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Dynamics of Business Cycle Synchronization in Turkey

Summary: The aim of the present article is to investigate the economic determinants of the synchronization across regional business cycles in Turkey between 1975 and 2010. The vast majority of studies in this field have concentrated on well-known determinants, such as inter-regional trade, financial integration, and industrial specialization, while largely ignoring spatial and geographical factors, including differences across regions in agglomeration, localization economies, market size, and urbanization. In this article, we incorporate these variables into our analysis and evaluate their roles in the comovement of regional business cycles. Our findings indicate two major results: first, low degree of synchronization during 1975-2000 has switched to relatively more correlated and synchronously moving regional cycles during 2004-2010. Second, having tested the variety of determinants, we find that the pairs of regions that have more similar industrial structure and market size, trade integration, and arbitrary degree of agglomeration and urbanization tend to synchronize more. Significance of these variables is robustly evident regardless of the time period analyzed and of the type of methodology employed.

Key words: Regional business cycles, Synchronization, Agglomeration, Industrial dissimilarity.

JEL: E32, E63, R11.

In the literature on economic integration, it has been widely argued that national economic policies (i.e. monetary policy) are likely to be sub-optimal for at least a fraction of regions in case of dissimilar economic fluctuations across the regions (Jakob de Haan, Robert Inklaar, and Richard Jong-A-Pin 2008). It is said that places experiencing a downward phase of the business cycle would prefer an expansionary fiscal and monetary policy, while others, in an upward phase, would prefer contractionary policies (De Haan, Inklaar, and Jong-A-Pin 2008).

This “one size does not fit all” problem stands as a politically important concern that has largely been discussed for the feasibility of European Monetary Union (EMU) (Paul R. Krugman 1991; Jeffrey A. Frankel and Andrew K. Rose 1998). Specifically, similarity across the business cycles within the EU and the US has been widely analyzed (Antonio Fatas 1997; Ignazio Angeloni and Luca Debola 1999; Jörg Döpke 1999; Gerald A. Carlino and Keith Sill 2001; Siem Jan Koopman and João Valle e Azevedo 2003; Carlo Altavilla 2004; Zsolt Darvas and György Szapáry 2004; Klaus Weyerstrass et al. 2011; Saša Obradović and Vladimir Mihajlović 2013). This similarity has been expressed with a popular term “synchronization” in the literature, which has been defined as the comoving economic cycles between two economies (i.e. countries or regions) in terms of output, employment, consumption, or any other aggregate economic activity. As no exact theoretical model exists behind synchronization (unlike RBC - Real Business Cycle Model or so), it has been largely discussed on empirical grounds.

A group of scholars searched for the possible determinants of comovements across regional business cycles. Intensity of bilateral trade, financial integration, and similarity in industrial structures across regions are referred to as the most commonly accepted determinants that induce the synchronization of business cycles (Todd E. Clark and Eric van Wincoop 2001; Şebnem Kalemli-Özcan, Bent E. Sorensen, and Oved Yosha 2001; Jean Imbs 2004).

Despite the extensive literature on this subject, several directions that need to be further extended exist. First, the vast majority of studies have concentrated on well-known variables in explaining the comovement of regional cycles while largely ignoring the spatial and geographical factors, such as agglomeration, localization economies, and urbanization.

The effects of such variables are summarized and empirically tested in a study conducted by Ioannis Panteladis and Maria Tsiapa (2014). In this study, synchronization among Greek regions (NUTS (Nomenclature Unit of Territorial Statistics)-III and NUTS-II) was analyzed over the period 1980-2008 using annual real Gross Domestic Product (GDP) values as the business cycle variable. They tested the various determinants to explain the comovements across regions, such as similarity in industrial structure, specialization in manufacturing, similarity in the degree of agglomeration, urbanization (population size of cities) and market potential of regions, intensity of bilateral trade linkages, and geographical distance. As a major finding, they reported that similarity in agglomeration and urban hierarchy across Greek regions has resulted in greater synchronization. Thus, pairs of regions with similar level of economic density and agglomeration have the enhanced productivity gains due to spatial externalities and clustering, which, in turn, lead to synchronization of business cycles. In a similar manner, also found to be an important factor is the localization economies. Similarity in industrial specialization that is positively related to the geographical proximity and existence of such localization economies would indicate significant intra-industry spillovers created by Marshallian externalities (Edward L. Glaeser et al. 1992) and induce the synchronization across regions. Due to their relevance in the previous literature, we incorporate these variables into our analysis and evaluate their roles in the comovement of regional business cycles in Turkey.

On our second contribution to the literature, in contrast to the general focus on the EU and the US, a number of studies on developing countries are, in contrast, much limited (Cesar A. Calderon, Alberto Chong, and Ernesto Stein 2007). Some exceptional studies include that of Hasan Engin Duran (2013), which analyzed the convergence patterns among the cyclical fluctuations of Turkish provinces between 1975 and 2000, and that of Christian V. Martincus and Andrea Molinari (2007), which studied the cycle synchronization within Brasil and Argentina between 1961 and 2000. We believe that Turkey is a relevant place for study because of the existing large socio-economic and geographical imbalances across regions and provinces

(Ferhan Gezici and Geoffrey J. D. Hewings 2004; Jülide Yildirim, Nadir Öcal, and Süheyla Özyildirim 2009).

Overall, the aim of the present article is to investigate the economic reasons behind the synchronization across regional business cycles in Turkey between 1975 and 2010. Data availability is a major concern in selecting the time period and spatial units. As Turkish Statistical Institute (TurkStat) discloses regional data for the periods 1975-2000 and 2004-2010 separately, we also analyze these periods separately from each other. In terms of spatial units, we focus on 26 NUTS-II-level regions for which the detailed information are given in Appendix 2.

The paper is organized as follows: in Section 1, we provide a brief account of the related literature; in Section 2, we implement our empirical analysis in two parts: Sub-section 2.1 is devoted to the analysis of the degree of synchronization across regions, while in Sub-section 2.2, we analyze the determinants of business cycle comovements. We conclude our study in Section 3.

1. Literature Review

In the related literature, a large number of empirical studies had attempted to analyse the similarity of business cycles and their convergence trends over time. For instance, studies focusing on the EU mostly point to the rising correlations among the member states, particularly after the introduction of European exchange rate mechanism (Fatas 1997; Angeloni and Debola 1999; Döpke 1999; Koopman and Valle e Azevedo 2003; Altavilla 2004; Darvas and Zsapáry 2004; Weyerstrass et al. 2011). Few others, by contrast, report evidence of ambigous or declining synchronization within the EU (Michael J. Artis and Wenda Zhang 1997, 1999; Andrew J. Hughes Hallet and Christian R. Ritcher 2004, 2006; Michael Massmann and James Mitchell 2004). With regard to studies on the US, the common view is that the levels of economic integration (trade and factor mobility) and cycle synchronization are generally higher than within the EU (Carlino and Sill 2001; Christophe Croux, Mario Forni, and Lucrezia Reichlin 2001; Michael T. Owyang, Jeremy Piger, and Howard J. Wall 2005). Therefore, the US is often considered to be a benchmark for the Eurozone as an optimal currency area (David Beckworth 2010).

From a theoretical point of view, three main driving factors behind the synchronization of regional fluctuations have been put forward in the literature.

First, similarity of industrial structure appears to be, perhaps, the most convincing one. If two regions tend to specialize in different sectors, they will, naturally, react differently to any sector-specific shock and experience-dispersed cyclical movements (Krugman 1991; Kalemli-Özcan, Sorensen, and Yosha 2001; David D. Selover, Roderick V. Jensen, and John Kroll 2005). In support of this argument, Clark and Van Wincoop (2001), Kalemli-Özcan, Sorensen, and Yosha (2001), Imbs (2004) and Stefano Magrini, Margherita Gerolimetto, and Duran (2013), all find a significant and negative role of industrial dissimilarity on the business cycle correlations. Moreover, in case of a nation-wide common economic shock, such as unanticipated changes in interest rate, commodity prices, or productivity, regions with arbitrary industrial structure will react differently to the aggregate disturbances, contributing further to the cyclical divergence process (Carlino and Robert Defina 1998; Carlino and Sill 2001).

As a second determinant, bilateral trade intensity has largely been suggested in the literature. Two contradicting effects of trade integration have been discussed. On the one hand, an optimistic argument states that intense trade ties among regions might create strong input-output linkages that could result in spillover of economic cycles and synchronization (Frankel and Rose 1998; Michael D. Bordo and Thomas Helbling 2003; Michael U. Bergman 2004; Marianne Baxter and Michael Kouparitsas 2005; Jim Lee 2010). Hence, increasing association among regional cycles serves as anectodal evidence in support of the argument that bilateral trade linkages are likely to induce the output correlation (Lee 2010; Duran 2013). Moreover, a number of scholars argue that the positive effect of trade intensity should mostly be attributed to intra-industry trade while inter-industry trade has an ambigous or negative effect on synchronization (Frankel and Rose 1998; Ayhan M. Kose and Kei-Mu Yi 2002). For instance, Johannes van Biesebroeck (2011) shows that manufacturing trade among US states is mostly intra-industry. Jarko Fidrmuc (2004) similarly argues that positive effect of trade intensity on sycnhronization must be due to intra-industry trade.

On the other hand, the pesimistic argument states that trade openness should be accompanied by specialization of regions in different industries (as in Standard Ricardian Trade Theories), which leads to diverging regional fluctuations. For instance, Rüdiger Dornbusch, Stanley Fisher, and Paul A. Samuelson (1977) argue that falling transport costs result in declining non-tradable sector, as it becomes easier to import rather than produce them. Thus, resources will be freed up and used in fewer production activities. Thus, specialization in different industries would generate asymmetric sector-specific shocks and less synchronized business cycles (Krugman 1991).

Lastly, financial integration and risk sharing among regional economies have been suggested as important determinants of business cycle synchronization (Kalemli-Özcan, Sorensen, and Yosha 2001). However, theoretical considerations indicate their negative effects (Maurice Obstfeld 1994; Jonathan Heathcote and Fabrizio Perri 2004). While investors have imperfect information and liquidity constraints, limited level of capital transfers can decrease business cycle correlation, as investors display a herding behavior by withdrawing the capital from host regions (Imbs 2004). Alternatively, weakening of synchronization might be seen as a consequence of specialization induced by financial integration. Such a liberalization process increases the access to a wide range of state contingent securities that in turn unhinge domestic consumption from domestic production, which then makes the region specialize according to the comparative advantage (Imbs 2004).

Understanding the significance of the determinants mentioned above, together with spatial and geographical components, requires a detailed empirical analysis that will be implemented in the next section.

2. Empirical Analysis

2.1 Synchronization of Regional Business Cycles, 1975-2010

The initial step in our analysis is to estimate the economic cycles for each region. There are several methodologies in the literature used to estimate the economic fluctuations. Baxter and Robert G. King (1999) and Lawrence J. Christiano and Terry J. Fitzgerald (2003) have developed a bandpass filter that aims to directly extract the cycle fluctuations within economic series. Specifically, the cycles are defined as the fluctutations lasting in a range from 18 to 96 months. Some examples of studies that employ bandpass filtering are William C. Gruben, Jahyeong Koo, and Eric Mills (2002), Koopman and Valle e Azevedo (2003), Altavilla (2004), Darvas and Szapáry (2004). Simpler methods in cycle extraction have also been employed, although to a lesser extent. For instance, Bordo and Helbling (2003) and Kose, Eswar S. Prasad, and Marco E. Terrones (2003) have adopted in their studies simple growth rates of economic activity.

However, among the choices, we prefer adopting Robert J. Hodrick and Edward C. Prescott (1997) (HP) filtering due to its simplicity and wide use as discussed in the literature (such as in Clark and Van Wincoop 2001; Kose and Yi 2002; Darvas, Rose, and Szapáry 2005; Calderon, Chong, and Stein 2007). It is also known to be a quite intuitive and tractable technique. In particular, the HP filter minimizes the following term:

$$\min \sum_{t=1}^{T} \left(y_t - \tau_t \right)^2 + \lambda \sum_{t=2}^{T-1} \left[\left(\tau_{t+1} - \tau_t \right) - \left(\tau_t - \tau_{t-1} \right) \right]^2 \quad (1)$$

where y is a measure of output, τ is the long-term trend of output, and λ is the smoothness parameter. As λ takes on greater values, smoother long-term trend is estimated. As suggested by Hodrick and Prescott (1997), we set λ to be equal to 100.

We use the annual *per capita* real GDP (at 1987 prices) for the period between 1975 and 2000 and the *per capita* real Gross Value Added (GVA) (at 2003 prices) for the period 2004-2010. We obtain most of our data from TurkStat[1], as it is the main data source in Turkey. Provincial-level GDPs and populations for the period between 1975 and 2000 have been borrowed from Erdoğan Özötün (1980, 1988), Orhan Karaca (2004) and Adnan Kasman and Evrim Turgutlu (2009) to whom we are heartily grateful.

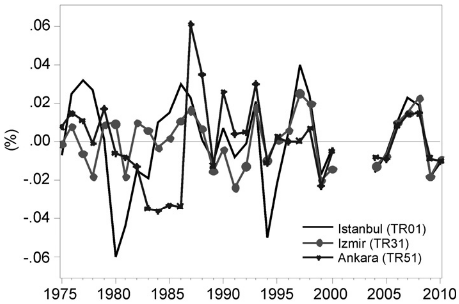
Due to lack of data, we are bound to use two different measures of output in two different periods: GDP data during 1975-2000 and GVA data for 2004-2010, as they are the only available datasets. Although, they do not indicate exactly the same measure, they are acceptable as the best proxies to each other. Such is the reason we find them plausible for use.

For the 1975-2000 period, we convert all provincial data into NUTS-II level. During the 1975-2000 period, some sub-provinces have become new provinces. However, three of these sub-provinces (Osmaniye, Bayburt, and Kirikkale) do not belong in the NUTS-II region, to which their principal provinces do. So to avoid further complication, we assume that these new provinces still belong to their initial principle province and calculate the NUTS-II territories using this assumption for the 1975-2000 period.

[1] **Turkish Statistical Institute (TurkStat).** 2013. Regional Statistics Branch. http://www.turkstat.gov.tr/UstMenu.do?metod=bilgiTalebi (accessed December 15, 2013).

For each region, we use logs of variables and calculate the deviations of regional outputs from their HP trends. It is worth noting that each region is likely to have a different trend behavior, such that while some regions may exhibit a steeper economic trend, others may experience mild changes. Having accepted this fact, we would like to emphasize that trend behavior is a long-run concept while our focus is only on short-term fluctuations. Therefore, we prefer not to analyse trend differences, as they are beyond the scope of our study.

The estimated economic cycles for the 3 biggest regions, which cover approximately 30% of the national population, have been depicted in Figure 1. It is necessary to note that during the 1975-2000 period, asynchronous regional fluctuations have been observed. However, from mid-1990s onwards, fluctuations seem to follow a quite correlated pattern that tends to move more synchronously and to exhibit an almost perfectly comoving regional cycles during the 2004-2010 period.



Source: Author's own analyses by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

Figure 1 Business Cycle of Selected Major Regions

To summarize the overall level of synchronization within the country, we calculate the bilateral Pearson correlation coefficient for each pair of regional business cycle. There are other existing methodologies in the literature that measure the level of synchronization (Fabio Moneta and Rasmus Rüffer 2006). One widely used method is the concordance index that measures the percentage of times that two regions experience the same economic phase (expansion or recession) in a period. This method has been used in Don Harding and Adrian R. Pagan (2002), Owyang, Piger, and Wall (2005) and Duran (2014). Another methodology is the dynamic factor model, which requires slightly more complex estimation procedure and has been adopted, for instance, by Mario Forni and Lucrezia Reichlin (1996) and Lee (2013). However, we prefer using simple correlations, as the above-mentioned methodologies require mostly high-frequency data, that is, quarterly or monthly, whereas we only have annual data.

$\rho_{i,j}$ represents the correlation between the cycles of regions i and j. Table 1 summarizes the cross-sectional average values of $\rho_{i,j}$ for each period. Bilateral regional cycle correlations are fully documented in Appendix 1 as average of both periods.

Table 1 Bilateral Business Cycle Correlations across Regions, N=325

	Mean	SD	SD/Mean
1975-2000			
HP Cycles	0,33	0,23	0,70
GR Cycles	0,30	0,22	0,73
2004-2010			
HP Cycles	0,57	0,38	0,67
GR Cycles	0,53	0,35	0,66

Note: SD: standard deviation, HP: Hodrick Prescott, GR: growth rate.

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

For the 1975-2000 period, we observe that the average correlation between two regions is 0.33, with a standard deviation of 0.23, which indicates low correlation, quite sizable idiosyncratic and asynchronous movements, and a high degree of heterogeneity. In comparison to other similar studies in the literature, our values indicate quite a lack of synchronization. For instance, Lourdes A. Montoya and De Haan (2008) have analyzed the synchronization of European regions with the aggregate European business cycle, and they have found that the correlation of a regional cycle with aggregate EU cycle is about 0.6 recently, which is almost twice of our that in our case. They still argue about large asymmetries in fluctuations. Another study is conducted by Carlino and Sill (2001), analyzing the correlation among regional fluctuations in the US from 1956 to 1995. They have found that almost all pairwise correlations are above 0.80, except that for the Farwest region. Similarly, in Magrini, Gerolimetto, and Duran (2013), it has been found that cycle correlation between a US state and the aggregate economy in the past decade is about 0.9, which is enormously larger than the Turkey case. Hence, we find this topic as very crucial, as the level of synchronization within the country is far below than those in other major countries.

However, during 2004-2010, the average correlation becomes 0.57, with a standard deviation of 0.38. Hence, an increasing pattern of synchronization is observed through the years, although heterogeneity is still present. We calculate the same averages using simple annual growth rates of output also rather than HP filtering, and the results indicate quite similar findings.

Overall, low degree of synchronization during 1975-2000 has switched to relatively more correlated and synchronously moving regional cycles during 2004-2010. This might have arisen for a number of economic reasons. Indeed, the dynamics and determinants of regional cycles might be different in each period, which is an issue to be explored in the next sub-section.

2.2 Determinants of Synchronization

The model proposed to analyze the dynamics of synchronization consists of two simultaneous equations, as follows:

$$\rho_{ij} = \alpha_0 + \alpha_1 S_{ij} + \alpha_2 T_{ij} + \alpha_3 G_{ij} + \alpha_3 GDPprod_{ij} + \varepsilon_{ij}, \quad (2)$$

$$S_{ij} = \gamma_0 + \gamma_1 T_{ij} + \gamma_2 Dist_{ij} + \gamma_3 GDPgap_{ij} + \delta_{ij}, \text{N=325.} \quad (3)$$

The first equation explains the direct determinants of pairwise regional business cycle comovements, denoted with ρ_{ij}. As mentioned above, it shows the bilateral Pearson correlation coefficient across the business cycles of regions *i* and *j*.

With respect to the explanatory variables, firstly, S_{ij} represents an index of industrial dissimilarity across regions *i* and *j* and is calculated as follows (Imbs 2004):

$$S_{ij} = \frac{1}{T}\sum_{t} \sum_{n=1}^{3} |s_{n,j,t} - s_{n,i,t}| \quad (4)$$

where $s_{n,i,t}$ represents the share of sector *n*'s output in total output of region *i*. Specifically, S_{ij} measures the time average of discrepancy across the pairs of regions in sectoral specialization. In calculation, output values for the 1987-2001 period have been used for the 1975-2000 period, and 2004-2010 values have been used for the second period. For the 1975-2000 period, nominal GDP data have been used; for 2004-2010, nominal GVA data have been used as the measure of output. Three main sectors have been considered in calculation: agriculture, industry, and service sectors. Greater values of *S* indicate more dissimilar industrial structure across the two regions.

Another explanatory variable is T_{ij}, which shows the level of bilateral trade intensity across regions *i* and *j*. However, trade flow data are not available at the regional level in Turkey. That is the reason we adopt two different measures to ensure its robustness. First, we apply the gravity model used in Imbs (2004) and Magrini, Gerolimetto, and Duran (2013), to estimate the inter-regional trade flows. Gravity model estimates the level of trade mass across the two regions depending on their geographical distance, market size, and population sizes. We adopt the same coefficients, as it is an acceptable procedure in the previous literature (Magrini, Gerolimetto, and Duran 2013). In particular, the estimated gravity model in Imbs (2004) for the 48 US states is as follows:

$$T1_{ij} = -1.355Dist + 1.057GDP_i * GDP_j - 0.635Population_i * Population_j. \quad (5)$$

Logs of GDP and population variables have been used. For the 1975-2000 period, the average value of real gross GDP and population has been used. For the 2004-2010 period, the average of real GVA has been used instead, and for the population data, the average for the 2007-2012 period has been employed.

The gravity approach might, in fact, be unsafe, as the model uses the coefficients adopted for the US economy. To avoid such a possible distortion, we employ a second measure of bilateral trade integration, which is defined on the basis of pairwise trade openness of regions, such that:

$$T2_{i,j} = \frac{X_i + I_i}{GVA_i} + \frac{X_j + I_j}{GVA_j} \quad (6)$$

where X_i is the number of exports done by region i, and I_i is denotes the volume of imports. These trade volumes are divided into regional GVAs to capture the degree of international trade openness of the region. Hence, higher $T2_{i,j}$ values indicate the fact that two regions that are more open to international trade are also likely to have strong trade ties between each other. However, due to lack of trade data, we can adopt *T2* only for the second period, 2004-2010.

G_{ij} represents a class of spatial and geographical factors as introduced in Panteladis and Tsiapa (2014). It includes several variables. First, *Aggl1* is a measure of dissimilarity in agglomeration across the two regions:

$$Aggl1_{i,j} = |Agg_i - Agg_j| \quad (7)$$

where *Agg* = *Output* / *Area* of the region. Output are the real GDP for the 1975-2000 period and the GVA for the 2004-2010 period. Alternatively, *Aggl2* has been defined as the differences across two regions in *employment* / *area* for the 2004-2012 period and *population* / *area* for the 1975-2000 period. Average values of output and employment have been used for the corresponding periods.

Regarding the possible effects of agglomeration differences on synchronization (captured by *Aggl1* and *Aggl*2), the impact can actually be twofold. The first one is the negative impact, such that dissimilarity in agglomeration across two regions might decrease cycle synchronization. This fact is emphasized in Panteladis and Tsiapa (2014) as they find that as the two regions have similar degree of economic density, they are likely to have similar level of productivity gains from agglomeration and spatial externalities, which in turn induces the bilateral cycle correlation.

The second impact is the fact that an opposite effect can also be observed. If this would be the case, regions with different levels of agglomeration and urban concentration tend to synchronize more. The rationale behind such a claim is as follows: different levels of concentration and density of economic activity are likely to create intense input-output linkages, exchange of production factors between highly agglomerated developed areas, and less concentrated underdeveloped areas (like between urban and rural fringes). Increased level of economic integration between these areas - *via* commodity trade and transfer of production factors - is likely to enhance the bilateral cyclical association.

Lastly, G_{ij} also includes a variable, "*Urb*", that captures the differences in urbanization across regions, given as follows:

$$Urb_{i,j} = |Citypop_i - Citypop_j| \quad (8)$$

where $Citypop_i$ is the population of the largest city in region *i.* Populations are expressed in logs, and average values of corresponding periods are used.

Finally, $GDPprod_{i,j}$ represents the multiplication of *per capita* real GDPs (or GVAs) in regions i and j. Average values of GDP or GVA data are used over the corresponding periods.

In the first equation, industrial dissimilarity (*S*) is known to be endogenous to the system as commonly argued in the literature (Frankel and Rose 1998; Imbs 2004; Magrini, Gerolimetto, and Duran 2013). In Imbs (2004) and Magrini, Gerolimetto, and Duran (2013), for instance, they argue that *S* has an endogenous nature: it affects the system and is affected by other variables; therefore, it should be instrumented with proper exogenous determinants. Exogenous variables could be trade, distance, and market size as suggested by Imbs (2004) and Magrini, Gerolimetto, and Duran (2013). For instance, *S* might influence the synchonization but might be affected by variable trade. Once two regions have strong trade linkages, they might specialize in different industries as suggested by the Ricardian Comparative Advantage Theory. So to overcome this problem and to avoid a possible bias, we model the dynamics of *S* in the second equation using its proper exogenous determinants.

The explanatory variables included in the second equation are *T, Dist*, and *GDPgap*. As explained earlier, *T* is the bilateral trade intensity, and the expected sign of γ_1 is negative such that trade openess is likely to induce the specialization of regional economies in different industries (Krugman 1991). *Dist* represents the distance, in kilometers, across the main city centers of regions (the distance data have been obtained from the General Directorate of Highways (KGM)). As argued in Panteladis and Tsiapa (2014), it measures the existence of localization economies that would enhance intra-industry spillovers across geographically nearby regions and increase the snychronization of cycles (Glaeser et al. 1992). Therefore, the expected sign of γ_2 is positive. Finally, *GDPgap* measures the differences in market size across two regions. Specifically, it is defined as the gap in the (logged) gross GDP (or GVA) of regions.

We estimate the system of equations using Three-Stage Least Squares (TSLS) algorithm given that the system is characterized by simultaneousness and endonegous relationships. Using the proper vectors of exogenous variables, order and rank conditions are quaranteed, and, thus, TSLS provides valid inference for the estimated coefficients. Results are summarized in Table 2.

Table 2 Three-Stage Least Squares Estimation

3SLS	Independent variables	1975-2000					Z-values
		Model (1)	Z-values	Model (2)	Z-values	Model (3)	
Dependent variable: *ρ*	*Constant*	1,243***	3,990	1,213***	3,920	1,321***	3,940
	S	-0,445***	-3,460	-0,446***	-3,480	-0,710***	-4,600
	T1	0,00012***	5,250	0,00012***	5,170	0,00012***	4,920
	GDPprod	-0,017**	-2,160	-0,017**	-2,080	-0,018**	-2,070
	Aggl1	0,00007***	4,110				
	Aggl2			0,00018***	4,060		
	Urb					0,217***	3,110
Dependent variable: *S*	*Constant*	0,194***	3,160	0,194***	3,160	0,198***	3,220
	T1	-0,013***	-2,740	-0,013***	-2,730	-0,013***	-2,720
	Dist	-0,018***	-2,740	-0,018***	-2,740	-0,018***	-2,730
No. of observations: 325	***GDPgap***	**0,235*** **	**6,170**	**0,234*** **	**6,160**	**0,220*** **	**5,850**

Note: *** denotes significance at 1% (P < 0,01), ** at 5% (P < 0,05), * at 10% (P < 0,1).

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

Table 2 (Continued) Three-Stage Least Squares Estimation

3SLS	Independent variables	2004-2010					Z-values
		Model (4)	Z-values	Model (5)	Z-values	Model (6)	
Dependent variable: ρ	*Constant*	-0,759***	-4,340	-0,763***	-4,370	-0,750***	-3,780
	S	-2,181***	-4,670	-2,176***	-4,670	-2,723***	-4,450
	T1	0,00009*	1,890	0,00009*	1,900	0,00006	1,110
	GDPprod	0,622***	9,260	0,623***	9,280	0,630***	7,980
	Aggl1	0,001***	2,640				
	Aggl2			0,274***	2,640		
	Urb					0,240***	2,990
Dependent variable: *S*	*Constant*	0,617***	5,910	0,617***	5,910	0,536***	5,300
	T1	0,035***	4,390	0,035***	4,390	0,029***	3,720
	Dist	0,048***	4,390	0,048***	4,390	0,039***	3,720
No. of observations: 325	***GDPgap***	**0,154*****	**7,340**	**0,154*****	**7,340**	**0,156*****	**7,450**

Table 2 (Continued) Three-Stage Least Squares Estimation

3SLS	Independent variables	2004-2010 (with alternative trade measure *T2*)					Z-values
		Model (4)	Z-values	Model (5)	Z-values	Model (6)	
Dependent variable: ρ	*Constant*	-0,819***	-5,450	-0,819***	-5,460	-0,672***	-4,010
	S	-2,855***	-7,130	-2,856***	-7,150	-3,759***	-7,220
	T2	0,004***	3,670	0,004***	3,670	0,005***	4,700
	GDPprod	0,629***	10,710	0,629***	10,710	0,624***	9,240
	Aggl1	0,0001	0,350				
	Aggl2			0,045	0,360		
	Urb					0,240***	3,230
Dependent variable: *S*	*Constant*	0,655***	6,470	0,655***	6,480	0,586***	6,000
	T2	0,039***	5,020	0,039***	5,020	0,033***	4,440
	Dist	0,052***	5,030	0,052***	5,030	0,044***	4,440
No. of observations: 325	***GDPgap***	**0,139*****	**7,160**	**0,139*****	**7,160**	**0,147*****	**7,760**

To begin with the period of 1975-2000, all variables in both equations are found to be significant at 1% (except *GDPprod*). With regard to the first equation, synchronization of regions is positively associated with industrial similarity and bilateral trade intensity. These findings are consistent with the previous explanations that regions that specialize in similar products and that have intense import-export linkages are likely to share the sector-specific and regional economic shocks easily, and, thus, these regions tend to synchronize more (Lee 2010). Moreover, regions with similar degree of agglomeration and urbanization have less synchronized business cycles. In other words, regions with different levels of urban concentration and agglomeration tend to synchronize more. This finding is in contrast with the findings of Panteladis and Tsiapa (2014), and it is most probably motivated by the fact that different levels of concentration and clustering of economic activity create transfer of production factors and input-output linkages among urban-peripheral or highly agglomerated-less agglomerated areas, which brings about higher cycle synchronization.

With regard to the second equation in which *S* is modeled, *Dist* and *T* have a negative and significant coefficient at 1%. This means that no evidence on localization economies is found and that industrial dissimilarity across regions tends to decrease with distance. Finally, with respect to the effect of market size, regions with different market sizes tend to specialize in different industries, which, in turn, negatively affecting the synchronization.

As for the recent period, 2004-2010, all variables are significant in both equations, regardless of which trade variable *(T1* or *T2)* is used. Hence, trade's positive impact on synchronization is shown to be robust across different measures. Once again, industrial similarity is found to be positively associated with the synchronicity of regional cycles. Moreover, the size of the coefficient is 3-4 times bigger than the coefficient during the 1975-2000 period. Differences in agglomeration and urban hierarchy have a significant and positive impact (except *Aggl1* and *Aggl2* in the equation in which *T2* is used).

With respect to the second equation, distance and trade openness have significant and positive coefficients, which indicate the fact that industrial similarity decreases with distance, and regions with higher bilateral trade tend to have more arbitrary industrial structure. This effect is true regardless of which trade variable is used.

It is worth noting that the sign of the distance variable's coefficient (γ_2) is negative during the first period, but it turns positive during the second period. It indicates the fact that during the 1975-2000 period, geographically nearby regions tend to display an arbitrary industrial structure. By contrast, the positive sign observed during the second period indicates the fact that geographically close regions exhibit relatively similar industrial structure. In other words, recent sectoral specialization tends to become more spatially correlated and similar among neighboring regions. Finally, differences in market size increase the industrial dissimilarity across regions, resulting in lower synchronization across regions.

Overall, one may argue that industrial similarity, trade intensity, differences in agglomeration and urban hierarchy, and market size are the robust variables over time. They have significant effects in both periods, with the same sign of coefficient. Thus, we may refer to them as structural variables in affecting the synchronicity of regional cycles.

Comparing our results with the ones in Panteladis and Tsiapa (2014), as it is the paper that inspires us, we observe some similarities and differences. In terms of similarities, for instance, they also found the significant role of similarity in industrial structure and trade intensity, such that pair of regions that have similar sectoral specialization in production (such as in agriculture and manufacturing) and the regions with strong input-output linkages tend to exhibit more synchronous cycles. In contrast, their finding on the effect of agglomeration and urbanization is different from ours. They report evidence of the fact that regions with similar level of economic concentration have more coherent cycles, whereas we find that pairs of regions that have arbitrary level of agglomeration tend to synchronize more.

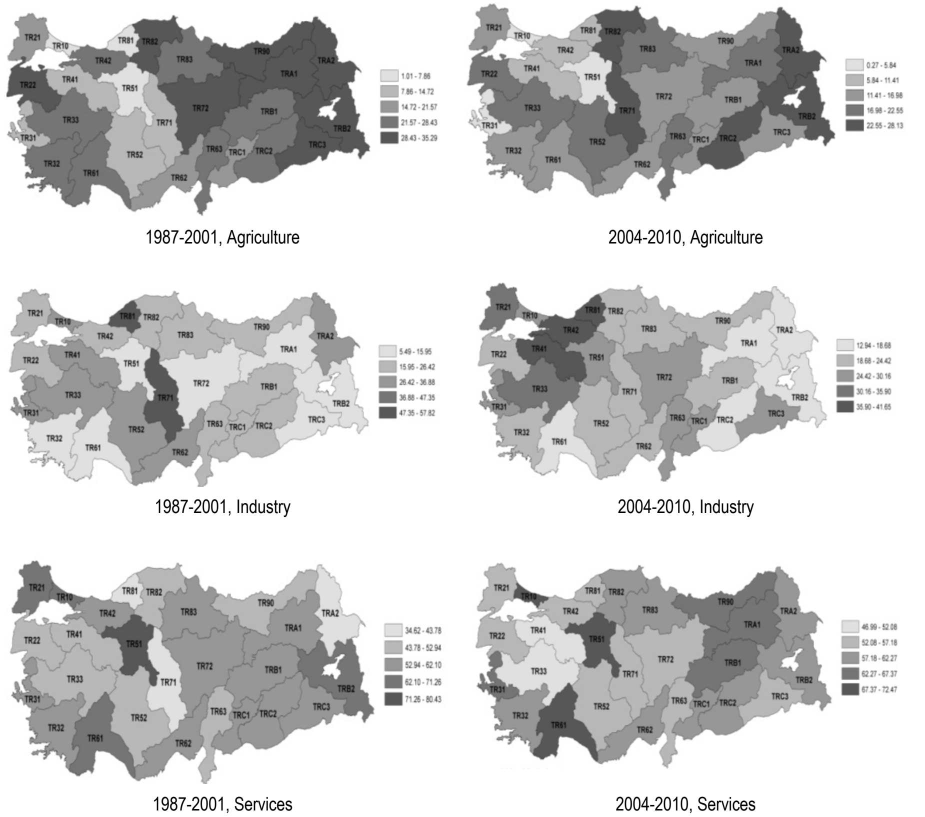
As we have argued earlier (in 2.1), comovements across regional cycles tend to increase recently and almost double in the recent period. Having figured out the determinants of synchronization, it is worthwhile discussing why such a rising synchronization is oberved. On the basis of our regression results, this pattern might be seen as a consequence of homogenization of industrial similarity across regions over time. To support this idea, we document in Table 3 and map in Figure 2 the sectoral shares of regional total output over time.

Table 3 Share of Sectors in Total Output (%)

NUTS-II regions	1987-2001, GDP			2004-2010, GVA		
	Industry	Service	Agriculture	Industry	Service	Agriculture
TR10	30,56	68,43	1,01	27,51	72,22	0,27
TR21	16,8	63,7	19,5	34,67	52,56	12,77
TR22	20,89	50,38	28,73	20,79	56,93	22,28
TR31	30,73	60,88	8,39	27,81	66,86	5,33
TR32	13,74	58,24	28,01	22,97	60,76	16,27
TR33	26,95	50,03	23,02	32,63	46,99	20,38
TR41	34,26	51,74	14	41,65	51,83	6,52
TR42	19,01	54,71	26,27	38,71	54,23	7,07
TR51	14,73	80,43	4,84	24,59	72,47	2,95
TR52	34,88	52,15	12,97	23,4	55,03	21,57
TR61	8,58	67,66	23,76	14,39	69,84	15,78
TR62	27,48	54,18	18,34	22,6	60,76	16,63
TR63	23,48	50,38	26,14	26,37	56,27	17,36
TR71	47,53	43,25	9,21	23,15	53,21	23,64
TR72	9,72	54,99	35,29	28,79	56,63	14,57
TR81	57,82	34,62	7,56	39,28	54,86	5,86
TR82	16,59	48,65	34,76	19,88	57,2	22,92
TR83	18,68	55,66	25,66	21,13	59,06	19,81
TR90	19,25	51,67	29,08	21,37	63,59	15,05
TRA1	11,31	58,23	30,46	17,03	63,8	19,17
TRA2	27,59	38,16	34,25	12,94	58,93	28,13
TRB1	20,8	56,43	22,77	20,25	64,83	14,91
TRB2	5,49	63,66	30,85	16,01	60,93	23,06
TRC1	21,19	60,24	18,57	29,59	58,39	12,02
TRC2	20,34	54,21	25,45	16,5	58,14	25,36
TRC3	12,38	56,84	30,78	28,92	54,37	16,71
Mean	**22,72**	**55,37**	**21,91**	**25,11**	**59,26**	**15,63**
SD	**11,83**	**9,38**	**9,76**	**7,68**	**6,3**	**7,32**
SD/Mean	**0,52**	**0,17**	**0,45**	**0,31**	**0,11**	**0,47**

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

However, we lack sectoral regional GDP data from 1975 to 1986, as they are not available in TurkStat. Hence, we can only report the values for the 1987-2001 period, which is the period that overlaps, more or less, well with the 1975-2000 period. Second, we demonstrate the shares of sectors in regional GVAs for the second period, 2004-2010.



Source: Author's own analyses by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

Figure 2 Geographical Distribution of Sectoral Specialization in Turkey (% Shares of GDP (for 1987-2001) and GVA (for 2004-2010) for Three Sectors)

We observe that during the 1987-2001 period, sectoral specialization is so heterogenous across regions, particularly in industrial production and agriculture, such that the region that specializes most in industrial production is TR81 (Zonguldak, Karabük, and Bartın), covering 57% of the region's GDP, and the region that specializes least in industrial production is TRB2 (Ardahan, Iğdır, Kars, and Ağrı), covering only 5% of the GDP. During 1987-2001, cross-sectional standard deviations of sectoral shares are quite high, with values of 12%, 9%, and 10% for industrial production, service, and agriculture sectors, respectively.

In contrast, looking at the recent period (2004-2010), a pattern of sectoral homogenization is observed, such that cross-sectional standard deviations of sectoral shares are lower compared with the 1975-2000 period, with values of 8%, 6%, and 7% for industrial production, service, and agriculture sectors, respectively.

Consequently, it becomes plausible to argue that the sectoral homogenization process has significantly contributed to the rising synchronization trend in Turkey.

Table 4 Size of the Impact of Main Variables on Synchronization (Impact of One SD Increase in Variables)

Variables	Parameters	1975-2000	2004-2010
S	α_1	-0,09	-0,27
T1	α_2	0,06	0,05
Aggl1	α_3	0,06	0,07
Aggl2	α_4	0,06	0,05
Urb	α_5	0,05	0,07

Note: For the parameters of *S* and *T* in Model (1) and Model (4) in Table 2 are referred.

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

Regarding the impact size of the main variables in our regression model, we summarize in Table 4 the response of $\rho_{i,j}$ to a one standard deviation increase in the explanatory variables. Using the estimated coefficients in Table 2, we find that the most influential variable is industrial dissimilarity (*S*), such that a one standard deviation increase in industrial dissimilarity across regions reduces the bilateral cycle correlation by 0.09 points in 1975-2000 and by 0.27 points in 2004-2010. Differences in agglomeration and urban hierarchy have a moderate impact, such that a one standard deviation increase in these variables increases the cycle correlation by 0.05-0.06 points in 1975-2000 and by 0.05-0.07 points in 2004-2010. Lastly, bilateral trade's impact has been found to be limited, such that a one standard deviation increase in pairwise trade results in the increase of synchronization by 0.06 points in 1975-2000 and by 0.05 points in 2004-2010.

All in all, the main message conveyed in this part is that the dynamics of regional output comovement in Turkey greatly depends on the structural characteristics of regions, such as industrial similarity, differences in urbanization, market size, and agglomeration economies.

2.3 Sensitivity Analysis

A crucial issue that must be adressed concerns the robustness of our results with respect to different methodologies. Therefore, in this part, we implement two types of sensitivity check.

First, a number of scholars (Glen Otto, Graham Voss, and Luke Willard 2001; Inklaar, Jong-A-Pin, and De Haan 2008; Artis and Toshihiro Okubo 2011; Magrini, Gerolimetto, and Duran 2013) argue that the correlation coefficient, ρ_{ij}, lies in an interval between -1 and 1, and if the variance of the error term is not adequately small, reliable inference can hardly be obtained, as the error term loses its normality properties. To overcome this, we apply a Fisher's Z transformation to bilateral regional cycle correlations, ρ_{ij}:

$$z_{i,j} = \frac{1}{2} ln\left(\frac{1+\rho_{i,j}}{1-\rho_{i,j}}\right). \quad (9)$$

It ensures valid inference because it maps [-1, 1] variation into a real line. We re-estimate the regression system using $z_{i,j}$ instead of ρ_{ij} as the dependent variable, and the estimates are presented in Table 5.

Table 5 Fisher *Z*-Transformation: Three-Stage Least Squares Estimation

3SLS_z	Independent variables	1975-2000					Z-values
		Model (1)	Z-values	Model (2)	Z-values	Model (3)	
Dependent variable: ρ	*Constant*	1,406***	3,800	1,371***	3,740	1,509***	3,800
	S	-0,493***	-3,230	-0,494***	-3,240	-0,805***	-4,390
	T1	0,00015***	5,390	0,00015***	5,310	0,00015***	5,070
	GDPprod	-0,020**	-2,070	-0,019**	-1,990	-0,021**	-2,010
	Aggl1	0,00009***	4,060				
	Aggl2			0,00021***	4,010		
	Urb					0,260***	3,140
Dependent variable: *S*	*Constant*	0,194***	3,160	0,194***	3,160	0,197***	3,220
	T1	-0,013***	-2,740	-0,013***	-2,730	-0,013***	-2,720
	Dist	-0,018***	-2,740	-0,018***	-2,740	-0,018***	-2,730
No. of observations: 325	***GDPgap***	**0,235*** **	**6,170**	**0,235*** **	**6,160**	**0,221*** **	**5,870**

Note: *** denotes significance at 1% (P < 0,01), ** at 5% (P < 0,05), * at 10% (P < 0,1).

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

Table 5 (Continued) Fisher *Z*-Transformation: Three-Stage Least Squares Estimation

3SLS_z	Independent variables	2004-2010					Z-values
		Model (4)	Z-values	Model (5)	Z-values	Model (6)	
Dependent variable: ρ	*Constant*	-1,479***	-4,360	-1,494***	-4,410	-1,465***	-3,900
	S	-4,870***	-5,420	-4,848***	-5,430	-5,415***	-4,730
	T1	0,00010	1,150	0,00010	1,160	0,00007	0,720
	GDPprod	1,156***	8,830	1,158***	8,880	1,144***	7,650
	Aggl1	0,002***	4,540				
	Aggl2			0,838***	4,520		
	Urb					0,498***	3,460
Dependent variable: *S*	*Constant*	0,530***	5,200	0,530***	5,200	0,432***	4,350
	T1	0,029***	3,640	0,029***	3,640	0,021***	2,730
	Dist	0,039***	3,640	0,039***	3,640	0,028***	2,730
No. of observations: 325	***GDPgap***	**0,163*** **	**7,810**	**0,163*** **	**7,810**	**0,163*** **	**7,800**

Table 5 (Continued) Fisher *Z*-Transformation: Three-Stage Least Squares Estimation

3SLS_z	Independent variables	2004-2010 (with alternative trade measure *T2*)					*Z*-values
		Model (4)	*Z*-values	Model (5)	*Z*-values	Model (6)	
Dependent variable: ρ	*Constant*	-0,990***	-4,290	-0,996***	-4,320	-0,763***	-3,260
	S	-6,037***	-7,860	-6,033***	-7,870	-7,249***	-7,490
	T2	0,012***	4,320	0,012***	4,330	0,013***	5,340
	GDPprod	0,962***	10,070	0,963***	10,080	0,922***	8,900
	Aggl1	0,001	1,290				
	Aggl2			0,296	1,280		
	Urb					0,440***	3,250
Dependent variable: *S*	*Constant*	0,133***	9,150	0,133***	9,140	0,139***	9,630
	T2	0,001***	3,220	0,001***	3,220	0,001***	3,020
	Dist	0,00003***	2,720	0,00003***	2,720	0,00002**	2,060
No. of observations: 325	***GDPgap***	**0,141*** **	**6,630**	**0,141*** **	**6,630**	**0,149*** **	**7,140**

The results tell almost the same story as in Table 2. Industrial similarity, trade, agglomeration, market size, and urban hierarchy are the variables structurally affecting cycle synchronization regardless of the time period analyzed.

Second, robustness check is implemented by estimating the system equation-by-equation *via* OLS. The results are summarized in Table 6.

Table 6 Equation-by-Equation; OLS Estimation

OLS	Independent variables	1975-2000					*T*-values
		Model (1)	*T*-values	Model (2)	*T*-values	Model (3)	
Dependent variable: ρ	*Constant*	0,857***	2,890	0,834***	2,830	0,614**	2,060
	S	-0,076	-1,260	-0,077	-1,270	-0,065	-1,010
	T1	0,0001***	5,030	0,0001***	4,970	0,0001***	4,660
	GDPprod	-0,011	-1,360	-0,010	-1,290	-0,004	-0,560
	Aggl1	0,0001***	3,240				
	Aggl2			0,0001***	3,210		
	Urb					0,072	1,280
Dependent variable: *S*	*Constant*	0,193***	3,120	0,193***	3,120	0,193***	3,120
	T1	-0,013***	-2,720	-0,013***	-2,720	-0,013***	-2,720
	Dist	-0,018***	-2,730	-0,018***	-2,730	-0,018***	-2,730
No. of observations: 325	***GDPgap***	**0,240*** **	**6,210**	**0,240*** **	**6,210**	**0,240*** **	**6,210**

Note: *** denotes significance at 1% (P < 0.01), ** at 5% (P < 0.05), * at 10% (P < 0.1).

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

Table 6 (Continued) Equation-by-Equation; OLS Estimation

OLS	Independent variables	2004-2010				
		Model (4)	*T*-values	Model (5)	*T*-values	Model (6)
Dependent variable: *ρ*	*Constant*	-0,737***	-5,030	-0,736***	-5,030	-0,726
	S	-0,389***	-2,700	-0,389***	-2,700	-0,367
	T1	0,0002***	5,370	0,0002***	5,370	0,0002
	GDPprod	0,511***	11,400	0,511***	11,420	0,512
	Aggl1	-0,0002	-0,740			
	Aggl2			-0,067	-0,730	
	Urb					-0,060
Dependent variable: *S*	*Constant*	0,712***	6,600	0,712***	6,600	0,712
	T1	0,043***	5,130	0,043***	5,130	0,043
	Dist	0,058***	5,130	0,058***	5,130	0,058
No. of observations: 325	***GDPgap***	**0,144*** **	**6,780**	**0,144*** **	**6,780**	**0,144**

Table 6 (Continued) Equation-by-Equation; OLS Estimation

OLS	Independent variables	2004-2010 (with alternative trade measure *T2*)					*T*-values
		Model (4)	*T*-values	Model (5)	*T*-values	Model (6)	
Dependent variable: *ρ*	*Constant*	-1,05934***	-8,06	-1,0529***	-8,02	-1,03374***	-7,81
	S	-0,61446***	-4,29	-0,61545***	-4,29	-0,60966***	-4,12
	T2	0,004101***	3,28	0,00407***	3,26	0,002067**	2,1
	GDPprod	0,542615***	11,74	0,541277***	11,7	0,556752***	11,92
	Aggl1	-0,00108***	-3,05				
	Aggl2			-0,38664***	-3,03		
	Urb					-0,10671*	-1,68
Dependent variable: *S*	*Constant*	0,140604***	8,67	0,140604***	8,67	0,140604***	8,67
	T2	0,000948***	2,83	0,000948***	2,83	0,000948***	2,83
	Dist	2,21E-05	1,36	2,21E-05	1,36	2,21E-05	1,36
No. of observations: 325	***GDPgap***	**0,151345*** **	**6,44**	**0,151345*** **	**6,44E+00**	**0,151345*** **	**6,44**

There are some remarkable differences between TSLS and OLS estimations. First, in the OLS estimation, the coefficient of industrial similarity is not significant during the 2004-2010 period, while bilateral trade openness is significant in both periods. Second, agglomeration and urban hierarchy are significant during the 1975-2000 period but insignificant during the 2004-2010 period. These differences imply the importance of neglected endogeneity in OLS estimation that might have contributed to the bias in the inferences; this bias is corrected in the TSLS estimation. Hence, both types of sensitivity check indicate once again the validity of our results in the TSLS estimation.

3. Conclusions

In this article, we have investigated the economic determinants behind the synchronization of regional business cycles in Turkey between 1975 and 2010. Our results can be summarized in two parts.

First, comovements across regional output fluctuations tend to increase recently, as we observe higher bilateral correlations among the cycles of regions. This pattern is possibly explained by homogenization of sectoral specialization across regions over time.

Second, among the variety of determinants tested, we find the pairs of regions that have more similar industrial structure, trade integration and arbitrary degree of agglomeration and urbanization tend to synchronize more. The significance of these variables is robust regardless of the time period analyzed and of the type of methodology employed.

In light of these results, the most important message we get is that industrial diversification and homogenization of sectors across the regions, which promote trade integration, would help in inducing the economic integration and enhancing the regional cycle synchronization. Thus, policies targeted to this objective would indeed be useful in dealing with economic asymmetries within the country.

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Appendix 1

Bilateral Business Cycle Correlations among NUTS-II Regions,
Average of 1975-2000 and 2004-2010

NUTS-II regions	TR10	TR21	TR22	TR31	TR32	TR33	TR41	TR42	TR51	TR52	TR61	TR62	TR63
TR21	0,78												
TR22	0,54	0,47											
TR31	0,67	0,52	0,49										
TR32	0,7	0,51	0,51	0,72									
TR33	0,84	0,71	0,59	0,76	0,76								
TR41	0,86	0,61	0,64	0,67	0,81	0,89							
TR42	0,66	0,64	0,3	0,55	0,64	0,62	0,66						
TR51	0,61	0,35	0,55	0,62	0,73	0,65	0,79	0,56					
TR52	0,66	0,47	0,56	0,57	0,66	0,71	0,74	0,56	0,7				
TR61	0,68	0,59	0,27	0,75	0,74	0,72	0,71	0,53	0,51	0,54			
TR62	0,55	0,59	0,28	0,58	0,56	0,51	0,54	0,67	0,62	0,56	0,64		
TR63	0,39	0,33	0,55	0,55	0,59	0,44	0,56	0,52	0,78	0,61	0,48	0,62	
TR71	0,84	0,69	0,54	0,63	0,59	0,81	0,8	0,61	0,46	0,7	0,64	0,43	0,36
TR72	0,74	0,53	0,37	0,66	0,55	0,67	0,68	0,56	0,57	0,65	0,58	0,57	0,41
TR81	0,72	0,63	0,16	0,5	0,56	0,7	0,62	0,53	0,19	0,44	0,7	0,36	0,07
TR82	0,55	0,53	0,18	0,51	0,35	0,44	0,47	0,34	0,3	0,39	0,59	0,43	0,27
TR83	0,72	0,7	0,48	0,54	0,64	0,64	0,69	0,68	0,67	0,73	0,6	0,84	0,66
TR90	0,62	0,52	0,55	0,48	0,61	0,64	0,79	0,54	0,59	0,64	0,57	0,49	0,57
TRA1	0,37	0,14	0	0,15	0,36	0,2	0,38	0,15	0,32	0,25	0,17	0,17	-0,03
TRA2	0,23	0,26	-0,29	0,09	0,15	0,18	0,17	0,21	-0,19	-0,12	0,31	0,07	-0,25
TRB1	0,64	0,55	0,42	0,52	0,44	0,71	0,74	0,5	0,4	0,51	0,6	0,46	0,27
TRB2	0,23	0,26	0,05	-0,06	0	0,12	0,23	0,24	0,07	0,17	0,2	0,34	0,17
TRC1	0,44	0,35	0,19	0,2	0,51	0,39	0,54	0,48	0,57	0,38	0,49	0,58	0,51
TRC2	0,24	0,06	-0,13	-0,07	0,28	0,06	0,24	0,32	0,14	-0,02	0,25	0,29	-0,02
TRC3	0,37	0,28	0,02	0,24	0,5	0,39	0,49	0,58	0,43	0,27	0,54	0,56	0,27

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

Appendix 1 (Continued)

Bilateral Business Cycle Correlations among NUTS-II Regions,
Average of 1975-2000 and 2004-2010

NUTS-II regions	TR71	TR72	TR81	TR82	TR83	TR90	TRA1	TRA2	TRB1	TRB2	TRC1	TRC2
TR72	0,67											
TR81	0,77	0,51										
TR82	0,61	0,46	0,44									
TR83	0,56	0,59	0,43	0,47								
TR90	0,72	0,53	0,55	0,35	0,68							
TRA1	0,24	0,28	0,21	0,48	0,34	0,29						
TRA2	0,29	0,14	0,57	0,22	0,03	0,3	0,2					
TRB1	0,72	0,59	0,65	0,35	0,51	0,77	0,15	0,39				
TRB2	0,28	0,14	0,24	0,21	0,35	0,41	-0,06	0,45	0,47			
TRC1	0,38	0,26	0,38	0,28	0,58	0,57	0,15	0,3	0,39	0,67		
TRC2	0,11	0,04	0,25	0,11	0,26	0,26	0,26	0,47	0,25	0,6	0,71	
TRC3	0,32	0,3	0,41	0,23	0,51	0,52	0,22	0,33	0,46	0,53	0,73	0,69

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).

Appendix 2

Definition of NUTS-II Regions

NUTS-II region	Provinces
TR10	İstanbul
TR21	Tekirdağ, Edirne, Kırklareli
TR22	Balıkesir, Çanakkale
TR31	İzmir
TR32	Aydın, Denizli, Muğla
TR33	Manisa, Afyon, Kütahya, Uşak
TR41	Bursa, Eskişehir, Bilecik
TR42	Kocaeli, Sakarya, Düzce, Bolu, Yalova
TR51	Ankara
TR52	Konya, Karaman
TR61	Antalya, Isparta, Burdur
TR62	Adana, Mersin
TR63	Hatay, Kahramanmaraş, Osmaniye
TR71	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir
TR72	Kayseri, Sivas, Yozgat
TR81	Zonguldak, Karabük, Bartın
TR82	Kastamonu, Çankırı, Sinop
TR83	Samsun, Tokat, Çorum, Amasya

TR90	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane
TRA1	Erzurum, Erzincan, Bayburt
TRA2	Ağrı, Kars, Iğdır, Ardahan
TRB1	Malatya, Elazığ, Bingöl, Tunceli
TRB2	Van, Muş, Bitlis, Hakkari
TRC1	Gaziantep, Adıyaman, Kilis
TRC2	Şanlıurfa, Diyarbakır
TRC3	Mardin, Batman, Şırnak, Siirt

Source: Author's own calculation by using data from TurkStat, Özötün (1980, 1988), Karaca (2004).