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Ufuk Gunes Bebek

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Abstract

This paper examines the extent of stability, specialisation and divergence in manufacturing industries' export patterns for EU15 countries at both industry and country level, distinguishing between intra and extra EU15 exports as well as different technological categories. Both countrywide and industrywide analyses suggest that specialisation patterns, on average, are rather sticky. Furthermore, as proposed, intra-EU15 specialisation patterns are less persistent, particularly in higher technology industries. From an industry specific point, such non-persistence within intra-EU15 patterns is reflected as convergence of countries, whereas persistent extra-EU15 patterns are reflected as divergence of countries, which again are more common in higher technology industries.

Keywords: Specialisation, Convergence, Comparative Advantage

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†School of Economics, University of Kent, Canterbury CT2 7NP
email:ugb2@kent.ac.uk

1 Introduction

The importance of international specialisation à la comparative advantage has been well documented since it was put forward by David Ricardo. Yet considering the European countries, further opening up of the national markets through the schemes of EU and EFTA and liberalisation in WTO has not produced specialisation among member states along the predictions of traditional trade theory. Instead of further specialisation in what one may call traditional industries, countries became specialised within industries expanding the volume of intra-industry trade among the trading partners. Although the underlying determinants of such trade flows have been well documented, they do not explicitly account for the patterns of specialisation.

Instead, majority of the studies concerning sectoral specialisation have focused on concentration patterns across Europe[1]. Whereas, few studies do indeed account for the patterns of specialisation. Amiti (1999) investigates the changes in industry specialisation patterns for EU countries and argues that there has been an increased specialisation during the period of trade liberalisation. Similarly, Brülhart (2001) shows that industrial specialisation increases slowly but steadily for the EU countries, which does indeed accelerate with the adoption of the Single Market. On the other hand, non-Eurocentric empirical literature precedes those analyses concentrating only on the specialisation patterns of EU countries.

Proudman & Redding (2000) investigate export specialisation patterns for G5 countries, arguing that there is no substantial evidence supporting increased specialisation. In a latter paper, Redding (2002) argues that there is no increase in the overall degree of specialisation for the analysed 7 OECD countries. On the other hand, by considering a mixture of developed and emerging economies, Brasili et. al (2000) provide evidence that emerging markets show higher mobility compared to their industrialised counterparts, which show persistent patterns along in the lines of the aforementioned studies. Then again, substantial number of studies argue for a move towards de-specialisation in countries' specialisation patterns rather than persistent patterns.

Kalemli-Ozcan et. al (2003) find that there has been a slight decline in the average value of specialisation for 21 OECD countries, while De Benedictis et. al (2008; 2009) argue that there is a

[1]Such as Haaland et al. (1999); Aiginger & Pfaffermayr (2004); Aiginger & Davies (2004)

significant decrease in the overall degree of specialisation and that countries diversify rather than specialise along their development path. In a recent paper, Amador et. al (2011) show that although specialisation patterns are persistent in cross-country export patterns, there is a tendency towards de-specialisation in high technology sectors. Considering such an array of empirical literature, it is quite evident that the choice of the sample countries significantly affects the outcome, which in turn precludes their generalizability. Given such a notion and that there are only a few studies concentrating on the EU case, current paper attempts to explicitly analyse the patterns of export specialisation of manufacturing industries in EU15 countries.

The analysis will undertake two related issues; the stability and extent of specialisation in export patterns at the country level and convergence (divergence) in export specialisation patterns at the industry level. More explicitly, specialisation (de-specialisation) at the country level puts emphasis on the extent of increase (decrease) in the level of dispersion in intra-country specialisation across industries; while convergence (divergence) at the industry level puts emphasis on to what extent did countries became more (less) similar in terms of specialisation in that particular industry across countries. Such an empirical analysis was carried out initially by Dalum et. al (1998), where they investigated, stability, specialisation and convergence aspects for OECD countries' exports. Apart from investigating similar issues for a different group of countries, the current paper extends the analysis analogous to the relevant theories.

Considering the free movement of goods, intra-EU and extra-EU exports face different trade constraints and barriers. Thus, specialisation patterns could be argued to differ among the two. Hence, the analysis will distinguish between export specialisation patterns concerning intra-EU15 and extra-EU15 as well as their overall exports. Moreover, the same analyses will be carried for the four main technological categories of industries as well as concerning all the manufacturing industries, as the level of technology embedded within each manufacturing industry will directly affect the pattern of export specialisation[2]. Hence controlling for the export destination as well as for the technological content of the industries would be relevant in analogous theories' appraisal.

The next section presents the theoretical framework and considerations for the determinants of export specialisation patterns across industries and countries. Section 3 presents the methodolog-

[2]Similar classification is also used in Amador et. al (2011)

ical framework for measuring the extent of specialisation followed by the employed methodology for measuring the stability of export specialisation patterns across industries and across countries. Section 4 presents the countrywide analysis followed by the industrywide analysis. Section 6 summarises the results and discusses some stylised facts.

2 Theoretical Framework

As emphasised in the previous section, the present paper distinguishes between trade patterns across industries (countrywide) and across countries (industrywide). Although such an analysis could be argued to be empirically trivial, they are based on different theoretical contexts. Such an issue was initially pointed by Leamer (1974), where he concisely argues that the fundamental theories of trade are industry specific rather than country specific.

From an industry specific point, standard trade theory such as the Heckscher-Ohlin model would predict specialisation patterns across countries vis-à-vis the different factor endowments each country have. By reconciling transport costs or barriers to trade, the model would predict increasing or decreasing patterns of specialisation across countries. For instance, reduction of trade barriers or harmonisation of institutions would bring about increased specialisation, which in turn would increase the degree of divergence across countries. Whereas, new trade theory allowing for increasing returns and differentiated products, such as the model by Grossman & Helpman (1989) that originates from Krugman (1979a; 1980; 1981) and Helpman (1981), would predict convergence across countries within same industries that concern high volumes of intra-industry trade and horizontally differentiated products while would predict divergence across countries within same industries that concern high volumes of vertically differentiated products.

Although these models can constitute grounds for explaining industrywide specialisation patterns, as pointed out, they are contextually industry specific rather than country specific. On the other hand considering neotechnology hypothesis, both the technology gap theory and product cycle theory underlines the countrywide differences in technology as the source of international trade flows; whereas the deficiency of classical and neo-classical theories of trade is their assumption of technology as an exogenous factor (Dosi et al., 1990).

Technology not only plays a role on the coordination and interdependence of countries but also dictates the patterns of change and transformation that each country face. Dosi et al. argue that international trade is based on technological gaps and cost-based adjustment mechanisms that are determined by country specific innovative capabilities, firm strategies and institutional factors[3]. Hence the ex-post comparative advantage is not an outcome of differences in countries' endowments but outcome of learning that differentiates between countries as well as industries.

Considering Soete (1987) there is substantial stability in each countrys industrywide pattern of technological advantage while each country has a different industrial pattern of technological advantage (Pavitt & Patel, 1988). This is further documented by Dosi et al. (1990) , where they argue that the patterns of variation of productivity gaps[4] across countries holding industries constant is wider than variation across industries holding countries constant. Furthermore evolution of trade patterns are closely related to country's technological specialisation (Soete, 1981). Hence, one may expect the country specific specialisation patterns to remain stable (Dalum et al., 1998).

On the other hand, from an orthodox point of view, Krugman (1987) presents a trade model with dynamic economies of scale in which cumulative past output determines current productivity through a learning-by-doing mechanism. That is, comparative advantage of countries is created over time by the dynamics of learning, rather than arising from national characteristics. His main finding is that, once the pattern of specialisation is established, it will be preserved in the future as the changes in relative productivity strengthen those existing patterns.

Although both technology gap theory and presence of learning-by-doing suggests stable patterns of specialisation, it may not necessarily be the case. The cumulative nature of technology together with the country specific capabilities can explain the uniform change that occurs within countries and industries as well as differences across countries. The innovative process and technical change may result in an irreversible process or explicitly, virtuous or vicious circles in innovativeness and competitiveness, as new technologies often brings about virtuous increasing returns; the more they are adapted, the more they gain experience and the more they are improved (Arthur, 1989).

[3]The microeconomic foundations of such trade can be found within the framework evolutionary economics where technology is argued to be endogenously generated, often firm specific and differentiated, cumulative in nature and firms with different technologies interact under disequilibrium.

[4]which they argue to correspond to the technology gaps.

Such virtuous and vicious circles arising from the cumulative nature of innovation and technology would be reflected as a divergence in countries' specialisation patterns (Dosi et al., 1990). Hence countries that were initially specialised in certain industries would further specialise while countries that lack such strengths in those industries would further de-specialise. On the other hand in the presence of technological diffusion, de-specialised countries would eventually catch-up specialised ones, and this would be reflected as a convergence in specialisation patterns. This process would further be accelerated in the presence of foreign direct investment, freer movement of capital goods, and freer diffusion of knowledge. Nevertheless, as pointed out before, country specific characteristics, institution-wide and capability-wide, would constrain this process. Abramovitz (1986) defines such constraints as the social capability which such convergence process' would be conditional on.

Such a virtuous circle leading to increased divergence can also be explained by countries' implicit need to innovate, not only to maintain their relative position but their absolute income levels. Krugman (1979b) developed a general equilibrium model of product cycle trade where there is no fixed pattern of trade vis-à-vis goods, yet continuum of innovation that is specific to industries which maintains the existing patterns. Krugman argues that, since the decline of industries in developed countries would be recurrent, they should continuously innovate to maintain their relative position. Although the nature of technology is quite different than that in technology gap trade theory[5], the presumed lags in technology transfers allow the developed countries to maintain their relative positions.

Considering these discussions on both the orthodox trade theories' as well as the neotechnology type trade theories' premises, the following arguments are proposed concerning the specialisation patterns of EU15 exports across industries as well as across countries.

Proposition 1 *Export specialisation patterns are expected, on average, to remain stable or sticky for the EU15 countries.*

Proposition 2 *Considering the increased integration among the member states and rather persistent status quo ante with non-member states; specialisation patterns against non-member states are expected to be more persistent compared to specialisation patterns within the EU.*

[5]Krugman's presumption of innovation is more in line with Arrow's (1962) suggestion of technology as information that is applicable and easy to re-produce and re-use, rather than being cumulative and strongly selective.

Proposition 3 *Such non-persistent patterns would be more relevant in higher technology industries while persistent patterns would likely to occur in lower technology industries.*

Since the countrywide and industrywide analyses are more or less the two sides of the same coin, the above discussions on expected outcomes in cross industry analysis would distinctively manifest themselves across countries. That is,

Proposition 4 *Export specialisation patterns are expected, on average, to remain stable or sticky in individual industries.*

Proposition 5 *As technological spillovers are likely to be potent among the member states rather than with non-members; convergence in export specialisation patterns would be more relevant for intra-EU15 exports than extra-EU15 exports.*

Proposition 6 *As technological spillovers would be more common in lower technology industries compared to higher technology industries, while the catching-up process would be much slower in higher technology industries; divergence in export specialisation patterns would be more relevant for higher technology industries.*

3 Methodological Framework

To analyse the intra-distribution dynamics of industry export structures and the extent of specialisation, intra-country and intra-industry stability and specialisation patterns will be assessed by means of estimating Galtonian regressions. This methodology was originally used by Hart & Prais (1956) in analysing changes in the business concentration and applied by; Sutcliffe & Sinclair (1980) in measuring seasonality of tourist arrivals in Spain; Creedy (1985) in investigating changes in income distribution in the UK; and Cantwell (1989; 1991) in analysing specialisation patterns across industrialised countries within the technological advantage context[6].

On the other hand Dalum et al. (1998) adapted Cantwell's methodology and intuition for analysing specialisation in export patterns in OECD countries. The procedure involves the esti-

[6]Cantwell employed the revealed technological advantage index, which measures comparative advantage in innovative activity rather than comparative advantage in trade.

mation of the correlation between the sectoral as well as the national distribution of the export specialisation at time t and an earlier time *t-1*, using a simple cross-section regression. Hence, as this method is based on the comparison of two cross-sections at two points in time, there is neither a time element nor the determinants of the relevant export specialisation. Nevertheless such an empirical pursuit, not only allows the assessment of the stability of export specialisation patterns, but also allows the testing of the extent of intra-country specialisation as well as the extent of intra-industry divergence.

3.1 Measuring Export Specialisation

Similar with the conventional literature, export specialisation will be assessed within the comparative advantage framework. Although the laws of comparative advantage are at the core determining international specialisation patterns, it is quite difficult to measure comparative advantage as the autarkic prices are not observable. Nevertheless it has been a common practice to measure comparative advantage by revealing it using actual trade flows and their shares using the so-called Revealed Comparative Advantage (RCA) index proposed by Balassa (1965). The Balassa Index (BI) can be written as,

$$BI_{ij} = \frac{X_{ij} / \sum_{i} X_{ij}}{\sum_{j} X_{ij} / \sum_{i} \sum_{j} X_{ij}}, \tag{1}$$

where X_{ij} represents the exports of industry i from country j, hence the numerator represents the share of an industry within national exports while the denominator represents the share of the same industry within world exports. As both the numerator and the denominator can range from *0* to *1*, BI is evidently quite asymmetric having an upper bound, which can theoretically tend to ∞, and a fixed lower bound at *0*. Having its demarcation at 1,such a property of the BI will likely skew its distribution.

Since the present paper analyses stability and extent of specialisation of export patterns across countries and periods using a regression analysis, the inherent risk of lack of normality in BI would violate the assumption of normality in error term. In addition, the inequality of the intervals also

indicates that the demarcation is not symmetric and the relative weight attached to the specialised compared to unspecialised industries would be unrestrained. Hence any temporal inference vis-à-vis μ_{BI} will be biased upwards for the changes in specialised industries while will be biased downwards for the changes in unspecialised industries (Proudman & Redding, 1998).

To alleviate the associated normality problems, Dalum et al. proposes a quasi-logarithmic transformation which is the linear approximation of equation (1). Their proposed symmetric RCA index can be written as,

$$SBI_{ij} = \frac{BI_{ij} - 1}{BI_{ij} + 1}. \tag{2}$$

Similar to BI, SBI also has a demarcation at *0*, but unlike the former, this index is bound between *-1* and *1* and hence will have a more symmetric distribution. Furthermore the equality of the intervals, which indicates a symmetric demarcation, also guarantees that the weight attached to the specialised and unspecialised industries to be the same. Given such properties, comparative advantage will be measured using SBI.

Although this method inherits an irrefutable degree of scepticism, there have been several attempts to associate such method with the analogous theory. Particularly, Hillman (1980) provided a sound theoretical relation. By assuming identical homothetic preferences among the reference countries, he derived a necessary and sufficient condition for the consistency between RCA identified by BI and pre-trade relative prices, in cross-country industry comparisons.

Furthermore Dosi et al. (1990) argue that within the framework evolutionary economics, the effects of intersectoral patterns of comparative advantage can be detected without the knowledge of notional pre-trade prices. Given that each economy is permanently in a state of microeconomic disequilibrium and technical change takes place all the time, while there are significant lags in technological diffusion and demand responses to international price changes, countries will always find an incentive to expand their exports in those sectors they have a relative cost-based advantage. Thus changes in their relative export shares would reflect their relative comparative advantage.

3.2 Countrywide Analysis

Stability of manufacturing industries' export patterns across industries will be tested using the following regression.

$$SBI_{i,T2} = \alpha_i + \beta_i SBI_{i,T1} + \epsilon_i, \tag{3}$$

where the subscripts T1 and T2 represent the initial and final periods while i represents the manufacturing industry and α, β are regression parameters and ϵ is the i.i.d. error term.

The intuition behind this regression is quite straightforward. Estimated slope parameter being equal to 1 corresponds to an unchanged export pattern between the examined periods. However, if $\hat{\beta} > 1$, then the country, on average, has become even more specialised in its already specialised industries while becomes less specialised in its initially low specialised industries. On the other hand if $1 > \hat{\beta} > 0$, then the country, on average, has increased its specialisation in industries that were less specialised while becomes less specialised in industries that were initially highly specialised. Analogous to the convergence literature, Dalum et al. terms the former as β-specialisation while the latter as β-de-specialisation. In the case of $\hat{\beta} < 0$, the ranking of industries are reversed.

Although the magnitude of $(1-\hat{\beta})$, the regression effect, will indicate whether a country strengthened or weakened in its specialisation patterns, it does not allow an assessment of the overall specialisation. That is, $\hat{\beta} > 1$ is not a necessary condition for an overall increase in the degree of specialisation (Cantwell, 1989). The degree of export specialisation in a country can be measured by the variance of its SBI index, which shows the extent of dispersion of the distribution around the mean. Following Hart (1976), the variance of the SBI index at time T2 can be written as,

$$\sigma^2_{i,T2} = \beta_i^2 \sigma^2_{i,T1} + \sigma^2_{i,\epsilon}, \tag{4}$$

while the square of the correlation coefficient is given by

$$\rho_i^2 = 1 - (\sigma^2_{i,\epsilon}/\sigma^2_{i,T2}) = (\sigma^2_{i,T2} - \sigma^2_{i,\epsilon})(1/\sigma^2_{i,T2}). \tag{5}$$

Combining equations (4a) and (4b), it follows that

$$\sigma^2_{i,T2} - \sigma^2_{i,\epsilon} = \beta_i^2 \sigma^2_{i,T1} = \rho_i^2 \sigma^2_{i,T2}, \tag{6a}$$

which can be rearranged as

$$\sigma^2_{i,T2} / \sigma^2_{i,T1} = \beta_i^2 / \rho_i^2 \tag{6b}$$

or

$$\sigma_{i,T2} / \sigma_{i,T1} = |\beta_i| \,/\, |\rho_i| \,. \tag{6c}$$

Hence the degree of export specialisation, indicated by the variance of the distribution, increases when $\beta_i^2 > \rho_i^2$, while it falls when $\beta_i^2 < \rho_i^2$. A higher variance would indicate a high or narrow degree of specialisation, while a low variance would indicate that the country has a broad range of comparative advantage or low degree of specialisation. Thus using the estimated regression values, the pattern of the distribution, as indicated by the level of dispersion, will remain constant if $|\hat{\beta}| = |\hat{\rho}|$. On the other hand if $|\hat{\beta}| > |\hat{\rho}|$, then the degree of specialisation has increased while $|\hat{\beta}| < |\hat{\rho}|$ will indicate that the degree of specialisation has decreased.

Analogous to the convergence literature, Dalum et al. terms the former as σ-specialisation while the latter as σ-de-specialisation. Estimated Pearson correlation coefficient ($\hat{\rho}$) measures the level of mobility of the industries within the distribution. The higher (lower) the $\hat{\rho}$, the more persistent (intermittent) will be the industries regarding their relative position, and hence the magnitude of $(1 - \hat{\rho})$ will indicate this mobility effect. Considering these two concurrent effects, although the magnitude of $(1 - \hat{\beta})$ may suggest a fall in the degree of specialisation, it can be outweighed by the mobility effect due to changes in the proportional position between industries. Hence assessment of the stability of a country's export patterns based on only the estimated slope coefficient can be misleading.

3.3 Industrywide Analysis

On the other hand, to test whether countries tend to converge or diverge within the individual industries, the following model will be estimated for each industry across countries.

$$SBI_{ij,T2} = \alpha_j + \beta_i SBI_{ij,T1} + \epsilon_{ij}, \tag{7}$$

where the subscripts T1 and T2 represent the initial and final periods while i and j represents the manufacturing industry and α, β are regression parameters and ϵ is the i.i.d. error term.

Similar to the countrywide analysis, the estimated slope parameter being equal to 1 corresponds to an unchanged export pattern between the examined periods. However, if $\hat{\beta} > 1$, then the countries that are highly specialised in that particular industry become even more specialised while countries that are initially under specialised become even less specialised, on average. On the other hand if $1 > \hat{\beta} > 0$, then on average, countries that are under specialised increase their specialisation, while countries that are highly specialised become less specialised in that particular industry. Analogous to the convergence literature, Dalum et al. terms the latter movement as β-convergence while the former movement as β-divergence. If the estimated slope coefficient were negative, then the ranking of the countries are reversed.

Homologous to the countrywide analysis, although the magnitude of $(1 - \hat{\beta})$, the regression effect, indicates whether countries converged or diverged in their export patterns for the particular industry, it does not allow an assessment of the overall convergence or divergence. Hence $\hat{\beta} > 1$ is not a necessary condition for an overall increase in the degree of divergence. Again following Hart,

$$\sigma^2_{ij,T2} / \sigma^2_{ij,T1} = \beta_j^2 / \rho_j^2 \tag{8a}$$

or

$$\sigma_{ij,T2} / \sigma_{ij,T1} = |\beta_j| \,/\, |\rho_j| \,. \tag{8b}$$

Thus the pattern of the distribution, as indicated by the level of dispersion, will remain constant if $|\hat{\beta}| = |\hat{\rho}|$. On the other hand if $|\hat{\beta}| > |\hat{\rho}|$, then the degree of divergence has increased while

$|\hat{\beta}| < |\hat{\rho}|$ will indicate that the degree of divergence has decreased. Analogous to the convergence literature, Dalum et al. terms the former as σ-divergence while the latter as σ-convergence. The estimated Pearson correlation coefficient ($\hat{\rho}$) measures the level of mobility of the countries within the distribution. The higher the $\hat{\rho}$, the more persistent will be the countries regarding their relative position and hence the magnitude of $(1-\hat{\rho})$ will indicate this mobility effect. Once again considering these two concurrent effects, although the magnitude of $(1-\hat{\beta})$ may suggest a fall in the degree of divergence, it can be outweighed by the mobility effect due to changes in the proportional position between countries.

4 Specialisation Patterns across Industries

In order to evaluate the extent of specialisation across industries for the EU15 countries, equation (3) will be estimated separately for EU15 countries' total exports as well as for their intra-EU15 and extra-EU15 exports concerning all manufacturing industries as well as the four main technological categories, employing SBIs based on the initial and the final 3-year averaged manufacturing exports. The analysis is conducted across 22 manufacturing industries[7] using the OECD's STAN Database covering periods between 1990[8] and 2007. Table 1 summarises the estimation results for EU15 countries exports to world.

Considering EU15 countries manufacturing industries, estimated slope coefficients are significantly different from 0 below 1%[9] level for their exports to world, indicating that reverse or random export specialisation patterns can be rejected. On the other hand concerning the stability of export patterns, for nine member states the estimated slope coefficients are found to be statistically significantly indifferent from 1, hence have quite stable export structures. Whereas for the other six states, on average, there is a tendency of increased specialisation for industries that were initially less specialised while decreased specialisation for industries that were initially highly specialised, indicated by slope coefficients that are statistically significantly below unity. Particularly Germany, Greece and Portugal show high regression effects. As for the relative position of the industries

[7] Industry classifications for technological categories are presented in Table 4

[8] Due to lack of data points, initial 3-year group for Austria is taken as 1993-1995 while for Luxembourg it is taken as 1999-2001

[9] Except for France for which significance is below 5% level.

Table 1: Countrywide Stability & Specialization Patterns of EU15 Manufacturing Exports

Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Austria	0.012	$0.887^{***\dagger}$	0.968^{***}	0.113	0.033	0.917
Belgium	-0.037	0.845^{***}	0.859^{***}	0.155	0.141	0.984
Denmark	0.003	0.868^{***}	0.894^{***}	0.132	0.106	0.971
Finland	-0.008	1.005^{***}	0.920^{***}	-0.005	0.080	1.093
France	-0.020	1.089^{***}	0.812^{***}	-0.089	0.188	1.341
Germany	-0.016	$0.713^{***\dagger}$	0.790^{***}	0.287	0.210	0.903
Greece	0.102^{**}	$0.738^{***\dagger}$	0.928^{***}	0.262	0.072	0.795
Ireland	-0.146^{**}	1.074^{***}	0.920^{***}	-0.074	0.080	1.167
Italy	0.027	0.948^{***}	0.743^{***}	0.052	0.257	1.275
Luxembourg	0.015	$0.884^{***\dagger}$	0.946^{***}	0.116	0.054	0.935
Netherlands	-0.037	1.146^{***}	0.861^{***}	-0.146	0.140	1.331
Portugal	0.088^{**}	$0.699^{***\dagger}$	0.854^{***}	0.301	0.147	0.819
Spain	0.019	1.057^{***}	0.852^{***}	-0.057	0.148	1.240
Sweden	-0.038	$0.834^{***\dagger}$	0.913^{***}	0.166	0.087	0.914
United Kingdom	-0.016	0.890^{***}	0.921^{***}	0.110	0.079	0.966

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10
† Statistically significantly different from 1 at 0.10 or less

within countries, only Italy and Germany, to some extent, show higher mobility effects.

These findings suggest that EU15 member countries, on average, have a rather sticky export specialisation pattern. Although these results suggest β-de-specialisation[10], the regression effect outweighs the mobility effect for six member states, indicating an increase in their overall degree of specialisation. Thus, although most EU15 countries faced a broadening in their specialisation patterns, or namely σ-de-specialisation, Finland, France, Ireland, Italy, Netherlands and Spain faced a change towards a narrow specialisation, or namely σ-specialisation. When EU15 countries' intra-EU15 exports are considered, different results are obtained and these are summarised in table 2.

Similar to their exports to world, the estimated slope coefficients for EU15 countries intra-EU15 exports are significantly different from 0 below 1% level, hence reverse or random export specialisation patterns can again be rejected. Furthermore, the estimated slope coefficients are found to be statistically significantly indifferent from 1 not only for the previous nine countries but also for Luxembourg. For the other five countries, again on average, there is a tendency of increased specialisation for industries that were initially less specialised while decreased specialisation for

[10] As the estimated slope coefficients that are greater than unity, are not statistically significantly indifferent than unity.

Table 2: Countrywide Stability & Specialisation Patterns of intra-EU15 Manufacturing Exports

Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Austria	0.018	$0.886^{***\dagger}$	0.947^{***}	0.114	0.053	0.936
Belgium	-0.025	0.822^{***}	0.828^{***}	0.178	0.172	0.993
Denmark	0.028	0.955^{***}	0.855^{***}	0.045	0.146	1.117
Finland	0.022	1.019^{***}	0.932^{***}	-0.019	0.068	1.094
France	-0.025	0.660^{***}	0.489^{**}	0.340	0.511	1.351
Germany	0.000	$0.682^{***\dagger}$	0.864^{***}	0.318	0.136	0.790
Greece	0.048	$0.675^{***\dagger}$	0.772^{***}	0.325	0.228	0.874
Ireland	-0.148	1.062^{***}	0.933^{***}	-0.062	0.067	1.138
Italy	0.030	0.945^{***}	0.725^{***}	0.055	0.275	1.304
Luxembourg	-0.001	0.902^{***}	0.941^{***}	0.098	0.059	0.959
Netherlands	-0.046	1.040^{***}	0.787^{***}	-0.040	0.214	1.322
Portugal	0.085^{**}	$0.716^{***\dagger}$	0.814^{***}	0.284	0.186	0.880
Spain	-0.018	0.755^{***}	0.571^{***}	0.245	0.429	1.322
Sweden	-0.037	$0.781^{***\dagger}$	0.901^{***}	0.219	0.099	0.867
United Kingdom	-0.033	0.740^{***}	0.685^{***}	0.260	0.315	1.080

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10
† Statistically significantly different from 1 at 0.10 or less

industries that were initially highly specialised. Once again Germany, Greece and Portugal show high regression effects. As for the relative position of the industries within countries, France, Spain, United Kingdom and to some extent Italy are found to show higher mobility.

Compared to overall exports, EU15 countries show a less sticky export specialisation patterns for their intra-EU15 exports, yet the results suggest β-de-specialisation[11]. Nevertheless, the regression effect outweighs the mobility effect for eight member countries, including the previous six. Thus, most EU15 countries faced a change towards a narrow specialisation in their export patterns, or namely σ-de-specialisation. Furthermore, the increase in dispersion has been to a greater extent with the exception for Ireland and Netherlands. Estimation results for EU15 countries' extra-EU15 exports are presented in table 3.

Similar to the previous analyses, the estimated slope coefficients for EU15 countries extra-EU15 exports are significantly different from 0 below 1% level, hence reverse or random export specialisation patterns can again be rejected. Yet, they are found to be statistically significantly indifferent from 1 for only seven countries, indicating a less stable export specialisation pattern. For the remaining eight countries, again on average, there is a tendency of increased specialisation

[11] As the estimated slope coefficients that are greater than unity, are not statistically significantly indifferent than unity.

Table 3: Countrywide Stability & Specialisation Patterns of extra-EU15 Manufacturing Exports

Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Austria	0.003	$0.870^{***\dagger}$	0.950^{***}	0.130	0.050	0.916
Belgium	-0.084	$0.806^{***\dagger}$	0.836^{***}	0.194	0.164	0.965
Denmark	-0.022	$0.724^{***\dagger}$	0.842^{***}	0.276	0.158	0.860
Finland	-0.052	0.886^{***}	0.844^{***}	0.114	0.156	1.050
France	-0.008	$1.281^{***\dagger}$	0.891^{**}	-0.281	0.109	1.438
Germany	-0.037	$0.571^{***\dagger}$	0.697^{***}	0.429	0.303	0.819
Greece	0.037	$0.758^{***\dagger}$	0.941^{***}	0.242	0.059	0.805
Ireland	-0.154^{*}	0.955^{***}	0.884^{***}	0.045	0.117	1.081
Italy	0.029	0.984^{***}	0.794^{***}	0.016	0.206	1.240
Luxembourg	0.025	$0.805^{***\dagger}$	0.852^{***}	0.195	0.148	0.945
Netherlands	-0.048	0.956^{***}	0.861^{***}	0.044	0.139	1.111
Portugal	0.040	$0.705^{***\dagger}$	0.814^{***}	0.295	0.186	0.866
Spain	-0.022	0.931^{***}	0.844^{***}	0.069	0.156	1.104
Sweden	-0.039	0.870^{***}	0.901^{***}	0.130	0.099	0.966
United Kingdom	0.000	0.713^{***}	0.810^{***}	0.287	0.191	0.881

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10
† Statistically significantly different from 1 at 0.10 or less

for industries that were initially less specialised while decreased specialisation for industries that were initially highly specialised. On the other hand, France shows a significant β-specialisation, suggesting a strengthening of the existing pattern of specialisation. As for the relative position of the industries within countries, only Germany shows high mobility effects. Although, on average, there is significant β-de-specialisation[12], the regression effect outweighs the mobility effect again for the previous six member countries that faced σ-specialisation in their exports to world. However the extent of the increase in their overall degree of specialisation has been much lower with the exception of France.

These findings combined with the previous analyses suggest that, on average, EU15 countries show a highly sticky specialisation pattern as argued by *proposition 1.* Furthermore, the countries that faced a significant change over the considered period faced a weakening of the existing specialisation patterns with the exception of France's extra-EU15 exports. Nevertheless, when the degree of change in overall specialisation patterns are assessed, nearly half of the member countries show an increase in their overall specialisation regardless of the export destination. Furthermore this increase is found to be strongest for their intra-EU15 exports while is found to be weakest for their

[12]With the exception of France, which shows a significant strengthening of existing export specialisation patterns.

extra-EU15 exports as suggested by *proposition 2*.

Although specialisation patterns across industries differ among within and outside EU15, it is quite likely that these patterns would also differ among different technological categories. When the technological categories of the manufacturing industries are controlled for, as well as the export destination, few stylised features emerge from the analysis[13]. Although most of the estimated slope coefficients are significantly different from 0 below 10% level for all three destinations, random export specialisation patterns are present slightly more for countries' exports to rest. On the other hand, most of the random specialisation patterns are found in HT industries' exports while are found least in LT industries. Considering the stability of export specialisation patterns over the analysed period, extra-EU15 exports show a higher stability compared to their intra-EU15 counterparts while similar to the previous point, LT industries are found to have the most stable export specialisation patterns followed by MHT, HT and MLT industries.

Considering the regression effect, countries' intra-EU15 exports show higher regression effects compared to their extra-EU15 exports. Similarly, the relative position of the industries have changed the least for the countries extra-EU15 exports, hence show lower mobility effects while countries' intra-EU15 exports show higher mobility effects. As for the technological categories, LT industries show both the lowest regression and lowest mobility effects whereas HT industries show the highest regression effects while MLT industries show the highest mobility effects.

These findings manifest themselves as higher β-specialisation for intra-EU15 exports compared to extra-EU15 exports. Furthermore HT industries, on average, show higher β-specialisation whereas for LT industries there is no significant β-specialisation present while only one significant β-specialisation for both MLT and MHT industries' exports. Finally when the change in the extent of overall degree of specialisation is considered, there is not a significant difference between export destinations. However EU15 countries show quite high σ-specialisation in higher technology industries, particularly in HT industries, while show higher σ-de-specialisation in lower technology industries as suggested by *proposition 3*.

[13]The estimation results for different technological categories are presented in the Appendix.

5 Specialisation Patterns across Countries

To analyse the convergence/divergence in export specialisation patterns in the EU15 countries, equation (7) will be estimated for pooled EU15 countries in order to attain the average EU15 pattern for each individual industry. In accordance with the previous analyses, equation (7) will be estimated separately for EU15's total world exports as well as for their intra-EU15 exports and extra-EU15 exports concerning all individual manufacturing industries, employing SBIs based on the initial and the final 3-year averaged manufacturing exports[14]. Table 4 summarises the estimation results for manufacturing exports to world.

For most of the industries, the estimated slope coefficients are significantly less than unity below 1% level hence indicating significant β-convergence except; rubber and plastics, metal products, and electrical machinery industries for which random specialisation patterns cannot be rejected; food, beverages and tobacco, paper, print and publishing industries for which the estimated slope coefficient is statistically significantly indifferent from unity; and non-metallic products industry which shows a significant divergence. Thus for those other industries, on average, countries that are less specialised increase their specialisation while countries that are highly specialised loses their advantage. However it should be noted that most of the estimated slope coefficients are quite high (low regression effects) indicating a low β-convergence. Similarly, if the persistence of countries regarding their relative position within these industries is considered, all industries, for which random specialisation patterns can be rejected, show low mobility effects indicating higher persistence.

Yet, as $\hat{\beta} > 1$ was not a necessary condition for an increase in the overall divergence, $\hat{\beta} < 1$ would also not suffice an increase in the overall convergence. On the other hand, one can argue that the countries did indeed converge in their export patterns if the regression effect outweighs the mobility effect, indicating σ-convergence. Although most industries show low mobility effects, it outweighs the regression effect in nearly half of the industries (as for three industries, the estimated correlations or slope coefficients or both are insignificant). Hence σ-convergence is found for only 9 industries. Considering the technological diversification within these, out of 10 industries showing

[14] As data for Austria and Luxembourg do not cover the employed time span, they are not included in the industrywide analysis.

Table 4: Industrywide Stability & Specialisation Patterns of EU15 Manufacturing Exports

Industry	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Low Technology Industries						
Food, beverages and tobacco	0.023	0.742***†	0.939***	0.258	0.061	0.790
Textiles, leather and footwear	-0.023	0.971***	0.890***	0.029	0.110	1.090
Wood and cork	-0.075**	0.929***	0.970***	0.071	0.030	0.957
Paper, print and publishing	-0.019	0.749***†	0.923***	0.251	0.077	0.811
Other Manufacturing	0.009	0.938***	0.861***	0.062	0.139	1.090
Medium Low Technology Industries						
Petroleum refining	0.029	0.928***	0.976***	0.072	0.024	0.951
Rubber and plastics	-0.058	0.005	0.004	0.995	0.996	1.190
Non-metallic products	-0.014	1.044***	0.895***	-0.044	0.105	1.166
Iron and steel	-0.002	0.789***	0.847***	0.211	0.153	0.932
Non-ferrous metals	0.012	0.763***	0.828***	0.237	0.172	0.922
Metal products	-0.019	0.791	0.465	0.209	0.535	1.700
Shipbuilding	-0.019	0.838***	0.807***	0.162	0.193	1.038
Medium High Technology Industries						
Industrial chemicals	0.053	0.927***	0.860***	0.073	0.141	1.079
Non-electrical machinery	-0.001	0.794***	0.882***	0.206	0.118	0.900
Electrical machinery	-0.010	0.542	0.417	0.458	0.583	1.301
Motor vehicles	-0.009	0.923***	0.959***	0.077	0.041	0.962
Other transport equipment	-0.029	0.852***	0.776***	0.148	0.224	1.098
High Technology Industries						
Pharmaceuticals	-0.003	0.838***	0.784***	0.162	0.216	1.069
Computers and office machinery	-0.088	0.815***	0.793***	0.185	0.208	1.029
Communication equipment	0.038	0.925***	0.764***	0.075	0.236	1.211
Instruments	0.016	0.846***	0.937***	0.154	0.063	0.900
Aerospace	-0.052	0.958***	0.884***	0.042	0.116	1.083

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10
† Statistically significantly different from 1 at 0.10 or less

a significant σ-divergence, only 4 industries are in lower technology categories whereas the other 6 (of which 4 are HT) are in higher technology categories. On the other hand out of 9 industries showing σ-convergence, 6 industries (of which 3 are LT) are in lower technology categories whereas only 3 are in higher technology industries. Estimation results for countries' intra-EU15 exports are summarised in table 5.

Again for most of the industries, the estimated slope coefficients are significantly less than unity below 1% level hence indicating β-convergence except; rubber and plastics and electrical machinery industries, for which random specialisation patterns cannot be rejected; food, beverages and tobacco, wood and cork, paper, print and publishing, metal products, non-electrical machinery

Table 5: Industrywide Stability & Specialisation Patterns of intra-EU15 Manufacturing Exports

Industry	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Low Technology Industries						
Food, beverages and tobacco	0.023	$0.734^{***\dagger}$	0.944^{***}	0.266	0.057	0.778
Textiles, leather and footwear	-0.001	0.909^{***}	0.869^{***}	0.091	0.131	1.045
Wood and cork	-0.051^{*}	$0.923^{***\dagger}$	0.975^{***}	0.077	0.025	0.946
Paper, print and publishing	-0.014	$0.736^{***\dagger}$	0.936^{***}	0.264	0.064	0.787
Other Manufacturing	0.002^{**}	0.900^{***}	0.827^{***}	0.100	0.173	1.088
Medium Low Technology Industries						
Petroleum refining	-0.031	0.919^{***}	0.828^{***}	0.081	0.172	1.109
Rubber and plastics	-0.053	0.005	0.005	0.995	0.995	0.955
Non-metallic products	0.019	1.053^{***}	0.889^{***}	-0.053	0.112	1.186
Iron and steel	-0.015	0.712^{**}	0.729^{***}	0.288	0.271	0.977
Non-ferrous metals	0.048	0.768^{***}	0.829^{***}	0.232	0.171	0.927
Metal products	-0.024	$0.445^{*\dagger}$	0.428	0.555	0.572	1.041
Shipbuilding	-0.065	0.911^{***}	0.774^{***}	0.089	0.226	1.177
Medium High Technology Industries						
Industrial chemicals	0.039	0.856^{***}	0.907^{***}	0.144	0.094	0.944
Non-electrical machinery	-0.001	$0.674^{***\dagger}$	0.824^{***}	0.326	0.176	0.819
Electrical machinery	0.003	0.277	0.254	0.723	0.746	1.089
Motor vehicles	0.007	0.960^{***}	0.953^{***}	0.040	0.047	1.008
Other transport equipment	-0.004	0.921^{***}	0.851^{***}	0.079	0.149	1.082
High Technology Industries						
Pharmaceuticals	-0.012	0.733^{**}	0.647^{**}	0.267	0.353	1.133
Computers and office machinery	-0.128	0.861^{***}	0.805^{***}	0.139	0.195	1.070
Communication equipment	-0.001	0.723^{**}	0.608^{**}	0.277	0.392	1.190
Instruments	0.001	$0.701^{***\dagger}$	0.910^{***}	0.299	0.090	0.770
Aerospace	-0.070	0.911^{***}	0.684^{***}	0.089	0.316	1.332

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10
† Statistically significantly different from 1 at 0.10 or less

and instruments industries for which the estimated slope coefficient is statistically significantly indifferent than unity; and non-metallic products industry which shows a significant divergence. Hence for most industries, on average, countries that are less specialised increase their specialisation while countries that are highly specialised lose their advantage.

However, although most of the estimated slope coefficients are high (low regression effects) indicating a low β-convergence, they are generally lower than those of exports to world, hence have higher regression effects. Particularly for metal products, pharmaceuticals, communication equipment and instruments industries, the estimated slope coefficients are moderately lower, indicating higher β-convergence. Similarly, unlike their exports to world counterparts, on average, industries

show higher mobility effects indicating lower persistence particularly for petroleum refining, iron and steel, pharmaceuticals, communication equipment and aerospace industries.

As for the overall degree of convergence/divergence, similar to the previous analysis, the mobility effect outweighs the regression effect in more than half of the industries (as for three industries either the estimated correlations or the slope coefficients are insignificant) and hence σ-convergence is found for only 8 industries whereas there is significant σ-divergence in 11 industries of which 5 industries are in lower technology categories whereas the other 6 (of which 4 are HT) are in higher technology categories. On the other hand out of 8 industries showing σ-convergence, 5 industries are in lower technology categories whereas only 3 are in higher technology industries. Lastly, regression results for EU15 exports to rest of the world are summarised in table 6.

Again for most of the industries, the estimated slope coefficients are significantly less than unity below 1% level hence indicating βconvergence except; electrical machinery industry, for which random specialisation patterns cannot be rejected; food, beverages and tobacco, wood and cork, petroleum refining and communications equipment industries, for which the estimated slope coefficient is statistically significantly indifferent than unity; and textiles, leather and footwear, rubber and plastics, metal products, industrial chemicals and pharmaceuticals industries, which show a significant divergence. Again for most industries, on average, countries that are less specialised increase their specialisation while countries that are highly specialised lose their advantage. Yet, although most of the estimated slope coefficients are high (low regression effects) indicating a low β-convergence, unlike exports to EU15, they are generally higher than those of exports to world, hence have lower regression effects. Nevertheless, the estimated slope coefficients for petroleum refining, shipbuilding, other transport equipment, communications equipment and aerospace industries are lower, indicating stronger β-convergence. On the other hand if the persistence of countries regarding their relative position within these industries is considered, on average, although industries show higher mobility effects in exports to rest compared to their exports to world they show lower mobility effects compared to their exports to EU15, indicating higher persistence compared with the latter.

As for the overall degree of convergence/divergence, similar to the previous analyses, the mobility effect outweighs the regression effect in more than half of the industries (as for electrical

Table 6: Industrywide Stability & Specialisation Patterns of extra-EU15 Manufacturing Exports

Industry	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Low Technology Industries						
Food, beverages and tobacco	0.009	$0.769^{***\dagger}$	0.918^{***}	0.231	0.082	0.837
Textiles, leather and footwear	-0.049	1.128^{***}	0.953^{***}	-0.128	0.047	1.184
Wood and cork	-0.092^{*}	$0.824^{***\dagger}$	0.941^{***}	0.176	0.059	0.876
Paper, print and publishing	-0.043	0.958^{***}	0.964^{***}	0.042	0.036	0.994
Other Manufacturing	0.006	0.951^{***}	0.910^{***}	0.049	0.090	1.045
Medium Low Technology Industries						
Petroleum refining	0.057	$0.764^{***\dagger}$	0.927^{***}	0.236	0.073	0.824
Rubber and plastics	-0.038	1.140^{**}	0.754^{***}	-0.140	0.246	1.512
Non-metallic products	-0.070	0.872^{***}	0.839^{***}	0.128	0.161	1.039
Iron and steel	-0.039	0.867^{***}	0.938^{***}	0.133	0.062	0.924
Non-ferrous metals	-0.090	0.748^{***}	0.745^{***}	0.252	0.256	1.005
Metal products	-0.073^{*}	1.335^{***}	0.863^{***}	-0.335	0.137	1.547
Shipbuilding	-0.043	0.707^{***}	0.749^{***}	0.293	0.251	0.944
Medium High Technology Industries						
Industrial chemicals	0.048	1.043^{***}	0.811^{***}	-0.043	0.189	1.286
Non-electrical machinery	0.015	0.935^{***}	0.940^{***}	0.065	0.06	0.995
Electrical machinery	-0.023	0.563	0.465	0.437	0.535	1.210
Motor vehicles	-0.031	0.838^{***}	0.904^{***}	0.162	0.096	0.926
Other transport equipment	-0.090	0.673^{**}	0.694^{***}	0.327	0.307	0.971
High Technology Industries						
Pharmaceuticals	-0.025	1.082^{***}	0.889^{***}	-0.082	0.111	1.217
Computers and office machinery	-0.022	0.872^{***}	0.809^{***}	0.128	0.191	1.078
Communication equipment	0.031	$0.623^{**\dagger}$	0.556^{**}	0.377	0.444	1.119
Instruments	0.034	0.952^{***}	0.920^{***}	0.048	0.08	1.034
Aerospace	-0.058	0.846^{***}	0.878^{***}	0.154	0.123	0.964

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10

† Statistically significantly different from 1 at 0.10 or less

machinery industry both the estimated correlation and slope coefficient are insignificant) and hence σ-convergence is found for only 10 industries whereas there is significant σ-divergence in 11 industries of which 6 industries are in lower technology categories whereas the other 5 (of which 4 are HT) are in higher technology categories. On the other hand out of 10 industries showing σ-convergence, 6 industries (of which 3 are LT) are in lower technology categories whereas only 4 are in higher technology industries.

A few stylised features emerge from this industrywide analysis. Considering the stability of export patterns, high-end technology industries, on average, are more stable compared to lower technology industries. Hence, although not as strong as in the case of countrywide analysis, the

results more or less comply with *proposition 4*. In accordance with this, lower technology industries show higher regression effects compared to their high-end counterparts whereas higher technology industries show greater mobility effects. These findings reveal themselves such that, on average, convergence in countries export patterns is more common for lower technology industries while divergence in countries export patterns is more likely to occur in higher technology industries as suggested by *proposition 6*.

On the other hand when the convergence/divergence in countries export patterns among the three destinations are considered, for only 9 industries the average behaviour in export patterns correspond with each other. On the other hand for 13 industries, the considered destinations affect the average behaviour either in terms of β-convergence/divergence or σ-convergence/divergence or both. To be more explicit, the degree of convergence/divergence differs for 9 industries among the considered destinations whereas for 6 industries the average behaviour of countries differs. On the other hand for 2 industries, both the relative convergence/divergence and the degree of convergence/divergence differ among the considered destinations. These findings provide support for distinguishing between different destinations, at least in terms of intra and extra EU15 export patterns[15]. Nevertheless, the overall degree of convergence, on average, is higher for intra-EU15 exports while is lower for extra-EU15 exports, which to some extent supports *proposition 5*.

6 Conclusion

The findings presented provide, more or less, a well fit to the previously emphasised propositions and are in line with the theoretical considerations. In both country-wide and industry-wide analysis, the export specialisation patterns are found to be rather sticky even if not stable, along in the lines of both the technology gap theory and presence of learning-by-doing and comply to the results in Proudman & Redding (2000), Brasili et. al (2000), Redding (2002) and Amador et. al (2011). Countries that showed low regression effects in their country-wide specialisation patterns tend to be specialised in those industries that display fairly low degree of β-convergence. On the other hand, the intra-EU15 export specialisation patterns are less persistent than extra-EU15 export

[15]Whereas, it should be noted that the average behaviour does not change between the three destinations for LT industries, which revealed itself as higher persistence (lowest mobility) with the exception of textiles, leather and footwear industry

specialisation patterns, which are in line with theoretical models that allow increasing returns and differentiated products. Furthermore this dynamism is more relevant in the higher technology industries.

From an industry specific point, the dynamism within intra-EU patterns is reflected as convergence of countries, whereas the more persistent extra-EU patterns are reflected as divergence of countries, within specific industries. Such divergence was argued to possibly arise from the cumulative nature of technology and the extent of diffusion of technology among countries, which in this case within the EU. Similarly, this divergence may also arise from countries' implicit need to maintain their absolute income levels. Considering the extensive growth literature on convergence of income levels, these findings should not be surprising within the EU framework. Furthermore, as expected, this divergence is more relevant to higher technology industries, as the catching-up process would be slowed down by the sluggish diffusion of technology; unlike Amador et. al (2011) where export patterns show tendency towards de-specialisation in high technology sectors.

Hence in all cases, by technological category and destination, specialisation and divergence processes move in the same direction, as expected. Nevertheless it should not be forgotten that this methodology only provides a partial analysis of investigating export specialisation patterns. That is, countries may specialise while adapting to their existing strengths. Furthermore the sectoral distribution of specialisation patterns may change to adapt to changing demand patterns, even though they are still directed by the countries existing strengths. Furthermore, as the employed method lacks the time element, these findings may not reflect the long-term patterns as well as the short-term fluctuations. Notwithstanding these issues, the current paper provides fair arguments on the extent of specialisation and divergence in export patterns for the EU15 countries analogous to a broad range of theories, while the underlying determinants of such patterns are not investigated, which are left for future research.

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A Appendix

Table 7: Countrywide Stability & Specialisation Patterns in EU15 Exports for Lower Technology Industries

Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Low Technology Industries						
Austria	0.080	0.681**	0.892**	0.319	0.108	0.763
Belgium	-0.025	0.766**	0.943***	0.234	0.058	0.813
Denmark	0.050	0.752*	0.820*	0.248	0.180	0.917
Finland	-0.096*	0.980***	0.995***	0.020	0.005	0.985
France	0.024	0.973***	0.947**	0.027	0.053	1.028
Germany	-0.064	0.434	0.412	0.566	0.588	1.051
Greece	0.012	0.711***†	0.961***	0.289	0.039	0.740
Ireland	-0.308*	1.006***	0.936***	-0.006	0.064	1.075
Italy	0.052	0.914***	0.973***	0.086	0.028	0.94
Luxembourg	0.092	1.197***	0.964***	-0.197	0.036	1.243
Netherlands	-0.116*	1.059***	0.932**	-0.059	0.068	1.136
Portugal	0.132	0.621***†	0.951**	0.379	0.049	0.653
Spain	0.103	1.397*	0.799	-0.397	0.201	1.749
Sweden	0.046	0.775***†	0.996***	0.225	0.004	0.778
United Kingdom	0.036	0.990***	0.954**	0.001	0.046	1.038
Medium Low Technology Industries						
Austria	-0.016*	0.941***†	0.999***	0.059	0.001	0.941
Belgium	-0.107***	0.873***†	0.989***	0.127	0.011	0.883
Denmark	0.005	0.723***†	0.956***	0.277	0.044	0.756
Finland	0.073*	0.861***	0.969***	0.139	0.031	0.889
France	-0.045*	0.473	0.431	0.527	0.570	1.10
Germany	-0.033	0.709***†	0.739*	0.291	0.261	0.959
Greece	0.187**	0.494**†	0.798**	0.506	0.202	0.62
Ireland	-0.485***	0.511**†	0.882***	0.489	0.118	0.58
Italy	0.143**	0.367	0.474	0.633	0.526	0.774
Luxembourg	-0.034**	1.001***	0.999***	-0.001	0.001	1.002
Netherlands	-0.084	1.003***	0.880***	-0.003	0.12	1.139
Portugal	0.115	0.430*†	0.651	0.570	0.349	0.661
Spain	0.016	1.004***	0.942***	-0.004	0.058	1.066
Sweden	-0.037	0.843***	0.736*	0.157	0.264	1.145
United Kingdom	-0.037	0.566	0.706*	0.434	0.294	0.802

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10

† Statistically significantly different from 1 at 0.10 or less

Table 8: Countrywide Stability & Specialisation Patterns in EU15 Exports for Higher Technology Industries

Medium High Technology Industries						
Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Austria	0.045**	0.975***†	0.998***	0.025	0.002	0.976
Belgium	0.000	0.717	0.750	0.283	0.250	0.956
Denmark	0.109	1.093**	0.832*	-0.093	0.168	1.314
Finland	-0.087	0.874	0.516	0.126	0.484	1.695
France	-0.022	0.574**†	0.815*	0.426	0.185	0.704
Germany	-0.160**	2.166**†	0.894**	-1.166	0.106	2.423
Greece	0.379***	1.207***	0.973***	-0.207	0.028	1.241
Ireland	0.058	1.242**	0.924**	-0.242	0.076	1.344
Italy	0.030	1.040***	0.991***	-0.04	0.009	1.049
Luxembourg	-0.163*	0.309**†	0.824*	0.691	0.176	0.375
Netherlands	-0.030*	1.005***	0.994***	-0.005	0.006	1.011
Portugal	0.026	0.494*†	0.697	0.506	0.303	0.709
Spain	0.058	0.702*	0.691	0.298	0.309	1.016
Sweden	0.008	0.993***	0.995***	0.007	0.005	0.998
United Kingdom	-0.045	1.125***	0.945**	-0.125	0.055	1.191
High Technology Industries						
Austria	-0.106	0.604***†	0.928**	0.396	0.072	0.651
Belgium	0.208	1.415	0.788	-0.415	0.212	1.796
Denmark	-0.071	1.176***	0.975***	-0.176	0.025	1.206
Finland	0.114	1.249**	0.900**	-0.249	0.100	1.387
France	-0.077	1.907***†	0.938**	-0.907	0.062	2.033
Germany	-0.019	0.495	0.572	0.505	0.428	0.864
Greece	0.850***	1.684***†	0.983***	-0.684	0.017	1.713
Ireland	0.004	1.070***	0.986***	-0.070	0.014	1.085
Italy	-0.875	-2.317	-0.405	3.317	1.405	5.716
Luxembourg	-0.133	0.569*	0.762	0.431	0.238	0.747
Netherlands	0.097	1.944**	0.902**	-0.944	0.098	2.157
Portugal	0.032	0.865**	0.852*	0.135	0.149	1.016
Spain	-0.170	0.735	0.399	0.265	0.601	1.844
Sweden	-0.156	1.219***	0.968***	-0.219	0.032	1.259
United Kingdom	0.032	0.746	0.565	0.254	0.435	1.320

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10

† Statistically significantly different from 1 at 0.10 or less

Table 9: Countrywide Stability & Specialisation Patterns in intra-EU15 Exports for Lower Technology Industries

Low Technology Industries						
Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Austria	0.098	0.664**	0.884**	0.336	0.116	0.751
Belgium	-0.012	0.824**	0.720	0.176	0.280	1.146
Denmark	0.081	0.664	0.776	0.336	0.224	0.856
Finland	-0.087	0.966***	0.994***	0.034	0.006	0.972
France	0.016	0.866***	0.966***	0.134	0.034	0.896
Germany	0.018	0.660	0.638	0.340	0.362	1.035
Greece	0.010	0.809***	0.973***	0.191	0.028	0.831
Ireland	-0.280**	0.981**	0.877*	0.019	0.123	1.119
Italy	0.042	0.859***	0.959***	0.141	0.041	0.895
Luxembourg	0.093	1.174***	0.956**	-0.174	0.044	1.227
Netherlands	-0.105	1.011**	0.911**	-0.011	0.089	1.110
Portugal	0.141	0.602**†	0.901**	0.398	0.099	0.668
Spain	0.131	1.145	0.640	-0.145	0.360	1.790
Sweden	0.068***	0.741***†	0.999***	0.259	0.001	0.741
United Kingdom	-0.04	0.826***†	0.990***	0.174	0.011	0.835
Medium Low Technology Industries						
Austria	-0.014	0.936***	0.996***	0.064	0.004	0.940
Belgium	-0.068**	0.800***†	0.979***	0.200	0.021	0.817
Denmark	0.080	1.051***	0.937***	-0.051	0.063	1.121
Finland	0.126**	0.848***	0.953***	0.152	0.047	0.889
France	-0.007	0.764	0.614	0.236	0.387	1.246
Germany	-0.028	0.678***†	0.899***	0.322	0.101	0.754
Greece	-0.029	0.547	0.559	0.453	0.441	0.978
Ireland	-0.398***	0.607**†	0.824***	0.393	0.176	0.737
Italy	0.171**	0.688**	0.621	0.312	0.379	1.108
Luxembourg	-0.037	1.036***	0.997***	-0.036	0.003	1.040
Netherlands	-0.101	0.915***	0.883***	0.085	0.117	1.035
Portugal	0.148	0.450*†	0.610	0.550	0.390	0.738
Spain	-0.021	0.126	0.076	0.874	0.924	1.654
Sweden	-0.022	0.738**	0.819**	0.262	0.181	0.901
United Kingdom	-0.054	0.539**†	0.469	0.461	0.531	1.149

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10

† Statistically significantly different from 1 at 0.10 or less

Table 10: Countrywide Stability & Specialisation Patterns in intra-EU15 Exports for Higher Technology Industries

Medium High Technology Industries						
Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Austria	0.101*	0.981***	0.966***	0.019	0.035	1.016
Belgium	-0.006	0.661	0.739	0.339	0.261	0.895
Denmark	0.113	1.020**	0.876*	-0.020	0.124	1.165
Finland	0.160***	1.339***	0.954**	-0.339	0.047	1.405
France	-0.008	0.142	0.150	0.858	0.850	0.950
Germany	-0.002	0.871	0.730	0.129	0.270	1.194
Greece	0.608	1.475**	0.917**	-0.475	0.083	1.608
Ireland	0.032	1.187**	0.935**	-0.187	0.066	1.270
Italy	0.043	0.965***	0.982***	0.035	0.018	0.983
Luxembourg	-0.148*	0.406**†	0.873*	0.594	0.127	0.465
Netherlands	-0.031	0.986***	0.967***	0.014	0.033	1.020
Portugal	0.039	0.466*†	0.721	0.534	0.280	0.647
Spain	0.050	0.716*	0.748	0.284	0.252	0.957
Sweden	0.064	1.196***	0.944**	-0.196	0.057	1.267
United Kingdom	-0.068	1.574**	0.929**	-0.574	0.071	1.694
High Technology Industries						
Austria	-0.191*	0.491**†	0.927**	0.509	0.074	0.530
Belgium	0.179	1.393	0.720	-0.393	0.280	1.934
Denmark	-0.069	1.381*	0.864*	-0.381	0.136	1.598
Finland	0.027	1.192*	0.823*	-0.192	0.177	1.448
France	-0.080	1.483	0.497	-0.483	0.504	2.987
Germany	0.008	0.614*	0.813*	0.386	0.187	0.755
Greece	1.339***	2.244***†	0.955**	-1.244	0.045	2.349
Ireland	-0.079	1.147***†	0.995***	-0.147	0.005	1.153
Italy	-1.072**	-4.274**†	-0.784	5.274	1.784	5.448
Luxembourg	-0.194	0.562**†	0.785	0.438	0.215	0.715
Netherlands	0.135	1.765*	0.768	-0.765	0.232	2.299
Portugal	-0.157***	0.749***	0.949**	0.251	0.051	0.789
Spain	-0.143	0.778	0.411	0.222	0.589	1.893
Sweden	-0.192**	0.945***	0.943**	0.055	0.057	1.002
United Kingdom	0.293**	-0.431**†	-0.531	1.431	1.531	0.812

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10

† Statistically significantly different from 1 at 0.10 or less

Table 11: Countrywide Stability & Specialisation Patterns in extra-EU15 Exports for Lower Technology Industries

Low Technology Industries						
Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Austria	0.061	0.720**	0.909**	0.280	0.091	0.793
Belgium	-0.055	0.683**	0.888**	0.317	0.112	0.769
Denmark	-0.022	0.911**	0.798	0.089	0.203	1.143
Finland	-0.113*	1.035***	0.995***	-0.035	0.005	1.040
France	0.027	1.162***	0.969***	-0.162	0.031	1.199
Germany	-0.048	0.749	0.639	0.251	0.361	1.173
Greece	-0.006	0.631**	0.822*	0.369	0.178	0.767
Ireland	-0.257**	0.767***†	0.943**	0.233	0.057	0.814
Italy	0.048	0.960***	0.960***	0.040	0.041	1.001
Luxembourg	0.158	1.074*	0.820*	-0.074	0.18	1.309
Netherlands	-0.103	0.943***	0.984***	0.057	0.016	0.958
Portugal	-0.040	0.891***	0.968***	0.109	0.032	0.921
Spain	-0.031	0.717	0.748	0.283	0.252	0.959
Sweden	0.019	0.862***	0.983***	0.138	0.017	0.877
United Kingdom	0.095	1.152***	0.900**	-0.152	0.100	1.280
Medium Low Technology Industries						
Austria	-0.023	0.951***	0.989***	0.049	0.011	0.962
Belgium	-0.187**	0.791***	0.952***	0.209	0.048	0.831
Denmark	-0.030	0.547***†	0.922***	0.453	0.078	0.593
Finland	0.017	0.682***†	0.874**	0.318	0.126	0.780
France	-0.083***	0.629	0.421	0.371	0.579	1.494
Germany	-0.017	0.845**	0.641	0.155	0.360	1.319
Greece	0.169**	0.540**†	0.841**	0.460	0.159	0.642
Ireland	-0.720***	0.174	0.586	0.826	0.414	0.297
Italy	0.121*	0.293	0.493	0.707	0.507	0.594
Luxembourg	-0.090**	0.926***†	0.996***	0.074	0.004	0.930
Netherlands	-0.055	0.965**	0.835**	0.035	0.165	1.156
Portugal	-0.040	0.783***	0.867**	0.217	0.133	0.903
Spain	-0.212***	1.417***†	0.931***	-0.417	0.069	1.523
Sweden	-0.042	0.879*	0.662	0.121	0.339	1.328
United Kingdom	-0.080	0.229	0.428	0.771	0.572	0.534

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10

† Statistically significantly different from 1 at 0.10 or less

Table 12: Countrywide Stability & Specialisation Patterns in extra-EU15 Exports for Higher Technology Industries

Medium High Technology Industries						
Country	$\hat{\alpha}$	$\hat{\beta}$	$\hat{\rho}$	$(1-\hat{\beta})$	$(1-\hat{\rho})$	$\hat{\beta}/\hat{\rho}$
Austria	0.010	0.917***	0.983***	0.083	0.017	0.933
Belgium	0.073	1.184**	0.927**	-0.184	0.073	1.278
Denmark	0.030	0.894	0.569	0.106	0.431	1.573
Finland	-0.268	-0.328	-0.216	1.328	1.216	1.517
France	-0.006	0.777**	0.702	0.223	0.298	1.108
Germany	0.048	0.243	0.165	0.757	0.835	1.472
Greece	0.121	0.937***	0.962***	0.063	0.038	0.974
Ireland	0.133	1.289**	0.952**	-0.289	0.048	1.354
Italy	0.061	1.226***	0.968***	-0.226	0.032	1.267
Luxembourg	-0.092	0.429	0.515	0.571	0.485	0.832
Netherlands	-0.113	0.684**	0.881**	0.316	0.119	0.776
Portugal	0.117	0.836*	0.752	0.164	0.248	1.113
Spain	0.052	0.301	0.152	0.699	0.848	1.976
Sweden	-0.046	0.527**†	0.914**	0.473	0.086	0.577
United Kingdom	-0.043	0.513*†	0.853*	0.487	0.147	0.601
High Technology Industries						
Austria	-0.089	0.549*	0.723	0.451	0.277	0.759
Belgium	0.047	1.136	0.768	-0.136	0.232	1.479
Denmark	-0.078	1.005***	0.975***	-0.005	0.025	1.030
Finland	0.191***	1.243**	0.925**	-0.243	0.075	1.344
France	-0.018	1.606***†	0.957**	-0.606	0.043	1.677
Germany	-0.076	0.276	0.606	0.724	0.394	0.456
Greece	-0.550*	0.0400	0.066	0.960	0.934	0.602
Ireland	-0.008	0.991**	0.907**	0.009	0.093	1.092
Italy	0.370	2.926	0.710	-1.926	0.290	4.124
Luxembourg	0.713**	1.710***†	0.829*	-0.710	0.171	2.064
Netherlands	-0.009	1.222	0.623	-0.222	0.378	1.963
Portugal	0.421	1.234	0.539	-0.234	0.462	2.291
Spain	0.119	1.688*	0.851*	-0.688	0.149	1.983
Sweden	-0.105**	1.242***†	0.985***	-0.242	0.015	1.261
United Kingdom	0.077	0.594*	0.851*	0.406	0.149	0.698

*** Significant at 0.01 , ** Significant at 0.05 , * Significant at 0.10

† Statistically significantly different from 1 at 0.10 or less