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INTRA-EUROPEAN UNION TRADE OPENNESS AND NEW MEMBERS' OUTPUT CONVERGENCE: A TIME-SERIES ANALYSIS

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Abstract

The current literature on the 5th European Union (EU) enlargement shows widespread support of beta-convergence between old and new members but partial support in favour of stochastic convergence. In this paper, I try to assess whether this process may have been significantly facilitated by intra-EU trade using a range of cross-section or panel cointegration and causality tests. This is a possibility not accounted for in the standard neoclassical model, nor deeply investigated in the enlargement literature, but one which can potentially explain the differences researchers observe across countries. Preliminary evidence fails to confirm the predominant role of trade openness in stimulating output convergence suggested, at a more general level, by previous research.

Keywords: Trade openness; output convergence; time-series.

JEL codes: F15; O19; C22.

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1 Introduction

A natural question in the mind of the researcher investigating the degree of output convergence associated with the fifth EU enlargement, is whether this is a consequence of the ongoing integration process. The answer is not obvious, especially if thought of in terms of neoclassical[1] or endogenous[2] growth theories. This paper focuses on a process of integration characterized by a substantial degree of trade liberalization[3] and it is structured in four sections. Section 1 introduces the research, section 2 reviews the state of the "trade, growth and convergence" debate assessing its relevance in the context of an enlarging EU, section 3 proposes an original empirical methodology and presents results, section 4 concludes.

2 Related Literature

2.1 Trade, Growth and Convergence

In the literature of the last 20 years, there has been more theoretical endorsement of the importance of international trade in economic growth than in convergence - e.g Grossman and Helpman (1990) , Rivera-Batiz and Romer (1991), Ben-David and Loewy (2003), and no conclusive empirical support for either. The matter is controversial in that, extending models of growth that assume exogenous technology and allowing trade to be a channel for transmitting innovation, has often the effect of making technology endogenous. This last condition, breaks the assumption of diminishing returns to factors of production, therefore questioning the existence of steady state levels of capital or output. Catching-up between poor and rich countries cannot happen in such open economies[4].

Whether or not the theoretical argument is strong, empirical confirmation has also been difficult to obtain. The link with trade has been tested under a variety of different points of view and methodologies: Dollar (1992), Sachs and Warner (1995), Edwards (1992) focused both on the research of an optimal indicator of trade openness and on its relation with economic growth. In general, these authors suggest that trade can stimulate growth. On the other hand, there is also a significant branch of the literature dedicated to prove the opposite. All of the three last-mentioned papers were strongly challenged by Rodriguez and Rodrik (1999) on the main consideration that "measures of

[1]See Solow (1956) or Swan (1956).

[2]See Romer (1992).

[3]as has been the case for the 5th EU enlargement.

[4]Note that in bilateral models, where the rich country is the only donor of the spillovers transmitted by trade, it is reasonable to think that technology improves both endogenously and asymmetrically, facilitating convergence. This effect can be understood within North-South models as Dinopoulos and Segerstrom (2006) or Greenaway et al. (2002). However, if these countries also have a comparative advantage, the link between trade and convergence is less clear. For example, in the Heckscher-Ohlin model "permanent specialization and non-convergence [can] occur" (Chatterjiee and Shukayev, 2006). On the other hand, convergence is also a possibility as detailed by Bajona and Kehoe (2010) and - in presence of uncertainty - by Chatterjee and Shukayev (2006).

trade barriers are often correlated with other growth-inhibiting factors" and "trade policy indicators that have been used in the empirical literature are not particularly good"[5] . In a more recent paper, Rodriguez (2007) also responds to comments[6] on his original 1999 critique and the contributions of Wacziarg and Welch (2003) , Warner (2003) and Dollar and Kraay (2004). He maintains the view that the new evidence still does "not alter the conclusion that standard measures of trade policies are basically uncorrelated with growth". At the same time, Perraton (2011) expresses concern on methodological issues and dissatisfaction with modelling strategies adopted in the trade–growth literature in general.

Empirical research focusing on trade and convergence brings mixed results. Ben-David (1993) tests convergence before and after trade liberalizations, and endorses the positive role of the second over the first. Gaulier (2003) however, argues that Ben-David (1993) evidence is weak. Further, Kelly (1992) and Leung and Quah (1996) suggest that convergence can occur even under increasing returns to scale but also note that it would be rather "perverse" to use endogenous growth theory to explain this finding, since e.g. Lucas (1988) or Romer (1992) were written precisely to explain large gaps between rich and poor countries. Slaughter (1997) excludes a link between trade and convergence.Serranito (2009) finds evidence of divergence in per capita income for the vast majority of developing countries by capturing nonlinear effect of trade on growth. Deardorff (2001) shows that an open economy neoclassical model can, at best, predict "club convergence"[7]. Finally, Cunat and Maffezzoli (2007) reach similar results using the Heckscher-Ohlin model.

Among all these options, I will borrow some ideas[8] from the Ben-David (1993) approach, and the later Rodriguez and Rodrik (1999) and Rodriguez (2006) critiques. The first author uses, as theoretical background, the factor prices equalization theorem (FPE) by Samuelson (1964) and Helpman and Krugman (1985). He also refers to the neoclassical growth theory as a source of explanation for convergence, when trade has no impact on reducing income disparities among countries. In a later paper, Ben-David and Loewy (2003) augment the Solow approach to take into account the impact of international trade developing, de facto, an endogenous growth alternative[9]. The second attempt has greater relevance in our particular context but has the limits discussed above with reference to endogenous growth theory. On the other hand, the Ben-David (1993) approach, is mainly empirical. It focuses on measuring the state of convergence in two post-liberalization and pre-liberalization sub-periods with reference to EU countries after the second World War, between 1950 and 1985. In contrast to the experience of the founding countries, the process of trade liberalization followed by the new members of the EU in the last 10 years has been relatively smooth with no clear break date. Moreover, country-specific accession agreements, were negotiated on individual bases[10].

[5] See Dollar and Kraay (2004).

[6] See for example Jones (2001).

[7] i.e. at best multiple steady states / a "a poverty trap".

[8] See section 2.2.1.

[9] Trade becomes technology-enriching, so that the latter is not exogenous to the model anymore.

[10] Note this consideration does not exclude the possibility that intra-group trade may have increased

In this context it is obviously challenging to identify a unique divide between liberalization and non-liberalization making this part of Ben-David's methodology difficult to replicate[11].

2.2 Trade and Convergence in the EU

Since part of the existing research confirms some degree of convergence between old and new members[12], the considerations above suggest the fifth round of EU enlargement offers an opportunity to test the impact of trade on output. Investigating the role of trade can also give some indications of whether the process of integration between the old EU members and the new eastern European economies, stimulated convergence between these groups of countries.

2.2.1 A closer look at Ben-David (1993)

The choice of Ben-David (1993) was to use the sigma-convergence[13] concept to measure income dispersion during the initial pre and post trade liberalization periods of the EU6[14]. However, the time-series literature has developed an alternative formulation of convergence introduced by Bernard and Durlauf (1995). The aim of this section is to link the two perspectives, adding additional elements to Rodriguez and Rodrik (1999). The original Ben-David (1993) argument can be re-interpreted as following:

Firstly, the central argument of Ben-David is that, following TFP arguments in Balassa (1964) and Samuelson (1964), when the degree of trade liberalization increases then convergence should occur. Following this logic, when convergence is confirmed among a set of liberalizing countries, if we can exclude other factors, then its determinant should be free trade. Starting from the assumption that a set of countries liberalised at a set point in time, the only thing that is left is measuring convergence. However, if this assumption of simultaneous trade liberalisation is difficult to substantiate simply by looking at historical policy changes, it is still possible to measure the degree of effective trade expansion[15]. This is not what Ben-David was doing in his original paper but, given the higher heterogeneity in the timing of their trade agreements with the old EU members, it seems the better option for the new members[16] (NMS8). Further, if the point of interest is trade as a vehicle of knowledge and innovation, then it is irrelevant if its expansion is a consequence of liberalization or not. Introducing this variation of the original framework, I can also use time-series techniques and test the direction of a potential causal relation between GDP per capita and trade openness.

during the period under investigation. See e.g. Spies and Marques (2009).

[11] I will see later that, in these circumstances, it is more convenient to focus on trade volumes. Much of Ben-David contribution, however, is still useful to our research, as detailed in next sections.

[12] See Ingianni and Zdarek (2009) for an overview or Figure (1) on beta/sigma-convergence.

[13] i.e. the decline in time of the variability of output across a set of countries is seen as convergence. For its relation with beta-convergence see e.g. Young et al. (2007).

[14] Belgium, France, Italy, Luxembourg, the Netherlands, and Germany.

[15] measured using the conventional indicator of openness given by total trade over output as in Frankel and Romer (1999).

[16] Lithuania, Latvia, Estonia, Czech Republic, Slovakia, Polonia, Hungary, Slovenia

Secondly, Ben-David (1993) uses the dispersion of relative income as a measure for convergence (sigma-convergence). The link between relative incomes can be explored more generally in terms of its long-run dynamics using the concepts of stationarity and cointegration as suggested by Bernard and Durlauf (1995) and Bernard and Durlauf (1996).

Finally, if the process of liberalization is diffused in time[17], it can be sufficient to observe that the degree of trade expansion[18] and the output are moving in the same direction (i.e. sharing a long-run / cointegrating relation) and that the direction of causality between the two variables goes from the first to the second. I refer to the last concept as "smooth" trade liberalization. In the next sections I try to apply this approach to the EU enlargement.

2.2.2 Relevance to the EU enlargement

As already mentioned[19], some research on the state of convergence in the new member states during the last decade exists. If this period is seen as subdivided into pre- and post-liberalization episodes, then the results of these studies can be interpreted, in the Ben-David (1993) view, as positive or negative evidence of the impact of trade on convergence.

However, some Ben-David (1993) original intuitions cannot be applied to our particular case. His context differs from the enlargement context in the consideration of at least other four points. At the time he considers:

1. Convergence in the EU was a new trend emerging after the liberalization.
2. Countries not joining the free-trade agreement did not experience the same levels of convergence with the EU liberalising countries.
3. Other not-integrated economies around the world did not experience the same levels of convergence among themselves in the same period of time.
4. The contribution of other factors to EU convergence was not as relevant as trade liberalization.

The first three were explicitly criticized by Rodriguez and Rodrik (1999); we are going to analyse their relevance for the EU enlargement.

The general consideration is that, since it is difficult to identify a pre- and post- liberalization period in the last decade for the new members, it is also difficult to test condition (1) exactly in the same way as Ben-David (1993). An alternative could be expanding the period of time under investigation (e.g. pre 90s) although empirically it represents

[17] i.e. making it difficult to clearly identify a pre- and post-liberalization stage

[18] Note the assumption here is trade expansion follows from liberalisation. This is not binding for my research, since its interest is not what determines trade but how its effective expansion influences convergence. On the other hand, I am keeping the assumption in the next section to guide the reader in the comparison of my approach to existing research.

[19] See the beginning of section (2.2).

a big challenge[20]. The Rodriguez critique focuses on setting the beginning of long run convergence to the pre-liberalization era. It is argued that it is the choice of countries in the original empirical exercise that biases its final results. Clearly, the context is very specific and it is likely that the critique is not relevant to other applications. I also note that, in the light of existing literature on convergence, it makes sense to test for a trend in convergence using a different approach than measuring the long-run dispersion in per capita output[21]. An often used alternative, which I am going to use in the next sections, is cointegration.

Regarding point (2) Rodriguez and Rodrik (1999) argue that Ben-David (1993) measures convergence using the group of non-liberalizing instead of the liberalizing countries as a benchmark. Following a strictly "neoclassical" perspective, discriminating between the two may be conceptually difficult, if we assume multiple steady states are associated with one choice. Empirically however, it would be possible to follow Rodriguez suggestions. For example, Bernard and Durlauf (1995) time-series technique is particularly flexible in accommodating multiple steady states. An alternative solution proposed by Rodriguez and Rodrik (1999) is a simple correction of the sigma statistic. In the case of the EU enlargement case, finding an alternative set of benchmark countries, would probably mean relying on Eastern non-European economies[22].

Point (3) is criticized by Rodriguez on empirical grounds, mainly on the consideration that there is "asymmetry in [the] selection of diverging and converging areas". Convergence and divergence is seen as a function of geographical distance and the original conclusion is reversed when looking at East Asian and Latin American countries. As usual, I note that convergence can be measured using a different methodology. Moreover, trying to prove (3) in our context would mean extending the Ben-David analysis to the 1995 - 2006 period, with potential empirical difficulties.

Point (4) is one of the strongest assumptions of Ben-David and must be considered carefully. In particular, in the case of the EU enlargement, there might be other factors, which were not fully relevant for the old members of EU (FDI, migration, labour mobility, reallocation of production units, etc...) - see for example Ghatak et al. (2009).

3 Empirical Analysis

This section aims to address some of the issues discussed above by introducing an alternative empirical methodology. This is applied to the fifth EU enlargement, with results reported in section (3.2).

[20] For example under the perspective of data availability, reliability and disaggregation for accession countries.

[21] This is a Ben-David (1993) choice that is not disputed by Rodriguez and Rodrik (1999)

[22] which did not benefit from free trade agreements in the period 1995 - 2006

3.1 Methodology

An interesting exercise, which is not explicitly considered in the literature cited above, consists of testing the relation between trade and output using causality tests. This is a commonly applied methodology in empirical work based on time-series data - see e.g. Liu (2009), and I believe it can help the debate[23].

As in the case of regressions-based exercises, the choice of a meaningful indicator for trade openness is an important, preliminary issue. Among the existing alternatives mentioned in section (1), I note that the case of NSM8 countries offers little choice. Dollar (1992) real exchange rates distortion and variability indexes should be avoided because the heterogeneous transition towards fixed exchange rates (ERMII) of the countries under investigation. The Sachs and Warner (1995) or modified Wacziarg and Welch (2003) dummy can be calculated only assuming a reliable measure of all its components[24] is readily available for all new member states. Similar difficulties arise for all the nine openness indicators surveyed by Edwards (1998). The most convenient choice appeared to be using an indicator similar to Frankel and Romer (1999) and relate per capita income with trade share (to EU) in the eight new members. Note that this paper has been criticized by Rodriguez based on considerations similar to what I reported in section 2.2.2 point (3). However, the methodology I am using is quite different and unaffected by geographical components[25], so I calculate the degree of openness as the ratio of import and exports over GDP for every country.

With reference to this indicator, I propose a three-steps testing procedure.

Firstly (**Step 1 or S1**), I test for cointegration[26] between openness and per-capita GDP. For individual countries, a single relation between these two variables implies they share a long-run relation (a stochastic trend).

Secondly (**Step 2 or S2**), I test for causality[27] between openness and per-capita GDP. This allows me to understand whether the long run relation identified in step 1 (S1) is driven by the first or the second variable[28]. This way I can determine whether, in each of the new EU members, current values of their per capita GDP are determined by past levels of intra-EU openness or vice-versa.

Finally (**Step 3 or S3**), I test for cointegration between new EU members' individual per-capita GDP and the EU15 average GDP. If also this last condition is satisfied, new members are stochastically converging to old members (S3) and convergence is caused

[23] See also Zaman (2008).

[24] Average tariff rates, non tariff barriers as % of imports, socialist economic system, state monopoly of exports, black market premium during the 70s and 80s.

[25] An alternative way of extending the analysis considering the role of distance as long as the geographical diversification of intra/extra regional trade, would be using some indicators of revealed trade preferences / relative geographic diversification and correcting for bilateral trade differences as recently proposed by Iapadre and Tironi (2009).

[26] I follow Johansen (1991).

[27] I will use Granger (1969) as detailed below. Note that in this context it may also be relevant to consider the Mosconi and Giannini (1992) or Yamamoto and Kurozumi (2006) tests for non-causality. See also Granger (2001).

[28] Note that it is also consequence of the Engle-Granger representation theorem that, if cointegration exists, there must be causality between the two variables.

by trade openness (S1 + S2).

I repeat these three steps for all eight new members and I also look at aggregated results using panel-data cointegration and causality tests. Results will be discussed in section (3.2). Before progressing however, it is important to discuss formally the way I use the concept of causality.

My reference framework is Granger (1969). Consider the unrestricted VAR(p):

$$y_t = A_i y_{t-1} + A_2 y_{t-2} + ... + A_{p-1} y_{t-(p-1)} + A_p y_{t-p} + Bx_t + \varepsilon_t \tag{1}$$

with $\underset{(1,k)}{y} = [y_1, y_2, ..., y_k]$ a vector of dependent variables[29], $\underset{(1,d)}{x} = [x_{1,}, x_2, ..., x_d]$ a vector of deterministic components[30], A_j the coefficient for the lagged y_{t-j} and ε_t a random innovations vector.

In differences - i.e. a DVAR(p):

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + \varepsilon_t \tag{2}$$

where I define $\Pi = \sum_{i=1}^{p} A_i - I$, $\Gamma_i = -\sum_{j=i+1}^{p} A_j$.

If the dependent variables are stationary, i.e. $\underset{(1,k)}{y} \sim I(0)$, Granger (1969) suggests to use an F-test, with reference to the null hypothesis that the l^{th} variable (y_l) does not cause the m^{th} variable (y_m) in the $\underset{(1,k)}{y}$ vector, with $l = 1, ..., k$ and $m = 1, ..., k \neq l$. Formally:

$$\begin{cases} \Gamma_{i,lm} = 0, \forall i = 1, 2, ..., k-1 \\ \Pi_{lm} = 0 \end{cases}$$

Note also that since I assume the rank of Π is greater than zero ($r(\Pi) = \tau > 0$), by definition I can rewrite:

$$\Pi = \alpha\beta'$$

where both α and β are $kx\tau$ parameter matrices.

If the dependent variables are non-stationary - i.e $\underset{(1,k)}{y} \sim I(1)$, the test can proceed only if these are cointegrated[31]. This condition is ensured by imposing the appropriate restriction to the matrix $\Pi = \alpha\beta'$, and transforming the unrestricted DVAR (2) into the following VECM[32]:

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[29] For example, openness and GDP for one of the eight new EU members.

[30] Assumed stationary for simplicity.

[31] this is important to rule out spurious regressions

[32] de facto a restricted DVAR itself

$$\Delta y_t = \alpha\beta' y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + B x_t + \varepsilon_t$$

where $1 < r(\alpha\beta') < k$ to ensure cointegration[33]. Note that β is a matrix such as its columns are now the coefficients of stationary combinations of the series in $\underset{(1,k)}{y}$ (i.e. cointegrating vectors), formally $\beta' \underset{(1,k)}{y} \sim I(0)$. Stating the null of non-causality is only a matter of taking into account the restriction on the Π matrix:

$$\begin{cases} \Gamma_{i,lm} = 0, \ , \forall i = 1, 2, ..., k-1 \\ \Pi_{lm} = \sum_s \alpha_{ls}\beta_{sm} = 0 \end{cases} \tag{3}$$

Since the VECM is a system of equations with (non-linear) cross-equation restrictions on their coefficients, the major issue is the estimation of β_{sm}. This is needed for testing the null (3) using F-tests and to calculate their asymptotic distribution, that, now, would be non-standard.

In particular circumstances however, an alternative solution is pre-testing for cointegration between the variables of the $\underset{(1,k)}{y}$ vector, and then run a non-causality test based on the unrestricted VAR(p).

For example, Sims et al. (1990) show that in trivariate systems the Wald F-test for causality is asymptotically chi-squared if cointegration is present and involves the variable that is excluded under the non-causality null.

More generally, Toda and Phillips (1993) show that, causality-testing asymptotics are chi-squared when the sub-matrices of α and β that are "relevant under the null"[34] have full rank.

Finally and most importantly, as Konya (2004) notes, this is assured in the bivariate cointegrated case[35] and Wald tests in a levels VAR are therefore asymptotically chi-squared.

My three steps procedure, only needs testing for causality in a bivariate system[36], so I can afford to use the VAR(p) in (1), once I rule out non-cointegration.

Alternative methods for testing causality exist and include, simple AR systems, instantaneous systems and linear feedback as in Geweke (1982). The latter allows the decomposition of the linear dependence between two generic variables x and y into three forms of linear feedback: from x to y, from y to x, and "instantaneously" between x and y. The advantage is not only the ability of identifying a causal relation between the two

[33] Note that this idea is the basis of the Johansen's test. A test on the rank of an estimated Π matrix, allows to capture signs of cointegration among the variables in $\underset{(1,k)}{y}$. Differently here, cointegration is imposed restricting the rank of Π to avoid spurious regressions.

[34] See equation (3).

[35] This the context of causality that is required, for example, in Table (4).

[36] I either test for causality between openness and gdp country by country or between one country GDP and the EU15 average.

variables but also the degree of feedback (strength of relation) between them. A detailed survey based on this approach is available in Granger (2001). Further investigation in this sense would certainly be beneficial to explore the magnitude of causality and I note it as a potential area for future research.

Additionally, my testing framework so far allows only to look into individual countries[37], whilst it may also be interesting to explore the NMS8 group as a whole. It is possible to maintain the reference to a bivariate system by using panel-data techniques.

Recently Hurlin (2008) and Dumitrescu and Hurlin (2012) proposed a test for Granger non-causality in heterogeneous panels which should serve our purpose. Abandoning the matrix notation and with reference to two generic non-stationary but cointegrated variables x and y[38], he starts estimating the following simple[39] model, with reference to a group of countries $n = 1, 2...., N$ at time $t = 1, 2, ..., T$:

$$y_{n,t} = \alpha_{n,0} + \sum_{i=1}^{L} \alpha_n^{(i)} y_{n,t-i} + \sum_{i=1}^{L} \beta_n^{(i)} x_{n,t-i} + \varepsilon_{n,t}$$

where $\beta_n = [\beta_n^{(1)}, ..., \beta_n^{(L)}]'$ and suppose the individual effects $\alpha_{n,0}$ are fixed for simplicity. The author tests the null hypothesis of homogeneous non-causality (HNC) against the alternative of causality still allowing for potential non-causality for some (not all) units. Formally:

$$H_0: \quad \beta_n = 0\,, \forall i = 1, 2, ..., N$$
$$H_1: \quad \begin{cases} \beta_n = 0 & \forall i = 1, 2, ..., N_1 \\ \beta_n \neq 0 & \forall i = N_1 + 1, N_2 + 2, ..., N \end{cases}$$

where N_1 unknown but $0 < \frac{N_1}{N} < 1$. Note that when $N_1 = N$, H_1 is in fact H_0 and there is no-causality for all the members of the panel (HNC). If $N_1 = 0$ there is causality for all members of the panel (HC). The test statistic is calculated averaging the individual Wald statistics for every country:

$$S_{N,T}^{Hnc} = \frac{1}{N} \sum_{n=1}^{N} S_{1,n}$$

following a similar methodology used in panel unit-roots tests by e.g. Im et al. (2003) or Pesaran (2007) . Critical values (5%) are either stochastically simulated from 50.000 replications or approximated from a standardized $\widetilde{Z}_N^{Hnc}$ statistic[40]. Monte-carlo simulations are available in the paper and show the test has good power in finite samples

[37]e.g. I can afford to test causality between openness and per capita GDP as required by S2, one country at the time.

[38]These will be substituted with GDP and trade openness, later on in our application.

[39]These are presented here for ease of comparison with the panel equivalent discussed at the end of this section.

[40]See Hurlin (2008) for further details.

Table 1: [S1] Long-run dynamics: multicountry OPN, GDP.

	LT°	**LV°**	**EE°**	**CZ°**
None	23.17722	23.87522	13.48084	18.08383
At most 1	0.002391	0.681248	0.155566	0.107913
Reject: H0 None	1%	1%	5%	1%
Reject: H0 AT1	N.R.	N.R.	N.R.	N.R.
Coint. Rels.	1	1	1	1
	SK	**PL°**	**SI**	**HU**
None	10.81877	14.30869	12.76467	7.328329
At most 1	0.020087	0.720219	4.223345	2.930365
Reject: H0 None	N.R.	5%	5%	N.R.
Reject: H0 AT1	N.R.	N.R.	5%	N.R.
Coint. Rels.	unknown	1	>1	unknown

Note: N.R. not rejected. 1% critical values: 16.31 (none), 6.51 (AT1). Source: author's calculations.

$(T = 10, 25, 50)$.

3.2 Results

Having introduced my three steps procedure in section 3, I present the results of an application to the eight countries involved in the first step of the fifth European enlargement, based on datasets from the IMF Directions of Trade Statistics and Eurostat New Chronos and UN Population Division. Before progressing, in Figure (1) I provide an impression of a similar exercise using simple regressions in the context of beta/sigma-convergence. The outcome is easy to read, with the first two pictures showing clear signs of catching-up[41] and a scatter diagram unable to capture any correlation between trade openness in the area. We will see how, testing for stochastic convergence, leads to a different evidence.

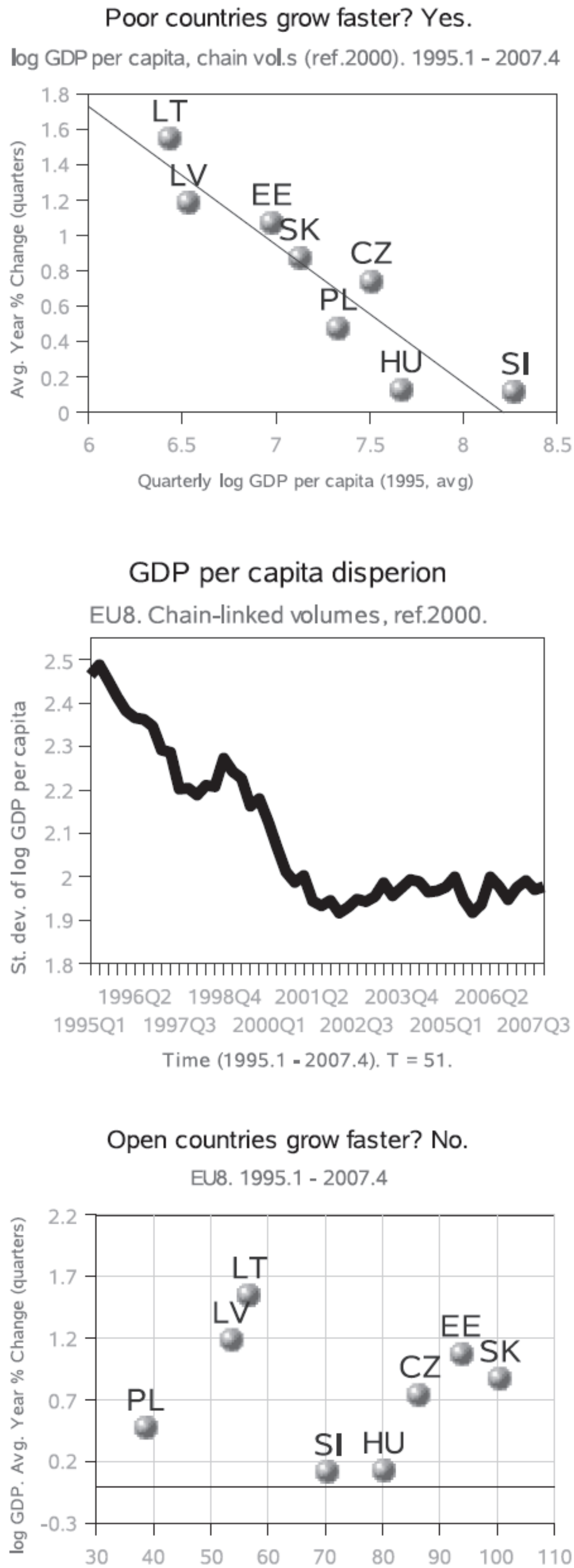
My cointegration results for **Step 1** (**S1**) are reported in Table 1 for single countries. In Tables 2 and 3 I repeat the exercise for the aggregated NSM8 group using panel data[42]. In the last case, it is interesting to note that the Pedroni (1999) tests show how the unit-root in the residuals is rejected only between units. Therefore, I can assume the roots are below unity but not the same[43] in all countries. This behaviour is reflected in the results of the disaggregated exercise, showing how the relation between OPN and GDP exists, but it is not very strong across the NSM8s.

Disaggregated causality results for **Step 2** (**S2**) are summarised in Table 4. Series were deseasonalised before testing and the test is run only between variables that are cointegrated according to **S1**[44].

For CZ, PL, LV and SI, I reject the null of openness not causing GDP per capita. In

[41] A negative coefficient for β and dispersion of GDP per capita diminishing in time.
[42] i.e. I create a 52x8 panel, where new members make the longitudinal dimension.
[43] I reject the null in the within-dimension.
[44] For this reason, I exclude Hungary and Slovakia.

Figure 1: Trade Openness and Catching-up



Source: author's calculations.

Table 2: [S1] Panel cointegration tests (Johansen based): OPN, GDP

H_0	**Fisher/Trace**	**P-value**	**Fisher/max-eigen**	**P-value**
None	43.13	0.0003*	39.14	0.0010*
At most 1	18.54	0.2935	18.54	0.2935
Coint. Rels.	1		1	

(*) Rejection at 5%. Critical values: Maddala and Wu (1999), combining Fisher (1932) and Johansen (1991, 2001) Source: author's calculations.

Table 3: [S1] Panel Cointegration (Engle-Granger based): OPN, GDP

Stat.	**P-value**	**Stat.**	**P-value**	**P-value (**)**	**Notes**
Panel PP	0.1327	*Panel* ν	0.3228	0.2833	Hom. coint.
Panel ADF	0.1535	*Panel* ρ	0.1763	0.1303	
Group PP	0.0056*	*Group* ν	0.0159*		Het. coint.
Group ADF	0.0049*				

(*) Rejection at 5% (**) From weighted stat. Critical values: Pedroni (1999). Source: author's calculations.

Table 4: [S2] Granger causality (Trade openness and GDP)

	CZ°	**EE**	**HU°**	**PL°**
GDPK$\not\Rightarrow$OPN	0.27746	0.62524	-	0.18068
OPN$\not\Rightarrow$GDPK	0.01023*	0.84716	-	0.00343*
	LV°	**LT°°**	**SK°**	**SI°**
GDPK$\not\Rightarrow$OPN	0.35768	0.00188*	-	0.69810
OPN$\not\Rightarrow$GDPK	0.02306*	0.59577	-	0.00233*

GDP chained vol's (2000) p.c., seasonally adj. (°) OPN to GDP. (°°) GDP to OPN. (*) Rejection at 5%. T=51. P-val's in table. Source: author's calculations.

Table 5: [S2] Imports-led growth (1 lag).

	CZ°	**EE°°**	**HU**	**LT**
GDP$\nRightarrow$IMP	0.40850	0.01491*	0.03178*	0.05136
IMP$\nRightarrow$GDP	0.00811*	0.93046	0.05815	0.00807
	LV°	**PL**	**SK°**	**SI°°**
GDP$\nRightarrow$IMP	0.77825	0.02071*	0.20299	0.00168*
IMP$\nRightarrow$GDP	0.01942*	0.02695*	0.02491*	0.71306

Notes: GDP at market prices, seasonal adjusted. (*) Indicates rejection at 5%. (°) IMP to GDP (°°) GDP to IMP. T = 51.

Source: author's calculations.

all these countries, Table 4 shows trade is contributing to growth and not the opposite. In order to capture the full picture, it can be convenient to work[45] with panel data and calculate the Hurlin average $S^{Hnc}_{N,T}$ statistic. Results are provided in Appendix, Table (9) and show that, within the NSM8 group, there is no overall or individual causality from GDP to EXP or IMP. However, there is some causality (potentially paired with some non-causality in individual countries) from IMP and possibly EXP to GDP. Decreasing the number of lags on the other hand, reduces the support to the export/import -led growth hypothesis and allows some causality in both directions (rejection of the H_0 in all cases).

The relation between OPN and GDP is even more difficult to interpret. Whilst it seems quite clear that a causal relation between OPN and GDP exists in some countries, it is not easy to exclude the possibility that it also operates in the opposite direction (GDP to OPN). Table (5) illustrates for individual countries.

The case of "inverse" causality (e.g. OPN$\nRightarrow$GDP but GDP$\Rightarrow$OPN) could be seen as an indication of a small contribution of trade to growth. If openness does not cause growth but the opposite is tested true, I can imagine the stimulus is generated mainly by other beneficial consequences of the integration process (FDI, migrations, spillovers, etc...) and then transmitted to trade (e.g. raising import volumes: GDP$\Rightarrow$IMP)[46]. This seems to be true for Lithuania in the case of openness and Estonia, Slovenia for imports only.

Simultaneous causality between components of trade (IMP or EXP) and output is also observed with interest in the literature. For example Weber (2007) underlines how a bivariate cointegration between GDP and imports can be theoretically seen as dependent on price inelasticity in the import function and stationarity in real exchange rates under PPP. This is the case of Poland, as evidenced by Table (5).

Another approach often used in the literature is trying to isolate the contribution of

[45]instead of a more subjective approach - i.e. counting the number of countries that show a direct causal relation between GDP and OPN, etc...

[46]The individual contributions of these variables can be explored by extending the design of the empirical exercise proposed in this chapter. For example, Won and Hsiao (2008) use a panel VAR to test causality between FDI, exports and economic growth in asian newly industrialised economies. Their analysis can be applied to convergence by comparing growth patterns of the countries under investigation.

Table 6: [S2] Export-led growth (1 lag)

	CZ°	**EE°°**	**HU°**	**LT°°**
GDP⇏EXP	0.43591	0.00898*	0.21206	0.03260*
EXP⇏GDP	0.04654*	0.24812	0.01070*	0.17315
	LV°°	**PL°**	**SK°**	**SI**
GDP⇏EXP	1.0E-06*	0.67098	0.42147	0.35212
EXP⇏GDP	0.31546	0.00271*	0.02847*	0.31590

GDP at market prices, seasonally adjusted. (°) EXP to GDP. (°°) GDP to EXP. (*) Rejection at 5%. T=51.

Source: author's calculations.

Table 7: [S3] Stochastic convergence: output differentials with EU15.

	LT	**LV°**	**EE°**	**CZ°**
None	36.30821	27.71801	36.32323	16.47171
At most 1	5.588638	3.825346	3.803221	0.750101
Reject: H_0 None	1%	1%	1%	1%
Reject: H_0 AT1	5.00%	N.R.	N.R.	N.R.
Coint. Rels.	>1	1	1	1
	SK°	**PL**	**SI**	**HU**
None	23.83750	7.134780	20.45711	7.949469
At most 1	0.109044	0.081142	4.217939	1.107816
Reject: H_0 None	1%	N.R.	1%	N.R.
Reject: H_0 AT1	N.R.	N.R.	5%	N.R.
Coint. Rels.	1	unknown	>1	unknown

Note: N.R. not rejected. 1% critical values: 16.31 (none), 6.51 (AT1).

Source: author's calculations.

exports to growth (export-led growth: ELG). A survey of the literature, with specific reference to causality, is available in Giles and Williams (2000).

Individual country contributions can be disaggregated easily from Table (6), however it is difficult to identify a unique direction of causality for all eight economies.

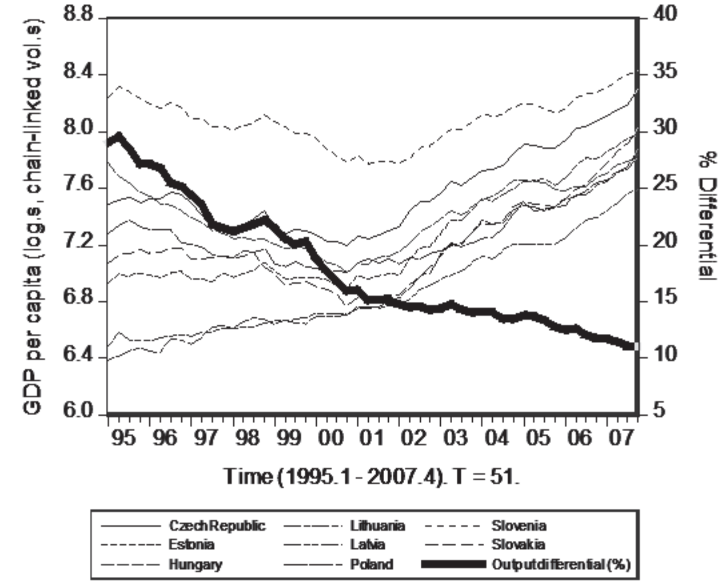
Finally, with reference to **Step 3** (**S3**), tests for stochastic convergence between individual new EU members and the EU15 average are shown in Table (7) and output gaps are pictured in Figure (2).

Summarising, the empirical evidence presented so far is quite mixed and does not give the firm conclusion that trade volumes contributed to convergence between new and old EU members either at the country level or on aggregate as detailed by the panel exercise presented above in this section.

4 Conclusions

I started from the consideration that there is not much consensus on the relation between trade, growth and convergence. I took elements from the major contributions in the field

Figure 2: [S3] Output gaps



Source: author's calculations.

and I proposed an empirical methodology that mixes ideas from the existing literature - mainly Ben-David (1993), and time series-techniques. I noted that NMS8 suffered from a degree of heterogeneity in their trade policy (and in their path towards trade liberalization) that is higher than in other studies where countries were chosen ad-hoc. This heterogeneity is reflected in my results and motivated me to move to panel data to assess formally the impact of effective trade on convergence in the eastern block of the European Union. Differently from some of my reference literature[47], I find that it is only in a limited number of cases[48] that would it be safe to conclude that increased trade volumes accelerated growth in the set of countries that started at lower levels of GDP per capita - see Table 8. This conclusion is not totally surprising and may have motivated the Rodriguez critiques I mentioned in this paper. Further, even if only marginally, it is also clear from my results that a higher degree of openness has been beneficial to some economies and generally does not hinder growth in poor countries[49] either. In these particular circumstances, policies targeting trade volumes do not appear particularly effective in the long-run but protectionism is not endorsed.

[47]See for example Kaitila (2004) 's application to the EU enlargement.
[48]and certainly not for the full set of NMS8 I investigated using Pedroni (1999) and Hurlin (2008) tests.
[49]The only instance of divergence being Slovenia.

Table 8: Empirical summary

		EE	LT	LV	CZ	SK	HU	PL	SI	NMS8
Cointegration,	*i. Openness*	Y	Y	Y	Y	?	-	Y	-	Y
NMS GDP with:	*ii. EU15 GDP***	-	Y	Y	Y	Y	-	-	-	NA
Causality,	*i. Openness*	-	-	Y	Y	Y	?	Y	?	-
to NMS	*ii. Imports*	-	-	Y	Y	Y	-	-	-	NA
GDP from:	*iii. Export*	-	-	-	Y	Y	-	Y	-	NA
Trade promotes	*convergence?*			Y	Y	Y?	-	-	-	-

Notes: Y: yes. -: no, NA: not available (*) Panel tests (**) Y indicates a long run relation between EU15 and individual GDP per capita.

Source: author's calculations.

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Table 9: APPENDIX: Hulrin (2008) Panel Non-Causality

H_0	L	S_n								$S^{Hnc}_{8;43}$	$c_{8,43}$	$\widetilde{c}_{8,43}$	Judg.	
		CZ	**EE**	**HU**	**LT**	**LV**	**PL**	**SK**	**SI**					
GDP$\nRightarrow$OPN	3	1.6773	2.1415	1.1356	1.7704	1.4315	3.1672	1.6051	3.1376	2.00827	R	NR	R	*
OPN$\nRightarrow$GDP		1.9781	3.3291	0.7957	0.8306	0.4909	2.8892	5.8008	3.9085	2.50287	R	R	R	***
GDP$\nRightarrow$IMP	3	1.2709	4.2226	1.1704	1.1611	1.1946	0.7062	0.6247	1.6548	1.50066	NR	NR	NR	***
IMP$\nRightarrow$GDP		1.2179	1.5720	1.7213	0.2146	2.1129	2.0869	5.7632	2.9137	2.20032	R	R	R	**
GDP$\nRightarrow$EXP	3	1.8385	2.0402	0.9669	0.5145	0.0624	1.3054	0.3538	2.1896	1.15891	NR	NR	NR	***
EXP$\nRightarrow$GDP		1.2685	3.1373	0.9220	1.0354	1.3037	1.5707	4.2596	2.3884	1.98568	NR	NR	NR	*
GDP$\nRightarrow$OPN	4	1.3594	2.7051	1.3287	2.5010	0.5248	2.0306	3.4729	4.6345	2.31962	R	R	R	***
OPN$\nRightarrow$GDP		3.0879	1.4133	1.3551	1.4624	1.2126	4.0719	3.6684	2.2843	2.31949	R	R	R	***
GDP$\nRightarrow$OPN	1	4.4209	5.5953	4.6129	4.5800	6.3552	1.1914	2.4194	3.7101	4.11065	R	R	R	***
OPN$\nRightarrow$GDP		6.4976	4.7352	2.8512	1.9466	1.1987	3.0358	12.3385	0.9363	4.19251	R	R	R	***
GDP$\nRightarrow$IMP	1	3.4418	6.0207	5.8345	2.1434	7.0037	0.8722	0.8602	3.0329	3.65120	R	R	R	***
IMP$\nRightarrow$GDP		3.6431	3.0068	0.0818	0.7324	5.3289	2.5055	11.6559	1.9992	3.61918	R	R	R	***
GDP$\nRightarrow$EXP	1	13.7452	3.3837	4.3790	4.2664	4.5703	0.0752	2.4929	3.1311	4.50548	R	R	R	***
EXP$\nRightarrow$GDP		2.1702	2.3402	0.1673	0.0051	2.9330	2.0805	6.9271	0.6108	2.15427	R	R	R	***

Notes. The approximated and simulated critical values for $N = 8$ and $T = 43$ are interpolated from Table 4 in Haurlin (2008): $c_{8,43}(0.05) = 2.1350$ and $\widetilde{c}_{8,43}(0.05) = 1.9958$. R indicates rejection of the null hypothesis (homogeneous non-causality), NR inability to dismissH_0. A subjective judgment is provided based on interpolated and non-interpolated c.v's (*** very significant). L is the number of lags. S_n and $S^{Hnc}_{8,43}$ are respectively the country and average Wald statistics. Source: author's calculations.