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PERSISTENCE VS. MOBILITY IN INDUSTRIAL AND TECHNOLOGICAL SPECIALISATIONS: EVIDENCE FROM 11 EURO AREA COUNTRIES

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Persistence vs. mobility in industrial and technological specialisations: Evidence from 11 Euro area countries

Raphaël Chiappini*

Abstract

This paper analyses the evolution of the specialisation pattern of 11 Euro area countries by analysing their comparative and technological advantages over the period 1990-2008. Using the estimation of marginal densities and Markov transition probabilities, we examine both the external shape of the distribution of technological and comparative advantages and the intra-distribution dynamics. Our results point out that there is, on average, a high persistence in industrial specialisation patterns of the 11 Euro area countries under scrutiny, confirming a lock-in effect, notably for Italy. Nevertheless, our results related to technological specialisation reveal a large mobility of technological advantages during the same period, especially in Spain.

Keywords: Specialisation dynamics, Revealed comparative advantage, Technological comparative advantage, Transition probability, Intra-distribution dynamics

JEL Classification: C14, F14, O33

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1 Introduction

Over the past decade, international trade has experienced an unprecedented growth following the emergence of new global actors such as China or India. However, the increase in exports from emerging economies on the global market has significant consequences on the export performance of developed countries. In particular, among Euro area countries, the consequences of the competition with developing countries depend on the country under scrutiny. For instance, countries like Germany, Spain or Netherlands have maintained their positions on the global market whereas other countries like France or Italy have lost export market shares. Portugal, Austria and Greece have also maintained their export market share but still represent a very small share of the euro area' exports.

Therefore, a large number of studies have focused their analysis on the impact of specialisation on countries export performances. Indeed, new trade theories emphasis that all industrial specialisations are not equivalent in terms of long-term potential growth. The empirical literature on international trade (Lucas 1988; Young 1991; Grossman and Helpman 1991) has proved that the growth rate of a country may be reduced by a "wrong" specialisation. However, studies on the impact of specialisation on countries export performances refer to static models based on the Constant Market Share Analysis (CMSA). In fact, unlike the classical theory of Ricardo (1817), the comparative advantages developed by countries are dynamic and grow over time. Furthermore, a country can develop a comparative advantage in a product where it has a comparative disadvantage. The theoretical literature on growth and trade highlights the dynamic and endogenous properties of comparative advantages (Krugman 1987; Lucas 1988, Grossman and Helpman 1991). Moreover, neo-Schumpeterian studies have pointed out the key role played by countries technological capabilities for the development of new comparative advantages. The learning-by-doing process of a country or a particular sector, generated by technological capabilities, would be the determinant of countries international specialisation. Thus, national innovation system and sectorial structure of export performance of countries would be closely related (Narula and Wakelin 1995). The distribution of a country's comparative advantages being the result of technological change, per capita income convergence will depend on the technological adaptation and diffusion. If there exist no technological diffusion barriers, this promotes convergence and countries international specialisation is only the result of factor endowments. Otherwise, if technological spillovers are faster inside countries than across the world, it implies per capita income discrepancies and countries international specialisation can suffer from path dependency and from a lock-in effect (Mancusi 2001). As consequence, initial differences in countries factor endowments imply discrepancies in structure of industrial specialisations and the creation of new comparative and technological advantages could be the result of public policies targeted on high potential sectors. Thus, Lall (2000) puts forth the evidence that countries will benefit from the implementation of learning systems. Indeed, it allows countries to absorb technologies efficiently and react competitively to changing technological conditions (Uchida and Cook 2005).

Based on these observations, there has recently been a growing interest for trade dynamics in the empirical literature. As a consequence, using non-parametric studies based on Markov transition probabilities, Proudman and Redding (2000), Brasili et al. (2000), Redding (2002) and De Benedictis and Tamberi (2004) have shown that there is a strong persistence in comparative advantages dynamics of industrialised countries. On the

contrary, Zaghini (2005), Ferto (2007) and Alessandrini et al. (2007) indicate that there exists mobility in industrial specialisations in Eastern European Countries and in India. In contrast, results from the study of Alessandrini and Batuo (2010) gives evidence of persistence in the trade specialisation of the four main African countries over the three last decades. Concerning technological specialisation, Mancusi (2001) does not find evidence of persistence in technological advantages for industrialised countries. Furthermore, their mobility seems to be higher than the mobility of industrial specialisation.

In this paper, we investigate whether Euro area countries have changed their specialisation over the recent period. In particular, we examine whether countries with the most disabling industrial specialisations in 1990 as Greece, Italy, Portugal and Spain have developed new comparative advantages in technological intensive sectors. We use two different indicators, one relying on industrial specialisation, the Balassa index (BI), and the other focusing on technological specialisation, the technological comparative advantage (TCA) index (Soete 1981; Patel and Pavitt 1991). We thus investigate and compare persistence and mobility of these two indices for 11 Euro area members[†] during 1990 to 2008.

This paper is organized as follows. Section 2 presents a survey of the trade literature on the dynamics of international specialisation. Section 3 discusses the measurement of trade and technological specialisation, our data and our methodology to evaluate countries specialisation dynamics. Section 4 presents our results on the dynamics of industrial and technological specialisation in Euro area. Section 5 concludes.

2 Theoretical background

If comparative advantages are supposed to be static in the founding model of Ricardo (1817), the standard Heckscher-Ohlin model provides insights on their dynamics. Indeed, according to this latter, the pattern of trade specialisation changes only if trading countries experience a change in their relative factor endowments. This prediction implies that the evidence of persistence in trade patterns is perfectly consistent with the model as soon as the relative factor endowments of countries has not changed significantly with respect to their main trading partners.

However, the analysis becomes more complicated when the hypothesis of increasing returns to scale are introduced in the model such as in the new trade theory. Indeed, interpretations of the model will depend on the specific assumptions about the nature of returns to scale. If economies of scale are internal to the firm as in models from Helpman (1981) and Helpman and Krugman (1985), the main implications of the factor proportions theorem stay valid. The conclusions are different when national external economies of scale exist and depend on the effects of those latter on the slope of the production possibility frontier. If external economies of scale are negligible with respect to the factor intensity differences between two sectors, Kemp (1969) and Markusen and Melvin (1981) shed light on the fact that the relative supply curve has an upward slope and implications from the standard Heckscher-Ohlin model are still valid. Otherwise, if external economies of scale are relevant, so that the production frontier is globally convex, the predictions of the model are very different. As a result, Wong (1995) indicates that in the presence of

[†]Austria, the Belgium-Luxembourg Economic Union (BLEU), Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain.

strong national external economies of scale, the world trade pattern is entirely determined by initial comparative advantages. However, those results on economies of scale are based on the assumption that external economies are national rather than international. Ethier (1979, 1982) follows this criticism and accepts the hypothesis that returns to scale depend on the size of the world economy. His results point out that in case of internationally decreasing costs, returns to scale have no impact on the pattern of international trade. In this case, the lock-in effect generated by external national economies wholly disappears.

The economic theory on dynamic of international trade has improved previous results by providing a dynamic vision rather than static. This strand of literature has emphasised the leading role of innovation and learning-by-doing effects in the determination of countries comparative advantages. Therefore, Grossman and Helpman (1990, 1991) use a three sector growth model where the state of technology is endogenous and with the assumption that the knowledge spillovers are international in scope. They find that past values of a country's production do not influence its long run trade pattern, which only depends on the relative factors endowments. On the contrary, if knowledge spillovers are not international in scope, learning-by-doing models points out that specialisation pattern will exhibit a lock-in effect. In this respect, Krugman (1987), Lucas (1988), Grossman and Helpman (1991) put forth the evidence that in the presence of dynamic economies of scale, the long run trade pattern is entirely determined by initial comparative advantage.

Another strand of theoretical literature has emphasised the role of factor accumulation in specialisation dynamics (Findaly 1970; Deardorff 1974; Davies and Reeve 1997). In those studies, trade specialisation could be reinforced or deteriorated through time. Relying on a Heckscher-Ohlin model with two countries, two goods and two factors, those models point out that trade openness increases factor discrepancies. Countries with more intensive labour factor relative to capital factor increase their endowment in human capital on the basis of a better remuneration of this factor implied by trade openness. A reverse phenomenon occurs in the other country, which increases in turn its endowment in capital factor. Thus, in this case, initial specialisation will suffer from a lock-in effect and there will be an increase in the degree of specialisation in both countries.

The new economic geography also shed light on the persistence of specialisations over time (Krugman 1991; Fujita et al. 1999). In those models, geographical advantage is supposed to be endogenous and regional specialisation is the result of the spatial pattern of agglomeration of economic activities. Firms concentrate their activities on a specific location, which attracts more firms and increase the attractiveness of the site. This cumulative causation process is based on technological externalities (learning-by-doing and knowledge spillovers). As long as these externalities are located in a particular place, production remains geographically concentrated. Therefore, the hypothesis of increasing returns to scale implies a persistence of pattern of specialisation. Finally, predictions of models on dynamics of trade patterns are ambiguous. Indeed, Proudman and Redding (2000) using a theoretical model of international trade and endogenous technological change derived from Dornbusch et al. (1977), conclude that "*whether international trade flows persist or exhibit mobility over time is ultimately an empirical question*" (Proudman and Redding 2000: p.377).

3 Data and empirical modelling of trade dynamics

This section introduces the empirical framework for analysing the dynamics of international trade and technological flows. We first describe the two measures of trade and technological specialisation. We then present two different approaches in order to evaluate countries dynamics of specialisation. The first one consists in the regression of the two measures of specialisation and the second one implies the use of the Markov transition probabilities.

3.1 Technological and industrial specialisation: two comparable measures

Despite several criticisms developed in the trade literature (see e.g. De Benedictis and Tamberi 2001), the index developed by Balassa (1965) remains the most popular tool to evaluate countries trade specialisations. This index, also known as the "Revealed Comparative Advantage" index, measures the share of a product's exports in the total exports of a country relatively to the country's weight in world exports. Thus, the Balassa index (BI) for a country i in product j is constructed as follows:

$$B_{i,j} = \frac{X_{i,j} / \sum_i X_{i,j}}{\sum_j X_{i,j} / \sum_i \sum_j X_{i,j}} \quad (1)$$

Where $X_{i,j}$ are exports of country i in product j . Note that the Balassa index is always positive. The comparative disadvantages correspond to values between zero and one and as soon as a country has a Balassa index superior to 1, it has a comparative advantage in product j . Using the Chelem database from the CEPPII, we compute the BI for 144 products at the *2-digit* level of disaggregation from the Standard International Trade Classification (SITC) for 11 Euro area members[‡]. In order to reduce the impact of outliers and the impact of wide variation in exchange rate or prices, we do not study the sectors 'Crude oil and natural' and 'Ores of uranium and thorium'.

This index commonly used in trade studies suffers from a normality problem and is not well suitable to estimate marginal densities of distributions. To deal with these problems, Dalum et al. (1998) have proposed to use a symmetric measure of the Balassa index. The index is transformed into a new one called "Symmetric Balassa Index" (SBI) or "Symmetric Revealed Comparative Advantage" (SRCA) index by the following formula:

$$SBI_{i,j} = \frac{B_{i,j} - 1}{B_{i,j} + 1} \quad (2)$$

Accordingly, each value of the SBI ranges from -1 to 1. The index is equal to zero when country i does not export product j and it tends to +1 when country i is the only exporter of product j . If $B_{i,j} = 1$, it implies that $SBI_{i,j} = 0$, which is the new line. Therefore, this transformation does not affect either the ranking of comparative advantages or the nature of industrial specialisation of each country.

To evaluate countries technological specialisations, most of empirical studies (in particular Soete 1981; Patel and Pavitt 1991; Mancusi 2001) use the Technological Comparative

[‡]Austria, the Belgium-Luxembourg Economic Union (BLEU), Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain.

Advantage (TCA) index. This latter is constructed the same way as the index of Balassa (1965) but focuses on the patent activity. Thus, the TCA index is defined as the ratio between the weight of country i in the world patents applications of sector j and the share of sector j in the total of world patents applications. This index is constructed as follows:

$$TCA_{i,j} = \frac{P_{i,j} / \sum_i P_{i,j}}{\sum_j P_{i,j} / \sum_i \sum_j P_{i,j}} \quad (3)$$

With $P_{i,j}$, the number of patents applications from country i in sector j . Values of the TCA index lies between zero and positive infinity. When it is below one, country i has a technological disadvantage in sector j . On the contrary, when the index is positive, country i has a technological advantage in sector j . For the construction of this indicator, we use data from Eurostat concerning the number of patents applications to the European Patent Office (EPO). It allows a disaggregation into 122 sectors over the period 1990 to 2008 for each country of our sample.

As for the Balassa index, we use the transformation proposed by Dalum et al. (1998). Furthermore, in the case of the technological index, this latter allows to solve what Cantwell calls the small number problem. The new index, called "Symmetric Technological Comparative Advantage" (STCA) index is expressed as follows:

$$STCA_{i,j} = \frac{TCA_{i,j} - 1}{TCA_{i,j} + 1} \quad (4)$$

The STAC index is, therefore, symmetrical and its values range from -1 to +1.

To estimate the evolution of the two indices of specialisation over time, two different approaches have been developed in the empirical literature. The first one, developed by Pavitt (1989) and Cantwell (1989), focuses on the conditional average of the distribution of the two indices. The second one evaluates the intra-distribution dynamics and is based on the Markov transition probabilities.

3.2 Regression of the two indices

To understand the evolution of specialisation patterns over time, Pavitt (1989) and Cantwell (1989) propose the regression of the Symmetric Balassa Index (SBI) or the Symmetric Technological Comparative Advantage (STCA) index. In line with previous empirical works from Zaghini (2005), Uchida and Cook (2005), Alessandrini and Batuo (2010) and Chiappini (2011a), we, therefore, estimate the following equation using the Ordinary Least Squares (OLS) regressions:

$$SBI_{i,j}^{07-08} = \alpha_i + \beta_i * SBI_{i,j}^{90-91} + \epsilon_{i,j} \quad (5)$$

Where $SBI_{i,j}^{07-08}$ represents the average of the SBI distribution between 2007 and 2008 for country i in product j , $SBI_{i,j}^{90-91}$ is the average of the SBI distribution between 1990 and 1991 of country i in product j , α_i and β_i are the parameters of the linear regression

and $\epsilon_{i,j}$ represents the residuals of the estimation. Interpretations of estimation results follow the following process. If $\beta_i = 1$, the specialisation of country i remains stable. If $\beta_i > 1$, country i has become more specialised in sectors for which it already has a comparative advantage. If $0 < \beta_i < 1$, on average the sign of the specialisation is still the same, but the value of the index has increased in sectors for which the initial value of the index was low and has decreased in sectors for which the initial value of the index was high. If $\beta_i < 0$, the sign of the index has changed. If $\beta_i = 0$, there is no relationship between initial and final pattern of specialisation. Note that in the empirical literature $(1 - \beta)$ is called the regression effect (Cantwell 1989). However, Dalum et al. (1998) point out that the interpretation of the β coefficient does not allow a conclusion on the evolution of the degree of a country's specialisation. Indeed Cantwell (1989) shows that:

$$\frac{\theta_i^{2\ 07-08}}{\theta_i^{2\ 90-91}} = \frac{\beta_i^2}{\rho_i^2} \quad (6)$$

Where ρ_i is the correlation coefficient from the regression and $\theta_i^{2\ 07-08}$ and $\theta_i^{2\ 90-91}$ are, respectively, the variances of the dependent and explanatory variable. The correlation coefficient (ρ_i) is a measure of the mobility of sectors along the distribution of the two indices. A high value for this coefficient implies that the relative products' position remains almost unchanged. In the empirical literature, $(1 - \rho)$ is commonly called the mobility effect. Three different conclusions could be drawn by comparing the regression and the mobility effect:

- If $\beta_i = \rho_i$, the dispersion of the distribution remains the same;
- If $\beta_i > \rho_i$, the degree of the specialisation has increased;
- If $\beta_i < \rho_i$, the degree of the specialisation has decreased.

Thus, this method allows a better understanding of a country's specialisation dynamic. However, this process only gives details on the conditional average of the distribution. In order to capture the evolution of sectors across the entire distribution, we have to rely on the methodology proposed by Quah (1993, 1996, and 1997) for his study on the convergence of per capita incomes. This approach, based on the transition probabilities has recently been used for the dynamic of comparative advantages (Proudman and Redding 2000; Brasili et al. 2000; Mancusi 2001; Redding 2002; De Benedictis et Tamperi 2004; Zaghini 2005; Ferto 2007; Alessandrini et al. 2007; Alessandrini and Batuo 2010).

3.3 Markov transition probabilities matrix

The Symmetric Balassa Index (SBI) and the Symmetric Technological Comparative Advantage (STCA) index allow rankings of the different sectors depending on their comparative or technological advantage. It provides a statistical distribution at any given time between 1990 and 2008. The evolution of the entire cross-section distribution of the SBI and the STCA over time represents the dynamics of a country's specialisation. A better way to estimate the intra-distribution dynamics and the structural stability of the

two indices over time is to rely on the General Markov Chain model. Following previous empirical studies on countries specialisation dynamics (Mancusi 2001; Redding 2002; Zaghini 2005; Alessandrini et al. 2007; Alessandrini and Batuo 2010), we refer to the Markovian models used in the cross-country growth or income literature (Quah 1993; Figueiredo and Ziegelmann 2010).

Let us suppose that $F_t(SBI)$ is the distribution across sectors (or products) of our Balassa index at time t . We can, then, define a probability measure associated with each $F_t(SBI)$, where:

$$\forall SBI \in \mathbb{R} : \phi_t([-\infty, SBI]) = F_t(SBI) \quad (7)$$

The stochastic difference equation modelling the distribution dynamics is then:

$$\phi_t = P^*(\phi_{t-1}, \mu_t), \text{ integer } t \quad (8)$$

Where $\{\mu_t : \text{integer } t\}$ is a sequence of disturbances to the entire distribution and P^* is an operator mapping disturbances and probability measures into probability measures. Following the empirical literature, we set the disturbances to zero and assume that the operator P^* is time invariant. The equation is then:

$$\begin{aligned} \phi_{t+s} &= P^*(\phi_{t+s-1}, 0) = P^*(P^*(\phi_{t+s-2}, 0), 0) \quad \forall s \in \mathbb{N} \\ &\vdots \\ &= (P^*)^s \phi_t \end{aligned} \quad (9)$$

If the space of possible values for SBI is divided into a number of discrete intervals, P^* becomes a matrix of transition probabilities:

$$\phi_{t+1} = P^* * \phi_t \quad (10)$$

Each elements $p_{i,j}$ of the matrix P^* is a first order Markov transition probability and measure the probability that a product beginning in cell i moves to a distinct cell j . These probabilities can be estimated by counting the number of transitions out and into each cell. Interpretations on mobility or persistence throughout the entire distribution of SBI can be easily made using the transition probability matrix. Indeed, high values of a transition probability along the diagonal denote a high persistence, while larger values for the off-diagonal terms indicate a high mobility.

Moreover, more detailed information about mobility in patterns of specialisation is given using indices of mobility. Two indices are proposed in the empirical literature (see Shorrocks 1978) and are easily measurable using the transition probability matrix. The first one (M_1) evaluates the trace of the transition probability matrix. Thus, this index directly captures the relative magnitude of diagonal and off-diagonal terms, and can be shown to equal the inverse of the harmonic mean of the expected duration of remaining

in a given cell (Redding 2002). The second index (M_2) evaluates the determinant (\det) of the transition probability matrix.

$$M_1 = \frac{K - \text{trace}(P^*)}{K - 1} \quad (11)$$

$$M_2 = 1 - |\det(P^*)| \quad (12)$$

For both indices, a higher value indicates a greater mobility of sectors throughout the distribution, while a value of zero implies total immobility.

4 Empirical results

To evaluate dynamics of industrial and technological patterns over time, we have to analyse the entire distribution of the two indices presented in 3.1. In a first section, we estimate the variation of the degree of specialisation of each country of our sample by analysing the external shape of the distribution of the two indices. In a second section, we evaluate the mobility or persistence of specialisations by studying the intra-distribution dynamic. We, therefore, rely on the two approaches presented in sections 3.2 and 3.3, the first one focuses on the conditional average of the distribution, while the other one instead concentrates on the dynamic of the entire distribution.

4.1 External shape of the distribution

The most common and detailed process to evaluate the external shape of the distribution for both SBI and STCA indices is the estimation of marginal density of each indices at the beginning and the end of the studied period. As a consequence, we estimate marginal densities of SBI and STCA for the 11 Euro area countries in 1990 and 2008. We use a non-parametrical method based on the kernel density estimation. We choose the Epanechnikov kernel. If the choice of the kernel has little effects on the estimation, the selection of bandwidth exhibits a strong influence on the resulting estimate. We therefore follow recommendations from Silverman (1986) for the selection of the bandwidth. Our results concerning the estimation of marginal densities of SBI and STCA in 1990 and 2008 are summarised in appendix 1.

Several conclusions can be drawn from the interpretation of marginal densities. First, we can notice that the density function of SBI is stable for most of countries of our sample, especially in Austria, Finland, France, Germany, Italy and Netherlands, suggesting a general persistence of trade specialisations among Euro area. However, densities of SBI for BLEU, Greece, Portugal and Spain become more symmetric, denoting a reduction of industrial specialisation for those countries. Results concerning the density function of STCA are more diversified and suggest a general mobility of technological specialisation. Indeed, we can notice that the STCA density function is only stable in the case of Germany and Italy. We also remark that density functions of Greece, Ireland and Portugal are markedly more right skewed than that of the other countries of our sample, suggesting a much higher degree of technological specialisation. Furthermore, the density function of STCA becomes more symmetric in Austria, BLEU, Finland and Spain, denoting a

decrease in the degree of technological specialisation for those countries. The study of density functions of SBI and STCA emphasises the fact that technological specialisation seems to be much more dynamic than trade specialisation, especially in a country like Spain.

4.2 Conditional average of the distribution

The previous analysis only gives information about the external shape of the distribution and not on the intra-distribution dynamics (if comparative disadvantages have become comparative advantages between 1990 and 2008). We therefore use the method proposed by Pavitt (1989) and Cantwell (1989) - described in section 3.2 - to evaluate the evolution of the conditional average of the distribution of industrial and technological comparative advantages. We regress the two indices (SBI and STCA) at the end of the period on their values at the beginning of the period using the OLS estimator. Our results are summarised in table 1.

Linear estimations of SBI and STCA indicate that the coefficient β is significant and positive for all countries of our sample and for both regressions. Moreover, a F-test reveals that β differ significantly from zero or one for all estimations, except in the case of the STCA for Spain. Thus, technological specialisation has strongly changed in Spain since 1990, because there is no relationship between initial and final pattern of technological specialisation in this country. Furthermore, β is found to be between zero and one in all regressions.

The analysis of the regression effect implies that there is on average a reduction in both industrial and technological specialisations in the Euro area. Indeed, the β coefficient is less than one, especially when looking at the technological advantages, suggesting a despecialisation for all countries of our sample. However, Dalum et al. (1998) have shown that $\beta > 1$ does not always imply an increase in the degree of a country's specialisation. They suggest the study of both regression and mobility effects.

When we study both effects, conclusions are quite different. First, we can remark that industrial specialisations are more stable than technological specialisations across our sample. Indeed, the ratio β/ρ is very close to one in first estimations, especially in the case of Finland, France, Germany, Italy, Netherlands and Spain. So, we find evidence of a lock-in effect for industrial specialisations and countries comparative advantages are determined by initial advantages. However, we can notice a small decrease in the degree of industrial specialisation in Austria, BLEU, Greece, Ireland and Portugal. Results are more heterogeneous concerning technological specialisations. Thus, we can notice a strong increase in the degree of technological specialisation in Germany between 1990 and 2008, confirming a polarisation of German technological activities (Lallement et al. 2002). On the contrary, there is a strong decrease in the degree of technological specialisation in Spain. So, there is a diversification of technological activities in Spain over the recent period. Moreover, technological advantages have remained relatively stable in France, Greece, Italy and Netherlands. Note, that there is a small reduction of the degree of technological specialisation in Austria, BLEU, Finland and Ireland.

Table 1: Stability of trade and technological specialisation between 1990 and 2008

Symmetric Balassa Index (SBI)							
1990-2008							
	α	β	ρ	β/ρ	$H_0 : \beta = 0$	$H_1 : \beta = 1$	Adj. R^2
Austria	-0.018	0.742***	0.796	0.932	245.15***	29.65***	0.63
BLEU	-0.032	0.787***	0.812	0.969	275.11***	20.13***	0.66
Finland	-0.055*	0.809***	0.783	1.033	225.05***	12.40***	0.61
France	-0.170	0.878***	0.849	1.034	366.09***	7.09***	0.72
Germany	-0.060***	0.761***	0.745	1.021	177.44***	17.44***	0.55
Greece	0.097***	0.667***	0.714	0.934	147.52***	36.90***	0.51
Ireland	-0.316***	0.737***	0.784	0.940	225.96***	28.87***	0.61
Italy	0.047**	0.879***	0.871	1.009	444.27***	8.35***	0.76
Netherlands	-0.073***	0.832***	0.845	0.984	355.68***	14.40***	0.71
Portugal	0.102***	0.680***	0.702	0.969	136.67***	30.51***	0.49
Spain	0.007	0.721***	0.734	0.982	166.01***	24.72***	0.54
Symmetric Technological Comparative Advantage (STCA)							
1990-2008							
	α	β	ρ	β/ρ	$H_0 : \beta = 0$	$H_1 : \beta = 1$	Adj. R^2
Austria	-0.017	0.503***	0.529	0.951	46.58***	45.40***	0.27
BLEU	-0.054	0.335***	0.343	0.977	16.05***	63.23***	0.11
Finland	-0.233***	0.348***	0.365	0.953	18.43***	64.86***	0.13
France	-0.096***	0.384***	0.383	1.003	20.67***	52.98***	0.14
Germany	0.012***	0.422***	0.359	1.175	17.73***	33.12***	0.12
Greece	-0.473***	0.262***	0.266	0.985	9.14***	72.66***	0.06
Ireland	-0.543***	0.134*	0.156	0.859	2.99*	124.15***	0.02
Italy	0.017	0.594***	0.582	1.021	61.50***	28.70***	0.33
Netherlands	-0.073***	0.543***	0.519	1.046	44.29***	31.41***	0.26
Portugal	-0.353***	0.339***	0.266	1.274	9.15***	38.84***	0.06
Spain	-0.120**	0.105	0.139	0.755	2.38	169.76***	0.01

*, **, ***: significant at the 0.1, 0.05 and 0.01 level.

4.3 Intra-distribution dynamics of the entire distribution

Following the analysis of Zaghini (2005), we classify the two indices into quartiles at each time t . Thus, the upper endpoints change over time and the transition probabilities denote the mobility of the distribution of our two indices (SBI and STCA) between the different quartiles. For example, the first row of the matrix evaluates the probability that a sector (or product) which was at the beginning of the period in the first quartile stay to this quartile, move to the second quartile, move to the third quartile or move to the fourth quartile at the end of the period. Finally, we estimate transition probability matrices for each country of our sample during the period 1990-2008. We obtain eleven four-by-four matrices describing the 18-year transition from 1990 to 2008[§]. Results concerning transition matrices of the SBI are summarised in table 2.

[§]For Greece and Portugal, we can only estimate three-by-three matrices for the STCA index due to the lack of patents applications in those countries which are, furthermore, concentrated into the first tertile.

Table 2: 18-year transition matrices of Balassa index (SBI)

Austria				BLEU					
	I	II	III	IV		I	II	III	IV
(648)	0.931	0.063	0.005	0.001	(648)	0.924	0.068	0.003	0.005
(648)	0.065	0.833	0.096	0.006	(648)	0.068	0.849	0.082	0.001
(648)	0.003	0.093	0.841	0.063	(648)	0.004	0.082	0.869	0.045
(648)	0.001	0.011	0.059	0.929	(648)	0.003	0.002	0.046	0.949
Finland				France					
	I	II	III	IV		I	II	III	IV
(648)	0.895	0.100	0.005	0.000	(648)	0.926	0.068	0.003	0.003
(648)	0.103	0.812	0.077	0.008	(648)	0.068	0.843	0.084	0.005
(648)	0.000	0.079	0.847	0.074	(648)	0.001	0.080	0.859	0.060
(648)	0.002	0.009	0.071	0.918	(648)	0.005	0.009	0.054	0.932
Germany				Greece					
	I	II	III	IV		I	II	III	IV
(648)	0.920	0.077	0.003	0.000	(648)	0.838	0.144	0.012	0.006
(648)	0.077	0.855	0.066	0.002	(648)	0.145	0.721	0.126	0.008
(648)	0.002	0.063	0.873	0.062	(648)	0.012	0.128	0.766	0.094
(648)	0.001	0.005	0.057	0.937	(648)	0.004	0.008	0.096	0.892
Ireland				Italy					
	I	II	III	IV		I	II	III	IV
(648)	0.883	0.100	0.012	0.005	(648)	0.949	0.049	0.002	0.000
(648)	0.099	0.790	0.102	0.009	(648)	0.048	0.853	0.096	0.003
(648)	0.015	0.104	0.801	0.080	(648)	0.003	0.096	0.864	0.037
(648)	0.003	0.006	0.085	0.906	(648)	0.000	0.001	0.039	0.960
Netherlands				Portugal					
	I	II	III	IV		I	II	III	IV
(648)	0.895	0.094	0.005	0.006	(648)	0.846	0.136	0.014	0.004
(648)	0.088	0.813	0.097	0.002	(648)	0.134	0.752	0.103	0.011
(648)	0.012	0.087	0.858	0.043	(648)	0.015	0.103	0.812	0.070
(648)	0.005	0.006	0.040	0.949	(648)	0.005	0.009	0.071	0.915
Spain									
	I	II	III	IV					
(648)	0.878	0.111	0.008	0.003					
(648)	0.108	0.770	0.113	0.009					
(648)	0.009	0.106	0.786	0.099					
(648)	0.005	0.012	0.094	0.889					

Note: The first column reports the total number of items-year observations beginning in each cell. I,II,III, IV represents the first, second, third and fourth quartile, respectively.

Our results reveal the strong persistence of industrial specialisations among the Euro area countries. Indeed, the largest values of the transition probabilities occur along the diagonal and are superior to 0.85 in Germany and Italy, 0.84 in BLEU and France and even superior to 0.72 in Greece and Portugal. This means for instance that the probability that an element move from on quartile to another between 1990 and 2008 is less than 15

% in Italy.

Besides, the highest values of diagonal elements concern the first quartile (I) and the fourth quartile (IV); this conclusion holds for all countries of our sample. It means that it is easier for countries to maintain a strong revealed comparative advantage than a medium one or a weak one. However, we can notice that Greece and Portugal display the lowest value on the diagonal of their matrix. Thus, the probability that one element from first quartile move to the second quartile is around 14 % in both countries. Those two countries have, therefore, known the biggest mobility of their industrial comparative advantages over the recent period. The study of the Balassa index thus confirms the strong persistence of industrial specialisations of industrialised countries. This conclusion contrasts with previous studies on emerging countries which highlighted a certain mobility of their industrial specialisation (Brasili et al. 2000; Zaghini 2005; Ferto 2007; Alessandrini and Batuo 2010).

The examination of technological advantages patterns lead to different conclusions. Indeed, table 3 reveals that there is, on average, a mobility of technological specialisations among the Euro area countries. Indeed, we can observe that the values of transition probabilities along the diagonal of the matrices are much lower than those corresponding to the Balassa index. This conclusion implies that technological advantages are less persistent than comparative advantages. Moreover, the highest values on the off-diagonal elements are recorded in Greece, Ireland and Portugal. Nevertheless, these observations have to be qualified. Indeed, those three countries present both the lowest values on the diagonal and the highest values among our sample at the first quartile (tertile). In fact, comparative advantages are concentrated on the first quartile (tertile) for those three countries. Indeed, more than e half of the distribution belongs to the first quartile (tertile). This phenomenon can be explained by the fact that those three countries display too few patents applications and have mainly comparative disadvantages in technological sectors. Even if there is a small mobility of their technological advantages, these countries still represent a very small share of world patents applications and have huge difficulties to develop new comparative advantages in technological intensive sectors.

Our results also reveal that the lowest values on the off-diagonal elements are observed for Germany, France, Italy and Netherlands. This confirms that the most technological advanced countries such as Germany or France have reinforced their position in sectors in which they already have comparative advantages and record the lowest mobility of their technological specialisation patterns. This finding is in line with a polarisation of technological activities in industrialised countries. However, results concerning Italy are more complex. Indeed, Italy is still specialised in low-medium technological sectors and exhibits stronger values than France on the diagonal of its transition matrix. These values range from 50 % to 70 % between 1990 and 2008. Italy is, therefore, one of the country for which technological advantages have been the most persistent. This contrasts with conclusions from Spanish transition matrix. Indeed, Spain and BLEU present the highest values on the off-diagonal elements of its matrix, if we exclude Greece, Ireland and Portugal. In these two countries, there is a strong mobility of technological advantages since 1990. Thus, the probability that a sector move from a quartile to another after 18 years ranges between 8 % and 23 % in Spain.

Table 3: 18-year transition matrices of Technological index (STCA)

Austria					BLEU				
	I	II	III	IV		I	II	III	IV
(558)	0.573	0.226	0.106	0.095	(558)	0.583	0.204	0.111	0.102
(540)	0.244	0.456	0.237	0.063	(540)	0.202	0.437	0.281	0.080
(558)	0.118	0.249	0.418	0.215	(558)	0.124	0.242	0.392	0.242
(540)	0.074	0.054	0.255	0.617	(540)	0.102	0.102	0.231	0.565
Finland					France				
	I	II	III	IV		I	II	III	IV
(560)	0.580	0.186	0.123	0.111	(558)	0.600	0.212	0.127	0.061
(538)	0.197	0.469	0.254	0.080	(540)	0.241	0.474	0.217	0.068
(558)	0.109	0.240	0.430	0.221	(558)	0.104	0.228	0.455	0.213
(540)	0.128	0.087	0.207	0.578	(540)	0.065	0.072	0.215	0.648
Germany					Greece				
	I	II	III	IV		I	II	III	
(558)	0.769	0.170	0.031	0.030	(1488)	0.806	0.012	0.182	
(540)	0.161	0.559	0.224	0.056	(60)	0.283	0.233	0.484	
(558)	0.050	0.208	0.550	0.192	(648)	0.416	0.044	0.540	
(540)	0.026	0.050	0.209	0.715					
Ireland					Italy				
	I	II	III	IV		I	II	III	IV
(1135)	0.714	0.017	0.098	0.171	(558)	0.692	0.188	0.082	0.038
(73)	0.301	0.164	0.343	0.192	(540)	0.198	0.504	0.235	0.063
(448)	0.264	0.072	0.424	0.240	(558)	0.072	0.233	0.502	0.193
(540)	0.339	0.018	0.226	0.417	(540)	0.046	0.061	0.195	0.698
Netherlands					Portugal				
	I	II	III	IV		I	II	III	
(558)	0.600	0.228	0.095	0.077	(1624)	0.837	0.005	0.158	
(540)	0.237	0.485	0.217	0.061	(35)	0.286	0.257	0.457	
(558)	0.093	0.215	0.477	0.215	(537)	0.459	0.033	0.508	
(540)	0.080	0.057	0.226	0.637					
Spain									
	I	II	III	IV					
(567)	0.541	0.200	0.129	0.130					
(531)	0.193	0.472	0.231	0.104					
(558)	0.127	0.228	0.430	0.215					
(540)	0.154	0.079	0.228	0.539					

Note: The first column reports the total number of items-year observations beginning in each cell. I,II,III, IV represents the first, second, third and fourth quartile, respectively.

Interpretations from the two mobility indices presented in table 4 confirm our previous conclusions.

Table 4: Mobility indices by country

Balassa index (SBI)			Technological index (STCA)		
	M_1	M_2		M_1	M_2
Greece	0.261	0.619	Ireland	0.760	0.992
Spain	0.226	0.551	Greece	0.710	0.930
Portugal	0.225	0.552	Portugal	0.699	0.920
Ireland	0.207	0.514	BLEU	0.674	0.980
Finland	0.176	0.451	Spain	0.673	0.972
Netherlands	0.161	0.422	Finland	0.648	0.968
Austria	0.155	0.408	Austria	0.646	0.973
France	0.147	0.388	France	0.607	0.955
Germany	0.138	0.368	Netherlands	0.600	0.953
BLEU	0.136	0.364	Italy	0.534	0.924
Italy	0.124	0.339	Germany	0.469	0.880

Note: Countries are ranked according the value of M_1 for each index

Industrial specialisation patterns in the Euro area countries present a strong persistence, whereas technological specialisation patterns which exhibit a strong mobility. As it is shown in the Markov transition probabilities matrices, Italy has experienced a strong mobility in both technological and industrial specialisation. Italy fails to develop new technological advantages and stays "locked" in its traditional specialisation. The lock-in effect is, therefore, verified for Italy and this country fails to converge towards the most developed countries of our sample such as France and Germany. It could explain why Italian firms lost export market shares on the international market over the recent past. They still export products with a low or medium added value and then have to tackle directly the competition with emerging markets. On the contrary, Spain displays high values of mobility indices for both specialisations. As a consequence, we can notice a strong mobility of its technological advantages characterized by a value of M_2 over 0.9. So, Spain has developed new comparative advantages, especially in high-medium technological sectors, allowing it to continue its convergence and to climb up the quality ladder. Our results also show a certain mobility of industrial specialisation in Greece and Portugal. However, those countries fail to develop activities in technological sectors and still present comparative disadvantages in those sectors. Interpretations of the two mobility indices also confirm the mobility of technological advantages in BLEU, Finland and Austria. On the contrary, the two biggest countries of the Euro area exhibit the lowest values for both indices, supporting the idea of a polarisation of activities in France and Germany (see e.g. Lallement et al. 2002).

5 Conclusion

This paper investigates the evolution of specialisation pattern of 11 Euro area members by analysing their comparative advantages as "revealed" by trade flows and patents applications over the period 1990-2008. Using the method developed by Pavitt (1989) and Cantwell (1989), the Markov transition probabilities and two indices of mobility, we find evidence that there is, on average, a high persistence in the industrial specialisation pattern among Euro area countries, confirming the theory of a lock-in effect developed in the theoretical literature. Comparative advantages are, therefore, mainly determined by

initial advantages. This conclusion is especially illustrated by the Italian case. Indeed, it is the only country which displays values of M_1 and M_2 lower than 0.13 and 0.34 for the Balassa index. It shows that Italian specialisation sectors have remained relatively constant during 1990-2008, which suggests a strong immobility of them. Italy did not tend to develop new comparative advantages and is still specialised in low technology sectors. Thus, the degree of industrial and technological specialisation of the country increase and its comparative and technological advantages are persistent. Italy still lags behind in terms of technological specialisation and the lowest mobility of its comparative advantages delays its convergence and the upgrading of its products quality. As a consequence, Italian products compete with those of emerging countries such as China or India, which benefit from a greater price competitiveness. On the long run, this could strongly affect Italian export performances on the global market.

On the contrary, Spain has developed new comparative advantages during the recent period, which could explain the rebound of Spanish exports. Indeed, its degree of specialisation has decreased and its technological advantages present a strong mobility since 1990. This supports the idea that the implementation of public policies on targeted sectors such as technological sectors allows to develop new comparative advantages in the country. Indeed, over the past decade, Spain has strongly increased its Research and Development expenditures and invested in high potential sectors (Chiappini 2011b). To a lesser extent, we also show that BLEU, Finland and Austria have developed new technological advantages.

We also find evidence that France, Germany and Netherlands have increased their specialisation in sectors in which they already had a comparative advantage in 1990. Indeed, these countries were already specialised in high and medium technology sectors in 1990. During the period 1990-2008, they have maintained and increased their positions in those sectors. Finally, Portugal and Greece exhibit high values of their mobility indices confirming mobility of their industrial specialisation. However, they still fail to develop new technological activities and remain specialised in low technological sectors.

References

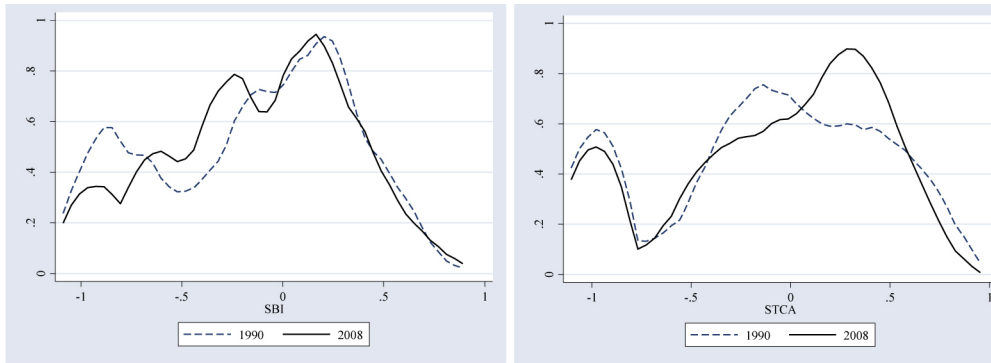
- Alessandrini, M., Fattouh, B., Scaramozzino, P. (2007). The changing pattern of foreign trade specialisation in Indian manufacturing. *Oxford Review of Economic Policy*, 23(2), 270-291.
- Alessandrini, M., Batuo, M.E. (2010). The trade specialisation of SANE: Evidence from manufacturing industries. *The European Journal of Comparative Economics*, 7(1), 145-178.
- Balassa, B. (1965). Trade liberalization and "revealed" comparative advantage. *The Manchester School of Economic and Social Studies*, 33(2), 99-123.
- Brasili, A., Epifani, P., Helg, R. (2000). On the dynamics of trade patterns. *De Economist*, 148(2), 233-257.
- Cantwell, J. (1989). *Technological innovation and multinational corporations*. Oxford: Blackwell Publisher.
- Chiappini, R. (2011a). Dynamique des spécialisations et performances commerciales des Pays d'Europe Centrale et Orientale. *Revue d'Etudes Comparatives Est-Ouest* 42(2), 165-193.
- Chiappini, R. (2011b). Comment mesurer la compétitivité structurelle des pays dans les équations d'exportation? *L'Actualité économique*, 87(1), 31-57.
- Dalum, B., Laursen, K., Villumsen, G. (1998). Structural change in OECD export specialisation patterns: de-specialisation and 'stickiness'. *International Review of Applied Economics*, 12(3), 423-443.
- Davies, D., Reeve, T. (1997). Human capital, unemployment, and relative wages in a global economy. *NBER Working Paper n° 6133*, National Bureau of Economic Research.
- De Benedictis, L., Tamberi, M. (2004). Overall specialisation empirics: Techniques and applications. *Open Economies Review*, 15(4), 323-346.
- Deardorff, A.V. (1974). Factor proportions and comparative advantage in the long run: Comments. *Journal of Political Economy*, 82(4), 829-833.
- Dornbusch, R., Fischer, S., Samuelson, P. (1977). Comparative advantage, trade and payments in a Ricardian model with a continuum of goods. *American Economic Review*, 67(1), 823-839.
- Ethier, W.J. (1979). Internationally decreasing costs and world trade. *Journal of International Economics*, 9(1), 1-24.
- Ethier, W.J. (1982). National and international returns to scale in the modern theory of international trade. *American Economic Review*, 72(3), 389-405.

- Ferto, I. (2007). The dynamics of trade in Central and Eastern European Countries. *Managing Global Transitions*, 5(1), 5-23.
- Figueiredo, E., Ziegelmann, F. (2010). The dynamics of the Brazilian income. *Economics Bulletin*, 30(2), 1249-1260.
- Findlay, R. (1970). Factor proportions and comparative advantage in the long run. *Journal of Political Economy*, 78(1), 27-34.
- Fujita, M., Krugman, P., Venables, A. (2001). *The spatial economy: Cities, regions, and international trade*. Cambridge: MIT Press.
- Grossman, G.M., Helpman, E. (1990). Comparative advantage and long-run growth. *American Economic Review*, 80(4), 796-815.
- Grossman, G.M., Helpman, E. (1991). *Innovation and Growth in the Global Economy*. Cambridge: MIT Press.
- Helpman, E. (1981). International trade in the presence of product differentiation, economies of scale and imperfect competition: A Chamberlain-Heckscher-Ohlin approach. *Journal of International Economics*, 11(3), 305-340.
- Helpman, E., Krugman, P. (1985). *Market structure and foreign trade: Increasing returns, imperfect competition and the international economy*. Cambridge: MIT Press.
- Kemp, M. (1969). *The pure theory of international trade and investment*. Englewood Cliffs: Prentice-Hall.
- Krugman, P. (1987). The narrow moving band, the Dutch disease and the competitive consequences of Mrs Thatcher: Notes on trade in the presence of scale economies. *Journal of Development Economics*, 27(1-2), 41-55.
- Krugman, P. (1991). *Geography and trade*. Cambridge: MIT Press.
- Lall, S. (2000). The technological structure and performance of developing country manufactured exports, 1985-98. *Oxford Development Studies*, 28(3), 337-369.
- Lallement, R., Mouhoud, E.M., Paillard S. (2002). Polarisation et internationalisation des activités d'innovation: incidences sur la spécialisation technologique des nations. *Région et Développement*, 16, 17-54.
- Lucas, R. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, 22(1), 3-22.
- Mancusi, M. L. (2001). Technological specialisation in industrial countries. *Review of World Economics (Weltwirtschaftliches Archiv)*, 137(4), 593-621.
- Markusen, J.R., Melvin, J.R. (1981). Trade, factor prices, and the gains from trade with

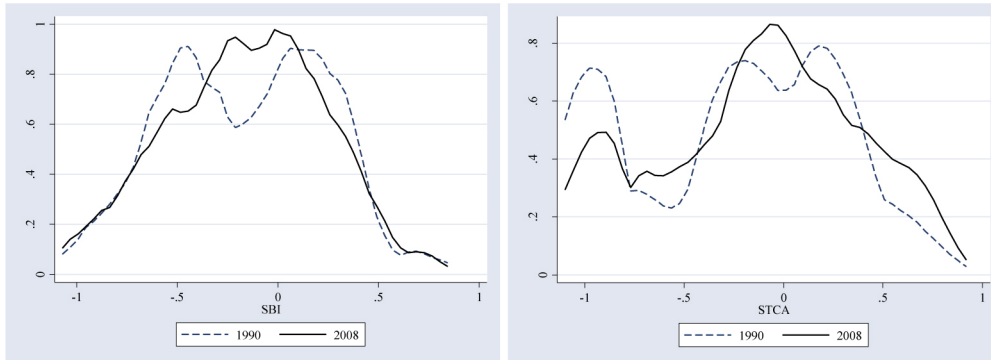
- increasing returns to scale. *Canadian Journal of Economics*, 14(3), 450-469.
- Narula, R., Wakelin, K. (1995). Technological competitiveness, trade and foreign direct investment. *Research Memoranda n°19*. Maastricht Economic Research Institute on Innovation and Technology.
- Patel, P., Pavitt, K. (1991). Large firms in the production of the world's technology: An important case of non-globalisation. *Journal of International Business Studies*, 22(1), 1-21.
- Pavitt, K. (1989). International patterns of technological accumulation. In N. Hood J.-E. Vahlne (Ed.), *Strategies in global competition* (pp. 126-151). London: Croom Helm Publisher.
- Proudman, J., Redding, S. (2000). Evolving patterns of international trade. *Review of International Economics*, 8(3), 373-396.
- Quah, D.T. (1993). Empirical cross-section dynamics in economic growth. *European Economic Review*, 37(2-3), 426-434.
- Quah, D.T. (1996). Empirics for economic growth and convergence. *European Economic Review*, 40(6), 1353-1375.
- Quah, D.T. (1997). Empirics for economic growth and distribution: Stratification, polarization and convergence clubs. *Journal of Economic Growth*, 2(1), 27-59.
- Redding, S. (2002). Specialisation dynamics. *Journal of International Economics*, 58(2), 299-334.
- Ricardo, D. (1817). *On the Principles of Political Economy and Taxation*. 3rd edition (1821), London: John Murray.
- Shorrocks, A. (1978). The measurement of mobility. *Econometrica*, 46(5), 1013-1024.
- Silverman, B.W. (1986). *Density estimation for statistics and data analysis*. London: Chapman Hall.
- Soete, L.L.G. (1981). A general test of the technological gap trade theory. *Weltwirtschaftliches Archiv*, 117(4), 638-666.
- Uchida, Y., Cook, P. (2005). The transformation of competitive advantage in East Asia: An analysis of technological and trade specialisation. *World Development*, 33(5), 701-728.
- Wong, K.-Y. (1995). *International trade in goods and factor mobility*. Cambridge: MIT Press.
- Young, A. (1991). Learning-by-doing and dynamic effects of international trade. *The Quarterly Journal of Economics*, 106(2), 396-406.

Zaghini, A. (2005). Evolution of trade patterns in the new EU member States. *Economics of Transition*, 13(4), 629-658.

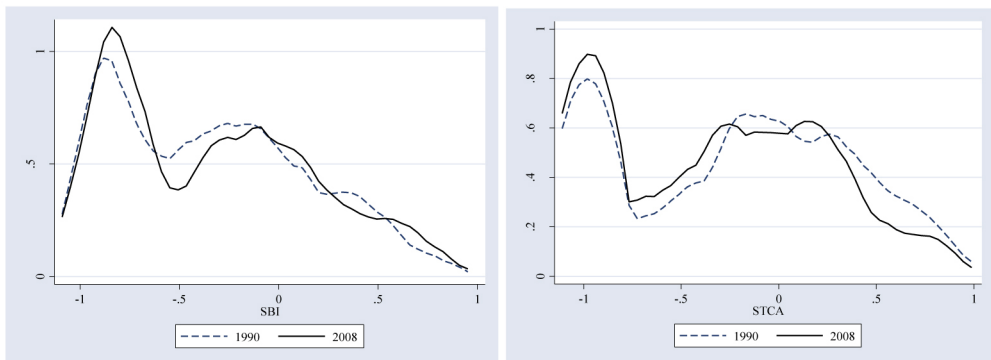
Appendix 1: Marginal densities of SBI and STCA in 1990 and 2008



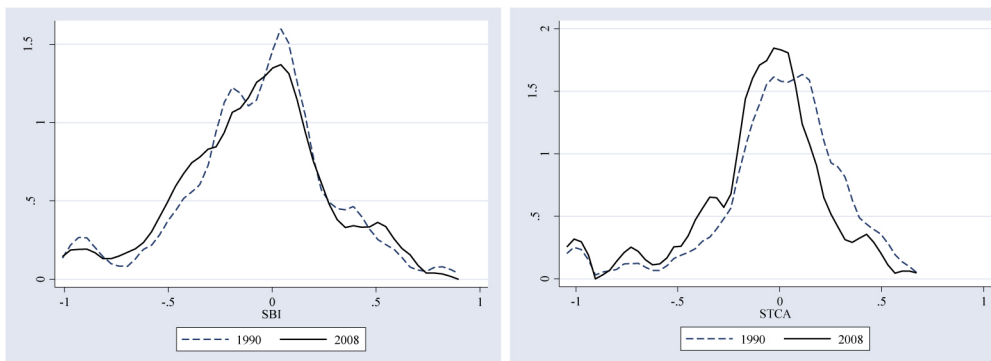
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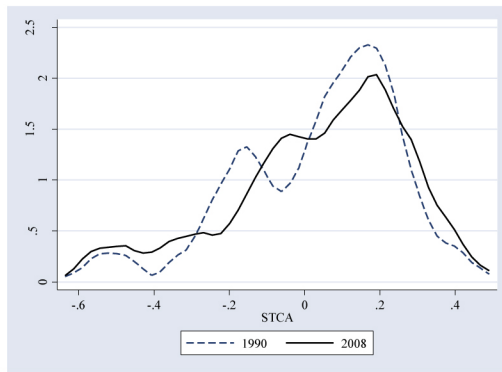
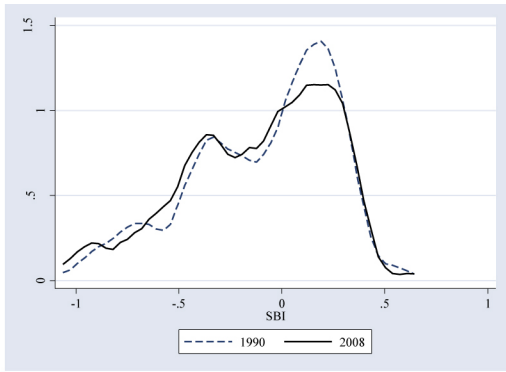
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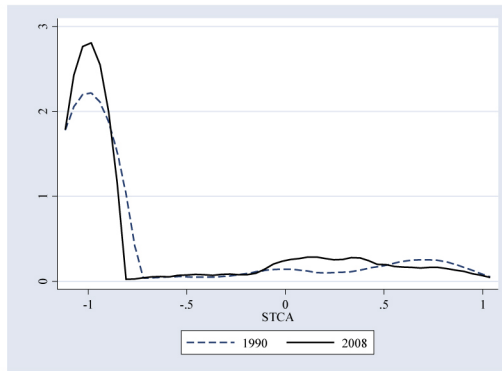
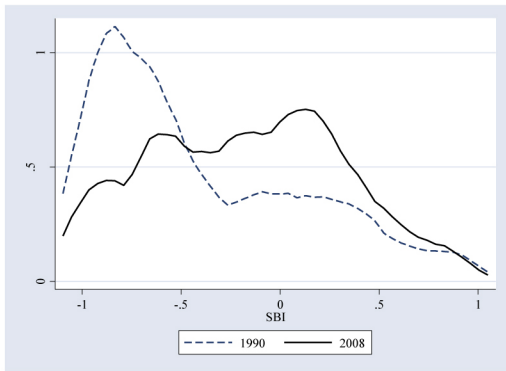
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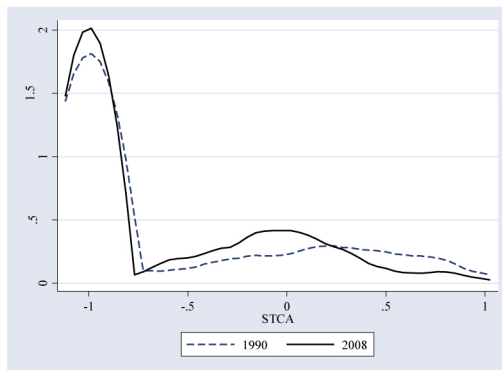
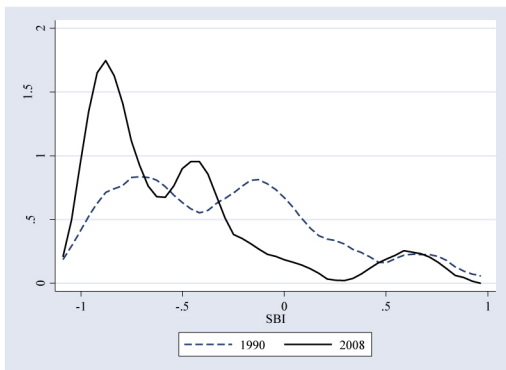
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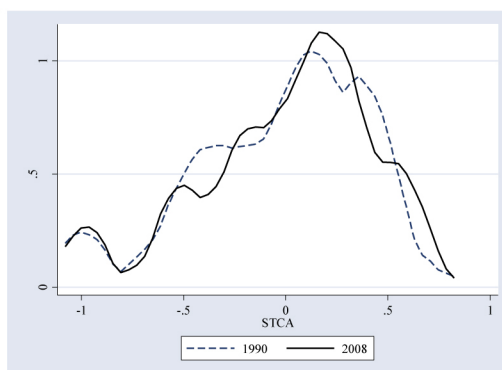
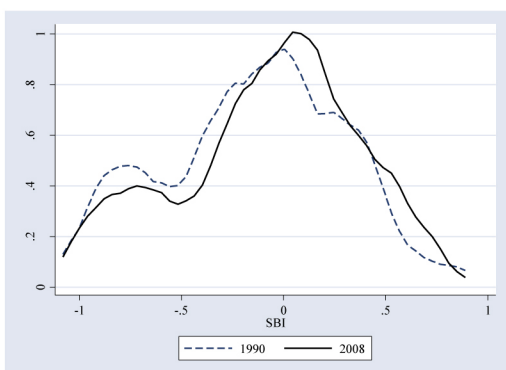
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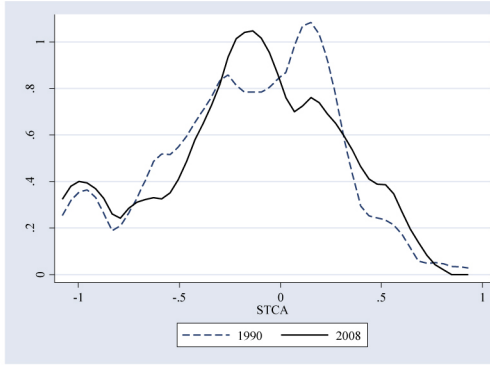
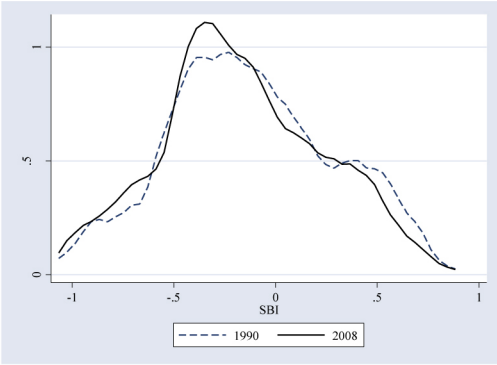
Greece



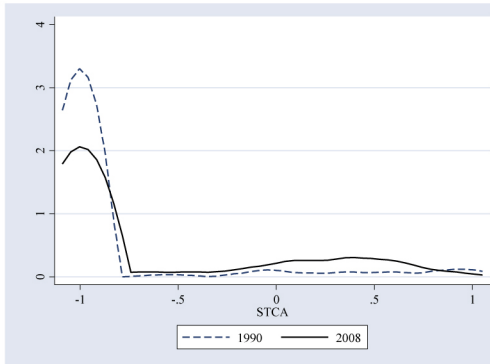
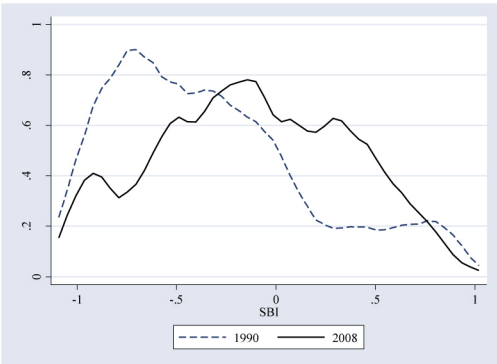
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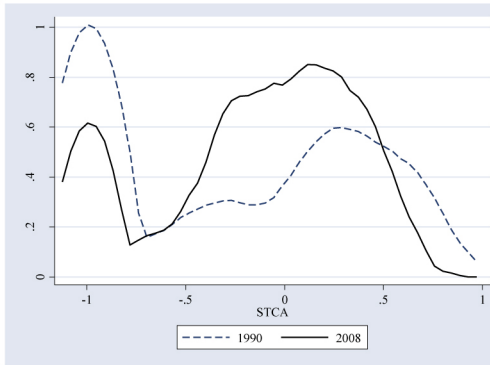
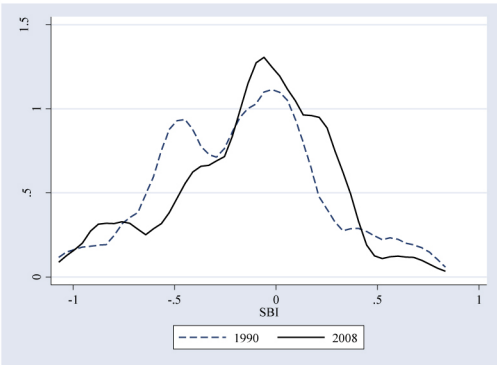
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RAPHAËL CHIAPPINI

Persistence vs. Mobility in Industrial and Technological Specialisations: Evidence from 11 Euro Area Countries