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The Impact of EU-Accession on Regional Business Cycle Synchronization and Sector Specialization*

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Abstract

According to difference-in-difference estimates business cycle synchronization and similarity in sector structures between acceding and pre-existing regions reduced after Eastern Enlargement. Results for Northern enlargement are more ambiguous. In both enlargements, however, region pairs affected by enlargement with highly synchronized business cycles before enlargement experienced smaller increases in business cycle synchronization and weaker reductions of structural differences relative to similar unaffected region pairs than region pairs with less synchronized business cycles. Similarly, affected regions that were more similar in terms of sector structure before enlargement experienced larger reductions in structural differences and business cycle synchronization than similar unaffected region pairs.

Keywords: *business cycle correlation, sector specialization, EU-enlargement, Difference-in-difference*

JEL-Codes: *F15, E32, R11*

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Introduction

Measuring and describing the evolution of business cycle synchronization in the European Union (EU) has been of high interest for empirical macro-economists in the last decades. This interest was fuelled both by the policy relevance of the topic as well as by theoretical controversies between proponents of endogenous optimum currency area theory. On the policy side ever since Mundell (1961) the similarity in countries' reactions to macro-economic shocks is considered one of the most important criteria for successful monetary unions. A high level of business cycle synchronization was therefore considered to be a precondition for European Monetary Union (EMU). On the theoretical side some proponents of endogenous business cycle theory (Frankel and Rose, 1997, 1998 and EC, 1990) argued that integration, by reducing transaction costs, leads to increased trade. In the face of predominantly country specific macro-economic shocks this should lead to higher business cycle synchronization. Others (e.g. Krugman, 1993, Bayoumi and Eichengreen, 1994, Clark and van Wincoop, 2001, Kalemli-Ozcan, 2001), however, argued that integration will primarily result in increased specialization of economies on sectors of production where they have comparative advantages. This, in the face of sector specific shocks, should lead to reduced business cycle synchronization.

This paper uses EU-enlargement as a testing ground for these hypotheses and analyzes the impact of two very different EU-enlargement steps on business cycle synchronization and sector specialization at the regional level. We look at "Eastern enlargement" by the 10 member states (EU-10) that joined the EU in May 2004 and on "Northern enlargement" by Sweden, Finland and Austria in 1995. Our contribution to existing literature is two-fold. First, in contrast to previous research focusing on the impact of EMU on the national level (Goncales et al., 2009, Christodoulopoulou, 2014), we focus on the impact of EU-enlargements on the smallest regional (NUTS-3) level for which consistent EU-wide data are available. Second, in contrast to previous literature on regional business cycle synchronization, which has mostly focused on identifying factors explaining differences in business cycle synchronization among regions (Fatas 1997, Belke and Heine 2006, Siedschlag and Tondl 2011, Park and Hewings 2012) or on regional business cycle synchronization in periods predating EU-enlargements (Barrios et al., 2003, Barrios and de Lucio, 2003, Artis et al., 2004, Montoya and de Haan, 2008) we offer an ex-post evaluation of whether regional business cycle synchronization and differences in regional sector specialization reduced or increased after EU-enlargement.

Our focus on small regions allows for an easier identification of the impact of EU-accession on sector specialization, as small regions differ more pronouncedly in comparative advantages than nation states and are thus also more likely to be affected by changes in comparative advantages. It also enables us to apply the difference-in-difference (DiD) approach followed in previous research using national data (Christodoulopoulou, 2014, Goncales et al., 2009) to much richer regional data. This provides for a large number of natural comparison groups for robustness tests and, as will be shown below, also allows us to explicitly assess the potential heterogeneity of the impact of enlargement on business cycle synchronization and sector specialization among European regions.

Data

We use annual regional estimates of aggregated gross value added (GVA) as well as its sector composition (differentiating between agriculture, manufacturing, construction, distributive services, financial services, real estate and non-market services) at the NUTS-3 level from the Cambridge econometrics database. In particular, for the analysis of Eastern enlargement in 2004, we take 1,227 NUTS-3 regions located in the countries of the EU-25 and use data covering the years 1993 to 2010. To analyze the effects of Northern enlargement in 1995 we constrain our sample to the EU-15 countries (i.e. 979 NUTS-3 regions) and focus on the time period between 1981 and 2001.[1] To measure business cycle synchronization between region pairs we first extract the business cycle component from each NUTS-3 region's GVA time series by the Corbae-Ouliaris (Corbae and Ouliaris 2006) filter.[2] From this cyclical component we calculate bilateral (i.e. re-

[1] The starting periods are dictated by data availability as time series for EU-10 regions are unavailable or unreliable before 1993 and changes in regional classification preclude an analysis before 1981. Data endpoints are chosen to incorporate in our baseline setting one full rolling window business cycle correlation measure after enlargement.

[2] This band-pass filter is used as it avoids loss of information at the data endpoints and has 'better' leakage properties at desired business cycle frequencies than some alternatives (Corbae et al., 2002). Alternative business cycle correlation measures, filtering methods and lengths of rolling windows are, however, considered in robustness checks below.

gion-by-region) seven-year rolling window correlations. Moreover, using the sector composition of GVA for each region we derive a Krugman type index (Krugman 1991) of structural differences between region pairs. This is given as half of the sum of absolute differences in sector shares across regions and takes a value of between zero, indicating equivalent sector shares in both regions, and one, indicating the maximum possible difference in sector composition.[3] We augment our data with the log difference in annual GVA per capita levels between region pairs (as a measure of differences in economic well-being and living standards between regions) and the geographic distance (in kilometers) between the capital cities of region pairs. Overall, we calculate annual bilateral business cycle correlations, indices of structural difference, (log) GVA per capita differences and distances for 752,151 NUTS-3 region pairs for Eastern enlargement and 478,731 NUTS-3 region pairs for the analysis of Northern enlargement.

Descriptive Statistics

Table 1 shows descriptive statistics for these data for the last pre- and post-accession years in both enlargements for a number of different region pair types. In the first two both regions are either located in the same country (labeled "internal") or in different pre-existing member countries (labeled "pre-member"). For these region pairs institutional conditions for cross-border exchange did not change on account of EU-enlargement. They will therefore be used as an unaffected reference (control) group in the anal-

[3] Formally, this is defined as $SD_{ij,t} \equiv \frac{1}{2}\sum_{k=1}^{K}\left|s_{ik,t} - s_{jk,t}\right|$, with $s_{s_{ik,t}}$ and $s_{jk,t}$ the GVA-share in sector k at time t in regions i and j.

ysis. In the second two region pair types, either one region (labeled "mixed") or both regions (labeled "acceding") belong to an acceding country. For these region pair types institutional preconditions for cross-border exchange changed on account of EU-enlargement, although potentially in different ways. They are therefore considered as affected region pairs below.

The table highlights the substantial differences between the two enlargement episodes analyzed. These apply to institutional regulations after accession and to economic, geographic and structural differences among regions. Institutionally the EU with the three countries of Northern enlargement joined in 1995 was very different from that joined by the EU-10 countries in 2004. This applies to the introduction of EMU in 1999, but also to derogation periods. In the course of Northern enlargement only few derogation periods applied after accession. In Eastern enlargement, by contrast, derogation periods applied amongst others to such important parts of the acquis communautaire as freedom of movement of labor. In addition, as can be seen from comparing the two columns reporting descriptive statistics for "mixed" region pairs in Table 1, acceding regions on average had higher GVA per capita than regions from pre-member countries (by 17% in the unweighted average) in Northern enlargement, but much lower GVA per capita in Eastern enlargement. Furthermore, due to a longer history of economic integration with the EU of the EFTA countries acceding in 1995 than of the mostly former COMECON countries acceding in 2004, also seven year rolling window business cycle correlations between acceding and incumbent regions were higher in Northern than in Eastern enlargement in the year preceding enlargement (0.28 in the former case but 0.14 in the later). Structural differences between acceding and incumbent regions were also smaller in Northern than in Eastern enlargement. The average index of structural difference between incumbent and acceding regions amounted to 0.18 in the year preceding Northern enlargement but to 0.21 in Eastern enlargement. Average geographic distances between acceding and incumbent regions were, however, larger in Northern than in Eastern enlargement on account of the remote location of some Finnish and Swedish regions.

{Table 1 around here}

Similarly, due to the low level of economic integration of the Austrian with the Swedish and Finnish economy, region pairs located in different acceding regions had lower business cycle correlations, but also slightly lower structural differences among themselves in Northern than in Eastern enlargement (see columns headed "acceding" region pairs in Table 1). The heterogeneity of acceding regions in terms of GVA per capita was, however, larger (with a standard deviation of 1.12) in Northern than in Eastern enlargement (standard deviation 1.03) as well as distances between acceding region pairs.

Development of indicators

Given this data a first assessment of the effect of EU-enlargements on business cycle synchronization and sector specialization consists of comparing the development of these variables across different region pair types.

If our target indicators increase (decrease) to a similar extent for all region pair types, this would suggest that EU-enlargements had no additional effect on them, but that the changes observed are due to a general trend impacting on all region pair types. If, however, the change is more (less) pronounced in acceding and mixed region pairs than in internal and/or pre-member region pairs, EU-accession might have had an additional positive (negative) impact in regions of accession countries.

{Figure 1 around here}

Figure 1 (top panel) reports cross-section averages of business cycle correlations for the two affected region pair types (i.e. mixed and acceding) as well as for region pairs of the pre-existing member countries.[4] Figure 1a on the top left hand side shows that the synchronization of business cycles increased for all types of region pairs in Eastern enlargement. In 2001, the business cycle correlations were below 0.1 in all region pair types, while at the end of the sample period they ranged between 0.5 and 0.6. This suggests an overall tendency towards regional business cycle convergence in the period from 2001 to 2010. Business cycle correlations also moved more or less in parallel for all region pairs before 2003 (i.e. the last year before Eastern enlargement). After this, however, bilateral correlations decreased among acceding region pairs up to 2005 and developed more slowly among mixed

[4] This reference group – similarly to our two affected groups – focuses on cross-border relationships.

than pre-member region pairs up to 2006 but picked up again thereafter. As a consequence the increase of cyclical synchronization from 2003 to 2010 among pre-member region pairs was higher than in acceding region pairs, but lower than in mixed region pairs.

Similarly, for Northern enlargement (Figure 1b) business cycle correlations start at levels of between 0.05 and 0.10 in 1987, with a peak in 1993 and then fall again until 2001 in all region pair types. The decline from 1994 to 2001 was, however, comparable in pre-existing region pairs and mixed region pairs (-0.18 each) but smaller in acceding region pairs (-0.15). This suggests that both after Eastern and Northern enlargement mixed region pairs experienced a larger or at least similar change in bilateral business cycle synchronization than pre-member region pairs, while evidence for acceding region pairs is less conclusive.

The bottom panel of Figure 1 displays the development of the average structural difference for the various region pair types considered. Figure 1c shows for Eastern enlargement that both affected region pair types became increasingly dissimilar, while pre-member region pairs became more similar after enlargement. This thus accords with Krugman's (1993) hypothesis that regional specialization increases after integration. The evidence for Northern enlargement is, however, less clear (Figure 1d). Over the period 1987 to 1994 structural differences between all region pair types decreased. After 1994 this trend continued (and only reversed in 1999) in acceding region pairs, while in pre-member and in mixed region pairs, structural differences increased strongly in 1995 and thereafter reduced in pre-member region pairs but increased (at least as of 1999) in mixed region pairs. Hence, relative to 1994 the increase in the index of structural difference was higher in pre-member region pairs as compared to both mixed as well as acceding region pairs.

Method

Northern and Eastern enlargement thus potentially impacted rather differently on regional business cycle synchronization and sector specialization between regions and also rather differently on different region pair types. Additional empirical evidence on these effects can be obtained by using a difference-in-difference (DiD) approach. This consists of dividing the data into a subset of region pairs affected by the enlargement, and another subset unaffected as well as grouping time periods (t) into a pre-accession and a post-accession period (with τ being the year of accession). Denoting the subsets of affected and unaffected region pairs by R_n where $n = 1$ represents the unaffected and $n \in \{2, 3\}$ the affected region pairs (with $n = 2$ indicating mixed region pairs and $n = 3$ acceding region pairs) the impact of EU-accession on business cycle synchronization and structural differences can be estimated by a regression of the form:

$$y_{ji,t} = \alpha_t D_t + \beta_j D_{ji} + \sum_{n=2}^{3} \delta_n D_{t \geq \tau} D_{j \in R_n} + \xi_{ji,t} \quad (1)$$

where $\xi_{ji,t}$ is an i.i.d. disturbance term and $y_{ji,t}$ is the dependent variable, (i.e. the business cycle correlation or the index of structural difference between regions (i) and (j) at time (t)). D_t is a set of dummy variables for each time period. This measures changes in the dependent variable over time that are common to all region pairs. D_{ji} is a set of dummy variables for each region pair. This controls for all region pair specific but time invariant influences on the dependent variable such as distance between regions, or whether one or both regions are border regions. α_t and β_j are parameters to be estimated.

The central parameters of interest in equation (1) are the δ_n. These measure the average change in $y_{ji,t}$ in the respective affected (i.e. mixed or acceding) region pairs relative to the unaffected region pairs after enlargement. This is because $D_{t\geq\tau}$ is a dummy variable that takes on the value of 1 if the time period under consideration is a post-accession period (i.e. $t \geq \tau$) and the $D_{j\in R_n}$ are dummy variables which take on the value 1 if the considered region pair type is affected by EU-accession. A statistically significant positive value of the δ_n implies that the indicator of interest increased in affected region pairs relative to unaffected region pairs after enlargement. A statistically significant negative parameter implies the opposite.

Equation (1) may, however, be overly restrictive on account of the substantial persistence of business cycle correlations (in particular in the case of rolling windows) as well as structural differences. Gächter and Riedl (2013) show that if this persistence is explicitly modeled this may substantially change results of DiD tests for the effect of EMU on national business cycle synchronization. Furthermore, Bertrand et al. (2004) show that DiD estimates as in equation (1) may result in overly high rejection rates of the no effects hypothesis in the case of auto-correlated errors. We therefore follow a suggestion by Bertrand et al. (2004) and estimate all parameters using clustered standard errors, as this reduces over-rejection. In addition, we also collapse the data by taking means of the pre-and post-accession values of the dependent variables and estimate equation (1) with only two periods. Third, we augment equation (1) by the lagged endogenous variable as an additional explanatory variable and, thus, estimate the following specification:

$$y_{ji,t} = \rho y_{ji,t-1} + \alpha_t D_t + \beta_j D_{ji} + \sum_{n=2}^{3} \delta_n D_{t\geq\tau} D_{j\in R_n} + \xi_{jit} \tag{2}$$

Angrist and Pischke (2009, p. 246 ff) show that equations (1) and (2) provide a bracketing property: If equation (2) is the "true" model and equation (1) is estimated, δ_n is overestimated. If equation (1) is "true" but equation (2) is estimated, δ_n is underestimated. The estimates of equation (1) and (2), in the absence of knowing the correct model, therefore, provide upper and lower bounds to the true effect.

The interpretation of the parameters δ_n in equations (1) and (2), however, rests on a number of assumptions. The most critical of these is that both affected and unaffected region pairs would have followed the same trends in business cycle correlations and structural difference in the absence of EU-accession. One way to increase the plausibility of this assumption would be to include additional variables to control for systematic deviations from the common trend assumption. Their inclusion, however, also creates new issues. Correct identification of δ_n requires that none of the control variables are influenced by the treatment. This is questionable for most of the time varying variables previously found to be important drivers of regional business cycle synchronization in the literature such as trade, foreign direct investments and structural differences. Theory suggests that all of these are themselves affected by integration. We therefore estimate versions of equations (1) and (2) without controls as well as with them.

A further assumption of DiD estimates is that unaffected region pairs are not indirectly affected by EU-accession for example through third country effects. As this cannot be tested, we use a number of alternative reference groups to assess the robustness of results (see Christodoulopoulou, 2014 for a similar approach). In the baseline specification, we use pre-member region pairs as our reference group. We, however, also estimate equations (1) and (2) using internal region pairs as reference group. Further, for Eastern enlargement, we explore whether Euro introduction in 1999 impacts on results, by excluding all countries joining the Euro in 1999 from the sample and constraining the reference group to regions belonging to Sweden, the UK and Denmark. For Northern enlargement, by contrast, we check the robustness of findings to EMU by including only region pairs from countries that joined the EMU in 1999 in the reference and affected region pair groups. Thus, we compare Austrian and Finnish regions to the EU-12 countries (all except Denmark und UK) joining the Euro in 1999.

Results for Eastern Enlargement

Table 2 shows baseline regression results for equation (1) for seven-year rolling window business cycle correlations based on the Corbae-Ouliaris filter (in the top panel) and indices of structural differences (in the bottom panel). Columns headed “Full-Panel” report results when estimating equation (1) for the full set of observations. Columns headed “2-Years-

Panel" use the collapsed (two periods only) version of the data and columns headed "Dynamic-Panel" present results for the specification in equation (2). For each of these versions, results of regressions using different reference groups are reported. The first of these considers pre-existing region pairs as a reference group. The second uses within-country region pairs, while the third omits all countries joining the Euro in 1999. For each model version and reference group columns headed (1) show results of models excluding controls, while columns headed (2) show results for models including time varying controls.[5]

{Table 2 around here}

The findings are rather insensitive to the model specification, the reference group and time dimension considered and are consistent with Krugman's hypothesis. They suggest, on the one hand, less synchronized business cycles after Eastern enlargement for both acceding and mixed region pairs relative to the reference group. The only exception to this are results for mixed regions pairs when using EU-15 pre-member region pairs as a reference group. This may, however, be due to the distortions arising from the EMU introduction in 12 out of the EU-15 countries just before the Eastern enlargement. On the other hand, the findings even more strongly point

[5] In the assessment of business cycle correlations we use as controls the index of structural differences and GVA per capita differences, while for the index of structural differences we resort only to GVA per capita differences.

to an increase in structural difference among the region pairs of interest in all specifications. More precisely, business cycle correlations reduced by up to -0.17 for mixed as well as for acceding region pairs after Eastern enlargement relative to unaffected pairs; differences in sector shares on average increased by between 0.01 and 0.04.

Also the coefficients of the lagged dependent variable in the dynamic panel specification are in the interval between 0 and 1 and the parameter estimates differ significantly both from zero and one, as would be expected from a stable dynamic process. Furthermore, the results for the structural difference variable in models assessing business cycle correlations indicate that an increase in structural differences between regions reduces business cycle correlations. The coefficients of the GVA per capita differences, by contrast, are positive and significant in most specifications both for structural differences and the rolling window business cycle correlations. Structural differences between region pairs thus increase with higher GVA per capita differences and, after controlling for structural differences, regions with more similar GVA per capita levels had lower business cycle synchronization in Eastern enlargement.

Results for Northern Enlargement

Table 3 presents the findings for Northern enlargement. The model specifications are identical to the analysis of Eastern enlargement. Results, however, are less clear-cut and depend on the reference group used as well as on the inclusion of the lagged dependent variable. When all region pairs from pre-existing EU-12 member countries are used as a reference group, business cycle correlations tend to have on average slightly decreased in the affected region pairs relative to the unaffected ones. This, however, holds only when the full time dimension is utilized. In the 2-years version of the panel, the coefficient estimates point in the other direction, but are less statistically significant respectively insignificant at all. In addition, when considering only region pairs from EU-12 but EMU countries, business cycle correlations increased in the dynamic specification and in the 2-years variant in both mixed and acceding region pairs, but point to opposing effects in the full panel specification.

The only case which provides the same direction in all model versions is when considering within-country region pairs as reference group. This delivers statistically significant positive coefficients for both mixed and acceding region pairs that range between 0.05 and 0.15. It thus signals an increase in business cycle synchronization. Overall, most results indicate an increase in business cycle synchronization for acceding and mixed region pairs after Northern enlargement. Results, however, are less robust across different specifications than in the case of Eastern enlargement.

The findings with respect to structural differences between regions (bottom panel of Table 3), by contrast, robustly indicate a reduction of structural differences between acceding region pairs after Northern Enlargement. All the coefficients on this variable are statistically significant and negative in all specifications except for the case using the EU-12 countries that joined EMU as a reference group in the 2-years panel. In cases where the coefficients are significant region pairs located in different acceding countries became structurally more similar (by between 0.2 to 1.0 percentage points) to each other. This contradicts Krugman's (1993) hypothesis.

For structural differences between mixed region pairs, by contrast, results depend heavily on the specification and reference group chosen. When using all region pairs of pre-existing member countries as a reference group the coefficient estimates are significantly positive in the case of the full static panel specification, negative when considering the full dynamic panel specification and insignificant in the case of the 2-years panel. Moreover, coefficients are statistically significantly positive in all specifications when using internal (i.e. within-country) region pairs as a reference group, but negative in all specifications when focusing only on region pairs that acceded the EMU in 1999.

{Table 3 around here}

Finally, structural differences impact positively on business cycle correlations in most of the model specifications. By contrast, differences in GVA per capita mostly have a positive impact on structural differences, but a significantly negative one on business cycle synchronization. The lagged endogenous variable in the dynamic specification is in the interval from zero to one in all specifications and highly statistically significantly different from both zero and one.

Robustness

These results are also confirmed by a number of robustness tests assessing the sensitivity of our baseline results to different measures of business cycle correlation, other business cycle filtering methods and different lengths of the rolling window (Table A1 in the appendix). In this sensitivity analysis, we repeated estimation of equation (1) using the Cerqueira-Martins (Cerqueira and Martins 2009) measure of business cycle synchronization.[6] This measure has the advantage that it does not take averages over a particular time period like in the case of rolling window correlations and, therefore, distinguishes temporary correlation due to some shocks in a particular period. We also applied the Hodrick-Prescott filter rather than the Corbae-Ouliaris filter for extracting the business cycle components and changed the length of the rolling window from seven to eight years. These changes do not affect the findings that business cycles became less synchronous between acceding and mixed region pairs after Eastern enlargement as almost all robustness tests indicate a lower business cycle synchronization relative to unaffected region pairs after Eastern enlargement.[7]

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[6] This index was originally defined as $\rho_{ij,t}^{cm} \equiv 1 - \frac{1}{2}\Bigg[(d_{j,t} - \bar{d}_j)/\sqrt{\frac{\sum_{t=1}^{T}(d_{j,t}-\bar{d}_j)^2}{T}} -$ *(di,t−di)t=1Tdi,t−di2T2* with *dj,t* and *di,t* the business cycle components of regions i and j, respectively. We use the Artis and Okubo (2011) version of this index (given as $\rho_{ij,t}^{cm^*} \equiv \frac{1}{2}\log\big(1/(1-\rho_{ij,t}^{cm})\big)$), as it is bounded between $\pm\infty$.

[7] The exceptions are when region pairs from pre-member countries are set as reference group (both for the HP-filtered data and the eight-year rolling window correlation), which may again indicate that this reference group is also affected by EMU introduction. Also the 2-years panel along with the Cerqueira-Martins business

With respect to Northern enlargement, the results from our robustness tests provide further support to a potentially increased business cycle synchronization of acceding and mixed region pairs relative to unaffected region pairs, as the majority of coefficient estimates are positively significant. This applies to all variants of the specification except when (a) focusing on the eight-years rolling window correlation and not using internal regions as a reference group, (b) using the seven-years rolling window correlation based on the HP-filter for cases where all pre-member region pairs or only EMU pre-member region pairs are considered as a reference group in the full static panel specification, and (c) using internal region pairs as a reference group in the 2-years panel specification for the Cerqueira-Martins business cycle correlation measure.

Heterogeneous effects

Enlargements could, however, also impact differently on different regions. For instance, region pairs that are more distant to each other may be less strongly affected by integration than region pairs located closer to each other. Alternatively, region pairs that already had high business cycle correlations before EU-accession may have experienced a lower increase (or larger decrease) in bilateral business cycle synchronization. These regions may also have differed in their reaction in terms of the changes in sector specialization. Likewise, region pairs which were structurally closer to each other already before EU-accession, on account of having rather similar

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cycle correlation measure and the EU-15 but non-EMU reference group point to an increase in business cycle synchronization.

comparative advantages, may have experienced weaker tendencies to specialize. Following Krugman's hypothesis this would also lead to lower increases (larger decreases) in business cycle synchronization among such region pairs.

{Figure 2 around here}

To test these hypotheses (using our baseline measures of business cycle synchronization and structural difference) we ran a series of further regressions in which region pairs were separated according to (a) the quartiles of business cycle correlations between these regions in the year before EU-accession, (b) the quartiles of structural differences between regions prior to enlargement, and (c) the quartiles of the distance between regions. We applied equation (1) to each of these quartiles separately. The results are graphically represented in Figure 2.[8] They suggest that region pairs affected by enlargement with rather synchronized business cycles already before accession (i.e. belonging to a higher quartile) also experienced the largest reduction or the smallest increase of cyclical synchronization relative to unaffected region pairs after both integration steps. This holds for both types of affected region pairs. Further, structural differences for mixed and acceding region pairs diverged more (in Eastern enlargement) or converged less (in

[8] Detailed regression outputs and results checking that using internal region pairs as a reference group does not alter findings qualitatively are available from the authors.

Northern enlargement) relative to unaffected region pairs than between regions whose business cycle was less synchronous before EU-accession.

Also more similar regions in terms of sector structure (i.e. belonging to the first quartile) before enlargement experienced higher decreases or lower increases in business cycle synchronization in both episodes of EU-accession (middle panel of Figure 2). The only exceptions are acceding region pairs in the case of Northern enlargement. In addition, affected region pairs that already differed substantially in sector structure prior to Eastern enlargement also exhibited the strongest increase in structural differences relative to unaffected region pairs. For Northern enlargement, the same applies to acceding region pairs.

Patterns with respect to distance (bottom panel of Figure 2) are less clear cut. Here mixed (acceding) region pairs that are more distant from each other experienced the lowest (highest) increases in structural difference relative to unaffected region pairs, but the largest increases in business cycle synchronization in Eastern enlargement. For Northern enlargement a markedly different behavior in mixed and acceding region pairs is found. In the former, both business cycle synchronization and structural differences increased most in the region pairs closest to each other. In the later the effects of enlargement oscillate substantially between different quartiles.

Conclusions

In sum, EU-accession by the 10 member states that joined the EU in May 2004 and Northern enlargement by Sweden, Finland and Austria in 1995 had rather different effects on business cycle synchronization and structural differences. Business cycles became less synchronous and differences in sector structure increased between NUTS-3 region pairs located in different acceding countries and mixed region pairs relative to region pairs of pre-member countries in Eastern enlargement. For Northern enlargement, by contrast, results are less robust.

These rather different findings suggest that the institutional as well as geographic, economic and structural differences between these two rounds of enlargement may have led to rather different patterns of adjustment. This is corroborated when considering different quartiles of the distribution of initial business cycle correlations and structural differences. In both cases of enlargement, regions with rather synchronized business cycles before accession also experienced the smallest increase (the largest reduction) of business cycle synchronization after enlargement and also structural differences between these regions diverged more (converged less) than in region pairs whose business cycles were less synchronous before enlargement. Similarly, region pairs that were more alike in terms of sector structure before enlargement experienced higher decreases (lower increases) in structural differences, which in accordance with Krugman's hypothesis also led to a higher reduction (smaller increases) in business cycle synchronization.

Given the rather different results for different enlargement episodes but the rather similar distributional results, future research should thus focus on developing more differentiated hypotheses on the effects of EU-enlargement and the formation of EMU on business cycle synchronization and sector specialization, which take explicit consideration of starting conditions. This may be of high policy relevance given that the European Commission was negotiating on membership with six countries in 2014, which all differ widely in economic development and level of integration with the EU, and seven countries with equally disparate starting conditions from the Eastern enlargement rounds in 2004 and 2007 were still waiting to join EMU at that time.

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Tables & Figures (main Text)

Table 1: Descriptive statistics

Integration Step	Eastern Enlargement					Northern Enlargement				
Region pairs	Internal i,j=within-country	Pre-Member i=EU-15 j=EU-15	Mixed i= EU-10 j=EU-15	Acceding i=EU-10 j=EU-10	Full-set i=EU-25 j=EU-25	Internal i,j=within-country	Pre-Member i=EU-12 j=EU-12	Mixed i= EU-3 j=EU-12	Acceding i=EU-3 j=EU-3	Full-set i=EU-15 j=EU-15
Year	2003					1994				
Correlation [rw7|co]	0.18	0.19	0.14	0.23	0.18	0.48	0.23	0.28	0.18	0.27
	(0.48)	(0.46)	(0.45)	(0.44)	(0.46)	(0.42)	(0.45)	(0.46)	(0.52)	(0.45)
Structural difference	0.17	0.20	0.21	0.17	0.20	0.16	0.20	0.18	0.15	0.19
	(0.08)	(0.09)	(0.08)	(0.07)	(0.08)	(0.08)	(0.09)	(0.08)	(0.06)	(0.09)
log GVA p.c. difference	-0.06	0.45	-0.62	0.10	0.14	-0.03	0.41	0.17	-0.40	0.30
	(0.95)	(1.25)	(1.12)	(1.03)	(1.25)	(0.99)	(1.26)	(1.21)	(1.12)	(1.23)
Distance (in km)	320.90	1,158.60	1,161.00	684.59	1,021.07	312.25	1,122.48	1,380.55	1,366.14	1,028.21
	(190.42)	(640.89)	(597.59)	(419.84)	(657.75)	(210.03)	(627.10)	(750.82)	(495.03)	(684.22)
Year	2010					2001				
Correlation [rw7|co]	0.61	0.52	0.50	0.54	0.53	0.19	0.05	0.10	0.03	0.08
	(0.32)	(0.36)	(0.34)	(0.31)	(0.35)	(0.47)	(0.48)	(0.47)	(0.43)	(0.48)
Structural difference	0.17	0.19	0.24	0.20	0.20	0.16	0.21	0.19	0.15	0.20
	(0.08)	(0.09)	(0.10)	(0.09)	(0.09)	(0.08)	(0.09)	(0.08)	(0.07)	(0.09)
log GVA p.c. difference	-0.07	0.47	-0.61	0.09	0.16	-0.03	0.40	0.19	-0.38	0.30
	(0.96)	(1.28)	(1.24)	(1.05)	(1.24)	(0.99)	(1.26)	(1.19)	(1.12)	(1.22)
Distance (in km)	320.90	1,158.60	1,161.00	684.59	1,021.07	312.25	1,122.48	1,380.55	1,366.14	1,028.21
	(190.42)	(640.89)	(597.59)	(419.84)	(657.75)	(210.03)	(627.10)	(750.82)	(495.03)	(684.22)
ΔYear	2010 minus 2003					2001 minus 1994				
Correlation [rw7|co]	0.43	0.33	0.36	0.31	0.35	-0.29	-0.18	-0.18	-0.15	-0.20
Structural difference	0.00	-0.01	0.03	0.03	0.00	0.00	0.01	0.01	0.00	0.01
GVA p.c. difference	-0.01	0.02	0.02	-0.02	0.02	0.00	-0.01	0.02	0.02	0.00

Source: Cambridge Econometrics, own calculations.
Notes: Values in brackets are standard deviations, “Internal” region pairs = region pairs located in the same country, “Pre-Member” region pairs = region pairs located in different incumbent countries, “Mixed” region pairs = region pairs in which one region is located in an acceding country and the other in an incumbent country, “Acceding” region pairs = region pairs located in different acceding countries. The business cycle correlation measure is based on a seven-year rolling window of Corbae-Ouliaris filtered data (denoted as [rw7|co]).

Tables & Figures (main Text)

Table 2: Baseline regression results for Eastern enlargement

Time Dimension (t)	Full-Panel						2-Years-Panel						Dynamic-Panel					
Reference Group (i,j)	EU-15		Within-country		EU-15 none EMU		EU-15		Within-country		EU-15 none EMU		EU-15		Within-country		EU-15 but none	
Model Specification	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Business Cycle Correlation [rw7|co]																		
Mixed (i,j)	-0.011***	-0.0028**	-0.029***	-0.023***	-0.14***	-0.13***	0.031***	0.053***	-0.065***	-0.052***	-0.17***	-0.16***	0.0075***	0.015***	-0.040***	-0.035***	-0.073***	-0.070***
	(0.0011)	(0.0011)	(0.0014)	(0.0014)	(0.0052)	(0.0052)	(0.0015)	(0.0015)	(0.0019)	(0.0019)	(0.0068)	(0.0068)	(0.0007)	(0.0007)	(0.0009)	(0.0010)	(0.0041)	(0.0041)
Acceding (i,j)	-0.16***	-0.15***	-0.17***	-0.17***	-0.17***	-0.17***	-0.014***	-0.0011	-0.11***	-0.10***	-0.093***	-0.096***	-0.031***	-0.029***	-0.091***	-0.088***	-0.077***	-0.081***
	(0.0045)	(0.0045)	(0.0046)	(0.0046)	(0.0064)	(0.0064)	(0.0054)	(0.0054)	(0.0056)	(0.0056)	(0.0081)	(0.0081)	(0.0027)	(0.0027)	(0.0029)	(0.0029)	(0.0047)	(0.0047)
ln(Struct. Diff.)		-0.0046***		-0.047***		-0.014***		-0.058***		-0.090***		-0.075***		-0.003***		-0.050***		0.00077
		(0.0013)		(0.0018)		(0.0045)		(0.0019)		(0.0027)		(0.0074)		(0.0006)		(0.0010)		(0.0029)
ln(GVA p.c. Diff.)		0.42***		0.32***		0.62***		0.59***		0.40***		0.45***		0.48***		0.41***		0.50***
		(0.0083)		(0.0130)		(0.0360)		(0.0093)		(0.0140)		(0.0380)		(0.0039)		(0.0068)		(0.0190)
Lagged Dep. Var.													0.40***	0.40***	0.32***	0.32***	0.32***	0.31***
													(0.0006)	(0.0006)	(0.0010)	(0.0010)	(0.0029)	(0.0029)
N	6,325,770	6,325,770	2,832,310	2,832,310	359,520	359,520	1,265,154	1,265,154	566,462	566,462	71,904	71,904	5,060,616	5,060,616	2,265,848	2,265,848	287,616	287,616
R-sq	0.288	0.289	0.325	0.326	0.258	0.261	0.306	0.312	0.386	0.390	0.265	0.271	0.68	0.17	0.62	0.23	0.59	0.18
Structural Difference																		
Mixed (i,j)	0.025***	0.025***	0.020***	0.020***	0.020***	0.020***	0.039***	0.039***	0.033***	0.033***	0.022***	0.021***	0.0070***	0.0071***	0.0058***	0.0058***	0.0070***	0.0069***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0006)	(0.0006)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0009)	(0.0009)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0004)	(0.0004)
Acceding (i,j)	0.031***	0.031***	0.025***	0.025***	0.017***	0.017***	0.039***	0.039***	0.033***	0.033***	0.011***	0.012***	0.0072***	0.0073***	0.0061***	0.0061***	0.0046***	0.0047***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0007)	(0.0007)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0011)	(0.0011)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0005)	(0.0005)
ln(GVA p.c. Diff.)		0.021***		0.012***		-0.033***		0.030***		0.0079***		-0.051***		0.0075***		0.0025***		-0.019***
		(0.0010)		(0.0016)		(0.0045)		(0.0011)		(0.0019)		(0.0050)		(0.0004)		(0.0006)		(0.0019)
Lagged Dep. Var.													0.69***	0.69***	0.69***	0.69***	0.63***	0.63***
													(0.0005)	(0.0005)	(0.0009)	(0.0009)	(0.0028)	(0.0028)
N	6,325,770	6,325,770	2,832,310	2,832,310	359,520	359,520	1,265,154	1,265,154	566,462	566,462	71,904	71,904	5,060,616	5,060,616	2,265,848	2,265,848	287,616	287,616
R-sq	0.032	0.033	0.066	0.066	0.183	0.184	0.073	0.074	0.134	0.134	0.282	0.285	0.94	0.93	0.93	0.93	0.91	0.86

Source: Cambridge Econometrics, own calculations.
Notes: Table reports coefficients for regressions as in equations (1) and (2) using three different reference groups: (a) pre-member region pairs (in columns labeled “EU-15”) = region pairs located in different EU-15 countries, (b) internal region pairs (in columns labeled “Within-country”) = region pairs located in the same country, (c) pre-member region pairs in none-EMU countries (columns labeled “EU-15 none EMU”) = region pairs located in different EU-15 countries that did not join EMU in 1999. Values in brackets are clustering corrected (by region pair) standard errors of the estimate. ***, (**), (*) signify significance at the 1% (5%) (10%) level, respectively. Region pair and time fixed effects are not reported. R-sq is the within R^2 value of the regression, N is the number of observations. The business cycle correlation measure is based on a seven-year rolling window of Corbae-Ouliaris filtered data (denoted as [rw7|co]).

Tables & Figures (main Text)

Table 3: Baseline regression results for Northern enlargement

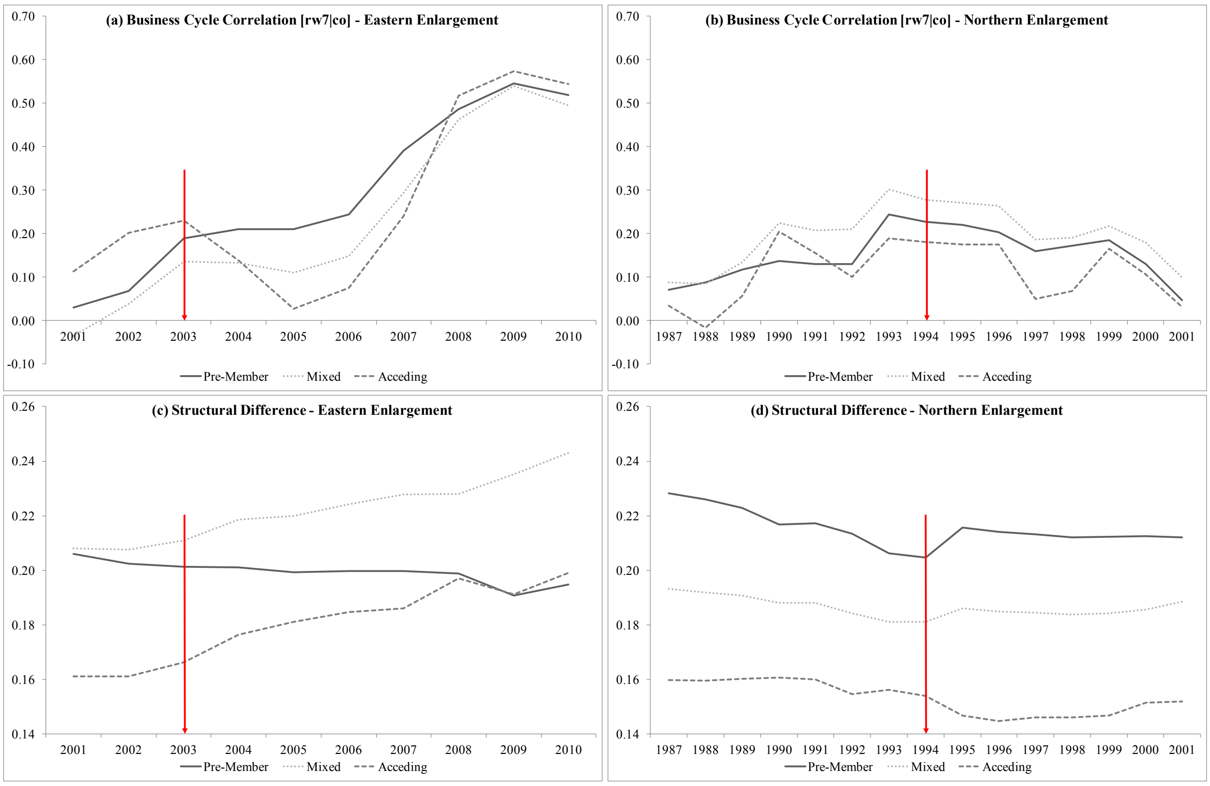
Time Dimension (t)	Full-Panel						2-Years-Panel						Dynamic-Panel					
Reference Group (i,j)	EU-12		Within-country		EU-12 but only EMU		EU-12		Within-country		EU-12 but only EMU		EU-12		Within-country		EU-12 but only EMU	
Model Specification	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Business Cycle Correlation [rw7|co]																		
Mixed (i,j)	-0.0063***	-0.0042**	0.11***	0.11***	-0.011***	-0.0072***	0.0013	0.0028	0.11***	0.11***	0.11***	0.12***	-0.014***	-0.013***	0.047***	0.046***	0.0065***	0.0076***
	(0.0017)	(0.0017)	(0.0020)	(0.0020)	(0.0021)	(0.0021)	(0.0026)	(0.0026)	(0.0032)	(0.0032)	(0.0033)	(0.0033)	(0.0006)	(0.0006)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Acceding (i,j)	-0.019**	-0.014	0.095***	0.096***	0.063***	0.069***	0.032**	0.033**	0.14***	0.14***	0.45***	0.45***	-0.017***	-0.015***	0.045***	0.046***	0.10***	0.11***
	(0.0097)	(0.0097)	(0.0097)	(0.0098)	(0.0140)	(0.0140)	(0.0160)	(0.0160)	(0.0160)	(0.0160)	(0.0240)	(0.0240)	(0.0031)	(0.0031)	(0.0029)	(0.0029)	(0.0049)	(0.0049)
ln(Struct. Diff.)		0.029***		0.031***		0.021***		-0.027***		0.015***		-0.090***		-0.0061***		0.014***		0.00069
		(0.0015)		(0.0023)		(0.0020)		(0.0030)		(0.0045)		(0.0038)		(0.0006)		(0.0008)		(0.0007)
ln(GVA p.c. Diff.)		-0.19***		-0.10***		-0.25***		-0.23***		-0.31***		-0.27***		-0.10***		-0.075***		-0.10***
		(0.0084)		(0.0160)		(0.0099)		(0.0160)		(0.0290)		(0.0190)		(0.0033)		(0.0057)		(0.0038)
Lagged Dep. Var.													0.58***	0.58***	0.64***	0.64***	0.60***	0.60***
													(0.0005)	-(0.0005)	(0.0008)	-(0.0008)	(0.0006)	-(0.0006)
N	6,009,240	6,009,240	2,228,950	2,228,950	3,927,300	3,927,300	801,232	801,232	297,194	297,194	523,640	523,640	5,208,008	5,208,008	1,931,754	1,931,754	3,403,660	3,403,660
R-sq	0.031	0.031	0.068	0.068	0.055	0.056	0.081	0.081	0.135	0.136	0.127	0.130	0.71	0.65	0.75	0.73	0.69	0.63
Structural Difference																		
Mixed (i,j)	0.0018***	0.0015***	0.0052***	0.0053***	-0.0030***	-0.0031***	-0.00029	-0.00042*	0.0061***	0.0061***	-0.0026***	-0.0026***	-0.0015***	-0.0015***	0.00052***	0.00052***	-0.0019***	-0.0019***
	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0000)	(0.0000)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Acceding (i,j)	-0.0066***	-0.0071***	-0.0032***	-0.0033***	-0.0079***	-0.0082***	-0.0095***	-0.0097***	-0.0030***	-0.0031***	0.0024	0.0024	-0.0049***	-0.0050***	-0.0028***	-0.0028***	-0.0021***	-0.0021***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0016)	(0.0016)	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0018)	(0.0018)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0004)	(0.0004)
ln(GVA p.c. Diff.)		0.027***		0.018***		0.010***		0.019***		0.0088***		0.0014		0.0036***		0.00085*		-0.00060**
		(0.0011)		(0.0019)		(0.0013)		(0.0015)		(0.0025)		(0.0018)		(0.0003)		(0.0005)		(0.0003)
													0.83***	0.83***	0.84***	0.84***	0.85***	0.85***
													(0.0003)	-(0.0003)	(0.0006)	-(0.0006)	(0.0004)	-(0.0004)
N	6,009,240	6,009,240	2,228,962	2,228,962	3,927,300	3,927,300	801,232	801,232	297,196	297,196	523,640	523,640	5,208,008	5,208,008	1,931,766	1,931,766	3,403,660	3,403,660
R-sq	0.027	0.028	0.025	0.025	0.016	0.016	0.017	0.018	0.009	0.009	0.012	0.012	0.95	0.95	0.95	0.95	0.96	0.96

Source: Cambridge Econometrics, own calculations.

Notes: Table reports coefficients for a regression as in equation (1) and (2) using three different reference groups: (a) pre-member region pairs (in columns labeled "EU-12") = region pairs located in different EU-12 countries, (b) internal region pairs (in columns labeled "Within-country") = region pairs located in the same country, (c) pre-member region pairs in only EMU countries (columns labeled "EU-12 but only EMU") = region pairs located in different EU-12 countries that joined EMU in 1999. Values in brackets are clustering corrected (by region pair) standard errors of the estimate. ***, (**), (*) signify significance at the 1% (5%) (10%) level, respectively. Region pair and time fixed effects are not reported. R-sq is the within R^2 value of the regression, N is the number of observations. The business cycle correlation measure is based on a seven-year rolling window of Corbae-Ouliaris filtered data (denoted as [rw7|co]).

Tables & Figures (main Text)

Figure 1: Business cycle correlation and structural difference



Source: Cambridge Econometrics, own calculations.

Notes: “Pre-Member” region pairs = region pairs located in different incumbent countries, “Mixed” region pairs = region pairs in which one region is located in an acceding country and the other in an incumbent country, “Acceding” region pairs = region pairs located in different acceding countries. Vertical line = year before accession. The business cycle correlation measure is based on a seven-year rolling window of Corbae-Ouliaris filtered data (denoted as [rw7|co]).

Tables & Figures (main Text)

Figure 2: Results for Eastern and Northern enlargement allowing for heterogeneity of treatment in initial business cycle correlation, structural difference and distance between region pairs

Source: Cambridge Econometrics, own calculations.

Notes: Figure plots coefficients for a regression as in equation (1) when stratifying the sample by quartiles of initial correlations (top panel), structural difference (middle panel) and distance (bottom panel) between regions. Full regression outputs are reported in the Annex available from the authors. The reference groups are region pairs of pre-existing countries for both enlargements. The business cycle correlation measure is based on a seven-year rolling window of Corbae-Ouliaris filtered data (denoted as [rw7|co]).

Annex Table

Table A1: Robustness tests for Eastern and Northern enlargement with respect to business cycle synchronization

Integration Step	Eastern Enlargement												Northern Enlargement											
Time Dimension	Full-Panel						2-Years-Panel						Full-Panel						2-Years-Panel					
Reference Group	EU-15		Within-country		EU-15 but non EMU		EU-15		Within-country		EU-15 but non EMU		EU-12		Within-country		EU-12 but only EMU		EU-12		Within-country		EU-12 but only EMU	
Model Spec.	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Measure	Augmented Cerqueira-Martins based on Corbae-Ouliaris filter [cm*|co]																							
Mixed (i,j)	-0.087***	-0.087***	-0.14***	-0.14***	-0.20***	-0.20***	-0.10***	-0.11***	0.013**	-0.0067	0.50***	0.47***	0.022***	0.023***	0.11***	0.11***	0.057***	0.056***	0.074***	0.072***	-0.12***	-0.11***	0.25***	0.24***
	(0.0022)	(0.0022)	(0.0029)	(0.0029)	(0.0120)	(0.0120)	(0.0047)	(0.0048)	(0.0061)	(0.0062)	(0.0250)	(0.0250)	(0.0027)	(0.0027)	(0.0036)	(0.0036)	(0.0034)	(0.0034)	(0.0068)	(0.0068)	(0.0085)	(0.0086)	(0.0088)	(0.0088)
Acceding (i,j)	-0.31***	-0.31***	-0.37***	-0.36***	-0.22***	-0.21***	-0.37***	-0.37***	-0.26***	-0.27***	0.20***	0.21***	0.082***	0.080***	0.17***	0.17***	0.31***	0.31***	0.075**	0.066*	-0.12***	-0.12***	0.45***	0.46***
	(0.0086)	(0.0086)	(0.0088)	(0.0089)	(0.0140)	(0.0140)	(0.0190)	(0.0190)	(0.0190)	(0.0190)	(0.0300)	(0.0300)	(0.0150)	(0.0150)	(0.0150)	(0.0150)	(0.0230)	(0.0230)	(0.0370)	(0.0370)	(0.0370)	(0.0370)	(0.0640)	(0.0640)
ln(Struct. Diff.)		-0.036***		-0.037***		-0.044***		-0.0085		0.14***		0.21***		-0.054***		-0.061***		-0.057***		-0.13***		-0.21***		-0.26***
		(0.0027)		(0.0040)		(0.0110)		(0.0059)		(0.0089)		(0.0250)		(0.0024)		(0.0042)		(0.0033)		(0.0078)		(0.0120)		(0.0100)
ln(GVA p.c. Diff.)		-0.20***		-0.19***		-0.73***		-0.45***		-0.44***		-1.40***		-0.036***		-0.20***		0.057***		0.20***		-0.17**		-0.019
		(0.0150)		(0.0240)		(0.0650)		(0.0280)		(0.0450)		(0.1200)		(0.0130)		(0.0280)		(0.0160)		(0.0420)		(0.0760)		(0.0500)
N	6,325,770	6,325,770	2,832,310	2,832,310	359,520	359,520	1,265,154	1,265,154	566,462	566,462	71,904	71,904	6,009,240	6,009,240	2,228,962	2,228,962	3,927,300	3,927,300	801,232	801,232	297,196	297,196	523,640	523,640
R-sq	0.011	0.011	0.018	0.018	0.047	0.048	0.004	0.005	0.001	0.002	0.016	0.033	0.005	0.005	0.011	0.011	0.006	0.006	0.006	0.007	0.001	0.004	0.014	0.016
Measure	7-years rolling window based on Hodrick-Prescott filter [rw7|hp]																							
Mixed (i,j)	0.0011	0.0075***	-0.048***	-0.044***	-0.086***	-0.081***	0.046***	0.063***	-0.060***	-0.050***	-0.17***	-0.16***	-0.012***	-0.0088***	0.17***	0.17***	-0.030***	-0.025***	0.0074***	0.0094***	0.16***	0.16***	0.10***	0.10***
	(0.0011)	(0.0011)	(0.0014)	(0.0014)	(0.0054)	(0.0054)	(0.0015)	(0.0015)	(0.0019)	(0.0019)	(0.0071)	(0.0071)	(0.0016)	(0.0016)	(0.0021)	(0.0021)	(0.0021)	(0.0021)	(0.0025)	(0.0025)	(0.0031)	(0.0031)	(0.0031)	(0.0031)
Acceding (i,j)	-0.025***	-0.022***	-0.074***	-0.072***	-0.062***	-0.064***	0.12***	0.14***	0.018***	0.026***	-0.011	-0.011	-0.0046	0.0011	0.18***	0.18***	0.040***	0.048***	0.050***	0.052***	0.20***	0.20***	0.40***	0.41***
	(0.0044)	(0.0044)	(0.0045)	(0.0045)	(0.0065)	(0.0066)	(0.0055)	(0.0055)	(0.0056)	(0.0057)	(0.0084)	(0.0084)	(0.0091)	(0.0091)	(0.0092)	(0.0092)	(0.0130)	(0.0130)	(0.0150)	(0.0150)	(0.0150)	(0.0150)	(0.0240)	(0.0240)
ln(Struct. Diff.)		-0.0041***		-0.020***		-0.0016		-0.065***		-0.072***		-0.072***		0.013***		0.020***		0.020***		-0.029***		0.0087**		-0.078***
		(0.0012)		(0.0018)		(0.0048)		(0.0019)		(0.0028)		(0.0075)		(0.0014)		(0.0023)		(0.0019)		(0.0029)		(0.0042)		(0.0036)
ln(GVA p.c. Diff.)		0.31***		0.25***		0.52***		0.32***		0.25***		0.32***		-0.25***		-0.21***		-0.32***		-0.31***		-0.32***		-0.35***
		(0.0080)		(0.0130)		(0.0370)		(0.0091)		(0.0150)		(0.0380)		(0.0083)		(0.0170)		(0.0097)		(0.0160)		(0.0280)		(0.0190)
N	6,325,770	6,325,770	2,832,310	2,832,310	359,520	359,520	1,265,154	1,265,154	566,462	566,462	71,904	71,904	6,009,240	6,009,240	2,228,950	2,228,950	3,927,300	3,927,300	801,232	801,232	297,194	297,194	523,640	523,640
R-sq	0.340	0.341	0.377	0.378	0.327	0.329	0.445	0.447	0.515	0.516	0.484	0.487	0.056	0.057	0.123	0.123	0.095	0.095	0.089	0.09	0.176	0.177	0.15	0.15
Measure	8-years rolling window based on Corbae-Ouliaris filter [rw8|co]																							
Mixed (i,j)	0.012***	0.020***	-0.0047***	0.0014	-0.12***	-0.11***	0.028***	0.046***	-0.053***	-0.042***	-0.16***	-0.15***	-0.0035**	-0.0015	0.095***	0.094***	-0.016***	-0.012***	-0.012***	-0.010***	0.11***	0.11***	0.065***	0.067***
	(0.0010)	(0.0010)	(0.0013)	(0.0013)	(0.0047)	(0.0047)	(0.0013)	(0.0014)	(0.0017)	(0.0017)	(0.0059)	(0.0059)	(0.0016)	(0.0016)	(0.0019)	(0.0019)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0025)	(0.0025)	(0.0025)	(0.0025)
Acceding (i,j)	-0.12***	-0.11***	-0.13***	-0.13***	-0.14***	-0.14***	-0.031***	-0.020***	-0.11***	-0.10***	-0.083***	-0.084***	-0.018*	-0.012	0.081***	0.082***	0.014	0.021	0.017	0.02	0.14***	0.14***	0.33***	0.33***
	(0.0041)	(0.0041)	(0.0041)	(0.0042)	(0.0059)	(0.0059)	(0.0049)	(0.0049)	(0.0050)	(0.0050)	(0.0071)	(0.0071)	(0.0093)	(0.0093)	(0.0093)	(0.0093)	(0.0140)	(0.0140)	(0.0120)	(0.0120)	(0.0130)	(0.0130)	(0.0180)	(0.0180)
ln(Struct. Diff.)		-0.011***		-0.053***		-0.0085**		-0.052***		-0.081***		-0.054***		0.034***		0.028***		0.021***		-0.0022		0.028***		-0.024***
		(0.0011)		(0.0016)		(0.0041)		(0.0017)		(0.0024)		(0.0065)		(0.0014)		(0.0021)		(0.0019)		(0.0024)		(0.0035)		(0.0029)
ln(GVA p.c. Diff.)		0.37***		0.24***		0.51***		0.44***		0.28***		0.30***		-0.18***		-0.064***		-0.24***		-0.31***		-0.38***		-0.40***
		(0.0075)		(0.0120)		(0.0320)		(0.0082)		(0.0130)		(0.0330)		(0.0079)		(0.0150)		(0.0093)		(0.0140)		(0.0230)		(0.0160)
N	6,325,770	6,325,770	2,832,310	2,832,310	359,520	359,520	1,265,154	1,265,154	566,462	566,462	71,904	71,904	6,009,240	6,009,240	2,228,970	2,228,962	3,927,300	3,927,300	801,232	801,232	297,196	297,196	523,640	523,640
R-sq	0.308	0.309	0.348	0.349	0.283	0.285	0.370	0.374	0.438	0.441	0.306	0.309	0.038	0.039	0.063	0.063	0.063	0.064	0.059	0.061	0.145	0.147	0.099	0.102

Source: Cambridge Econometrics, own calculations. Note: See notes to Tables 2 and 3.

Annex (from authors)

Table A2: Results allowing for heterogeneity of treatment

Dep. Variable	Business Cycle Correlation [rw7|co]				Structural Difference			
Quartile	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Eastern Enlargement								
Reference Group	EU-15							
Q-Indicator	Business Cycle Correlation [rw7|co]							
Mixed (i,j)	-0.0041**	-0.028***	-0.053***	-0.070***	0.027***	0.026***	0.024***	0.023***
	(0.0017)	(0.0018)	(0.0017)	(0.0016)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Acceding (i,j)	-0.057***	-0.093***	-0.13***	-0.14***	0.036***	0.030***	0.028***	0.029***
	(0.0089)	(0.0075)	(0.0067)	(0.0055)	(0.0012)	(0.0010)	(0.0010)	(0.0010)
N	1,581,450	1,581,440	1,581,440	1,581,440	1,581,450	1,581,440	1,581,440	1,581,440
R-sq	0.663	0.442	0.200	0.034	0.037	0.034	0.031	0.028
Q-Indicator	Structural Difference							
Mixed (i,j)	-0.020***	-0.018***	-0.0088***	0.0075***	0.016***	0.021***	0.027***	0.038***
	(0.0024)	(0.0021)	(0.0021)	(0.0023)	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Acceding (i,j)	-0.20***	-0.18***	-0.14***	-0.064***	0.016***	0.023***	0.036***	0.050***
	(0.0070)	(0.0085)	(0.0100)	(0.0140)	(0.0007)	(0.0010)	(0.0014)	(0.0020)
N	1,581,450	1,581,440	1,581,440	1,581,440	1,581,450	1,581,440	1,581,440	1,581,440
R-sq	0.325	0.301	0.287	0.242	0.131	0.038	0.044	0.101
Q-Indicator	Distance (in km)							
Mixed (i,j)	-0.0016	-0.012***	-0.041***	0.0088***	0.025***	0.024***	0.028***	0.023***
	(0.0024)	(0.0021)	(0.0022)	(0.0023)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Acceding (i,j)	-0.20***	-0.22***	-0.19***	0.26***	0.028***	0.029***	0.035***	0.048***
	(0.0057)	(0.0090)	(0.0140)	(0.0180)	(0.0007)	(0.0011)	(0.0017)	(0.0023)
N	1,581,450	1,581,440	1,581,440	1,581,440	1,581,450	1,581,440	1,581,440	1,581,440
R-sq	0.321	0.348	0.297	0.198	0.034	0.033	0.039	0.031
Northern Enlargement								
Reference Group	EU-12							
Q-Indicator	Business Cycle Correlation [rw7|co]							
Mixed (i,j)	0.037***	0.020***	0.019***	0.0021	0.0092***	0.0012**	-0.0014***	-0.0014***
	(0.0032)	(0.0033)	(0.0030)	(0.0025)	(0.0005)	(0.0005)	(0.0005)	(0.0004)
Acceding (i,j)	0.01	-0.037*	-0.045**	-0.059***	0.00072	-0.0079***	-0.0097***	-0.011***
	(0.0150)	(0.0190)	(0.0180)	(0.0160)	(0.0019)	(0.0020)	(0.0018)	(0.0015)
N	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310
R-sq	0.174	0.039	0.074	0.241	0.045	0.029	0.022	0.019
Q-Indicator	Structural Difference							
Mixed (i,j)	-0.004	-0.0028	-0.0068**	-0.033***	-0.0013***	-0.0059***	-0.0071***	-0.0028***
	(0.0029)	(0.0032)	(0.0034)	(0.0041)	(0.0004)	(0.0004)	(0.0005)	(0.0005)
Acceding (i,j)	-0.043***	-0.016	-0.0059	0.018	-0.016***	-0.026***	-0.020***	-0.0045*
	(0.0140)	(0.0180)	(0.0240)	(0.0390)	(0.0013)	(0.0015)	(0.0019)	(0.0025)
N	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310
R-sq	0.042	0.038	0.032	0.021	0.133	0.026	0.051	0.218
Q-Indicator	Distance (in km)							
Mixed (i,j)	0.043***	-0.048***	-0.014***	-0.015***	0.013***	0.0016***	-0.014***	0.0079***
	(0.0039)	(0.0039)	(0.0033)	(0.0028)	(0.0005)	(0.0005)	(0.0005)	(0.0004)
Acceding (i,j)	-0.11***	-0.053**	-0.0096	-0.0055	-0.011***	-0.0024	-0.014***	-0.0021
	(0.0250)	(0.0240)	(0.0180)	(0.0150)	(0.0021)	(0.0019)	(0.0016)	(0.0016)
N	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310	1,502,310
R-sq	0.036	0.028	0.035	0.036	0.029	0.039	0.03	0.03

Source: Cambridge Econometrics, own calculations.
Note: Table reports coefficients for a regression as in equation (1) when stratifying the sample by quartiles of initial correlations (top panel), structural difference (medium panel) and distance (bottom panel) between regions. Values in brackets are clustering corrected (by region pair) standard error of the estimate. ***, (**), (*) signify significance at the 1% (5%) (10%) significance level, respectively. Region pair and time fixed effects are not reported. R-sq is the within R^2 value of the regression, N is the number of observations. The reference groups are region pairs of pre-existing countries for both enlargements. The business cycle correlation measure is based on a seven-year rolling window of Corbae-Ouliaris filtered data (denoted as [rw7|co]).

Annex (from authors)

Table A3: Number of NUTS-3 regions

Country	Eastern Enlargement	Northern Enlargement
AT	35	35
BE	44	44
DE	429	326 [1)]
GR	51	51
ES	59	59
FI	20	20
FR	96	96
IE	8	8
IT	107	107
LU	1	1
NL	40	39 [2)]
PT	28	28
SE	21	21
UK	133	133
DK	11	11
EU-15	1,083	979
CZ	14	
SK	8	
SI	12	
CY	1	
MT	2	
LT	10	
LV	6	
EE	5	
PL	66	
HU	20	
EU-10	144	
EU-25	1,227	

Notes: 1) Data on Eastern Germany (NUTS-2 regions DE3, DE4, DE8, DED, DEE and DEG) is omitted. 2) Data on Flevoland (NL230) is missing.

Annex (from authors)

Table A4: Results for Eastern enlargement allowing for heterogeneity of treatment

Reference Group	Within-Country							
Dep. Variable	Business Cycle Correlation [rw7|co]				Structural Difference			
Quartile	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Q-Indicator	Business Cycle Correlation [rw7|co]							
Mixed (i,j)	0.0040*	-0.047***	-0.098***	-0.12***	0.024***	0.020***	0.018***	0.017***
	(0.0023)	(0.0023)	(0.0022)	(0.0019)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Acceding (i,j)	-0.049***	-0.12***	-0.17***	-0.20***	0.033***	0.025***	0.022***	0.023***
	(0.0092)	(0.0076)	(0.0067)	(0.0056)	(0.0012)	(0.0010)	(0.0010)	(0.0010)
N	708,080	708,080	708,080	708,070	708,080	708,080	708,080	708,070
R-sq	0.692	0.469	0.235	0.066	0.067	0.073	0.067	0.060
Q-Indicator	Structural Difference							
Mixed (i,j)	-0.0070**	-0.025***	-0.030***	-0.040***	0.018***	0.020***	0.023***	0.032***
	(0.0030)	(0.0028)	(0.0029)	(0.0031)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Acceding (i,j)	-0.18***	-0.19***	-0.17***	-0.13***	0.018***	0.022***	0.030***	0.043***
	(0.0078)	(0.0087)	(0.0095)	(0.0120)	(0.0007)	(0.0010)	(0.0012)	(0.0017)
N	708,080	708,080	708,080	708,070	708,080	708,080	708,080	708,070
R-sq	0.338	0.330	0.325	0.311	0.166	0.088	0.055	0.052
Q-Indicator	Distance (in km)							
Mixed (i,j)	0.012*	0.0024	0.015***	-0.021	0.023***	0.022***	0.020***	0.049***
	(0.0064)	(0.0031)	(0.0047)	(0.0170)	(0.0007)	(0.0004)	(0.0005)	(0.0012)
Acceding (i,j)	-0.22***	-0.18***	-0.19***	0.012	0.025***	0.025***	0.025***	0.064***
	(0.0120)	(0.0072)	(0.0085)	(0.0220)	(0.0012)	(0.0008)	(0.0010)	(0.0020)
N	708,080	708,080	708,080	708,070	708,080	708,080	708,080	708,070
R-sq	0.347	0.370	0.335	0.262	0.018	0.046	0.090	0.111

Source: Cambridge Econometrics, own calculations.
Note: Table reports coefficients for a regression as in equation (1) when stratifying the sample by quartiles of initial correlations (top panel), structural difference (medium panel) and distance (bottom panel) between regions. Values in brackets are clustering corrected (by region pair) standard error of the estimate. ***, (**), (*) signify significance at the 1% (5%) (10%) significance level, respectively. Region pair and time fixed effects are not reported. R-sq is the within R^2 value of the regression, N is the number of observations. The reference groups are internal (i.e. within-country) region pairs. The business cycle correlation measure is based on a seven-year rolling window of Corbae-Ouliaris filtered data (denoted as [rw7|co]).

Annex (from authors)

Table A5: Results for Northern enlargement allowing for heterogeneity of treatment

Reference Group	Within-Country							
Dep. Variable	Business Cycle Correlation [rw7|co]				Structural Difference			
Quartile	1st	2nd	3rd	4th	1st	2nd	3rd	4th
Q-Indicator	Business Cycle Correlation [rw7|co]							
Mixed (i,j)	-0.052***	-0.024***	0.0057*	0.016***	0.0018***	0.0044***	0.0042***	0.0068***
	(0.0040)	(0.0037)	(0.0034)	(0.0037)	(0.0006)	(0.0005)	(0.0005)	(0.0006)
Acceding (i,j)	-0.070***	-0.083***	-0.070***	-0.013	-0.0058***	-0.0056***	-0.0034*	-0.0037
	(0.0140)	(0.0160)	(0.0190)	(0.0240)	(0.0017)	(0.0017)	(0.0018)	(0.0023)
N	557,235	557,235	557,235	557,235	557,235	557,235	557,235	557,235
R-sq	0.162	0.082	0.177	0.4	0.018	0.024	0.026	0.043
Q-Indicator	Structural Difference							
Mixed (i,j)	0.12***	0.12***	0.11***	0.078***	0.016***	0.013***	0.0050***	0.00064
	(0.0041)	(0.0041)	(0.0041)	(0.0042)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Acceding (i,j)	0.069***	0.12***	0.088***	0.11***	0.0021	-0.0052***	-0.014***	-0.0045**
	(0.0180)	(0.0170)	(0.0200)	(0.0260)	(0.0016)	(0.0016)	(0.0016)	(0.0020)
N	557,250	557,235	557,250	557,215	557,250	557,235	557,250	557,227
R-sq	0.086	0.07	0.065	0.055	0.124	0.028	0.046	0.189
Q-Indicator	Distance (in km)							
Mixed (i,j)	0.27***	0.14***	0.028***	-0.14***	0.0097***	0.016***	-0.00041	0.0027
	(0.0082)	(0.0057)	(0.0048)	(0.0190)	(0.0012)	(0.0007)	(0.0006)	(0.0019)
Acceding (i,j)	0.075	-0.068*	-0.026	-0.11***	-0.035***	-0.0062**	-0.0073***	-0.0045**
	(0.0750)	(0.0370)	(0.0170)	(0.0230)	(0.0077)	(0.0028)	(0.0015)	(0.0023)
N	557,230	557,235	557,250	557,235	557,242	557,235	557,250	557,235
R-sq	0.128	0.098	0.039	0.045	0.041	0.044	0.011	0.024

Source: Cambridge Econometrics, own calculations.
Note: Table reports coefficients for a regression as in equation (1) when stratifying the sample by quartiles of initial correlations (top panel), structural difference (medium panel) and distance (bottom panel) between regions. Values in brackets are clustering corrected (by region pair) standard error of the estimate. ***, (**), (*) signify significance at the 1% (5%) (10%) significance level, respectively. Region pair and time fixed effects are not reported. R-sq is the within R^2 value of the regression, N is the number of observations. The reference groups are internal (i.e. within-country) region pairs. The business cycle correlation measure is based on a seven-year rolling window of Corbae-Ouliaris filtered data (denoted as [rw7|co]).