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Fragmented Integration and Business Cycle Synchronization in the Greek Regions

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Abstract

This paper examines the degree of business cycles synchronicity among Greek regions and investigates the determinants of the business cycle co-movements of output associated with the functional and spatial aspects of the integration process among the Greek regions. We analyse nearly 30 years (1980 through 2008) of data at the NUTSIII level (prefectures). We conclude that the prefectures are more synchronised with the NUTSII regions than they are at the national level, emphasising a regional (NUTSII) border effect. Moreover, the intensification of the integration process seems to diachronically affect the structural characteristics of the Greek regions and the geography of cyclical synchronisation. Our study reveals a two-stage integration in which we detected urbanisation economies in the first stage and localisation economies in the second stage. The metropolitan regions, apart from their prominent position in economic growth, show a confined level of business cycle synchronisation with the other regions, stressing Greece's pattern of economic and structural dualism.

Key words: *synchronisation cycles, Greek regions, integration, econometric analysis*

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Introduction

The gradual deepening of integration has intensified the interaction and the interdependency between different areas and economies. The consequences are of economic as well as spatial dimension: asymmetry in the economic benefits between the less and the more developed regions and persistence of regional disparities (Camagni and Capello 2010), erosion of distance-bearing border areas in a state of flux (Niebuhr 2008) and regions with inferior technologically productive systems and weakened competitive positions must tackle the pressures of global competition and exposure to international market forces (Feenstra 1998).

In this context, Greek regions are in the lower tail with respect to development in the EU as characterised by a loss of regional competitiveness (Zemanek et al. 2009) and by spatial heterogeneity as these regions face a combination of problems, including underdevelopment, backwardness and peripherality (Monastiriotis 2007). Moreover, the Greek economy is based on the dominance of a metropolitan urban system because the metropolitan region grows more rapidly than the national average and thus reaps pertinent advantages in terms of external economies, productive restructuring and extensive infrastructure improvement (Petrakos 2009).

The study of the influence of integration on the economic growth of regions could be related to classical business cycles defined by absolute expansions and contractions of economic activity (Burns and Mitchell 1946). However, this relationship does not provide information on the tendency of economic fluctuations to become synchronised. There is new knowledge about the influence of integration on *business cycle synchronisation*, which recently has been the focus of considerable research. Business cycle synchronisation is the co-movement of business cycles expressed in terms of deviations around an estimated trend (Lucas 1977). The degree of synchronisation of business cycle fluctuations among regions is conditioned upon certain common structural characteristics, making the shocks together with the fluctuations more symmetric. Consequently, the growth rate movements of some regions may be more or less synchronised, which is revealed by studying their synchronisation cycles.

In our case, the intensified integration process has unavoidably affected the development pattern of the Greek regions and, consequently, their business cycle synchronisation. The literature on Greek business synchronisation cycles is limited, and it is focused mostly on the association of cycles with the European Union (indicatively, Montoya and de Haan 2007, Leon 2006) or on the Real Business Cycles (Michaelides et al. 2007). This paper fills this gap by detecting the business cycle synchronisation of the Greek regions with respect to specific structural variables that explain the degree of this synchronicity.

Hence, the goal of this paper is first, the assessment of the degree of business cycle synchronisation of regions over a span of time and second, the investigation of determinants of the business cycle co-movements of output associated with the functional and spatial aspects of the integration process among the Greek regions. The analysis outcomes are based on three salient points. First, the prefectures (NUTSIII regions) are more synchronised with the NUTSII regions than with the national level, highlighting a regional (NUTSII) border. Second, there is a two-stage integration process in Greek regions that differentially affects the dynamics of the business cycle synchronisation. At the first stage, the integration process reinforces the urbanisation of economies, and at the second stage it reinforces the localisation of economies. Third, the metropolitan regions, apart from their prominent position at the level of economic development**,** display a confined level of business synchronisation with other regions, stressing the pattern of an economic and structural dualism in Greece.

The paper is structured as follows. Section 1 summarises the literature. Section 2 details the methodology. Section 3 elaborates the synchronisation of regional cycles, and section 4 describes the geography of synchronisation. Section 5 detects the determinants of the co-fluctuations using an econometric approach. Finally, section 6 presents the concluding remarks.

1. Literature review

The issue of synchronisation is of interest as many contemplated actions encourage questions about their cycles. In this section, we present some interesting contributions in the literature and emphasise the most crucial issues.

Most literature on business cycle synchronisation focuses on both the national and regional levels. The investigation of the increasing or decreasing synchronicity of business cycles has been broadly studied using different data sets, spatial levels, time intervals and investigative methods. Various studies have concluded that European business cycles have become more synchronised (Artis and Zhang 1997, Barrios et al. 2001) among the more developed Economic Monetary Union (EMU) members (Beine et al. 2003), that there is greater synchronisation among EMU members compared to the European periphery (Beine et al. 2003), that synchronisation has increased recently in some peripheral countries (Marelli 2006), that there are remarkable similarities between the business cycle patterns of countries despite the significant differences in the patterns of fiscal and monetary policies and terms of trade (Christodoulakis et al. 1995) and that the cross-correlation of regions across national borders has increased over time (during the period 1979-1992 associated with the ERM implementation), while, simultaneously, cross-regional correlation within countries has decreased (Fatas 1997).

However, other studies allege that there is less apparent evidence of the correlation of the cyclical movements (Harding and Pagan 2001) considering that the correlation of synchronised cycles remains low, or even decreases, with respect to the Greek regions (Montoya and de Haan 2007). In general, there are two streams of thought. The first stream supports the idea that economic integration leads to more symmetric fluctuations which, in turn, leads to more synchronised business cycles. The second stream of thought agrees with Krugman (1991) and the notion that increasing integration will lead to regional concentration of industrial activities which, in turn, will lead to sector or region-specific shocks, increasing the likelihood of asymmetric shocks and diverging business cycles (Camacho et al. 2006). However, the bulk of the literature suggests increasing synchronicity (Marelli 2006).

The business cycle association among countries with inferior development characteristics and, particularly, the cycle association between Greece and the EU has been a subject of study. The results highlight the lack of cyclical convergence of Greece with the Euro area (Gouveia and Correia 2008), a less synchronised cycle with the EU cycle after the introduction of the euro (Gogas and Kothroulas 2009), few signs of convergence (Crowley and Lee 2005), a low correlation of the business cycle with the Euro area business cycle combined with greater volatility (Papageorgiou et al. 2010), a decrease in volatility over time and a weaker correlation and transmission in the synchronisation of cycles with the Euro zone (Leon 2006), and a greater synchronisation with Algeria, Egypt and Tunisia than with other European countries (Gallegati et al. 2004).

Studies have examined not only the extent to which business cycles have become similar but also the *driving forces* of the co-movement of output. The determinants that affect the synchronisation cycles vary. First, the relative size (in terms of population) significantly affects economic co-fluctuations (Barrios and de Lucio 2003). Differences in industrial structure patterns and specialisation among regions are also important factors in business cycle synchronisation, as industry-specific shocks generate a higher degree of business cycle synchronisation among regions with similar production structures than among regions with asymmetric structures (Imbs 2001). Accordingly, industry-specific shocks usually play a more important role at the regional than at the cross-national level (Belke and Heine 2006). Moreover, the integration process is believed to have a stronger effect on the synchronisation cycles in regions rather in countries due to the intensified trade relations and specialisation levels (Tondl and Traistaru 2006). Some studies suggest that the correlation of regional business cycles with the national cycle remains high over time in spite of European economic integration, implying the existence of a border effect (Montoya and de Haan 2007). Other studies, however, indicate that the border effect has notably decreased (Barrios and de Lucio 2003). Concisely and specifically, the business cycle correlation should be studied employing a multivariate approach because it depends on a variety of factors, including structural and policy-related variables (Haan et al. 2008).

2. Methodology

Synchronicity is the co-movement of growth rates over time. Growth rates are measured as the rate of change in the real (inflation-adjusted) gross domestic product (GDP) of a region. In our analysis for the estimation of business cycles in Greece, we use annual observations of the GDP in constant prices at the NUTSIII Greek region level (prefectures) for a period of 29 years (1980 through 2008). For the identification of the business cycle, we use the deviation cycle proposed by Lucas (1977), which is defined as a cyclical fluctuation in the cyclical component of a variable around its trend. The deviation cycle is identified by isolating the cyclical component from the trend component, and for this purpose, it is necessary to apply a specific de-trending technique that transforms the non-stationary variable of regional output into a stationary variable. There are a variety of filtering techniques to extract the cyclical components of the macroeconomic series. Most studies apply non-parametric filters divided into high-pass or low-pass filters, which remove high frequencies.

We use the Hodrick-Prescott filter (1997), which estimates the trend component by minimising deviations from the trend, subject to a predetermined smoothness of the resulting trend. It is a high-pass filter that removes fluctuations with a frequency of more than eight years and places those fluctuations into the trend (Haan et al. 2008). The advantages of this standard practice are that it is easy to implement and the resulting cyclical residuals are similar to those of the band-pass filter (Belke and Heine 2006, Haan et al. 2008). We decompose the economic series of interest (the real GDP of Greek prefectures in log terms) into the sum of a slowly evolving secular trend and a transitory deviation from it, which is classified as the following cycle:

Observed series (X_t) = Permanent trend (T_t) + Cycle (Z_t)

The HP filter has been widely used in business cycle literature. The filter extracts the trend T_t from a given data X_t by minimising the following function:

$\sum_{t=1}^{N}(X_t - T_t)^2 + \lambda((\mathrm{T}_t - \mathrm{T}_{t-1})^2 - (T_{t-1} - T_{t-2}))^2$, where X_t is the actual series, T_t is the trend series and λ is the smoothing parameter, which penalises the acceleration in the trend component relative to the business cycle component ($X_t - \hat{T}_t$). In other words, the λ parameter controls the smoothness of the adjusted trend series T_t -; that is, as $\lambda \rightarrow 0$, the trend approximates the actual series X_t, while as $\lambda \rightarrow \infty$, the trend becomes linear and, thus, deterministic. According to Marcet and Ravn (2003), the parameter λ, which is

determined endogenously in the annual data, should be between 6 and 7, whereas according to Ravn and Uhlig (1997), it should be equal to 6.25.

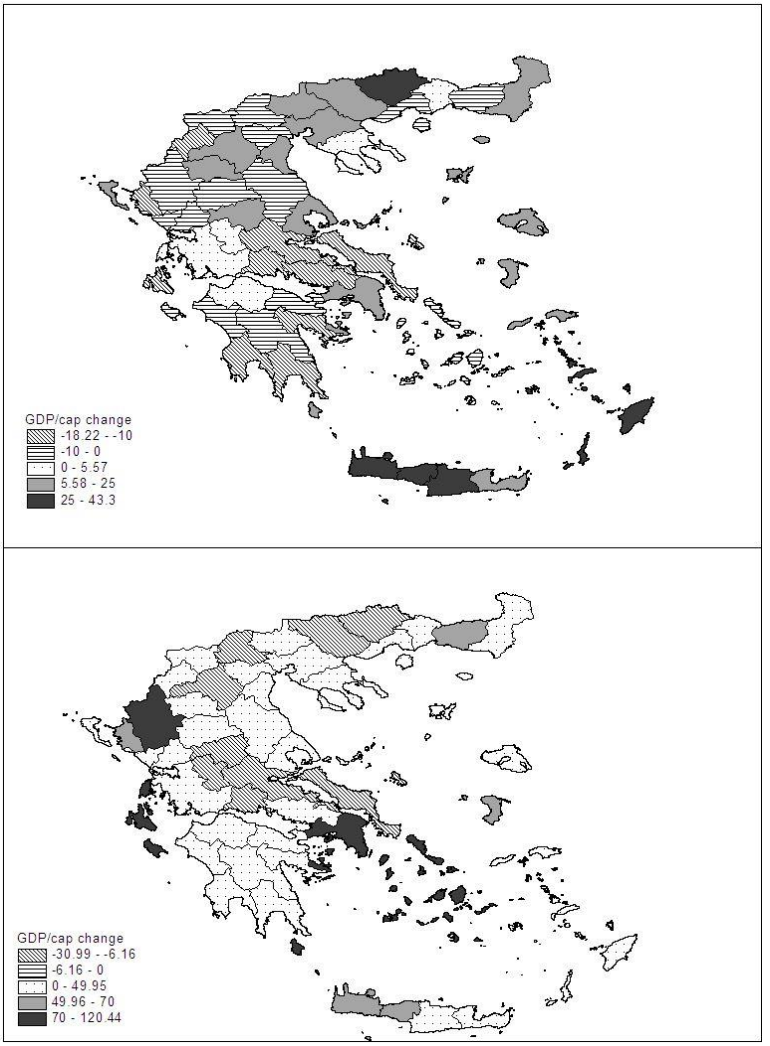
The next methodology we employ calculates the cross-correlation coefficient to estimate the degree of linear co-movement of regions in different time series. For this purpose, we use the Pearson correlation coefficient for the cyclical part of the GDP. If the business cycle correlation coefficient has values of approximately 1, it denotes full business cycle convergence, while if it has values of approximately -1, it suggests full business cycle divergence. Therefore, regions with low correlation coefficients are less synchronised and possess different economic structures (Kenen 1969). Nevertheless, low values of business cycle correlation should be interpreted carefully as low synchronisation may, instead, be an expression of agglomeration tendencies on a regional level that occur according to an optimising calculus (Belke and Heine 2006).

3. Stylised facts

Initially, it is imperative that certain stylised facts concerning the changes of the development level and the production structure of Greece after the EU accession be noted, not only because some of the characteristics may influence the integration process in the NUTSIII regions, but also because they will enable the correct interpretation of our results (Montoya and Haan 2007).

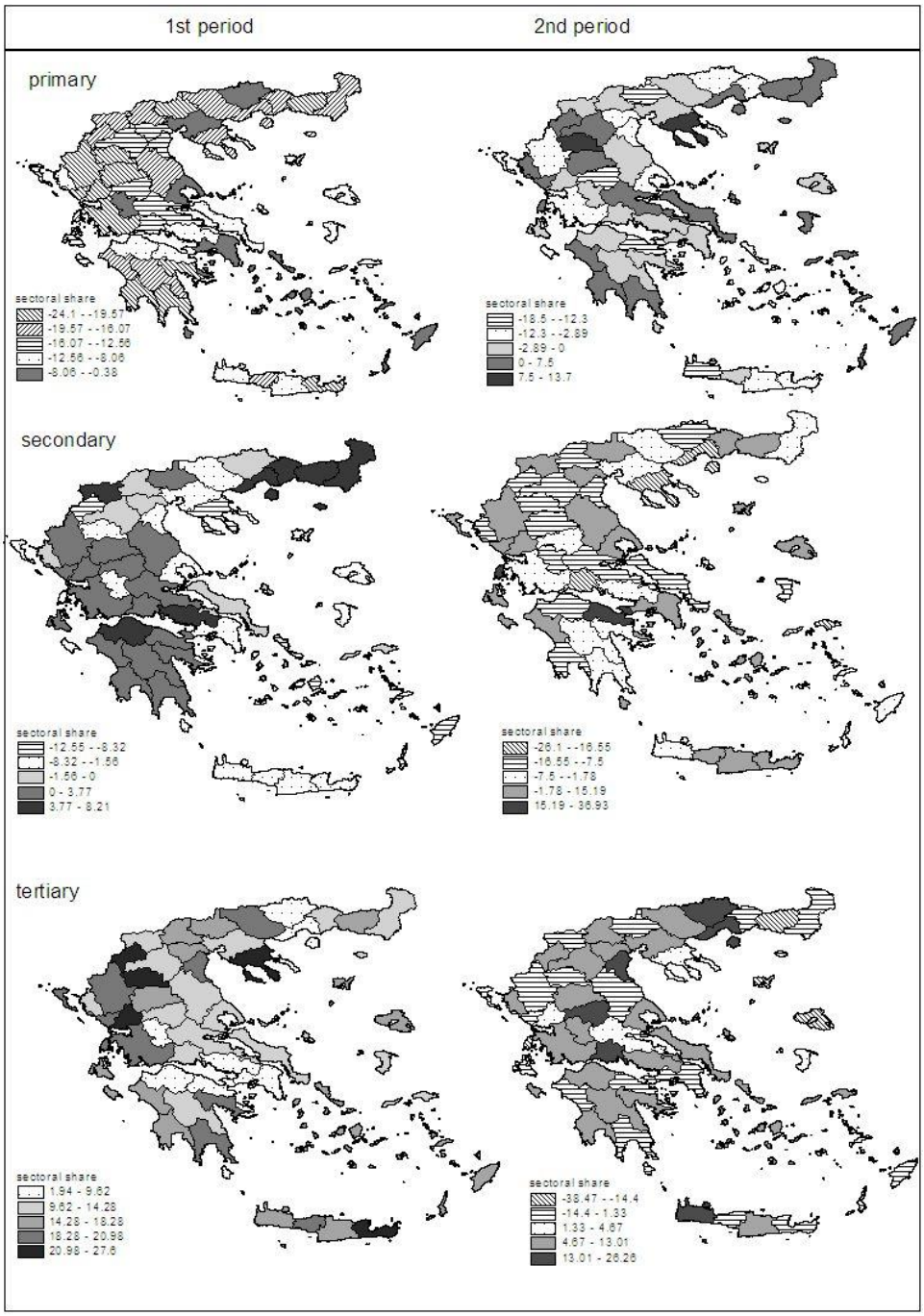
First, the real growth of the GDP per capita in the two under study sub-periods (1981-1992 and 1993-2006) is depicted in Figure 1. The prefectures that exhibit a GDP/cap change *above the national average* are in grey colours, while the regions that display values *below the national average* are noted with raster. There are two substantial points that should be emphasised regarding the developed dynamics between the two time intervals. First, the growth of that GDP/cap was profoundly higher in the second vis-à-vis the first sub-period in 43 out of the 51 prefectures. Conversely, the first sub-period was marked by a prolonged recession that is related to a de-industrialisation process in the most important industrialised centres (starting before the completion of industrialisation, Pitelis and Antonakis 2003), to a government orientation towards the amplification of public consumption without any parallel increase in production (Kalaitzidakis and Kalivitis 2008) and to a low capacity of absorption in the EU fund programs (Petrakos and Psycharis 2004).

Figure 1. Real growth of GDP/cap in the NUTSIII regions of Greece during the sub-periods (1981-1992 and 1993-2006) (constant prices 2000)



Second, the spatial pattern of economic growth displays significant differences among the two sub-periods as a slight economic growth was presented in the prefectures during the first sub-period, which affected both metropolitan as well as some peripheral regions. On the contrary, a growth of considerable size in the GDP/cap at the second sub-period clearly displays a selective spatial character that favours the metropolitan region of Attica and some island regions characterised by a significant development of tourist activities. Thus, it is remarked that integration induced a further expansion to the metropolitan region and promoted the maintenance of dynamism in those regions such that they did not lose their competitive advantage due to their exhibition in the competition forces.

Figure 2. Growth (%) of employment share in the three broad sectors during the first sub-period (1981-1992) and the second sub-period (1993-2006)



Equally evident are some significant observations and a number of peculiarities regarding the changes of the production system in Greece. In Figure 2, the change of the gross value added share in each sector (primary, secondary and tertiary) for the two sub-periods is depicted. In the first sub-period, a clear and absolute trend of decline in the primary sector in nearly all prefectures is observed; whereas in the second sub-period, there appears to be a decrease in the share of the secondary sector parallel with an increase in the primary sector and, to a lesser degree, in the tertiary sector. These outcomes are the consequence of the de-industrialisation process and the strong competitive forces resulting in the contraction of their production base during the integration process (Petrakos and Psycharis 2004). Accordingly, regions tend to be even more specialised in sectors that are labour-intensive with small, inward-looking firms that have minimal technology and postulate their heavy dependence on the primary sector or the traditional-type tertiary sector. The expansion of the metropolitan region proves precisely the inability (at the local and national levels) of the productive resources to be further exploited and deployed in-depth at the sectoral and regional levels.

4. The synchronisation of regional (prefectural) cycles

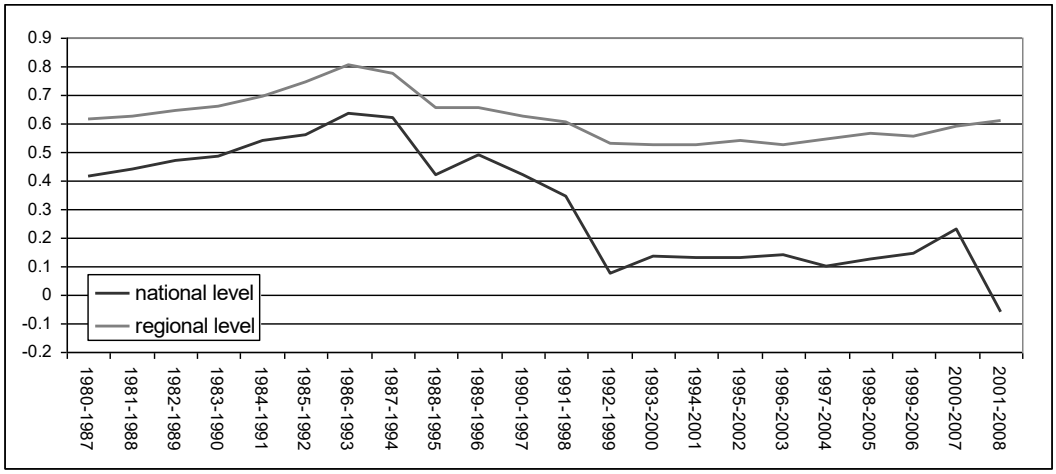
For our analysis, we compute the correlation coefficients between the prefectural cycles (51 regions at NUTSIII level) with, first, the national cycle and, second, the cycle of the broader NUTSII regions (NUTSIII regions represent sub-regional units). The first method emphasises the co-fluctuating cycles among the prefectures and the national average, whereas the second method emphasises the interregional correlation coefficients to capture the regional specific border effect.

There are two approaches to analyse the correlation coefficient over time. The first splits the sample into various periods and examines the integration effect on each of them, and the second uses the rolling window technique to observe the evolution of the correlation coefficient (Massmann and Mitchell 2003). Instead of splitting the sample into arbitrary periods, we opt for using a rolling window of eight years (Montoya and De Haan 2007). The results for the average correlation coefficient of all prefectures with both the national and the regional reference cycle are displayed in Figure 3. As shown, the average correlation of the prefectural cycle with the national cycle experienced a steep decline from 1990 through 2008. In contrast, the average correlation of the prefectural cycle with the regional cycle, despite the diminishing degree of synchronicity, remains higher than the correlation with the national cycle. Moreover, it recuperated slightly between 2001 and 2008.

On the basis of our findings, it is evident that there is a differentiated tendency regarding the degree of business cycle synchronisation. The discrepancy between the

synchronisation of the prefectural cycle and the national and regional cycles suggests that the integration process is more intensive at the regional NUTSII level, as the cycle of the prefectures in Greece do not seem to co-fluctuate with the national cycle. The exception to this is the Attica region where the business cycle proves to be synchronised with the national cycle, an outcome that could be attributed to the gradual concentration of a substantial part of the total economic activities in the region.

Figure 3. Prefectural (NUTSIII) cycle correlation with regional (NUTSII) and national business cycles 8-year rolling window



5. The geography of synchronisation

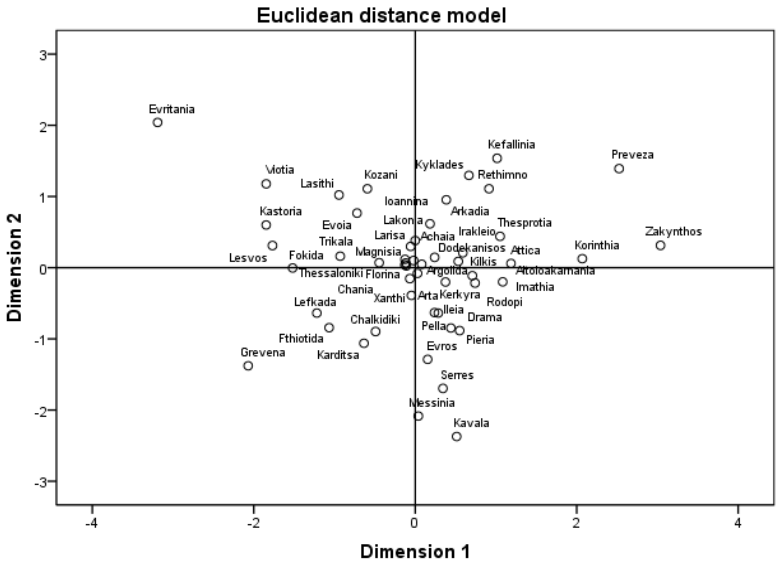
It is interesting to investigate the correlation of the business cycles among the prefectures of different regions as well as the correlation among the prefectures of the same administrative region to pinpoint the degree of intraregional and interregional synchronisation at the NUTSIII level. For this reason, we applied a multidimensional scaling technique (MDS) to the cyclical components of the 51 prefectures (regions at NUTSIII level). This technique converts a set of dissimilarity measures in several dimensions into two dimensions by minimising the squared sum of the difference between the real and the estimated distance. The purpose of the MDS is to provide a visual representation of the pattern of proximities among a set of objects represented by the business cycles of the prefectures.

From a more technical point of view, the MDS identifies a set of vectors in p-dimensional space such that the matrix of the Euclidean distances, which correspond as closely as possible to some function of the input matrix according to a standardised residual sum

of squares (STRESS) function. The smaller the STRESS value, the better the representation. In our case, we use a two-dimensional configuration as the STRESS value is 0.005, which denotes that the distances in the map represent, without distortions, the input data. Thus, there is no need for higher dimensional configuration.

Figure 4 illustrates the prefectures whose business cycles are highly synchronised. We collect evidence by scrutinising whether these prefectures belong to the same region or to different regions. Apart from those prefectures that belong to the same NUTSII region, implying a regional (NUTSII) border effect, there are also similarities among prefectures of different NUTSII regions, suggesting common characteristics with respect to both their spatial and their production structures. The identification of these common characteristics leads inductively to the next step, which attempts to determine these characteristics by an econometric approach to synchronisation cycles.

Figure 4. Multidimensional scaling of the NUTSIII regions (1980-2008)



6. Econometric analysis

In this section, our objective is to provide insight into which and to what degree variables explain the different co-fluctuation cycles in the Greek regions. Specifically, our econometric analysis is based on three important points. First, we use an interdisciplinary approach and compile a multivariate model, which investigates a series of industrial and regional-specific factors affecting the synchronicity of business cycles

between two prefectures (NUTSIII regions). Second, our research examines the cross-correlation of all possible region-pairs with each other. Third, the study period from 1980 through 2008 is divided into two separate time intervals, 1980 through 1992 and 1993 through 2008, to appraise the differential consequences of integration dynamics. The first sub-period is marked by Greece's accession to the EU (1981), and the second is marked by the completion of the Single European Market (SEM), which steered the local economies to unprecedented economic and structural changes. This division into the two sub-periods considers the Maastricht treaty and the creation of the EU (the European Community successor) as watersheds because studies of business cycle synchronisation identify a "Maastricht effect" associated with the further deepening of European integration (Altavilla 2004). Therefore, this paper attempts to *disentangle* the effects of the two-stage integration of Greece on its regional co-fluctuation cycles.

To identify the driving forces of the co-movement of output, we compile and estimate a gravity econometric model with the following form: $Y_{ijt} = \alpha_o + \sum_{r=1}^{n}(\alpha_r X_{rit}) + \varepsilon_{ijt}$, where Y_{ijt} is the dependent variable, α_0 is the constant term, $\sum_{r=1}^{n} X_{rit}$ is a set of determinants, $\sum_{r=1}^{n} a_r$ is a set of the estimators of determinants, $\varepsilon_{ijt} \sim N(0,\sigma^2)$ is the disturbance term (with 0 mean and constant variance), i and j denote the region-pairs, r denotes the independent variables that are 1-n and t is the time period under consideration. The model studies the 51 Greek NUTSIII regions that correspond to the administrative units of prefectures, and it separately estimates two sub-periods (1980-1992 and 1993-2008) to perceive and assess peculiar integration effects in the regions during the periods of EU and SEM accession. All data are from the Hellenic Statistical Authority.

Analytically, the econometric model to determine business synchronisation cycles is as follows:

$$\rho(\widetilde{y}_i, \widetilde{y}_j)_t = a_o + b_1 ISIM_{ijt} + b_2 ISIM_{ijt} PRIM_{ijt} + b_3 SPEC_{ijt} + b_4 SPEC_{ijt} DIST_{ijt} + b_5 DLINK_{ijt} + b_6 AGGL_{ijt} + b_7 POT_{ijt} + b_8 LARGE_{ijt} + b_9 MEDIUM_{ijt} + b_{10} VSMALL_{ijt} + b_{11} INTRAREG_{ijt} + e_{ijt}$$

The dependent variable $\rho(\widetilde{y}_i, \widetilde{y}_j)$ denotes the business cycle correlation between regions i and j over time period t. Business cycle synchronisation is defined bilaterally as the contemporaneous correlation of cyclical components of the real GDP between two regions. Following Frankel and Rose (1998), the business cycle synchronisation is measured bilaterally by computing the simple contemporaneous correlation between cyclical components of the annual real GDP for region i and j over the time span t. The results are obtained from our econometric model by running two different regressions applied in two distinct, non-overlapping time periods (1980-1992 and 1993-2008).

The independent variables were analysed as follows. First, *the index of similarity in production* (ISIM) was introduced in the econometric model following Kenen's (1969) conventional hypothesis that the dissimilarity of sectoral specialisation patterns has long been recognised as a potential source of asymmetric shocks or, inversely, that greater ***similarity*** in production will increase business cycle synchronisation. The variable is defined as the minus sign of the index of dissimilarity (proposed by Jackson and Petrakos 2000): $ISIM_{ijt} = -\sum_{s}((i_{st} - j_{st})^2)$, where i and j are the regions under comparison in the period t for the broad sectors s (primary, secondary and tertiary). In Greece, a de-industrialisation process began in the 1980s, became more pronounced in the second half of the 1990s and became increasingly more dramatic during the dawn of the new millennium (Petrakos et al. 2007). This sweeping restructuring of the productive base resulted in a reasonable increase in the share of traditional-type services as well as an overwhelming increase in the share of agriculture (as presented in section 3). As a consequence of these systemic changes, the correlation of the similarity index with the business synchronicity alone and in relation with the primary share (PRIM) to capture the impact of common traditional characteristics on the synchronisation pattern between region pairs is investigated. The variable is expected to be positively related to the synchronisation cycles. The main argument is that the gradual decrease of the secondary sector in favour of the increasing share of the primary sector, especially in the second sub-period (according to the preceding analysis), results in the similarity of the productive bases among regions, thus causing the shocks and business cycle fluctuations to be more symmetric.

The relationship between the similarity in the sectoral production patterns with the synchronisation cycles is also investigated in the manufacturing sector by including the specialisation variable in the econometric model. Following several studies that attest that industry-specific shocks are more important determinants of synchronisation cycles at the regional than at national level (Clark and Shin 2000), we decided to include in our econometric model a *similarity in manufacturing specialisation* (SPEC) variable, which is indicated by the minus sign of the specialisation distance between two regions i and j: $SPEC_{ijt} = -\left|SPEC_{it} - SPEC_{jt}\right|$, where a region's specialisation index ($SPEC_{it}$) is measured using the relative Theil index[1] (Theil 1967) and is estimated for the two-digit manufacturing sectors. High values of manufacturing specialisation in a region-pair suggest similarities in their manufacturing structure. This similarity transmits the sector-

[1] It is calculated by the equation $SPEC_i = \sum_{j=1}^{J} a_j(i)\ln(\frac{a_j(i)}{\alpha_j})$, with $0 \le T_i \le \ln(1/a_j^*)$, a_j^* as the minimum value in the range of values α_j; i denotes the studied region, J indicates the total number of branches in which region i specialises and a_j^* is the share of each branch in the studied area. The merits of the Theil index are described broadly in the literature as it is neither scale nor mean dependent, it is not excessively affected by extreme values, it is independent of the number of regions and it is decomposable in between-group and within-group coefficients.

specific shocks into the region-pairs, thus activating symmetric business cycle co-fluctuations.

Medium-sized regions tend to be specialised in a small number of sectors of mainly standardised traditional items and low-tech products, thus supporting and guiding the development of intra-sectoral specialisation (Petrakos and Economou 2000) and local industry-level economies-of-scale or localisation economies (Henderson 1997). In our econometric analysis, the hypothesis of the existence of any localisation economies is investigated by correlating the specialisation with the distance variable (DIST). The existence of such economies, in essence, would signify a positive impact of intra-industry spillovers generated by Marshallian specialisation externalities (Glaeser et al. 1992, Griliches 1979) on synchronisation cycles. Therefore, it is expected that the specialisation has a positive relationship with the synchronisation cycles, which inverts to negative over a threshold of distance. Furthermore, it is expected that this hypothesis is confirmed mainly at the second sub-period as medium-sized cities during that time interval experienced more seriously the effects of the de-industrialisation process and were led to a higher degree specialisation due to the integration process (Petrakos and Economou 2000).

As a consequence of globalisation and specialisation, a new form of productive organisation known as outsourcing was developed, implying a breakdown in the vertically integrated mode of production[2]. A production process can be decomposed into a series of distinct steps or tasks to exploit the differences in comparative advantages in different locations or to reduce the optimal scale of production. These industries are related via input-output linkages or vertical relationships that indicate the development of synergies among the economic units as a result of their 'forward and backward' linkages. In the econometric model, this factor, which determines the form of the economic relationships between industries, is represented by the variable *inter-industrial input–output linkages*. This variable measures the degree to which an industry uses imported inputs and is calculated by determining the ratio of the subtraction of the output and the value added in the total output: $LINK_i = \sum_{j=1}^{J} \frac{Q_j - VA_j}{Q_j}$, where i denotes the region, j the branch, Q the output and VA the value added (Forslid et al. 2002, Falcioğlu and Akgüngör 2006). High values of the variable imply a significant presence of outsourcing. However, in a gravity-type model, the values of the two regions are related, implying that the conventional average of a very high value of one region and a smaller value of the second region could attribute a biased high value. To overcome this problem, a dummy variable (DLINK) is used that takes the value 1 under the condition that *both* of the regions have values above the national average, and 0 otherwise.

[2] Bhagwati and Dehejia (1994) call this "kaleidoscope comparative advantage", as firms shift location quickly; Krugman (1996) uses the phrase "slicing the value chain"; Leamer (1996) prefers "delocalisation" whereas Antweiler and Trefler (1997) introduce "intra-mediate trade".

Frankel and Rose (1998) allege that intra-industry trade tends to make regions more correlated, while Kose and Yi (2001) suggest that vertical specialisation may be the key linkage that synchronises business cycles of countries with close trade relationships. The intuition is that if closer trade relationships are characterised by tighter links in the chain of production, fluctuations in one economy should be transmitted to the other (Arkolakis and Ramanarayanan 2009). Under this supposition, the relationship of the vertical integration with the synchronisation cycles is expected to be positive.

Agglomeration economies refer to various forms of clustering of economic activities, which are the main source of enhanced productivity gains due to the effect of spatial externalities together with increasing returns within regions, resulting in an uneven distribution of economic activities (density) across space (Ciccone and Hall 1996). The variable *of similarity in agglomerations* is included in the econometric model (AGGL) to detect whether regions of similar economic density are synchronised. It is indicated as the minus sign of the distance in agglomerations between two regions i and j: $AGGL_{ijt} = -\left|AGGL_{it} - AGGL_{jt}\right|$, where agglomerations of a region i ($AGGL_{it}$) are represented by the ratio of output to area size (which is more accurate than size, Ciccone and Hall 1996): $AGGL_{it} = Q_{it} / A_{it}$, where i denotes the region, Q the output and A the area. There are two theoretical strands on the effects of agglomeration in the business synchronisation, that of Krugman (1991), which alleges that regional concentration of industrial activities will lead to sector- (or even region-) specific shocks, thereby increasing the likelihood of asymmetric shocks and diverging business cycles; and that of Frankel and Rose (1998), which deems that similar levels of concentration lead to more symmetric fluctuations. Thus, this econometric model attempts to elucidate the impact of agglomeration economies on the synchronisation cycles of Greek regions.

The parameter of geography is embraced in the econometric analysis by including the variable of similarity in the market potential (POT) of the econometric model. It is indicated as the minus sign of the distance in market potential between two regions i and j: $POT_{ijt} = -\left|POT_{it} - POT_{jt}\right|$, where the market potential specifies the geo-economic position of the regions. It is estimated as follows (Petrakos 2000): $POT_{it} = \sum_{k=1}^{K} \left(\frac{GDP_i GDP_k}{d_{ik}}\right)$, where i denotes the studied region, k the rest of the regions, K the total of the rest of the regions, the GDP of the region i and d the distance between the regions i and k. This variable reflects the geo-economic dynamic of a region as it measures the magnitude of the economic dynamism as well as the relative accessibility of the one region/market from the rest of the Greek regions/markets. A different size in market potential can generate cross-regional differences in business cycles (Molinari and Martincus 2007). In this paper, the hypothesis that regions with similar geographical characteristics and advantages are equally favoured, and consequently, their economic cycles are synchronised is investigated.

The urban hierarchy by size distribution of cities in the synchronisation cycles is also examined. The varying *size of cities* reflects, presumably, differentiated structures of their production systems, a parameter that leads the regions to confront, in an asymmetric way, any internal or external shock. Therefore, dummy variables that define regions by the population of their capital cities (according to the categorisation of CEC 1996) into large (LARGE >300,000), medium (MEDIUM 100-300,000), small (SMALL 50-100,000) and very small (VSMALL <50,000) have been included.

Finally, we have included a dummy variable that defines whether NUTSIII regions are *members of the same broader NUTSII region* (INTRAREG). The hypothesis that a positive contribution of the variable in the synchronicity signifies the existence of a regional border effect is, thus, examined.

We evaluate the econometric model determinants using a cross-section regression, one for each period, and the WLS (weighted least squares) method. As discussed previously, the majority of econometric studies tend to overlook the relative population size of regions, treating all observations as equal (Petrakos and Artelaris 2009). The WLS allow regions to have an influence on regression results that is analogous to their size via the weight matrix W. The population of each region can be used as the diagonal element in the weighting of the non-singular positive definite matrix $W_{nxn,}$ which has zero off-diagonal elements (Artelaris et al. 2011): $W_{n\times n} = \begin{pmatrix} p_{11} & 0 & 0 & 0 \\ 0 & p_{22} & 0 & 0 \\ 0 & 0 & ... & 0 \\ 0 & 0 & 0 & p_{nn} \end{pmatrix}$

The results of the econometric model are displayed in Table 1. It is clear that the determinants of business synchronism between the two sub-periods profoundly display some distinct differences.

Specifically, at the first sub-period (1981-1992), regions characterised by a similarity in agglomeration economies (AGGL) seem to be synchronised. Moreover, regions that have large capitals (>300,000 inh., LARGE) are those that display symmetric fluctuations. Therefore, it appears that the economic cycles of metropolitan regions as well as the cycles of the regions characterised by higher economic density display similar synchronisation patterns. This pattern of business synchronisation favours larger regions with an eventual diversified productive base and dominance in the development scale, signifying the role of urbanisation economies in the synchronisation cycles.

Regions with similar market potential also seem to be synchronised, although the correlation is statistically significant at the 0.10% level. Thus, economies with similar levels of access in markets tend to have more symmetric business cycle fluctuations.

It is also worthwhile to note the positive and statistically significant correlation of the variable that denotes any common NUTSIII region members in the broader NUTSII

region in the synchronisation cycles. This signifies the important role of the NUTSII region's border effect and the functioning of the productive systems of each NUTSII region as separate and eventually introverted entities.

In contrast, the characteristics of the synchronised regions during the second sub-period are considerably different. First, the regions are more synchronised with respect to the similarity in their production structure (ISIM) by the condition of a high share in the primary sector: $\partial Y_{it} / \partial ISIM_{ijt}$ = $b_3+b_4PRIM_{ijt}>0 \Rightarrow PRIM_{ijt} > -b_3/b_4$ or PRIM>0.06. This condition appears to be fulfilled by the overwhelming majority of regions. Inasmuch as the Greek regions rely on agriculture (Konsolas et al. 2002), it is logical that a significant number of the regions are commonly affected by shocks.

Regions that exhibit similarity in the manufacturing specialisation are also synchronised with respect to their geographic adjacency: $\partial Y_{it} / \partial SPEC_{ijt}$ = $b_3+b_4DIST_{ijt}<0 \Rightarrow DIST_{ijt} < -b_3/b_4$, or DIST<318.9 km. This outcome is in accord with the integration effects in Greece where the non-significant presence of high technological and innovative systems, as well as the shrinkage of the production base due to the de-industrialisation in the regions, has led to an intensification of the specialisation externalities (localisation economies), which are, by nature, stronger in low-tech industries (Henderson et al. 1995).

The inter-industrial input-output linkages also demonstrate a significant role in business cycle synchronisation during the second sub-period. The dummy variable that is used does not determine a similarity mode in outsourcing between two regions that could occur at either low or high levels but rather a mode of high levels of the phenomenon, per se. In this sense, the positive and statistically significant relationship of the dummy variable to the dependent variable signifies that regions that are heavily linked vertically in the production chain are synchronised.

The similarity in market potential between two regions seems to be more meaningful in the synchronisation of their business cycles at the second sub-period. On the contrary, the variable that denotes any common NUTSIII region members in the broader NUTSII region is presented as a non-significant determinant in business synchronisation. These outcomes lead to the inference that integration has induced significant geographical impacts in Greece. That is, the influence of the NUTSII border effect has been weakened as NUTSIII regions belonging to the same administrative NUTSII region do not provide any special gravity in their synchronisation. On the contrary, the geo-economic position of a region constitutes a significant parameter for its prosperity, thus correlating its business cycle with that of others.

Similar levels of agglomeration economies play an important role in business synchronisation. The concern is whether the form of the agglomeration economies is the

same as that of the first sub-period, which, according to the research, it is not. Rather, the structure of the agglomeration economies emanates from the correlation of dummy variables according to capital size. The negative and statistically significant correlation of regions with large capital cities as the dependent variable signifies that regions of considerable size are apparently not synchronised. On the contrary, the business cycles of regions with medium- and very small-sized capital cities seem to be synchronised.

Concisely, in the second sub-period, the regions that are more synchronised are of medium and very small size and are characterised by a traditional-type agricultural production structure, by a production vertically linked mode and by the development, in relatively close proximity, of specialisation externalities. These regions signify the existence of localisation economies that are correlated with similar economic cycles and, therefore, with a common synchronisation.

Table 1. Results of the econometric model of business synchronisation cycles in the Greek regions, 1980-2008 (cross-section WLS model)

Independents	period: 1980-1992		period: 1993-2008	
	(1)	(2)	(3)	(4)
ISIM	-0.31	-0.37	-1.47 (***)	-1.45 (**)
ISIM⊙PRIM	0.25	2.27	23.25 (***)	20.26 (**)
SPEC	0.09	0.07	0.25 (***)	0.22 (**)
SPECDIST	-0.0001	-0.0001	-0.0008 (***)	-0.0006 (**)
DLINK	-0.06		0.25 (***)	
AGGL	7.1110^{-5}		0.0001 (***)	
POT		2.3710^{-14} (*)		7.8210^{-15} (***)
LARGE	0.68 (***)		-0.71 (***)	
MEDIUM	0.13		0.37 (***)	
VSMALL	0.02		0.28 (***)	
INTRAREG	0.30 (***)		0.16	
R^2adj	0.36	0.29	0.17	0.13
F	18.54	7.18	26.02	34.91
N	1275	1275	1275	1275

**** statistically significant at 1% level, ** statistically significant at 5% level, * statistically significant at 10% level*

7. Conclusions

This paper attempts to identify the pattern of business synchronisation cycles in Greek regions and the attractors of regional co-fluctuations due to the integration process since the EU accession. The econometric analysis split the time period into two distinct intervals, which accentuated a series of important idiosyncrasies between these two

sub-periods that are associated with the dynamics of integration and the regions' structural characteristics.

During the first sub-period, characterised by the accession of Greece in the EU, the gradual regional integration-cum-incipience of the de-industrialisation process triggered important structural and urban transformations. This paper confirms that similar levels of agglomeration economies drive co-fluctuations of the economic cycles among the large urban centres. This pattern of business synchronisation favours larger regions characterised by a diversified productive base that signifies the role of the urbanisation economies in the synchronisation cycles. Furthermore, the important role of the NUTSII region's border effect signifying the functioning of the productive systems of each NUTSII region as a separate, eventual inward-looking entity is revealed.

In contrast, the second sub-period coincided with the completion of the SEM and the creation of the EU. During this period, there was a second-stage integration, which affected the medium-sized regions. Obviously, the deepening of European integration adversely affected the production structure of Greek regions, as economies that were over the threshold in the employment share of the primary sector are those that are more synchronised. The extended de-industrialisation of this sub-period and the poor inherited endowments of regions did not steer them to specialise in sectors with increasing returns. Thus, in the manufacturing sector, a deeper specialisation in labour-intensive activities has led to the intensification of the specialisation externalities and the development of localisation economies, which constitute a parameter for business cycle synchronisation of regions.

The integration process has increased the outsourcing of production as the business cycles of regions that are heavily linked vertically in the production chain present common characteristics and correlations. This intensified connectivity among economies is reflected in the production systems but could also be extended to the broader economic level. Indeed, the integration has important geographic impact, as the influence of the NUTSII border effect has been weakened and the administrative NUTSII region does not designate, to any significant degree, whether the NUTSIII regions could by synchronised.

In summation, the integration has altered the pattern of synchronisation cycles in Greece, placing emphasis on the geographic factor and supporting linkages and externalities among medium- and small-sized regions. Furthermore, the business cycles of metropolitan centres are not strongly correlated, thus demonstrating their differentiated routes and, particularly, the expansion of Attica that occurred at the expense of the other regions in Greece. Consequently, these developments could be interpreted as a further gap in the distributional pattern of economic activities across space as well as a perpetuation of the structural dualism in Greece.

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