are defined in section 3. The bottom row of the table shows the growth rate of exports between *t-1* and *t*. Rows marked with (w/o) and (w/) refer to pre- and post-concordance figures, respectively.

Table 4

ADDED, DROPPED, AND CONTINUING IMPORTED PRODUCTS—BEFORE AND AFTER THE CONCORDANCE, 1995–2005

	(t-1–t)	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average 95-05
Added (t)	w/o	1,326	561	596	463	445	362	934	287	570	347	589.1
		(14.4)	(6.0)	(6.3)	(4.9)	(4.8)	(3.9)	(10.0)	(3.0)	(6.1)	(3.7)	(6.3)
	w/	294	241	200	232	239	234	214	185	223	181	224.3
		(3.8)	(3.1)	(2.6)	(3.0)	(3.1)	(3.0)	(2.7)	(2.3)	(2.8)	(2.3)	(2.9)
Dropped (t-1)	w/o	1,220	439	633	581	457	339	817	306	687	441	592.0
		(13.2)	(4.7)	(6.7)	(6.2)	(4.9)	(3.7)	(8.8)	(3.3)	(7.3)	(4.8)	(6.4)
	w/	223	206	221	213	182	193	196	192	185	217	202.8
		(2.9)	(2.6)	(2.8)	(2.7)	(2.3)	(2.4)	(2.5)	(2.4)	(2.3)	(2.7)	(2.6)
Continuing	w/o	7,990	8,877	8,805	8,820	8,826	8,932	8,477	9,105	8,705	8,834	8,737.1
		(86.8)	(95.3)	(93.3)	(93.8)	(95.1)	(96.3)	(91.2)	(96.7)	(92.7)	(95.2)	(93.6)
	w/	7,509	7,597	7,617	7,604	7,654	7,700	7,738	7,760	7,760	7,766	7,670.5
		(97.1)	(97.4)	(97.2)	(97.3)	(97.7)	(97.6)	(97.5)	(97.6)	(97.7)	(97.3)	(97.4)
All (t-1)	w/o	9,210	9,316	9,438	9,401	9,283	9,271	9,294	9,411	9,392	9,275	9,329.1
		(1.2)	(1.3)	(-0.4)	(-1.3)	(-0.1)	(0.2)	(1.3)	(-0.2)	(-1.2)	(-1.0)	(0.0)
	w/	7,732	7,803	7,838	7,817	7,836	7,893	7,934	7,952	7,945	7,983	7,873.3
		(0.9)	(0.4)	(-0.3)	(0.2)	(0.7)	(0.5)	(0.2)	(-0.1)	(0.5)	(-0.5)	(0.3)

Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The top part of this table shows the number of added/dropped/continuing products (and, in parenthesis, the relative frequency with respect to the number of products in *t-1*) imported by Portugal, for each pair of subsequent years between 1995 and 2005. Added, dropped, and continuing products are defined in section 3. The bottom part of the table shows the total number of products imported in year *t-1*, and, in parenthesis, its growth rate between *t-1* and *t*. Rows marked with (w/) and (w/o) refer to pre- and post-concordance figures, respectively.

Table 5

CONTRIBUTION OF ADDED, DROPPED AND CONTINUING PRODUCTS TO THE PERCENTAGE CHANGE IN TOTAL IMPORTS – BEFORE AND AFTER THE CONCORDANCE, 1995–2005

	(t-1–t)	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	Average 95-05
Added	w/o	10.4	3.3	4.9	1.7	5.0	0.6	8.7	0.3	3.3	0.5	3.9
	w/	0.1	0.3	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Dropped	w/o	10.9	2.7	4.0	1.6	6.0	0.7	8.8	0.2	2.8	0.6	3.8
	w/	0.2	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.1
Continuing	w/o	9.1	11.6	13.2	7.4	14.3	2.0	-1.9	-2.4	8.7	2.4	6.4
		8.7	12.1	14.0	7.4	13.5	2.0	-2.0	-2.4	9.2	2.4	6.5
Imports		8.6	12.2	14.1	7.4	13.4	2.0	-2.0	-2.3	9.2	2.3	6.5

Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The top part of this table shows imports associated with added/dropped products and the change in imports associated with continuing products, between year *t-1* and *t*, relative to total imports in *t-1*. Added, dropped, and continuing products are defined in section 3. The bottom row of the table shows the growth rate of imports between *t-1* and *t*. Rows marked with (w/o) and (w/) refer to pre- and post-concordance figures, respectively.

percent of exports (imports) in the beginning year.[11] After applying the concordance, they represent just 0.2 (0.1) and 0.3 (0.1) percent of beginning-year exports (imports).

Second, the biggest impact occurs in those years when changes in the HS6 classification are implemented, *i.e.* 1995 – 1996 and 2001–2002. Overall, post-concordance statistics on added and dropped products are much less volatile over time.

Third, the growth rate in the total number of exported or imported products can actually switch sign after applying the concordance.[12]

3.2. Exports and imports growth: a product-level perspective

In the previous section we established the importance of applying the concordance methodology outlined in section 2.1 to properly analyze trends in exports and imports. In this section, we take advantage of post-concordance data to show trends in the number of exported (imported) products, and their contribution to export and import growth, to (from) several key groups of countries. Specifically, we partition countries into 7 mutually exclusive and exhaustive sets: Spain, Germany, Other EU, Other OECD, countries belonging to the Community of Portuguese Language Countries (CPLP in Portuguese), China, and the Rest of the World.[13] This partition is motivated by geographical, economic, and historical reasons.

Table 6 shows, for each group of countries, a snapshot, at the beginning and end of the sample period, of two measures of intensity of the trade link with Portugal. The first measure is the number of products imported from (exported to) Portugal as a share of Portugal's overall export (import) portfolio of product types. The second measure is simply each country's share in Portugal's total exports or imports.

Charts 1 and 2 show instead, for each country group, the evolution over time of the number of products exported and imported (measured on the left axis), as a consequence of product adding and dropping (measured on the right axis).[14] The number of exported products exhibits a positive trend in all destination groups, with an average accumulated increase of 79 percent in 1995-2005 (Chart 2). Charts 3 and 4 show the evolution over time of the growth rate of exports and imports (measured on the left axis), as well as the contribution of added and dropped products (measured on the right axis). Both growth rates of exports and imports are lower in the second half of the sample than in the first half, with the exception of those associated to China and the countries belonging to the Community of Portuguese Language Countries.[15] The contribution of added and dropped products to the growth rate of exports (or imports) is generally low, in the order of 1 or 2 percent, again with the exception of China and the CPLP countries, which show a more volatile dynamics. Consistently with the literature, the growth rates of total exports (imports) follow the dynamics in the growth rate of exports (imports) associated with surviving products.

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11 We do not deflate trade volumes, for two reasons. First, product-level deflators are not available. Second, our main results would not change since we aim at comparing the contribution to exports (or imports) of added and dropped products with and without the concordance.

12 This occurs, for example, in 1998–1999 and 2002–2003 for exports, and in 1998–1999, 1999–2000, and 2003–2004 for imports.

13 "Other EU countries" includes Austria, Belgium-Luxembourg, Denmark, Finland, France, Greece, Italy, Ireland, Netherlands and Sweden, and United Kingdom; "Other OECD countries" includes United States, Australia, Canada, Switzerland, Czech Republic, Hungary, Iceland, Japan, Republic of Korea, Mexico, Norway, New Zealand, Poland, Slovak Republic, and Turkey; "CPLP countries" include Brazil, Angola, Cape Verde, Guinea-Bissau, Mozambique, Sao Tome and Principe, and Timor-Leste.

14 The plot referring to the group "Rest of the World" has been omitted to save space but is available upon request to the authors.

15 Note the difference in the scale of the axis of the plots associated with China and the countries belonging to the Community of Portuguese Language Countries.

Table 6

NUMBER OF EXPORTED AND IMPORTED PRODUCTS AND ASSOCIATED TRADE SHARES, BY COUNTRY GROUP, 1995–2005

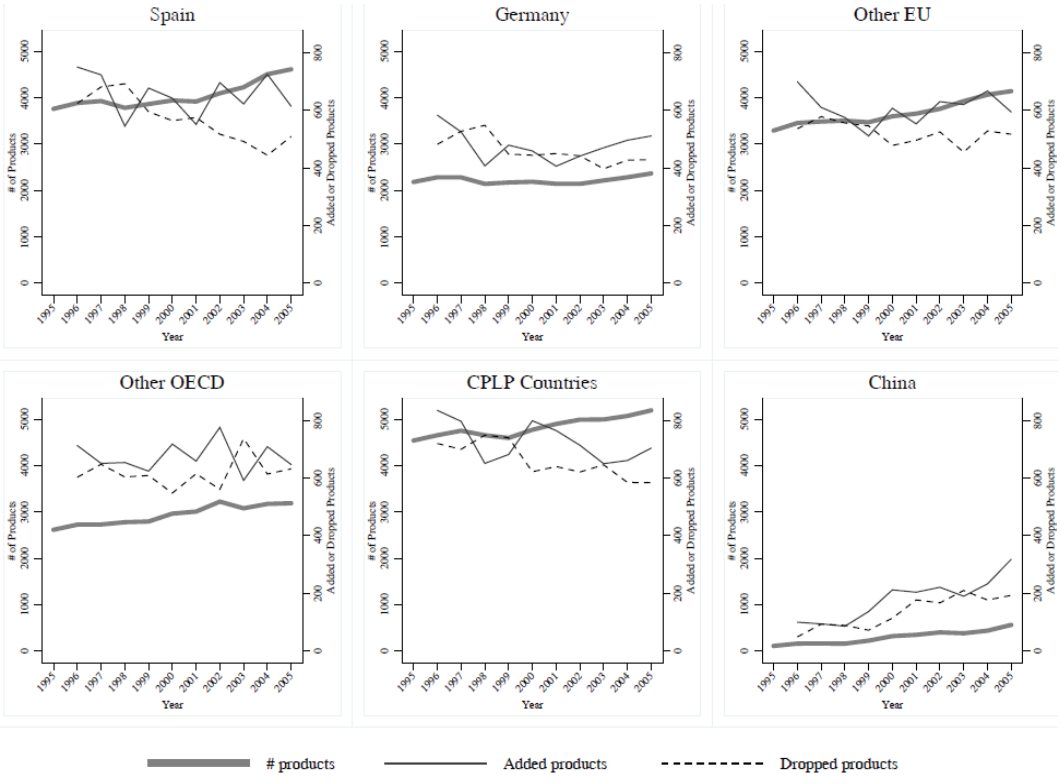
	# of Products				Trade Share			
	Exports		Imports		Exports		Imports	
	1995	2005	1995	2005	1995	2005	1995	2005
Spain	3,763	4,615	6,422	7,278	16.1	26.6	22.9	32.7
	(61.4)	(69.8)	(83.1)	(91.6)				
Germany	2,185	2,368	5,492	5,734	21.1	12.7	15.1	15.1
	(35.7)	(35.8)	(71.0)	(72.2)				
Other EU	3,294	4,145	6,932	7,081	44.4	39.4	40.0	33.2
	(53.8)	(62.7)	(89.7)	(89.1)				
Other OECD	2,617	3,189	4,643	4,381	9.6	10.1	10.7	7.4
	(42.7)	(48.2)	(60.0)	55.1)				
CPLP	4,542	5,193	1,233	2,162	3.4	4.3	1.7	1.5
	(74.1)	(78.6)	(15.9)	(27.2)				
China	109	563	1,304	2,846	0.2	0.6	0.6	1.3
	(1.8)	(8.5)	(16.9)	(35.8)				
Rest of the World	2,699	3,616	2,998	3,644	5.3	6.3	9.0	8.8
	(44.0)	(54.7)	(38.8)	(45.9)				
Total	6,128	6,611	7,732	7,947	100.0	100.0	100.0	100.0

Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The left part of this table shows the number of products exported to (or imported from) each of the country groups defined in section 3.2. Shares in terms of the total number of exported or imported products are shown in parenthesis. The right part of the table shows the share of Portuguese exports (or imports) associated with each country group. CPLP is the Portuguese acronym for the Community of Portuguese Language Countries.

Chart 1

TRENDS IN THE NUMBER OF EXPORTED PRODUCTS, BY COUNTRY GROUP, 1995–2005

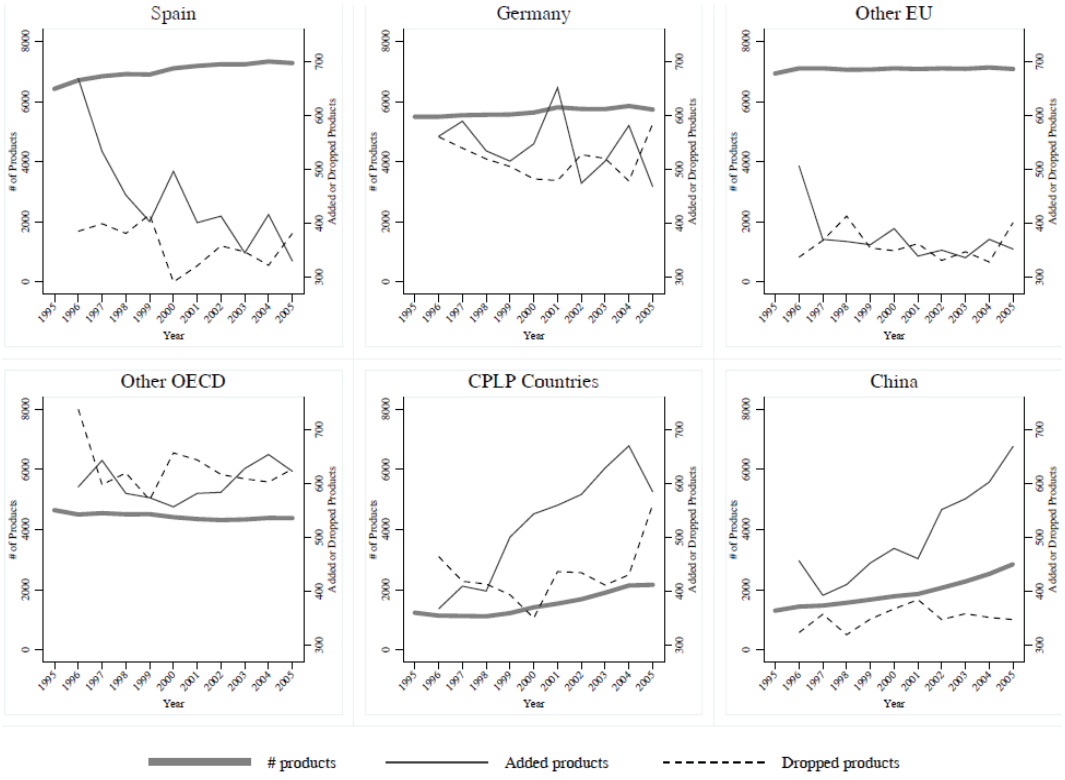


Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The thick line in each plot (measured on the left axis) represents the number of products exported by Portugal in each year of the 1995–2005 sample period. The thin solid line (measured on the right axis) represents the number of exported products added between *t-1* and *t*. The thin dashed line (measured on the right axis) represents the number of exported products dropped between *t-1* and *t*. Added and dropped products are defined in section 3.1. Country groups are defined in section 3.2. CPLP is the Portuguese acronym for the Community of Portuguese Language Countries. The plot referring to the group "Rest of the World" has been omitted but is available upon request to the authors.

Chart 2

TRENDS IN THE NUMBER OF IMPORTED PRODUCTS, BY COUNTRY GROUP, 1995–2005



Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The thick line in each plot (measured on the left axis) represents the number of products imported by Portugal in each year of the 1995–2005 sample period. The thin solid line (measured on the right axis) represents the number of imported products added between *t-1* and *t*. The thin dashed line (measured on the right axis) represents the number of imported products dropped between *t-1* and *t*. Added and dropped products are defined in section 3.1. Country groups are defined in section 3.2. CPLP is the Portuguese acronym for the Community of Portuguese Language Countries. The plot referring to the group "Rest of the World" has been omitted but is available upon request to the authors.

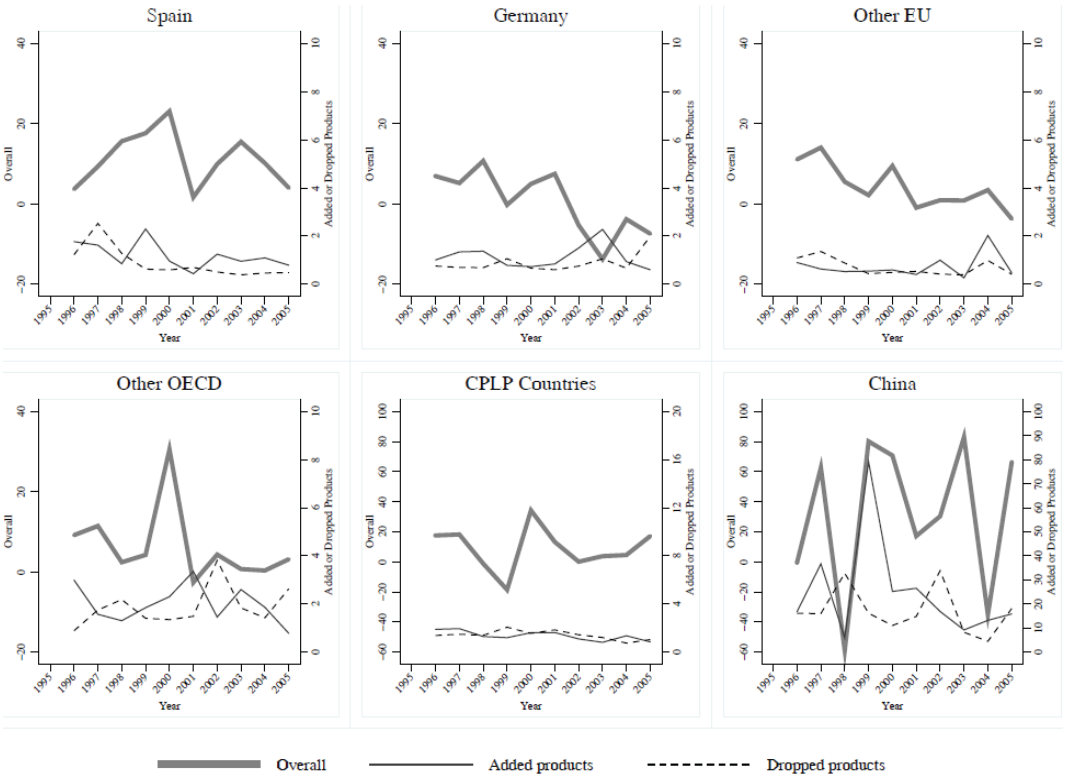
Spain is clearly Portugal's main foreign partner. In 2005, in terms of the extensive margin, it attracts about 70 percent of the products that belong to Portugal's export portfolio and provides Portugal with about 92 percent of its imported products. This translates into about 27 percent and 33 percent of Portugal's total exports and imports, a significant increase with respect to 1995 (Table 6). As chart 1 shows, the number of products exported to Spain (thick line), fairly flat up to the end of the 90s, picks up at the beginning of the 2000-decade, mainly as the result of a slowdown in the rate of dropped products (dashed line). In other words, while the number of products added to the Spanish market does not show any particular trend (thin solid line), those products that are already in the market show a higher degree of persistence.

Overall, more than three fourths of Portugal's exports and imports are associated to a European Union country, and European countries attract/provide the majority of exported/imported products. Worthwhile mentioning is the drop in exports to Germany, from 21.1 percent in 1995 to 12.7 percent in 2005 (Table 6 and Chart 3). Other OECD countries also attract or provide a large share of products and represent about 10 percent of exports and 7 percent of imports (in 2005). The CPLP countries are the destination of a large share of exported products, but are much less relevant in monetary terms, representing 4.3 percent of exports in 2005.

Particularly interesting is the case of China, which shows an impressive increase in the number of exported products (from 1.8 percent of Portugal's export product-portfolio in 1995 to 8.5 percent in

Chart 3

TRENDS IN THE GROWTH RATE OF EXPORTS, BY COUNTRY GROUP, 1995–2005



Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The thick line in each plot (measured on the left axis) represents the yearly growth rate of exports between year *t-1* and year *t*. The thin solid line (measured on the right axis) represents the ratio between the exports of added products (in *t*) and total exports in *t-1*. The thin dashed line (measured on the right axis) represents the ratio between the exports of dropped products (in *t-1*) and total exports in *t-1*. Added and dropped products are defined in section 3. Country groups are defined in section 3.2. CPLP is the Portuguese acronym for the Community of Portuguese Language Countries. The plot referring to the group "Rest of the World" has been omitted but is available upon request to the authors.

2005) and, especially, imported products (from 16.9 percent of Portugal's import product-portfolio to 35.8 percent) – see table 6. The latter is due to a dramatic increase in the number of added imported products, in spite of a fairly flat number of dropped products (Chart 2). This dynamics mimics the one occurring in the CPLP countries (except for the last year of the sample) and contrasts with the one of Spain, which shows a substantial decrease in the number of added imported products.

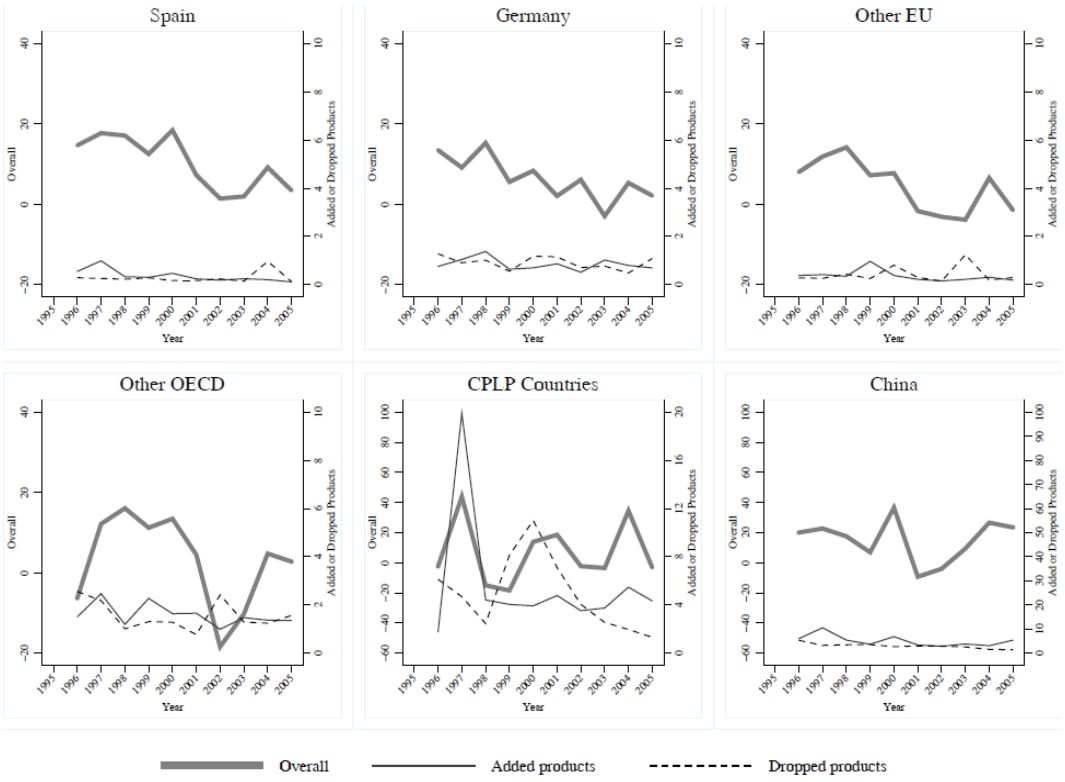
4. Conclusions

Controlling for changes in product codes over time is critical in the growing body of research examining firms' product-mix choices. In this article, we use Van Beveren, Bernard and Vandenbussche (2012)'s methodology, based on Pierce and Schott (2012), to study trends in Portuguese exports and imports for the 1995–2005 period. We find that, after applying the concordance, the extent to which product adding and dropping drive year-to-year changes in Portuguese exports and imports is greatly downsized. A time-homogenous product classification system is necessary to correctly understand the dynamics of exports and imports.

A merit of the algorithm proposed by Pierce and Schott (2012) is that it can be extended to incorporate future revisions of exported and imported products classification systems, and can be applied to create concordances of other product classification systems over time. For example, Van Beveren, Bernard

Chart 4

TRENDS IN THE GROWTH RATE OF IMPORTS, BY COUNTRY GROUP, 1995–2005



Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data), and authors' calculations.

Notes: The thick line in each plot (measured on the left axis) represents the yearly growth rate of imports between year *t-1* and year *t*. The thin solid line (measured on the right axis) represents the ratio between the imports of added products (in *t*) and total imports in *t-1*. The thin dashed line (measured on the right axis) represents the ratio between the imports of dropped products (in *t-1*) and total imports in *t-1*. Added and dropped products are defined in section 3. Country groups are defined in section 3.2. CPLP is the Portuguese acronym for the Community of Portuguese Language Countries. The plot referring to the group "Rest of the World" has been omitted but is available upon request to the authors.

and Vandenbussche (2012) create a concordance for the eight-digit Prodcom categories used to classify products in European domestic production data. These tools will surely prove to be important in understanding product-level choices both of Portuguese domestic producers and exporters.

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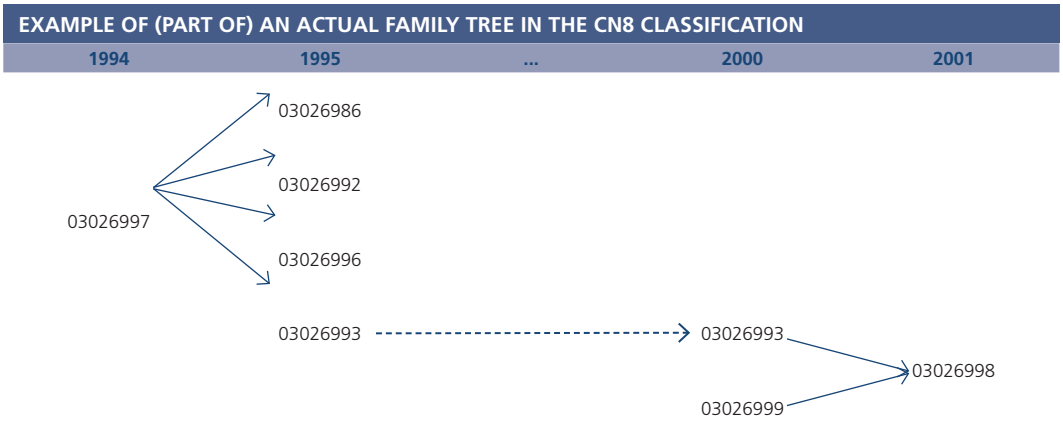
Annex – Concordance Methodology

This section provides more details on the concordance methodology introduced in section 2.1.

Consider the following actual case (illustrated in Chart A1) of codes' mappings: in 1995, code 03026997 ("Saltwater fish – other") is replaced by 4 different codes, specifying distinct fish species, 03026986 ("…southern blue whiting…"), 03026992 ("…pink cusk-eel…"), 03026993 ("…Kathetostoma giganteum…") and 03026996 ("…Saltwater fish, edible, fresh or chilled, n.e.s. …"); in 2001, one of these 1995-new codes, 03026993, was merged with the code 03026999 ("…Fresh or chilled saltwater fish, edible excl.… Kathetostoma giganteum…"), both replaced by the new code 03026998 ("…Fresh or chilled saltwater fish, edible excl…"); in this case, all the codes involved – 03026997, 03026986, 03026992, 03026993, 03026996, 03026999 and 03026998 – shall be considered as belonging to the same family tree and shall be assigned the same unique (synthetic) code.

Chart A1

EXAMPLE OF (PART OF) AN ACTUAL FAMILY TREE IN THE CN8 CLASSIFICATION



Source: Eurostat (Classification files from Ramon server).
Notes: This chart shows an actual example of (part of) of a family tree in the CN8 classifications between 1994 and 2001.

The identification of family trees depends on the beginning and end year of the concordance. There are two basic types of family tree: growing trees and shrinking trees. Obviously, actual trees can be combinations of growing and shrinking sub-trees. The family tree shown in chart A1 spans the 1994–2001 period and consists of (at least) two sub-trees: a growing tree between 1994 and 1995, and a shrinking tree, between 2000 and 2001.

The algorithm we use for the concordance of CN codes between arbitrary beginning and end years accounts for both types of family trees, as well as combinations of the two types. Empirically, the family identification comprises two conceptual steps:

Identifying family "branches" within each correspondence file, by searching for simple (one-to-one) and complex (one-to-many, many-to-one, and many-to-many) mappings that have, at least, one common obsolete or new code. We assign the same synthetic code to all the codes belonging to a family branch.

Identifying chains linking family branches over time, by searching for new codes re-appearing as obsolete in a posterior year. We assign the minimum synthetic code (across family branches) to all codes belonging to branches of the same family tree.

Step 2 implies that the choice of the beginning and end year of the sample affects the identification of chains linking codes over time.

Table A1 provides summary statistics on the number of original CN8 codes re-classified and number of families they are grouped into after step 1 (within-year identification), for each year in our sample.

The largest number of obsolete codes occurs between 1995 and 1996 and between 2001 and 2002, when the HS6 classification changed.

Tables A2 and A3 provide summary statistics on the impact of the concordance after steps 1 (within-year grouping) and 2 (over-time chaining) are performed. Table A2 decomposes two sets of CN8 codes: (i) original CN8 codes are decomposed into those that are replaced and not replaced by synthetic codes during the concordance; (ii) surviving CN8 codes (after the concordance) are decomposed into those that are actual (original) and synthetic and, subsequently, each of these sub-sets is decomposed into codes that are common to 1995 and 2005 and those that are unique to each of those years. These decompositions are performed for exports and imports and for 1995 and 2005.

Note that the percentage of original codes involved in reclassifications, which was, on average 4% before the over-time chaining (Table A1), is now larger than 30% in 1995 and 2005, both for imported and exported product codes.

Table A1

NUMBER OF OBSOLETE AND NEW CODES (1995,2005)

Effective year	Total # of CN8 codes	# of obsolete codes	# of new codes	# of families (including simple changes)	# of simple changes
1995	10,448	531	871	383	31
1996	10,495	1,257	1,304	792	435
1997	10,606	170	281	130	0
1998	10,587	334	315	175	0
1999	10,428	303	144	132	3
2000	10,314	223	109	96	0
2001	10,274	90	50	42	1
2002	10,400	847	973	504	311
2003	10,404	16	20	12	0
2004	10,174	503	273	211	7
2005	10,096	186	108	95	5
Média	10,384	405	404	234	72

Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data), and authors' calculations.

Table A2

NUMBER OF ORIGINAL AND SYNTHETIC CODES, EXPORTS AND IMPORTS (1995,2005)

	Exports				Imports			
	1995	%	2005	%	1995	%	2005	%
Original CN8 codes	7,090	100	7,492	100	9,210	100	9,181	100
Not-replaced	4,790	68	5,195	69	6,080	66	6,256	68
Replaced	2,300	32	2,297	31	3,130	34	2,925	32
Actual+synthetic codes after concordance	6,128	86	6,611	88	7,732	84	7,947	87
Actual codes	*4,790*	*68*	*5,195*	*69*	*6,080*	*66*	*6,256*	*68*
Common to both years	4,375	62	4,375	58	5,909	64	5,909	64
Appear in only one year	415	6	820	11	171	2	347	4
Synthetic codes	*1,338*	*19*	*1,416*	*19*	*1,652*	*18*	*1,691*	*18*
Common to both years	1,217	17	1,217	16	1,597	17	1,597	17
Appear in only one year	121	2	199	3	55	1	94	1

Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The top part of this table shows the number of original CN8 codes, associated with positive exports or imports in 1995 or 2005, and subdivides them into those replaced and not replaced by a synthetic code. The bottom part of the table shows the number of actual and synthetic CN8 codes after the concordance has been applied, and subdivides both actual and synthetic codes into those common to both 1995 and 2005 and those that appear in only one of these two years. Even columns display values as percent of the first row in the preceding column.

Table A3

EXPORTS AND IMPORTS ASSOCIATED TO ORIGINAL AND SYNTHETIC CODES (1995,2005)

	Exports				Imports			
	1995	%	2005	%	1995	%	2005	%
Original CN8 codes	16,132	100	27,394	100	22,831	100	42,150	100
Not-replaced	11,761	73	18,278	67	14,446	63	26,762	63
Replaced	4,371	27	9,116	33	8,385	37	15,388	37
Actual+synthetic codes after concordance	16,132	100	27,394	100	22,831	100	42,150	100
Actual codes	*11,761*	*73*	*18,278*	*67*	*14,446*	*63*	*26,762*	*63*
Common to both years	11,611	72	17,973	66	14,285	63	25,930	62
Appear in only one year	150	1	305	1	161	1	832	2
Synthetic codes	*4,371*	*27*	*9,116*	*33*	*8,385*	*37*	*15,388*	*37*
Common to both years	4,345	27	9,026	33	8,349	37	15,216	36
Appear in only one year	26	0	90	0	36	0	172	0

Sources: Eurostat (Classification files from Ramon server), *INE* (Trade data) and authors' calculations.

Notes: The top part of this table shows the amount, in millions of euros, of exports and imports associated with original CN8 codes, and subdivides them into those associated with codes that were or were not replaced by a synthetic code. The bottom part of the table subdivides exports and imports into those associated with actual or synthetic codes that are common to both 1995 and 2005 or appear in only one of these two years. Even columns display values as percent of the first row in the preceding column.