# Trade Diversity and Stages of Development–Evidence on EU Countries

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## 1. Introduction

Following recent interest in the relationship between the diversity of economic activity and stages of economic development [Cadot et al., 2011a; Imbs and Wacziarg, 2003], the main purpose of this paper is to present related empirical evidence concerning EU countries. In particular, we will aim at locating European economies within the so-called 'diversification curve' (revealed in international panel data settings) which approximates the link between trade diversity measures and income per capita levels.

The process of economic development (the movement along stages of development) is marked by a process of a structural transformation in which countries: *(i)* change the set of produced (and traded) goods *(ii)* change the typology of goods, typically moving towards more demanding products. Here we focus on the first aspect, analyzing quantitative changes in the composition of trade baskets, occurring as countries move towards higher levels of income per capita[2]. It has been found that the effects of trade (in particular export) diversification on economic growth can be nonlinear, with developing countries gaining most from diversification and higher income countries benefiting from major specialization [Hesse, 2009]. Consequently, we expect that EU countries, being mainly high-income ones, should already have high-

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[2] Trade diversification in the economic growth process can also go along with changes in the relative importance of intra-industry trade (IIT) and inter-industry trade. For instance, Brülhart [2009, p. 417] shows that trade among high-income countries is characterized by the highest IIT shares on average while IIT among the low-income countries is almost non-existent. In the simplest way IIT can be seen as two-way trade of differentiated products with similar prices, but due to the growing importance of trade in qualitatively differentiated products, it has been disentangled into IIT in *horizontally* differentiated (similar) products and IIT in *vertically* differentiated products (with different quality). Vertical IIT (VIIT) accounts for specialization in products of different quality within industries and can be further decomposed into '*up-market*' VIIT and '*down-market*' VIIT. Up-market VIIT takes place when unit values of export flow are greater than import unit values.

ly diversified trade structures and could actually gain from their deconcentration.

The analysis focuses on a group of EU27 countries, observed across the years 1988–2010 and compared to a sample of 136 international economies at all levels of development. We will use very detailed product level statistics (six digit HS0, almost 5,000 product lines) to calculate synthetic measures of traded products diversity. Importantly, the analysis will be performed simultaneously for imports and exports which will allow us to confront patterns of product diversification typical for both flows.

The remaining part of the paper is structured as follows: in Section 2 we will briefly summarize related literature, focusing on the evidence concerning trade diversification process in European countries. Methodology used in the present study (details on data and adopted measures of product diversity) will be described in Section 3. The core of the paper will be presented in Section 4 where we will first compare patterns of trade diversification in EU27 sample with respect to the rest of the world, and subsequently estimate econometrically the 'diversification curve', locating EU countries in a comparative setting versus international trends. Both flexible nonparametric and parametric estimation methods will be used. Finally, Section 5 concludes the paper.

## 2. Related literature

Recent empirical literature on the relationship between diversification of economic activity and stages of development originates mainly from the seminal contribution of Imbs and Wacziarg [2003] who were among the first to reveal nonmonontonicity in the link between diversification and income per capita levels. Using measures of concentration calculated with sector level employment and export data, they revealed a specific hump shaped pattern of diversification in the process of economic growth. Poor countries tend to deconcentrate their economic structures (introducing more varieties) but at some point in the development process, economies tend to re-concentrate: such a pattern is illustrated by a U-shaped 'diversification curve', with a turning point revealed by Imbs and Wacziarg to occur around $9,000 (1985 PPP). Such a 'diversification curve' was obtained by linking income per capita levels (plotted on horizontal axis) and the index of production concentration (on the vertical axis). The U-shape of the curve results from the use of an inverse measure of diversification (based on inequality/concentration index), consequently the decreasing part of the U-curve corresponds to the decreasing concentration (increasing diversification) of economic activity along the development process, while the upward rising part of the U-curve illustrates the re-concentration track.

Since then many studies deviated from Imbs and Wacziarg [2003] contribution, introducing methodological or conceptual modifications in the original approach (see Cadot et al., 2012 for an excellent literature review). The

U-shaped path of diversification followed by respecialization/reconcentration was confirmed by Koren and Tenreyro [2007], using different production data. Other authors focused on the diversity visible in trade structures: Klinger and Lederman [2011] found a U-shaped pattern of diversification of exports with a turning point at $22,500 (2000 PPP). Cadot et al. [2011a] reached a similar conclusion (turning point at $25,000, 2005 PPP) and moved a step further: in particular, they examined what forces can drive the upward rising part of the curve. Using the decomposition properties of the Theil index (employed as an inverse measure of product diversity) they explore intensive and extensive margins of trade[3]. The decreased concentration of exported products typical for lower income countries results from a rise in the number of exported products (activity at extensive margin), intensive margin dominates around the turning point and afterwards the extensive one dominates again: rich countries close export lines quicker than they open new ones which explains the reconcentration track.

A slightly different stream of research proposed another view on the stages of diversification, where its degree for each country is assessed with respect to the rest of the sample through the use of the so-called relative measures of diversification [Bickenbach et al., 2010; de Benedictis et al., 2009]. In such a setting the relative diversification track dominates in the economic development process (countries' economic structures become more and more dissimilar with respect to the typical benchmark) and no robust tendency towards respecialization occurs[4].

Export studies dominate the literature on trade diversification, while evidence on imports' diversity and its relationship with economic development, performed in a panel data setting, is much more scarce. Most of the import related studies focused on country-specific effects of a rise in imported inputs variety on productivity and welfare (see Cadot et al., 2012, Section 5 for an overview). A different aspect of import diversity—the geographical one—was examined for more countries by Cadot et al. [2011b], They analyze the geographical concentration of OECD imports across countries of origin (i.e. the diversity of suppliers) and find that that reconcentration of imports after the year 2000 was caused by rising importance of China as a supplier.

As far as the specific case of EU countries is concerned, the evidence on stages of trade diversification is rather limited, especially if we seek for studies performed with a highly disaggregated trade data. Parteka [2009] has presented patterns of evolving economic activity concentration with respect to income per capita levels of 25 European countries (revealing U-shaped pat-

[3] The distinction between the two margins became popular after the paper by Hummels and Klenow [2005]. Roughly speaking, the extensive margin concerns changes in the number of active product lines while intensive margin of trade refers to the variation in trade values for already traded goods.

[4] See Parteka [2010] for a comparison between the results obtained with absolute and relative diversification measures calculated with employment and export sector level statistics.

tern similar to what Imbs and Wacziarg, 2003, found in an international sample of countries) but the focus here is on employment and not on trade. Funke and Ruhwedel [2005] calculate relative export variety measure based on Feenstra [1994] index, confirming the role of export variety fostering economic growth of 14 East European transition economies (1993–2000). Along these lines, Misztal [2011] argues that export diversification was a positive determinant of economic growth in 27 EU countries in the later period (1995–2009). To the best of our knowledge, EU-focused import-export studies on stages of diversification are missing.

## 3. Measurement

### 3.1. Data

Trade statistics on imports and exports used in our study come from UNComtrade and have been downloaded using World Integrated Trade Solutions software[5]. We use direct statistics for imports and mirrored data for exports (imports are usually recorded with more accuracy than exports because imports generally generate tariff revenues while exports don't). Mirroring implies using information from the partner, so that in order to obtain value of exports from A to B we use data on imports from A reported by B. We are interested in tracing product diversification patterns in the course of time, so we use as disaggregated data for a long period of time as possible: we rely on HS0[6] 6-digit division[7]. We use automatic conversion tables from WITS to obtain concordance between various revisions of the HS system. After necessary clearing of rough data (eliminating 'silent lines'—never traded goods etc.) we are left with a set of 4,963 product lines (all commodities—the list of chapters corresponding to broad product categories is reported in Table A1. in the Appendix). With these statistics for each country and year we will calculate the synthetic measures of product diversity (defined in Section 3.2) and then match them with income per capita data and additional country level statistics. GDP per capita (in PPP, 2005 int. USD), population (in 1000) and GDP (in PPP, 2005 int. USD) statistics come from World Bank's World Development Indicators (release 2011).

[5] https://wits.worldbank.org/WITS

[6] HS stands for the Harmonized System. It is an international nomenclature for the classification of products which allows participating countries to classify traded goods on a common basis for customs purposes. HS0 corresponds to the first launch of the system (1988/1992). Disaggregation deeper than 6-digit is not harmonized across countries so cannot be used in cross-country studies.

[7] "The six digits can be broken down into three parts. The first two digits (HS-2) identify the chapter the goods are classified in, e.g. 09 = Coffee, Tea, Maté and Spices. The next two digits (HS-4) identify groupings within that chapter, e.g. 09.02 = Tea, whether or not flavoured. The next two digits (HS-6) are even more specific, e.g. 09.02.10 Green tea (not fermented)..." (information from UNComtrade Knowledgebase http://unstats.un.org/unsd/tradekb/Knowledgebase/Harmonized-Commodity-Description-and-Coding-Systems-HS).

As for the country composition and time span, throughout the whole analysis we will compare European Union countries (EU27) to the 'Rest of the World' (RoW) sample, composed of 136 extra-EU economies observed across the years 1988–2010. The two datasets are unbalanced (due to data availability) and are summarized in Table A2 in the Appendix. EU27 countries, along with their average income per capita levels and years covered by the analysis, are listed in Table A3 in the Appendix. In order to distinguish between economies at different stages of development we use the classification of the World Bank which clusters countries into five groups according to their income per capita (LI—low income, LMI—lower middle income, UMI—upper middle income, HI—high income: OECD and non-OECD members). As can be seen in Table A3., all but four EU27 countries (Bulgaria, Lithuania, Latvia, and Romania) belong to high income (HI) group, mainly HI-OECD, except Cyprus and Malta which are not OECD members.

Table 1. shows key statistics concerning our EU27 sample (486 country-year observations) and the remaining sample of 136 countries (1,419 country-year observations). In line with the existing evidence on diversification drivers [Cadot et al., 2012; Parteka and Tamberi, 2011], we consider: income per capita levels, country size (measured terms of GDP and population) and petrol abundance as factors potentially influencing the degree of trade diversification. In order to place EU27 sample in a comparative setting, we will also report all of these statistics for the aforementioned five country groups, classified according to their stages of development. In general, on average EU 27 countries are richer (in terms of GDP per capita), smaller in terms of population (the difference in GDP is much less pronounced) and less abundant in petrol than the remaining RoW sample.

## Table 1.

**Key statistics (potential determinants of trade diversification) on EU and non-EU countries (RoW) in the sample**

| Countries group: | | No. of obs. (1) | GDPpc [PPP, const. 2005 int. USD] (2) | Population [1000] (3) | GDP [$10^9$ const. 2005 int. USD] (4) | Share of fuel exports [%] (5) |
|---|---|---|---|---|---|---|
| EU27 | | 1419 | 23050.5 | 18635.08 | 470 | 4.7 |
| RoW (136) | | 486 | 11291.3 | 58617.35 | 460 | 16.1 |
| Countries (EU27 + 136 non-EU) divided by income group* | low income | 178 | 922.521 | 25302.02 | 24 | 3.2 |
| | low-middle income | 333 | 2971.01 | 80446.18 | 170 | 14.4 |
| | upper middle income | 609 | 8173.75 | 67029.41 | 380 | 17.2 |
| | high income non-OECD | 195 | 26384.5 | 3716.91 | 92 | 28.8 |
| | high income OECD | 590 | 27031.4 | 32986.63 | 990 | 6.3 |

Note: average values across country-year observations (1988–2010) * country groups according to the World Bank's (2011) classification. RoW—Rest of the World.
Source: own elaboration based on GDP per capita, GDP, population and share of fuel exports (as % of all merchandise exports) from World Bank's World Development Indicators (2011).

### 3.2. Measures of imported and exported products' diversification

As the simplest measure of product diversity we consider the number of active product lines with non-zero export (import) value, respectively for export (import) diversification measures. We denote them as $Nactive_{it}^{exp}$ and $Nactive_{it}^{imp}$ where $i$ refers to country and $t$ to time period. Additionally, we express the number of exported/imported products with respect to the number of products effectively being exported (imported) at the world level at time $t$, obtaining $RelNactive_{it}^{exp}$ and $RelNactive_{it}^{imp}$.

The process of product diversification at the extensive margin could be visible through the increase in the number of traded goods. Hence, to quantify this issue we need to count the number of new product lines appearing in the country's export (import) portfolio. However, given that many trade relations are extremely vulnerable and tend to disappear very quickly (as has been documented by Besedes and Prusa, 2006), instead of a mere change in $Nactive_{it}^{exp}$ and $Nactive_{it}^{imp}$ we calculate the number of new product lines which are added to export (import) basket and, importantly, manage to survive. In order to do so, we will adopt two alternative definitions. First, in line with Besedes and Prusa [2006], for each country and time period we will define a new product as such which was not exported (imported) by this country in the prior year but started to be exported (imported) at time $t$ and is still exported (imported) in the following year $(t + 1)$. This definition is based on one-year cutoff and three-year moving window to define the spell. The second definition (based on Cadot et al., 2011a) is more restrictive and uses a five-year moving window and a two-year cutoff. Consequently, we will count the number of new product lines using the two alternative definitions: $Nnew(1)_{it}^{exp}$, $Nnew(1)_{it}^{imp}$ and $Nnew(2)_{it}^{exp}$, $Nnew(2)_{it}^{imp}$.

Finally, we rely on Theil measure of product concentration which serves as an inverse measure of product diversification (calculated as in Cadot et al., 2011a and based on Theil, 1972):

$$Theil_{it}^{exp} = \frac{1}{n}\sum_{k=1}^{n}\left(\frac{x_{ikt}}{\overline{x_{it}}}\cdot \ln\frac{x_{ikt}}{\overline{x_{it}}}\right) \tag{1}$$

where $i$ refers to countries, $k = 1, \ldots, n$ to products, $x$ stands for exports' value while $\overline{x_{it}} = \frac{\sum_{k=1}^{n} x_{ikt}}{n}$ is the average (across products) export value of country $i$. Similarly, in case of imports, the index is obtained as:

$$Theil_{it}^{imp} = \frac{1}{n}\sum_{k=1}^{n}\left(\frac{m_{ikt}}{\overline{m_{it}}}\cdot \ln\frac{m_{ikt}}{\overline{m_{it}}}\right) \tag{2}$$

with $m$ referring to imports value. The computation of Theil index involves the use of natural logarithm, so in cases in which the argument of ln turned out to be equal to zero (due to the presence of zero trade flow—products not present in country's trade portfolio), we substituted it with a very small num-

ber ($10^{-10}$), which allowed us to compute correctly the index affecting its value only negligibly. The lower bound of Theil indices is 0 (and corresponds to maximum product diversity within the analysed set of product lines) while the upper limit is equal to $\ln(n)$, signalling maximum product concentration (minimum diversity) of trade portfolio.

Summary statistics of import and export product diversifiction measures, separately for EU27 and RoW samples, are reported in Table 4A in the Appendix.

## 4. Stages of import and export diversification

### 4.1. Prima facie evidence—EU27 versus RoW sample

In Table 2 and Table 3 we report the comparison between measures of imported and exported products diversity typical for EU27 countries in our sample and for other countries. First of all, it is clear that EU27 have well diversified baskets of traded goods: on average they export 3,816 and import 4,378 kinds of commodities (out of 4,963 products theoretically present in our HS0 set). These values correspond, respectively, to 78% and 90% of goods effectively exported and imported at the world level (column 2). For comparison, countries from RoW sample, composed of 136 extra EU27 economies, import 77% and export only 47% of all goods that are imported (exported) in the world. As can be seen, product heterogeneity varies greatly across development levels—the difference is especially pronounced in case of export portfolio (Table 2) with low income countries covering only 21% of the potential export basket and 83% for high income OECD countries. Note that high income non-OECD countries do not have very heterogeneous exports, mainly due to the fact that they are often small (in terms of population) and petrol abundant countries (see Table 1), thus relying on exports of petrol products.

**Table 2.**

**Measures of *exported* products diversity—EU27 versus other countries**

| Countries group: | | No of active export product lines (max = 4963) (1) | Relative number of active export product lines (2) | Theil index (exports) (3) | No of new export lines (1) (4) | No of new export lines (2) (5) |
|---|---|---|---|---|---|---|
| EU27 | | 3816 | 0.47 | 2.750 | 162 | 64 |
| RoW (136) | | 2299 | 0.78 | 4.700 | 189 | 69 |
| Countries (EU27 + 136 non-EU) divided by income group* | low income | 1014 | 0.21 | 5.718 | 155 | 49 |
| | low-middle income | 1662 | 0.35 | 5.003 | 198 | 71 |
| | upper middle income | 2528 | 0.52 | 4.438 | 222 | 84 |
| | high income non-OECD | 2291 | 0.47 | 4.932 | 208 | 86 |
| | high income OECD | 4063 | 0.83 | 2.821 | 131 | 49 |

Note: average values across country-year observations (1988–2010) * country groups according to the World Bank's (2011) classification.
Source: own elaboration based on trade data from UNComtrade.

## Table 3.

**Measures of *imported* products diversity—EU27 versus other countries**

| Countries group: | | No. of active import product lines (max = 4963) (1) | Relative number of active import product lines (2) | Theil index (imports) (3) | No. of new import lines (1) (4) | No. of new import lines (2) (5) |
|---|---|---|---|---|---|---|
| EU27 | | 4378 | 0.90 | 2.170 | 63 | 30 |
| RoW (136) | | 3760 | 0.77 | 2.700 | 99 | 38 |
| Countries (EU27 + non-EU) divided by income group* | low income | 3063 | 0.63 | 3.261 | 154 | 47 |
| | low-middle income | 3476 | 0.71 | 2.943 | 127 | 50 |
| | upper middle income | 3931 | 0.80 | 2.470 | 99 | 39 |
| | high income non-OECD | 3746 | 0.77 | 2.865 | 99 | 38 |
| | high income OECD | 4467 | 0.91 | 2.156 | 49 | 23 |

Note: average values across country-year observations (1988–2010) * country groups according to the World Bank's (2011) classification.
Source: own elaboration based on trade data from UNComtrade.

Similar pattern of varying export and import heterogeneity across various stages of development is confirmed when we compare average values of Theil index (column 3 of Table 2 and Table 3). Its low value for EU27 (2.75 in case of exports and 2.17 in case of imports) indicates a high degree of product heterogeneity and low product concentration.

As far as the process of diversification visible through the introduction (and survival) of new product lines is concerned, EU27 countries already having well diversified baskets of exported and imported products add every year less new lines than countries from the RoW sample (columns 4 and 5 of Table 2 and Table 3).

### 4.2 Country specific trends (EU27)

In order to provide evidence on trade diversity evolution in particular EU countries from our sample, in Figure 1 we show plots of synthetic measure of export ($Theil^{exp}$) and import ($Theil^{eimp}$) concentration against time. There is some heterogeneity across countries, but several common observations can be done. First of all, most of the countries from the EU27 sample, being already well developed ones (and classified as high income countries—see Table 3A in the Appendix) registered an increase in both import and export measure of product concentration, which corresponds to the respecialization track. This is in line with Cadot et al. (2011a) pattern of trade reconcentration at higher stages of economic development. Such a pattern, common for imports and exports, concerns such European countries as: AUT, BEL, CZE, FRA, GBR, GER, HUN, IRL, ITA, LTU, LUX (till 2007), NLD, SVK, SVN and SWE. On the other extreme, we find less developed countries such as BGR or ROM (classified as upper-middle income countries). Romania followed

a clear path of trade diversification (drop in $Theil^{exp}$ and $Theil^{eimp}$) while Bulgaria was characterized by a U-shaped pattern of diversification followed by reconcentration of exports and imports in the recent years. Hence, trends in trade diversity seem to be linked to stages of development. We will address this issue in the next section, where we examine econometrically the link between import/export diversity indices and income per capita.

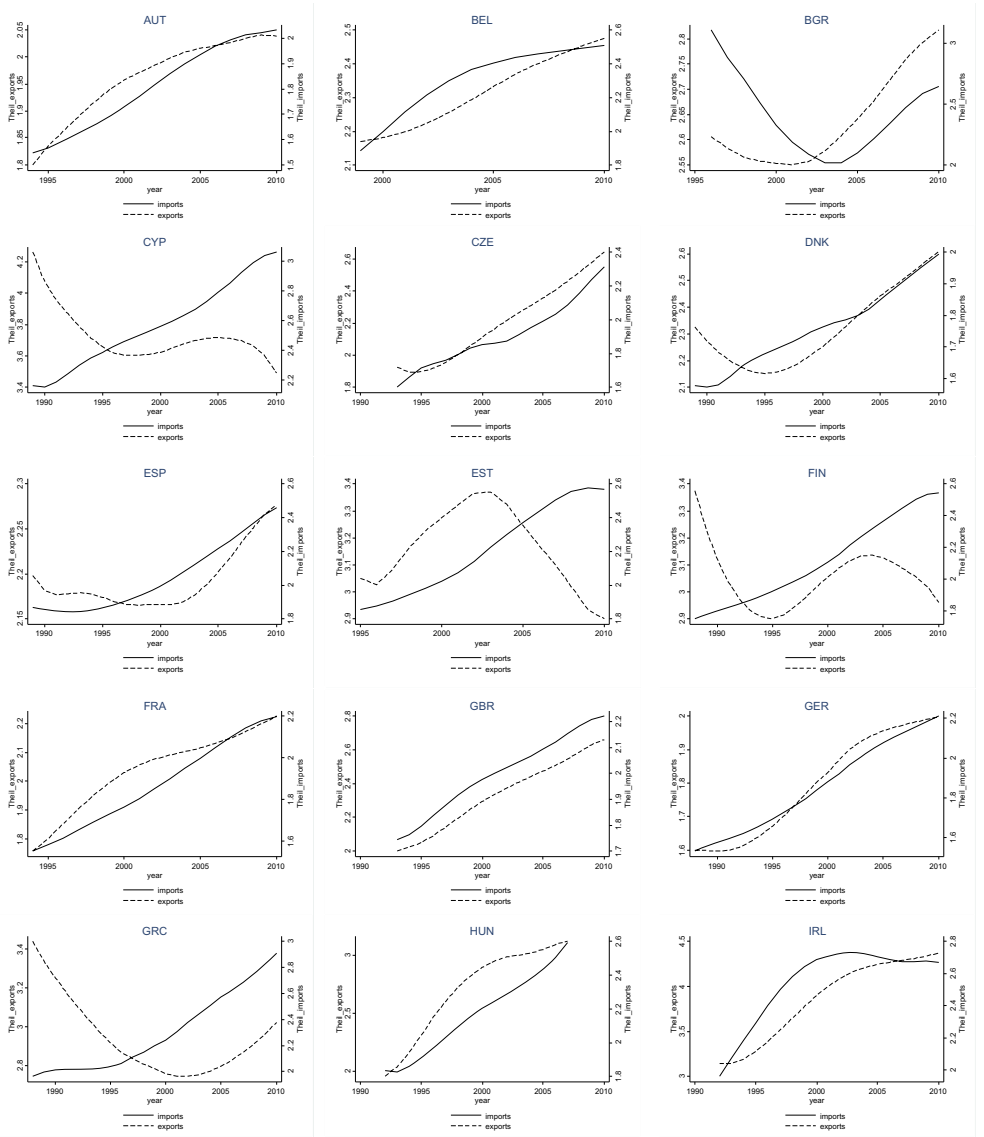



**Figure 1.**

**Evolution of import and export diversity in EU27 countries**

Source: own elaboration based on trade data from UNComtrade (HS0, 4963 product lines).

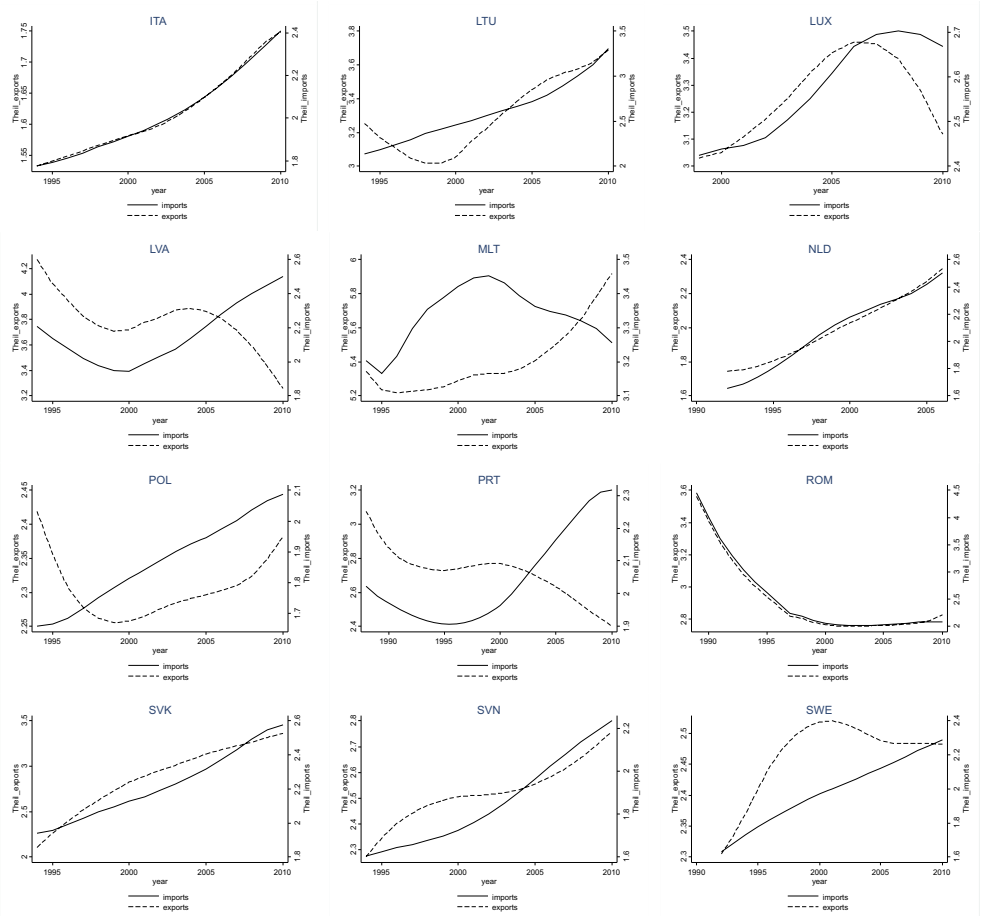



**Figure 1 cont.**

**Evolution of import and export diversity in EU27 countries**
Source: own elaboration based on trade data from UNComtrade (HS0, 4963 product lines).

### 4.3 Estimation results

As stated in Section 2, recent empirical literature on diversification dynamics focused on the nonlinear relationship between measures of product concentration and economic development levels. Hence, in order to check the existence (or not) of such a relationship in our sample of EU27 countries, in the first step we perform a nonparametric estimation in the form of the lowess curve (Cleveland, 1979) which can be described by the following equation:

$$Y_{it}^{exp} = f\left(GDPpc_{it}\right) \tag{3}$$

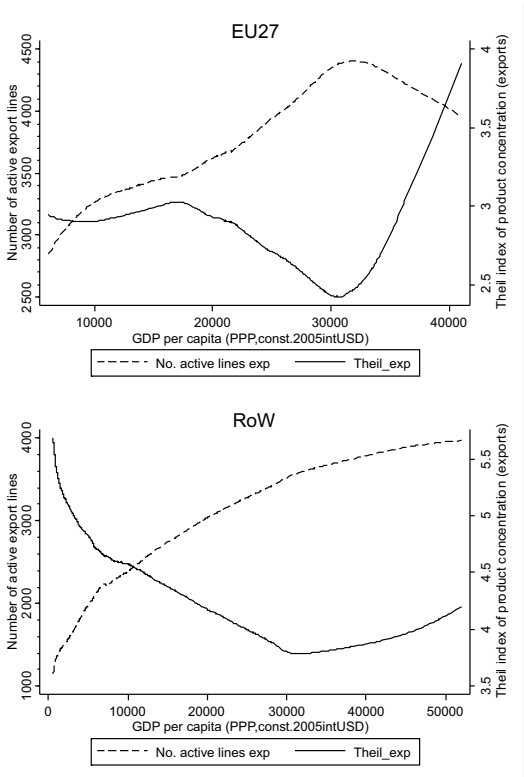
where $Y^{exp} = \{Nactive^{exp}, Theil^{exp}\}$ denotes one of the synthetic measures of exported products diversity defined in eq. 1 and eq. 2, $i$ refers to countries

and $t$ to time period. *GDPpc* is a proxy of the development level (income per capita in real terms) and $f(.)$ is a flexible function estimated through the use of the lowess smoother and represented graphically. Similarly, the equation for imports takes on the following form:

$$Y_{it}^{imp} = f\left(GDPpc_{it}\right) \tag{4}$$

where $Y^{imp} = \{Nactive^{imp}, Theil^{imp}\}$ denotes one of our synthetic measures of imported products diversity.

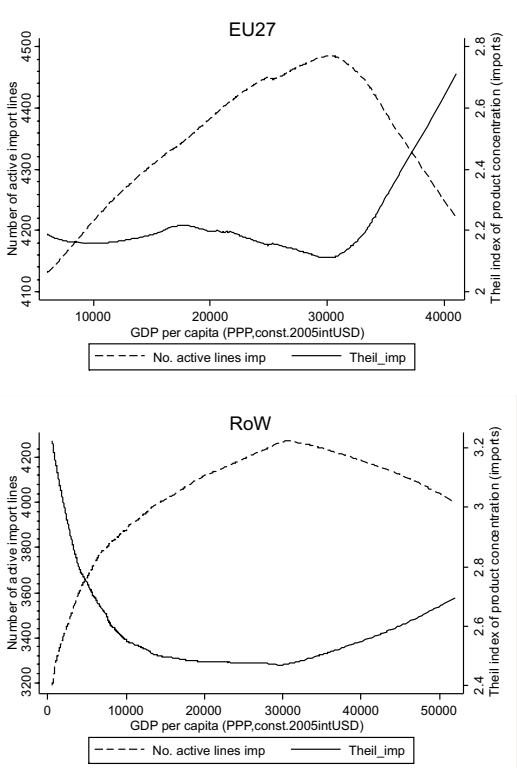
Graphical representation of nonparametric curve for exports is shown in Figure 2, while Figure 3 presents data for imports. We will compare the pattern typical for the EU27 sample (upper plot) with that emerging from the RoW sample (lower plot).




## Figure 2.

**Measures of product diversity versus level of economic development, nonparametric plots (EU27 and RoW), exports**

Note: RoW—Rest of the World (136 countries); nonparametric plot obtained with lowess—span = 0.8, sample without outliers defined as observations below the 1st or above the 99th percentile.
Source: own elaboration based on trade data from UNComtrade (HS0, 4,963 product lines) and GDP per capita from World Bank's World Development Indicators (2011).




## Figure 3.

**Measures of product diversity versus level of economic development, nonparametric plots (EU27 and RoW), imports**

Note: RoW—Rest of the World (136 countries); nonparametric plot obtained with lowess—span = 0.8, sample without outliers defined as observations below the 1st or above the 99th percentile.
Source: own elaboration based on trade data from UNComtrade (HS0, 4,963 product lines) and GDP per capita from World Bank's World Development Indicators (2011).

By analyzing exports (Figure 2) concerning the EU27 sample, we can observe a rise in the number of exported product lines ($Nactive_{it}^{exp}$) up to an income per capita level of approximately $30,000 [PPP, 2005] followed by a subsequent drop in $Nactive_{it}^{imp}$ which marks the reconcentration track. Theil index, measuring product concentration, mirrors the plot obtained with the number of active lines and thus follows a U-shaped path. By comparing EU27 to the rest of the word (RoW) sample, we note that in the latter case the pattern of progressing export diversification is dominating (constant increase in $Nactive_{it}^{exp}$ as income per capita grows, only a slight increase in $Theil^{exp}$ at higher stages of development). This is in line with the predictions based on Cadot et al. [2011a] hump-shaped evidence on export diversity evolution because EU27 sample is composed of more developed countries than RoW sam-

ple (compare average income per capita levels reported in Table 1: $23,050.5, PPP 2005 in the case of EU27 and $11,291.3, PPP 2005 in the case of RoW).

With regard to trends typical for the import structures (Figure 3), the pattern is very similar, with increasing import diversity in EU27 sample up to an income per capita levels of $30,000 [PPP, 2005] and observable reconcentration afterwards. On average, less developed RoW sample is characterized by strong import diversification path at the initial stages of economic development.

However, unconditional lowess estimation does not take into account other factors which affect diversification opportunities. Consequently, we should correct eq. (3) and (4) for the inclusion of additional right hand side variables and assess their statistical significance. In the following step, in order to check the pattern revealed through nonparametric estimation, we estimate parametrically the following models:

$$Y_{it}^{exp} = \alpha + \beta_1\left(GDPpc_{it}\right) + \beta_2\left(GDPpc_{it}\right)^2 + \beta_3 GDP_{it} + \beta_4 Fuel_{it} + D_t + v_{it} \quad (5)$$
$$\forall Y^{exp} = \left\{Nactive^{exp}, Theil^{exp}\right\}$$

and

$$Y_{it}^{imp} = \alpha + \beta_1\left(GDPpc_{it}\right) + \beta_2\left(GDPpc_{it}\right)^2 + \beta_3 GDP_{it} + \beta_4 Fuel_{it} + D_t + v_{it} \quad (6)$$
$$\forall Y^{imp} = \left\{Nactive^{imp}, Theil^{imp}\right\}$$

In alternative specifications, real income per capita enters linearly or in a quadratic form (to correct for eventual non-linearity in diversification-income relationship and check its importance once other factors are taken into account). Additionally, following empirical literature on the determinants of trade diversification [Cadot et al, 2011b; Parteka and Tamberi, 2011] we consider the importance of such country specific characteristic as: country size (*GDP*) and petrol abundance (*Fuel*—as percentage of total merchandise exports). All models include time dummies (in order to account for common business cycle effects)[8].

As far as export diversity is concerned (results reported in Table 4 and Table 5), when considering the number of exported products, it turns out to be positively and significantly related to income per capita levels (columns 1, 2 and 3 of Table 4). Coefficients associated with *GDPpc* in models employing Theil index of export concentration are negative (column 1, 2, and 3 of Table 5) which is correct, given that it is an inverse measure of product diversification. Quadratic formulation turns out to be not significant. Country size and petrol abundance are among positive determinants of export diversity in the EU27 sample. The results concerning imports' diversification

[8] We do not adopt FE estimation with country dummies as it would wipe out most of the variability across countries which is captured for instance by the inclusion of size variable.

and its relation to stages of development (reported in Table 6 and Table 7) are similar: the number of imported products is positively related to income per capita levels (negative coefficient is obtained when Theil index of import concentration is used as a dependent variable). The model with the number of imported products as a dependent variable (Table 6) performs better in terms of variables' significance and goodness of fit. All in all, the crucial conclusion is that also within the EU27 sample the diversity of exported and imported products increases in income per capita.

## Table 4.

**Estimation results—exports (dependent variable: number of active lines), EU27 sample**

| | Dependent variable: No. of active export product lines | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| (GDPpc)$^2$ | | | | –7.30E – 08 | –1.74E – 07 | –5.20E – 07 |
| | | | | [–0.14] | [–0.37] | [–1.23] |
| GDPpc [PPP, const. 2005 int. USD] | 5.501e – 02*** | 4.020e – 02*** | 4.509e – 02*** | 5.810e – 02*** | 4.757e – 02** | 6.752e – 02*** |
| | [19.45] | [13.45] | [14.19] | [2.59] | [2.23] | [3.56] |
| GDP [PPP, const. 2005 int. USD] | | 4.571e – 10*** | 4.539e – 10*** | | 4.571e – 10*** | 4.534e – 10*** |
| | | [9.58] | [9.79] | | [9.58] | [9.85] |
| Fuel exports [% total merchandise exports] | | | 2.541e + 01*** | | | 2.736e + 01*** |
| | | | [3.13] | | | [3.72] |
| No. of observations | 460 | 458 | 458 | 460 | 458 | 458 |
| adj R2 | 0.33 | 0.42 | 0.44 | 0.33 | 0.42 | 0.44 |
| Time fixed effects | yes | yes | yes | yes | yes | yes |

Note: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively. Least Squares estimates, sample without outliers defined as observations below 1st or above 99th percentile. Robust t-statistics in parenthesis under coefficients.
Source: own elaboration based on trade data from UNComtrade (HS0, 4,963 product lines); GDP per capita, GDP and fuel exports from WB WDI (2011).

## Table 5.

**Estimation results—exports (dependent variable: Theil index), EU27 sample**

| | Dependent variable: Theil index of export concentration | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| (GDPpc)$^2$ | | | | –4.56E – 10 | –3.13E – 10 | 4.81E – 11 |
| | | | | [–0.62] | [–0.50] | [0.08] |

| | Dependent variable: Theil index of export concentration | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| GDPpc [PPP, const. 2005 int. USD] | –2.671e – 05*** | –8.828e – 06** | –1.446e – 05*** | –7.41E – 06 | 4.44E – 06 | –1.65E – 05 |
| | [–6.48] | [–2.01] | [–3.31] | [–0.25] | [0.18] | [–0.68] |
| GDP [PPP, const. 2005 int. USD] | | –5.637e – 13*** | –5.543e – 13*** | | –5.636e – 13*** | –5.543e – 13*** |
| | | [–11.48] | [–11.67] | | [–11.33] | [–11.68] |
| Fuel exports [%total merchandise exports] | | | –2.964e – 02*** | | | –2.981e – 02*** |
| | | | [–3.15] | | | [–3.13] |
| No. of observations | 455 | 453 | 453 | 455 | 453 | 453 |
| adj R2 | 0.1 | 0.26 | 0.28 | 0.1 | 0.26 | 0.28 |
| Time fixed effects | yes | yes | yes | yes | yes | yes |

Note: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively. Least Squares estimates, sample without outliers defined as observations below 1st or above 99th percentile. Robust t-statistics in parenthesis under coefficients.
Source: own elaboration based on trade data from UNComtrade, 2011 (HS0, 4963 product lines); GDP per capita, GDP and fuel exports from WB WDI (2011).

## Table 6.

**Estimation results—imports (dependent variable: number of active lines), EU27 sample**

| | Dependent variable: No. of active import product lines | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $(GDPpc)^2$ | | | | –4.324e – 07*** | –4.529e – 07*** | –5.345e – 07*** |
| | | | | [–2.70] | [–2.94] | [–3.66] |
| GDPpc [PPP, const. 2005 int. USD] | 1.672e – 02*** | 1.282e – 02*** | 1.384e – 02*** | 3.507e – 02*** | 3.207e – 02*** | 3.687e – 02*** |
| | [12.68] | [8.38] | [8.67] | [4.86] | [4.41] | [5.35] |
| GDP [PPP, const. 2005 int. USD] | | 1.147e – 10*** | 1.138e – 10*** | | 1.137e – 10*** | 1.124e – 10*** |
| | | [7.91] | [7.94] | | [8.00] | [8.06] |
| Fuel exports [% total merchandise exports] | | | 5.671e + 00** | | | 7.427e + 00*** |
| | | | [2.42] | | | [3.42] |
| No. of observations | 462 | 460 | 460 | 462 | 460 | 460 |
| adj R2 | 0.49 | 0.53 | 0.53 | 0.49 | 0.53 | 0.54 |
| Time fixed effects | yes | yes | yes | yes | yes | yes |

Note: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively. Least Squares estimates, sample without outliers defined as observations below 1st or above 99th percentile. Robust t-statistics in parenthesis under coefficients.
Source: own elaboration based on trade data from UNComtrade, 2011 (HS0, 4963 product lines); GDP per capita, GDP and fuel exports from WB WDI (2011).

## Table 7.

**Estimation results—imports (dependent variable: Theil index), EU27 sample**

| | Dependent variable: Theil index of import concentration | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| (GDPpc)$^2$ | | | | –1.15E – 10 | –1.07E – 10 | –1.81E – 10 |
| | | | | [–0.34] | [–0.33] | [–0.58] |
| GDPpc [PPP, const. 2005 int. USD] | –8.143e – 06*** | –1.83E – 06 | –7.35E – 07 | –3.28E – 06 | 2.74E – 06 | 7.07E – 06 |
| | [–3.82] | [–0.76] | [–0.31] | [–0.22] | [0.19] | [0.51] |
| GDP [PPP, const. 2005 int. USD] | | –1.735e – 13*** | –1.739e – 13*** | | –1.738e – 13*** | –1.745e – 13*** |
| | | [–8.26] | [–8.17] | | [–8.14] | [–8.06] |
| Fuel exports [% total merchandise exports] | | | 6.10E – 03 | | | 6.69E – 03 |
| | | | [1.24] | | | [1.45] |
| No. of observations | 459 | 457 | 457 | 459 | 457 | 457 |
| adj R2 | 0.2 | 0.26 | 0.26 | 0.2 | 0.26 | 0.26 |
| Time fixed effects | yes | yes | yes | yes | yes | yes |

Note: *, ** and *** denote significance at 10%, 5% and 1% levels, respectively. Least Squares estimates, sample without outliers defined as observations below the 1st or above the 99th percentile. Robust t-statistics in parenthesis under coefficients.
Source: own elaboration based on trade data from UNComtrade, 2011 (HS0, 4963 product lines); GDP per capita, GDP and fuel exports from WB WDI (2011).

### 4.4 Extensions and robustness checks[9]

First of all, we checked if changes in the level of disaggregation of trade data used for the calculation of diversity indices could influence the results. In order to do so, we recalculated, for the same set of countries and years, Theil indices of product concentration defined in eq. (1) and eq. (2) with more aggregated data: we used statistics classified according to SITC rev. 3, 4-digit nomenclature (712 lines). Indices obtained with HS0 6-digit product level data (~5,000 products, used in the main analysis) and those calculated with SITC 4-digit data are highly correlated. For the whole sample (1,905 obs.) $corr(Theil^{exp}\_HS0, Theil^{exp}\_SITC) = 0.93$; $corr(Theil^{imp}\_HS0, Theil^{imp}\_SITC) = 0.89$ while in the sample of EU countries only $corr(Theil^{exp}\_HS0, Theil^{exp}\_SITC) = 0.87$; $corr(Theil^{imp}\_HS0, Theil^{imp}\_SITC) = 0.94$. Consequently, the results (e.g. the lowess curves plotted in Figure 2 and Figure 3. obtained with less disaggregated data are very similar to the benchmark ones.

Secondly, we considered modifications in the estimated empirical model. We included the degree of trade openness (*OPEN*) as an additional explanatory variable, potentially influencing diversification possibilities. We then

[9] All the results referring to this section are obtainable upon request from the author. They are not presented here due to space limits.

considered a change in the estimation method (applying instrumental variables estimator), treating income per capita as potentially endogenous and instrumented with its own lag. Finally, we substituted *GDP*, as a measure of country size, with population (*POP*); the two variables are highly correlated: *corr*(*GDP*, *POP*) = 0.93. In all of the cases, the main result (negative relationship between synthetic measures of traded product diversity and the level of economic development) remains robust.

## 5. Summary of the findings and conclusions

Following recent interest in diversification-economic development relationship, this paper presents related empirical evidence concerning EU countries. Our analysis focuses on EU27 economies observed across the years 1988–2010 and compared to an international sample of 136 economies at all levels of income per capita. Through the use of very detailed product level statistics (circa 5,000 goods) on both export and import flows, we are able to trace changes in trade diversification visible at a level of detail deeper than sector or industry.

The results presented in this paper lead to a few observations. First of all, in line with the 'stages of diversification' approach [Imbs and Wacziarg, 2003] and existing empirical literature on trade diversity and its relationship with income per capita [Cadot et al., 2011a], EU countries can be located among economies with already well diversified baskets of exported and imported products. On average, EU27 countries export 78% and import 90% of goods effectively exported and imported at the world level. However, in terms of evolution along the development path, most EU countries, being already well developed (and classified as high income countries), registered an increase in both import and export measures of product concentration in the analyzed period (reconcentration track). Less developed EU economies, such as Bulgaria and Romania. followed a typical diversification path, characteristic for countries at lower stages of development.

In all, evidence on EU27 fits well in a general 'diversification curve' (illustrating the product diversity-development relationship) which predicts diversification followed by a reconcentration track. Using both non-parametric (lowess) and parametric estimation methods, we estimate the curve in our sample of EU27 countries. The results obtained confirm a positive relationship between trade diversity and income per capita levels, with a possibility of reconcentration at higher stages of development (observable in nonparametric estimates). Further research could focus on changes in the typology of goods traded at distinct stages of development.

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# Appendix

## Table 1A.

**List of product categories present in disaggregated trade data used in the analysis**

| | |
|---|---|
| 01–05 | Animal & Animal Products |
| 06–15 | Vegetable Products |
| 16–24 | Foodstuffs |
| 25–27 | Mineral Products |
| 28–38 | Chemicals & Allied Industries |
| 39–40 | Plastics / Rubbers |
| 41–43 | Raw Hides, Skins, Leather, & Furs |
| 44–49 | Wood & Wood Products |
| 50–63 | Textiles |
| 64–67 | Footwear / Headgear |
| 68–71 | Stone / Glass |
| 72–83 | Metals |
| 84–85 | Machinery / Electrical |
| 86–89 | Transportation |
| 90–97 | Miscellaneous |
| 98–99 | Service |

Note: numbers correspond to HS 2-digit code.
Source: UNComtrade

## Table 2A.

**Summary statistics of country-year panels: EU27 and 'RoW—Rest of the World' sample**

| | | EU27 countries | RoW (Rest of the world) |
|---|---|---|---|
| Total number of country-year obs. | | 486 | 1,419 |
| Time span | | 1988–2010 | 1988–2010 |
| Number of countries | | 27 | 136 |
| Number of year obs. per country | Mean | 18 | 10 |
| | Min | 12 | 1 |
| | Max | 23 | 23 |
| Number of country obs. per year | Mean | 21 | 61 |
| | Min | 4 | 7 |
| | Max | 27 | 103 |

Source: own elaboration

## Table 3A.

**List of European countries (EU27) covered by the analysis**

| Country code | Country name | Income group* | GDP per capita [PPP, const.2005 int. USD]** | Years covered by the analysis | |
|---|---|---|---|---|---|
| | | | | First | Last |
| AUT | Austria | HI-OECD | 31864.6 | 1994 | 2010 |
| BEL | Belgium | HI-OECD | 31735.3 | 1999 | 2010 |
| BGR | Bulgaria | UMI | 8857.79 | 1996 | 2010 |
| CYP | Cyprus | HI-nonOECD | 21986.6 | 1989 | 2010 |
| CZE | Czech Republic | HI-OECD | 18435.4 | 1993 | 2010 |
| DEU/GER | Germany | HI-OECD | 29069.6 | 1988 | 2010 |
| DNK | Denmark | HI-OECD | 30139.5 | 1989 | 2010 |
| ESP | Spain | HI-OECD | 24020.7 | 1989 | 2010 |
| EST | Estonia | HI-OECD | 13504.8 | 1995 | 2010 |
| FIN | Finland | HI-OECD | 26349.9 | 1988 | 2010 |
| FRA | France | HI-OECD | 28154.1 | 1994 | 2010 |
| GBR | United Kingdom | HI-OECD | 29747.5 | 1993 | 2010 |
| GRC | Greece | HI-OECD | 21101.5 | 1988 | 2010 |
| HUN | Hungary | HI-OECD | 13499.7 | 1992 | 2007 |
| IRL | Ireland | HI-OECD | 30952.2 | 1992 | 2010 |
| ITA | Italy | HI-OECD | 27161.6 | 1994 | 2010 |
| LTU | Lithuania | UMI | 12000.1 | 1994 | 2010 |
| LUX | Luxembourg | HI-OECD | 66777.1 | 1999 | 2010 |
| LVA | Latvia | UMI | 10659.3 | 1994 | 2010 |
| MLT | Malta | HI-nonOECD | 19966.7 | 1994 | 2010 |
| NLD | Netherlands | HI-OECD | 31695.1 | 1992 | 2006 |
| POL | Poland | HI-OECD | 12676.2 | 1994 | 2010 |
| PRT | Portugal | HI-OECD | 19329.4 | 1988 | 2010 |
| ROM | Romania | UMI | 8257.19 | 1989 | 2010 |
| SVK | Slovak Republic | HI-OECD | 14937.6 | 1994 | 2010 |
| SVN | Slovenia | HI-OECD | 21107.5 | 1994 | 2010 |
| SWE | Sweden | HI-OECD | 29122.1 | 1992 | 2010 |

Note: * country groups according to the World Bank's (2011) classification: LI—low income, LMI—lower middle income, UMI—upper middle income, HI- high income (OECD and non-OECD members), ** year average
Source: own elaboration.

## Table 4A.

**Summary statistics of import and export diversification measures—EU27 and other countries (RoW—Rest of the World)**

| | Export diversification measures | | | | | | |
|---|---|---|---|---|---|---|---|
| | index | group | obs | mean | sd | min | max |
| Number of active products | $Nactive^{exp}_{it}$ | EU27 | 472 | 3784 | 873 | 829 | 4858 |
| Relative number of active products | $RelNactive^{exp}_{it}$ | EU27 | 472 | 0.77 | 0.18 | 0.17 | 0.99 |
| Number of new product lines (1year cutoff) | $Nnew(1)^{exp}_{it}$ | EU27 | 444 | 155 | 121 | 2 | 680 |
| Number of new product lines (2year cutoff) | $Nnew(2)^{exp}_{it}$ | EU27 | 418 | 60 | 58 | 0 | 320 |
| Theil index of product concentration | $Theil^{exp}_{it}$ | EU27 | 467 | 2.80 | 0.79 | 1.63 | 5.96 |
| | Export diversification measures | | | | | | |
| | index | group | obs | mean | sd | min | max |
| Number of active products | $Nactive^{exp}_{it}$ | RoW | 1395 | 2320 | 1435 | 171 | 4798 |
| Relative number of active products | $RelNactive^{exp}_{it}$ | RoW | 1395 | 0.47 | 0.29 | 0.03 | 0.98 |
| Number of new product lines (1year cutoff) | $Nnew(1)^{exp}_{it}$ | RoW | 1302 | 185 | 127 | 2 | 765 |
| Number of new product lines (2year cutoff) | $Nnew(2)^{exp}_{it}$ | RoW | 1218 | 65 | 55 | 0 | 319 |
| Theil index of product concentration | $Theil^{exp}_{it}$ | RoW | 1400 | 4.66 | 1.44 | 1.85 | 7.84 |
| | Import diversification measures | | | | | | |
| | index | group | obs | mean | sd | min | max |
| Number of active products | $Nactive^{imp}_{it}$ | EU27 | 474 | 4383 | 317 | 2435 | 4867 |
| Relative number of active products | $RelNactive^{imp}_{it}$ | EU27 | 474 | 0.90 | 0.06 | 0.50 | 0.99 |
| Number of new product lines (1year cutoff) | $Nnew(1)^{imp}_{it}$ | EU27 | 424 | 60 | 51 | 0 | 307 |
| Number of new product lines (2year cutoff) | $Nnew(2)^{imp}_{it}$ | EU27 | 398 | 27 | 32 | 0 | 204 |
| Theil index of product concentration | $Theil^{imp}_{it}$ | EU27 | 471 | 2.18 | 0.41 | 1.60 | 4.07 |
| | Import diversification measures | | | | | | |
| | index | group | obs | mean | sd | min | max |
| Number of active products | $Nactive^{imp}_{it}$ | RoW | 1393 | 3788 | 721 | 1257 | 4868 |
| Relative number of active products | $RelNactive^{imp}_{it}$ | RoW | 1393 | 0.77 | 0.15 | 0.26 | 0.99 |
| Number of new product lines (1year cutoff) | $Nnew(1)^{imp}_{it}$ | RoW | 1038 | 95 | 78 | 0 | 340 |
| Number of new product lines (2year cutoff) | $Nnew(2)^{imp}_{it}$ | RoW | 969 | 34 | 43 | 0 | 214 |
| Theil index of product concentration | $Theil^{imp}_{it}$ | RoW | 1396 | 2.69 | 0.53 | 1.62 | 4.15 |

Note: Sample without outliers defined as observations below the 1st or above the 99th percentile.
Source: own elaboration.

**Abstract** **Trade Diversity and Stages of Development—Evidence on EU Countries**

The paper presents the dynamics of trade diversification with respect to stages of development in the European context. The analysis focuses on EU27 countries observed across the years 1988–2010 and compared to a sample of 136 international economies at all levels of income per capita. We will use product level statistics (six digit HS0) and confront export and import patterns of absolute diversification/concentration. The results show that in line with 'stages of diversification' approach [Imbs and Wacziarg, 2003], EU27 countries are characterized by a high degree of trade diversity (on average, EU27 countries export 78% and import 90% of goods effectively exported and imported at the world level) and within the analyzed period most of them registered a reconcentration of trade structures. Obtained estimation results confirm a positive relationship between trade diversity and economic development levels (conditional mainly upon the size of the country) with a possibility of reconcentration at higher stages of development (observable in nonparametric estimates).

**Keywords:** diversification, concentration, trade, economic development
**JEL:** F14, O11, O52