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The impact of the enlargement process on the export dynamics of the European Union

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Outline

- Introduction
- Theoretical background
- Methodology
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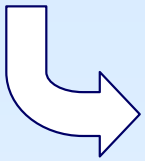
- Results
- Conclusions

- CEECs new EU member states (EU10) have faced as a major challenge the adoption of the *acquis communautaire* of the EU
- This institutional setting has been a leading factor in enhancing the overall economic performance of new EU members
- EU10 have been characterized by high dependence on low-technology sectors, with a strong structural divergence from EU15
- Concerns on a potential overall effect of the EU enlargement process bringing to improvement for EU15 export flows towards EU10 rather than increasing trade potential of EU10

- Increasing attention to the trade effects looking at specific sectors rather than total trade



- The idea that not just exports per se matter for growth but that the composition of exports (Feder, 1983) as well as the technology cintents (Guaresma and Worz, 2003) matters
- Recent contributions have focused on the large positive impact on economic growth depending on the specialization pattern of export flows in highly sophisticated products (Hausmann et al., 2007; Lall et al., 2006; Rodrik, 2006)
- International differences in technological and innovative capabilities play a fundamental role in explaining differences in both productivity and export competitiveness (Dosi et al., 1990; Fagerberg, 1994)

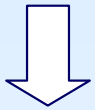
Aim of the paper

- Analyse the impact of the enlargement process on exports specialization, by including in a gravity model the role of technological innovation
- Shape the role of the stock of knowledge by using the number of patents granted for each sector classified by the OECD technology concordance
- Estimate a gravity model for four macro-sectors classified on the basis of their technological content
- Analyse the role of the enlargement process in forcing economic structures of new EU countries to be specialized into high tech productions

- Interactions in the global economy generate forces that may accelerate growth, as the exchange of technical information the diffusion of knowledge between technologically advanced countries and the followers (Grossman and Helpman, 1991)
- Export composition hardly influences differences in economic performance at the country level (Greenaway et al., 1999)
- Trade may prevent duplication in research efforts and promote the differentiation of innovations enhancing productivity and/or consumers' utility (Rivera-Batiz and Romer, 1991)
- Relative productivities at the country level vary substantially across industries, so that the sectoral technological specialization hardly affects export dynamics and consequently economic growth (Eaton and Kortum, 2002)

- Many empirical contributions has focused on the agri-food sector, since its relevance in the economy of EU10, while general analyses on trade patterns of EU10 related to the enlargement period are not frequent
- Structural features of new accession countries are so distant in some cases that the evolution of each country could be hardly dissimilar, so that empirical analyses should take into account carefully differences existing among EU10 (De Benedictis and Tajoli, 2006)
- There are very few contributions on technological innovation for Eastern European countries (Krammer, 2009) and more specifically on the linkages between technological innovation and catching-up in trade flows (Cavallaro and Mulino, 2008)

→ From previous empirical contributions, we assume that economic integration of EU10 countries into the European Union has brought to some extent to a convergence in the technological specialization patterns, and we want to investigate if these changes has influenced the export dynamics of EU member states



In particular, we investigate if the cohesion and convergence process has promoted export flows in high-technology sectors for the new member states, as a first sign of increasing productivity gains and positive externalities

- The gravity equation we have estimated for trade flows of the European Union countries is based on the Helpman (1995) factor based model, thus considering as dependent variable the export flows
- We have adopted a gravity model with countries fixed effects for shaping multilateral resistance terms (Anderson and van Wincoop, 2003)
- We have adopted the approach by De Benedictis et al. (2005) by including exporting and importing countries fixed effects, and a country-pairs time-variant trend variable (number of observations for the EU10 sample provides insufficient degrees of freedom for the estimation of 2NT dummies for unidirectional trade)

- We have adopted the two stages procedure proposed by Helpman et al. (2008), as the inclusion of a time-variant control variable for firms heterogeneity coming from a first stage *probit* selection equation (to correct for biases coming from zero export flows in the dataset, especially for the EU10 sample)
- In order to include a transaction cost variable related to firms heterogeneity that is not included among the regressors of the second stage estimation, we have decided to adopt the "Cost of Doing Business" variable provided by the World Development Indicators dataset
- We have addressed dynamics by including lags of our dependent variable, and endogeneity of the technological innovation variable by instrumenting it with lags by adopting a System GMM estimator (Blundell and Bond, 1998)

- The country sample considered is made of 24 exporting countries (the i_{th} countries):

✓ 14 old EU members (all EU15 members excluding Luxembourg)

✓ and 8 new CEECs member states (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic, Slovenia)

✓ and 145 j_{th} importing countries

- The time period is 1996 to 2007, thus allowing to include all EU15 as already existing EU member states, while considering only the CEECs as new members
- The full sample covers a total of 41.760 potential available observations, of which 24.360 for EU15 and 17.400 for EU10.

The final equation for our gravity model is given by:

$$x_{ijt}^{k} = \alpha_i + \delta_j + \pi i_{jt} + \sum_{p=1}^{n} \lambda_p x_{ij,t-p}^{k} + \beta_1 col_{ij} + \beta_2 cont_{ij} +$$

$$+ \beta_3 dist_{ij} + \beta_4 land_j + \beta_5 mass_{ijt} + \beta_6 simil_{ijt} +$$

$$+ \beta_7 endow_{ijt} + \beta_8 tecdis_{ijt} + \beta_9 fhet_{ijt}^{k} +$$

$$+ \beta_{10} enl + \beta_{11} kpat_{i,t-q}^{k} + \beta_{12} prod_{it}^{k} + \varepsilon_{ijt}$$

Variables:

$$mass_{ijt} = \ln\left(GDP_{it} + GDP_{jt}\right)$$

$$simil_{ijt} = \ln\left[1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}}\right)^2\right]$$

$$endow_{ijt} = \left|\ln\left(\frac{GDP_{it}}{POP_{it}}\right) - \ln\left(\frac{GDP_{jt}}{POP_{jt}}\right)\right|$$

$$ARCO_{it,jt} = \frac{1}{2}\left[\frac{1}{3}\left(\frac{\ln(TEL_{it,jt})}{\ln(TEL_{\max})} + \frac{\ln(INTERNET_{it,jt})}{\ln(INTERNET_{\max})} + \frac{\ln(ELECAP_{it,jt})}{\ln(ELECAP_{\max})}\right) + \frac{1}{2}\left(\frac{\ln(EDU_{it,jt})}{\ln(EDU_{\max})} + \frac{\ln(FDI_{it,jt})}{\ln(FDI_{\max})}\right)\right]$$

$$tecdis_{ijt} = \ln\left|ARCO_{it} - ARCO_{jt}\right|$$

- The knowledge stock is defined following the stock of knowledge function (Popp, 2002) considering only the accumulation factor and the related decay rate of the stock, while excluding the component related to diffusion

$$KPAT_{it}^{k} = \sum_{s=0}^{t} PAT_{is}^{k} e^{[-\beta_1 (t-s)]}$$

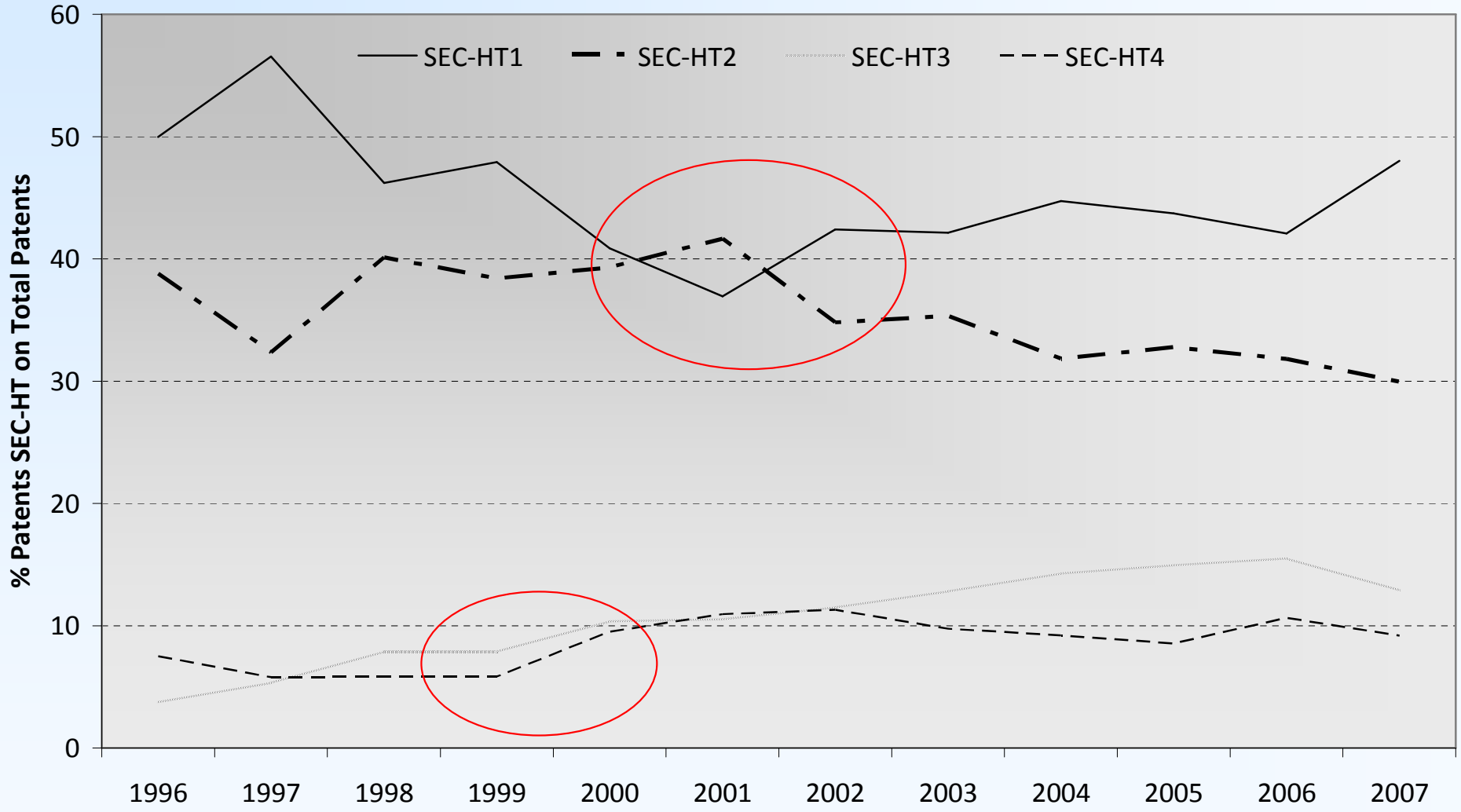
- PAT represents the number of patents produced by industry *k* in country *i* in year *s*, where *s* represents an index of years up to and including year *t*. β1 represents the rate of decay (a standard average value of 0.3)
- Statistics are taken from PATSTAT, and we have accounted only for EPO application.

Macro sector	Sector	ISIC Rev. 3	NACE	PATENTS FIELD
High-technology industries (SEC-TEC1)	1. Aircraft and spacecraft	353	35.3	43
	2. Pharmaceuticals	2423	24.4	13
	3. Office, accounting and computing machinery	30	30	28
	4. Radio, TV and communications equipment	32	32	34-35-36
	5. Medical, precision and optical instruments	33	33	37-38-39-40-41
Medium-high-technology industries (SEC-TEC2)	6. Electrical machinery and apparatus	31	31	29-30-31-32-33
	7. Motor vehicles, trailers and semi-trailers	34	34	42
	8. Chemicals excluding pharmaceuticals	24 excl. 2423	24 excl. 24.4	10-11-12-14-15-16
	9. Railroad equipment and transport equipment	352 + 359	35.2-35.4-35.5	44
	10. Machinery and equipment, others	29	29	21-22-23-24-25-26-27
Medium-low-technology industries (SEC-TEC3)	11. Building and repairing of ships and boats	351	35.1	45
	12. Rubber and plastics products	25	25	17
	13. Coke, refined petroleum prod. and nuclear fuel	23	23	09
	14. Other non-metallic mineral products	26	26	18
	15. Basic metals and fabricated metal products	27-28	27-28	19-20
Low-technology industries (SEC-TEC4)	16. Manufacturing, others; Recycling	36	36	46
	17. Wood, pulp, paper, paper prod., print. & pub.	20-21-22	20-21-22	06-07-08
	18. Food products, beverages and tobacco	15-16	15-16	01-02
	19. Textiles, textile products, leather and footwear	17-18-19	17-18-19	03-04-05

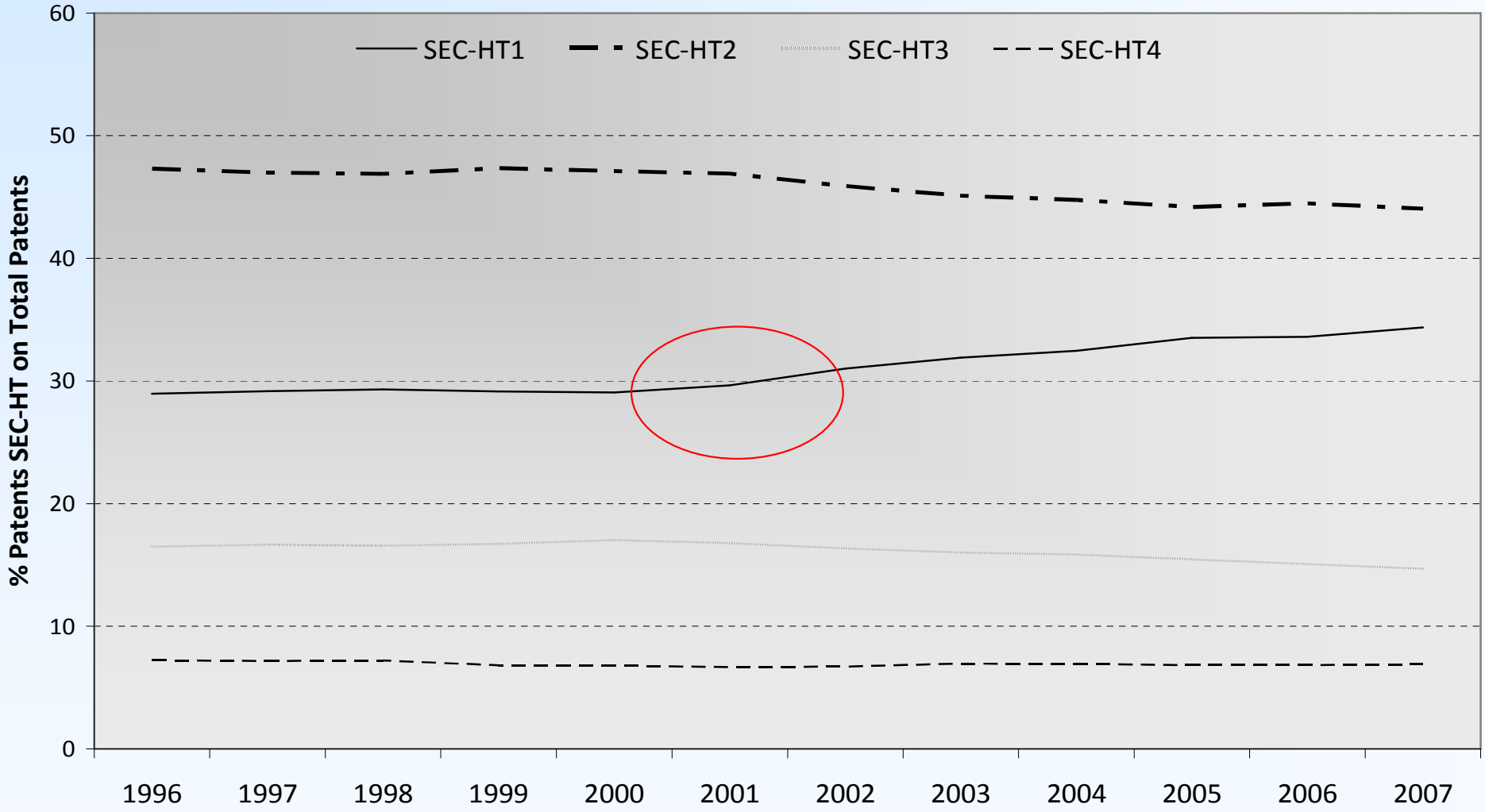
Some details on patents data…

- By using patents we avoid some of the pitfalls when using R&D expenditures (highly disaggregated for sectors and fully available also for CEECs)
- The year of the patent application is used since patents sorted by application years are closely correlated with R&D expenditures (Griliches, 1990)
- We use a stock of knowledge function instead of a pure patents count approach due to the empirical evidence that cumulative domestic innovative efforts is an important determinant of productivity and competitiveness (Coe and Helpman, 1995)

Technological specialization EU10 (1996 - 2006)



Technological specialization EU15 (1996 - 2006)



Effect on total trade of the enlargement process on EU25

	OLS	XTIVREG	XTIVREG-HMR	System GMM	System GMM-HMR
EXP_{t-1}	0.714***	0.584***	0.686***	0.433***	0.183***
COL	0.373***	0.606***	0.389***	0.767***	0.947***
CONT	-0.116***	-0.321***	-0.401***	-0.210	-0.174
DIST	-0.418***	-0.688***	-0.525***	-0.616***	-1.098***
LAND	0.000	0.012	-0.133***	-0.219***	-1.187***
MASS	0.777***	1.304***	0.543***	0.456***	0.799***
SIMILARITY	0.334***	0.323***	0.173***	0.523***	0.111
ENDOWM	-0.021***	-0.054***	0.100***	0.409***	0.954***
TECDIS	-0.079	0.083	0.666	-1.458***	-1.449***
FHET			0.558***		0.434***
ENL	0.121***	0.114***	0.213***	0.120***	0.164***
$KPAT_{t-1}$	-0.092**	-0.019	0.140***	0.252***	0.287***
R2	0.953	0.9122	0.9097		
WALD	451775.7	2.62E+06	233677.1		
F-STAT				125618.7	14736.82
AR(1)				-9.98 (0.00)	-12.87 (0.00)
AR(2)				1.22 (0.22)	-1.39 (0.16)
OBS	22,450	24,146	23,324	22,324	23,564

Effect on export flows of EU15 for different sectors

	EXP TOT	SEC-TEC1	SEC-TEC2	SEC-TEC3	SEC-TEC4
EXP_{t-1}	0.335***	0.256***	0.060	0.042	0.223***
COL	0.763***	1.329***	1.619***	1.876***	0.928***
CONT	-0.213	0.025	0.837	0.296	0.024
DIST	-0.423***	-0.400***	-0.702***	-0.578***	-0.402***
LAND	-0.580***	-1.021***	-0.585**	-1.059***	-0.398*
MASS	0.291***	0.721***	0.420***	0.736***	-0.212
SIMILARITY	0.293***	0.606***	0.868***	0.895***	-0.402***
ENDOWM	1.103***	-0.689***	-0.990***	-0.997***	1.210***
TECDIS	-1.626***	-1.761***	-1.138***	-2.100***	-0.411*
FHET	0.448**	0.521***	0.545***	0.457***	0.529***
ENL	0.189***	0.108***	0.074***	0.058*	0.081***
$KPAT_{t-1}$	0.219***	0.392***	0.129**	0.230***	0.159***
PROD		0.414***	1.076***	0.949***	0.479***
OBS	15,148	17,766	17,765	17,764	15,745
F-STAT	32698.91	9644.61	8679.57	5690.88	6512.82
AR(1)	-5.33 (0.00)	-10.67 (0.00)	-7.74 (0.00)	-10.66 (0.00)	-8.06 (0.00)
AR(2)	0.96 (0.33)	1.6 (0.67)	1.53 (0.13)	1.4 (0.16)	-0.35 (0.73)

Effect on export flows of EU10 for different sectors

	EXP TOT	SEC-TEC1	SEC-TEC2	SEC-TEC3	SEC-TEC4
EXP_{t-1}	0.154	0.312***	0.235***	0.175**	0.220
COL	1.195	0.094	1.097**	1.505***	1.082**
CONT	1.527	0.395	0.588	1.148	-0.740
DIST	-1.224***	-1.340***	-0.963***	-0.654***	-0.717***
LAND	-1.556***	-0.273	-0.681	-1.432***	-1.054*
MASS	1.852***	0.384*	0.131	0.849**	0.340
SIMILARITY	-0.194	1.076*	-0.127	0.520	0.847
ENDOWM	0.327*	0.559***	0.444***	0.123	0.394**
TECDIS	-2.654***	-3.149***	-2.830***	-2.554***	-2.358***
FHET	0.548**	0.621***	0.525***	0.857	0.569***
ENL	0.137**	0.387***	0.278***	0.353***	0.485***
$KPAT_{t-1}$	0.214**	0.146**	0.113**	0.084***	-0.010
PROD		0.435***	0.772***	0.483***	0.664***
OBS	8,416	6,657	7,045	5,764	4,224
F-STAT	925.99	995.46	1485.06	1010.33	1409.43
AR(1)	-8.46 (0.00)	-11.36 (0.00)	-11.15 (0.00)	-8.45 (0.00)	-7.51 (0.00)
AR(2)	0.42 (0.67)	2 (0.10)	-1.89 (0.12)	-1.8 (0.17)	0.84 (0.40)

- The coefficients for distance are much lower for the EU15 than for the EU10 at the general level, but the gap is quite larger corresponding to the high-tech sectors
- For EU10 trade barriers related to trade costs, in terms of transactional and sunk costs are still a great constraint for exporting goods with high economic value
- This result is reinforced by the higher values assumed by the coefficients associated to the lagged dependent variable, which is considered as a sign of a strong persistence in trade patterns and a proxy of the existence of sunk costs

- Results for similarity and relative endowment can be interpreted as a sign of the larger amount of intra-industry trade in the higher technological sectors for EU15
- For the EU10 coefficients for relative endowment reveal that different factor endowments bring to different specialization patterns, and inter-industry flows will be more important the greater the difference between countries in terms of their factor endowments
- Technological distance plays a crucial role for the export dynamics of both EU10 and EU15, but for EU10 countries it is important especially for the first two sectors, meaning that the specialization patterns toward high-tech sectors are strongly affected by differences in factor endowments and technological capabilities

- Looking at the technological upgrading process of the EU10, the impact of the stock of knowledge on the export dynamics is positive and it is favouring sectors with the higher technological contents
- The existing stock of knowledge for the EU15 has a rather larger impact on trade flows than for EU10, especially for high tech sectors
- High income levels and sophisticated demand patterns induce innovative responses of domestic firms. Per capita income levels in EU10 countries are still much lower than in the EU15, thus the domestic demand is still not sufficient to induce technological innovation and production specialization in highly sophisticated goods
- Integration into the EU single market does help to reach a wider market for high value goods

- ✓ The enlargement process has produced a positive impact on the export dynamics of the European Union
- ✓ This impact seems to be larger for new member states than for EU15
- ✓ Technological innovation plays a crucial role in explaining export performance of EU, more consistently for EU15 than for EU10
- ✓ If the enlargement process will bring to a gradual reduction of the technological gap between EU10 and EU15, new members could gain substantially in terms of international competitiveness in the high-tech sectors

Thank you for your attention!

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