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ABSTRACT

The aim of the present article is to investigate the economic determinants of the synchronization across regional business cycles in Turkey between 1975-2010. The vast majority of studies in this field have concentrated on well known determinants, such as interregional 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, 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.

Keywords Regional Business Cycles, Synchronization, Agglomeration, Industrial Dissimilarity

JEL Codes E32, E63, R11

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1 Introduction

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. (De Haan et al., 2008). Such that places which experience 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 et al. 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) (Frankel and Rose, 1998; Krugman, 1991). Specifically, similarity across the business cycles within EU and US has mostly been analyzed (Fatas, 1997; Döpke, 1999; Angeloni and Debola, 1999; Obradovic and Mihajlovic, 2013; Koopman and Azevedo, 2003; Darvas and Zsapary, 2004; Altavilla, 2004; Weyerstrass et al. 2011; Carlino and Sill, 2011). From a theoretical point of view, a strand of scholar search for the possible determinants of co-movements across regional business cycles. Intensity of bilateral trade, financial integration and similarity in industrial structures across regions are referred to as most commonly accepted determinants that induce the synchronization of business cycles (Kalemli-Özcan et al. 2001; Imbs 2004, Clark and Van Wincoop, 2001)

Despite the extensive literature on this subject, there exists several directions which needs to be further extended. First, the vast majority of studies have concentrated on well known variables in explaining the co-movement of regional cycles while largely ignoring the spatial and geographical factors such as agglomeration, localization economies, market size and urbanization. The effects of such variables are summarized and tested empirically in a study by Panteladis and Tsiapa (2013) according to whom similarity in agglomeration and urban hierarchy across Greek regions has resulted in greater synchronization. So, regions with similar level of economic density and agglomeration have the enhanced productivity gains due to spatial externalities and clustering, that in turn, lead business cycles to synchronize. In a similar manner, Localization economies is also found to be an important factor. Such that similarity of industrial specialization is positively related to the geographical proximity and existence of such localization economies would indicate significant intra-industry spillovers created by Marshallian externalities (Galeser, 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.

Second, In contrast to the general focus on EU and US, number of studies on developing countries are, in contrast, much limited (Calderon, 2007). Some exceptional studies are Duran (2013) who analyze the convergence patterns among the cyclical fluctuations of Turkish provinces between 1975-2000 and Martincus and Molinari (2007) who study cycle synchronization within Brasil and Argentina between 1961-2000. We believe that Turkey is a relevant place for study since there exists large socio-economic and geographical imbalances across regions and provinces (Yildirim et al., 2009; Gezici and Hewings, 2004).

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. Since TURKSTAT (Turkish Statistical Institute) discloses regional data for the periods between 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-2 level regions for which the detailed information is given in Appendix 2.

The organization of the paper is as follows: in section 2, we provide a brief account of the related literature, in section 3, we implement our empirical analysis in two parts: sub-section 3.1 is devoted to the analysis of degree of synchronization across regions while in sub-section 3.2, we analyze the determinants of business cycle comovements. We conclude our study in section 4.

2. Literature Review

In the related literature, large number of empirical studies had an attempt to analyse the similarity of business cycles and their convergence trends over time. For instance, studies focusing on EU mostly point to the rising correlations among the member states, particularly after the introduction of European Exchange Rate mechanism. (Fatas, 1997; Döpke, 1999; Angeloni and Debola, 1999; Koopman and Azevedo, 2003; Darvas and Zsapary, 2004; Altavilla, 2004; Weyerstrass et al. 2011). Few others, by contrast, report evidence of ambigous or declining synchronization within EU (Artis and Zhang, 1997; 1999; Massman and Mitchel, 2004; Hallet and Ritcher, 2004; 2006). With regard to the studies on U.S., the common view is that the level of economic integration (trade and factor mobility) and cycle synchronization is generally higher than within EU (Croux et. Al., 2001; Owyang, Piger and Wall, 2005; Carlino and Sill, 2001). Therefore, U.S. is often considered to be a benchmark for the Eurozone as an optimal currency area (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 et al., 2001; Selover et al., 2005). In support of this argument, Kalemli-Özcan et al. (2001), Imbs (2004), Clark and Van Wincoop (2001) and Magrini et al. (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 which contributes further to the cyclical divergence process. (Carlino and Defina, 1998; Carlino and Sill, 2011)

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 arqument states that intense trade ties among regions might create strong input-output linkages that results in spillover of economic cycles and synchronization. (Lee, 2005; Frankel and Rose, 1998; Baxter and Kouparitsas, 2005; Bergman, 2004; Bordo and Hebling, 2003). Hence, increasing association among regional cycles serves as anectodal evidence in support of the argument that bilateral trade linkages is likely to induce the output correlation (Duran, 2013; Lee, 2005). Moreover, a strand 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; Kose and Yi, 2002). For instance Van Biesebroeck (2010) shows that manufacturing trade among U.S. states is mostly intra-industry, Firdmuc (2004) similarly argues that positive effect of trade intensity on sycnhronization must be due to intra-industry trade.

One the other hand, the pesimistic argument states that trade openess should be accompanied by specialization of regions in different industries (as in Standard Ricardian Trade Theories) which leads to diverging regional fluctuations. For instance, Dornbusch, Fisher and Samuelson (1977) argues that falling transport costs results in declining non-tradable sector, as it becomes easier to import rather than producing 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 an important determinant of business cycle synchronization (Kalemli-Özcan et al., 2001). However, theoretical considerations indicate its negative effects (Obsfeld, 1994; Heathcote and Perri, 2004). Such that as investors have imperfect information and liquidity constraints, limited level of capital transfers can decrease the business cycle correlation as investors display a herding behaivor by withdrawing the capital from host regions (Imbs, 2004). Alternatively, weakenning of synchronization might be seen as a consequence of specialization induced by financial integration. Such a liberalization process increases the access to the wide range of state contingent securities that in turn unhinges domestic consumption from domestic production which then makes the region to specialize according to the comparative advantage (Imbs, 2004).

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

3. Empirical Analysis

3.1 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 (Chistiano and Fitzgerald, 2000; Baxter and King, 1999). Among the variety of choices, we prefer adopting Hodrick-Prescott (1997) (HP) filtering due to its simplicity and widely use in the literature. In particular, the HP filter minimizes the following term :

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

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=100.

In terms of data, we use annual per capita real GDP (at 1987 prices) for the period between 1975 and 2000 and per capita real Gross Value Added (GVA) (at 2003 prices) for the period of 2004-2010. We obtain most of our data from TURKSTAT as it is the main data source in Turkey. Provincial level of GDPs and populations for the period between 1975 and 2000 have been borrowed from Turgutlu and Kasman (2009) ; Karaca (2004); Özötün (1980;1988) to whom we are heartily grateful. For the 1975-2000 period, we convert all provincial data into NUTS-2 level. During 1975-2000 period, some sub-provinces have become a new province. 3 of these sub-provinces (Osmaniye Bayburt and Kirikkale), however, do not belong to the NUTS-2 region 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-2 territories using this assumption for the 1975-2000 period.

For each region, we use logs of variables and calculate the deviations of regional outputs from their HP trends. 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 immediate to note that during 1975-2000 period, asynchronous regional fluctuations have been observed. However, from mid-1990s onwards fluctuations seem to follow a quite correlated pattern that tend to move more synchronously and exhibit an almost perfectly comoving regional cycles during 2004-2010 period.

(Figure 1)

To summarize the overall level of synchronization within the country, we calculate bilateral pearson correlation coefficient for each pair of regional business cycle.

Such that $\rho_{i,j}$ represents the correlation between the cycles of region 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 an average of both periods.

(Table 1)

For the period of 1975-2000, we observe that the average correlation between two regions is 0.33 with a standard deviation of 0.23 which indicates quite sizable idiosyncratic and asynchronous movements as well as a high degree of heterogeneity. However, during 2004-2010, average correlation becomes 0.57 with a standard deviation of 0.38. Hence, an increasing pattern of synchronization is observed throughout the years although the heterogeneity is still present. We calculate the same averages using also simple annual growth rates of output 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 that is an issue to be explored in the next sub-section.

3.2 Determinants of Synchronization

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

$$\rho_{ij} = \alpha_0 + \alpha_1 S_{ij} + \alpha_2 T_{ij} + \alpha_3 G_{ij} + \alpha_3 GDPprod_{ij} + \varepsilon_{ij}$$

$$S_{ij}=\gamma_0+\gamma_1 T_{ij}+\gamma_2 Dist_{ij}+\gamma_3 GDPgap_{ij}+\delta_{ij} \quad , \qquad N=325$$

The first equation explains the direct determinants of pairwise regional business cycle comovements denoted with, ρ_{ij} . As mentioned before, it shows the bilateral Pearson's 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 calculated in a following way (Imbs, 2004):

$$S_{ij}=\frac{1}{T}\sum_{t} \square \sum_{n=1}^{3} ¿\, s_{n,j,t}-s_{n,i,t} \vee ¿$$

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 of 1987-2001 period has been used for 1975-2000 period and 2004-2010 values have been used for the second period. For 1975-2000, nominal GDP; for 2004-2010, nominal GVA data have been used as a measure of output.Three main sectors have been considered in calculation; agriculture, industry and service sector. Greater values of S indicate more dissimilar industrial structure across the two regions.

Another explanatory variable is T_{ij} that shows the level of bilateral trade intensity across regions *i* and *j.* Trade data is not, however, available at the regional level in Turkey. That's why we apply a gravity model used in Imbs (2004) and Magrini et al. (2013) to estimate the interregional trade flows. Gravity model estimates the level of trade mass across the two regions depending on their geographical distance, market size and population sizes. In particular, the estimated gravity model in Imbs(2004) for the 48 U.S. States:

$$T_{ij}=-1.355\, Dist+1.057\, GDP_i ¿\, GDP_j-0.635\, Population_i * Population_j \quad .$$

We adopt same coefficients as it is an acceptable procedure in the previous literature (Magrini et al., 2013). Logs of **GDP** and **population** variables have been used. For 1975-2000 period, average value of real gross GDP and population has been used. For the 2004-2010 period, average of real gross value added has instead been used and for population data, an average of 2007-2012 period has been employed.

Next, G_{ij} represents a class of spatial and geographical factors as introduced in Panteladis and Tsiapa (2012). it includes several variables. First, *Aggl1* is a measure of dissimilarity in agglomeration across the two regions:

$$Aggl\,1_{i,j}=¿\, Agg_i-Agg_j \vee ¿$$

where *Agg=Output/Area* of the region. Output has been defined as real Gross GDP for 1975-2000 period and gross GVA for 2004-2010 period. Alternatively *Aggl2* has been defined as the differences across two regions in *employment/area* for 2004-2012 and *population/area* for 1975-2000 period. Average values of output and employment have been used for the corrisponding periods. Lastly, G_{ij} includes also a variable, '*urb',* capturing the differences in urbanization across regions. In detail,

$$Urb_{i,j}=¿\, Citypop_i-Citypop_j \vee ¿$$

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 percapita 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. (Imbs, 2004; Frankel and Rose, 1998; Magrini et al., 2013). To overcome this problem and to avoid a possible bias driven, 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 before, *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 General Directorate of Highways (KGM)). As argued in Panteladis and Tsiapa (2012) 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 the system is caractherized by simulteneity 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)

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 such that regions which specialize in similar products and which 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, 2005). Moreover, regions with similar degree of agglomeration and urbanization have less synchronized business cycles. In other words, regions with different level of urban concentration and agglomeration tend to synchronize more. This finding is in contrast with the findings of Panteladis and Tsiapa (2012) and it is most probably motivated by the fact that different levels of concentration and clustering of economic activity creates transfer of production factors and input-output linkages among urban-peripheral or highly agglomerated-less agglomerated areas that brings about higher cycle synchronization.

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

As for the recent period, 2004-2010, all variables are significant at 1 % in both equations (except *T* in the first equation). Once more, industrial similarity is positively associated with the synchronicity of regional cycles. Moreover, the size of the coefficient is 3-4 times bigger than the coefficient during 1975-2000. Trade variable seems to have little/no effect on synchronization while differences in agglomeration and urban hierarchy have a significant and positive impact.

With respect to the second equation, distance and trade openess have significant and positive coefficients which indicates the fact that industrial similarity decreases with the distance and regions with higher bilateral trade tend to have more arbitrary industrial structure. Finally, differences in market size increases the industrial dissimilarity across regions, that results in lower synchronization across regions.

Overall, one may argue that industrial similarity, 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. That's why we may refer them as structural variables in affecting the synchronicity of regional cycles.

As we have argued before (in 2.1), co-movements across regional cycles tend to increase recently and almost doubles in the recent period. Having figured out the determinants of synchronization, It is worthwhile spending few words on 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 and Figure 2)

We observe that during 1987-2001, sectoral specialization is so heterogenous across regions, particularly in industry and agriculture. Such that the region which specializes most in industry is TR81 (Zonguldak, Karabük, Bartın) covering the 57 % of GDP and the region which specializes least in industry is TRB2 (Ardahan, Iğdır, Kars, Ağrı) covering only 5 % of GDP. During 1987-2001, cross sectional standard deviations of sectoral shares is quite high and 12 %, 9% , 10% for industry, 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 to 1975-2000 period, i.e. 8 %, 6% , 7% respectively for industry, service and agriculture sectors.

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

(Table 4)

Regarding the impact size of the main variables in our regression model, we summarize in Table 4 the response of $\rho_{i,j}$ to 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 one standard deviation increase in industrial dissimilarity across regions reduces the bilateral cycle correlation by 0.09 points in 1975-2000 and 0.26 points in 2004-2010. Respectively, differences in agglomeration and urban hierarchy have a moderate impact such that one standard deviation increase in these variables increases the cycle correlation by 0.07-0.08 points in 1975-2000 and 0.05-0.06 points in 2004-2010. Lastly, bilateral trade's impact has been found rather limited such that one sd increase in pairwise trade results in the increase of synchronization 0.05 points during 1975-2000 and 0.04 points during 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 caractheristics of regions such as industrial similarity , differences in urbanization, market size and agglomeration economies.

3.3 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 strand of scholars (Otto et al., 2001; Inklaar et al., 2008; Artis and Okubo, 2011; Magrini et al., 2013) argue that the correlation coefficient, ρ_{ij} , lies in an interval between –1 and 1 and if variance of the error term is not adequately small, reliable inference can hardly be obtained since the error term loses its normality properties. To overcome this, we apply a Fisher's z transformation to bilateral regional cycle correlations, ρ_{ij} :

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

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

(Table 5)

The results tell almost the same story as in Table 2. Industrial similarity, agglomeration, market size and urban hierarchy are the variables affecting structurally the cycle synchronization regardless of the time period analzed. Similar to what we have seen before, the effect of trade openess tends to fade out over time.

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

(Table 6)

There are some remarkable differences between TSLS and OLS estimation. First, in the OLS estimation the coefficient of industrial similarity is not significant during 2004-2010 period, while bilateral trade openess is significant in both periods. Second, agglomeration and urban hierarchy is significant during 1975-2000 but insignificant during 2004-2010 period. These differences imply the importance of neglected endogenenity in OLS estimation that might have biased the inferences and it is, thus, corrected in TSLS estimation. Hence, both types of sensitivity checks indicate once more the validity of our results in TSLS estimations.

4. Conclusions

In this article, we have investigated the economic determinants behind the synchronization of regional business cycles in Turkey between 1975 and 2000. 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 that the pairs of regions that have more similar industrial structure and market size, and arbitrary degree of agglomeration and urbanization tend to synchronize more. The significance of these variables are robust regardless of the time period analyzed and of the type of methodology employed. Another important variable, bilateral trade intensity is found to be significant during 1980s and 1990s but its impact tends to fade out and become weakly evident during 2004-2010 period.
In the light of these results, the most important message we get is that industrial diversification and homogenization of sectors across the regions would help inducing the economic integration and enhance the regional cycle synchronization. Thus, policies targeted to this objective would indeed be useful in dealing with economic asymmetries within the country.

References

Altavilla C. 2004. "Do EMU members share the same business cycle?", *Journal of Common Market Studies,* 42(5): 869–896.

Angeloni I. and Dedola L. 1999. "From the ERM to the euro: new evidence on economic and policy convergence among EU countries ", ECB Working Paper No. 4.

Artis M. J. and Zhang W. 1997. "International business cycles and the ERM ", *International Journal of Finance and Economics,* 2(1): 1–16.

Artis M. J. and Zhang W. 1999. "Further evidence on the international business cycle and the ERM: is there a European business cycle? ", *Oxford Economic Papers*, (51): 120–132.

Artis M. and Okubo T. 2011. "The Intranational Business Cycle in Japan", *Oxford Economic Papers*, (63): 111-133.

Baxter M. and Kouparitsas M. 2005. "Determinants of business cycle comovement: a robust analysis", *Journal of Monetary Economics*, (52): 113–157.

Baxter M. and King R.G. 1999. " Measuring Business Cycles: Approximate Bandpass Filters ", *Review of Economics and Statistics*, (81): 575-93.

Beckworth D. 2010. "One Nation Under the Fed? The Asymmetric Effect of US Monetary Policy and Its Implications for the United States as an Optimal Currency Area ", *Journal of Macroeconomics*, (32): 732-746.

Bergman U.M. 2004. "How similar are European business cycles?", Mimeo, Lund University.

Bordo M.D. and Helbling T. 2003. "Have national business cycles become more synchronized?" NBER Working Paper No. 10130.

Calderon C., Alberto C. and Ernesto S. 2007. "Trade intensity and business cycle synchronization: Are developing countries any different? ", *Journal of International Economics*, 71(1): 2-21

Carlino G. and DeFina R. 1998. "The differential regional effects of monetary policy ", *Review of Economics and Statistics,* (80): 572-87.

Carlino G. and Sill K. 2001. “Regional Income Fluctuations: Common Trends and Common Cycles “, *The Review of Economics and Statistics*, (83): 446-456.

Clark T.E. and E. VanWincoop. 2001. “ Borders and business cycles“, *Journal of International Economics,* (55): 59–85.

Christiano L. and Fitzgerald J. 2000. “The Band Pass Filter “, *International Economic Review*, 44(2): 435-465

Croux C., Forni M. and Reichlin, L. 2001. “A measure for comovement of economic variables: theory and empirics “, *Review of Economics and Statistics,* (83): 232–241.

Darvas Z. and Szapary G. 2004. “ Business cycle synchronization in the enlarged EU: comovements in the new and old members.“, Central Bank of Hungary Working Paper No. 2004/1.

De Haan J., Inklaar R. and Pin R.J.A. 2008. “Will Business Cycles In The Euro Area Converge? A Critical Survey Of Empirical Research“, *Journal of Economic Surveys*, 22(2): 234-273.

Dopke J. 1999. “Stylised facts of Euroland’s business cycle “, *Jahrbucher fur NationalOkonomie und Statistik* (219): 591–610.

Dornbusch R., Fischer S. and Samuelson, P. A. 1977. “Comparative Advantage, Trade, and Payments in a Ricardian Model with a Continuum of Goods“, *American Economic Review*, 67(5): 823-39,

Duran H.E. 2013. “Convergence Of Regional Economic Cycles In Turkey“, Review of Urban and Regional Development Studies, 25(3): 152-175,

Fatás A. 1997. “EMU: Countries or Regions? Lessons From the EMS Experience“, *European Economic Review*, (41): 743-751.

Fidrmuc J. 2004. “The Endogeneity of the Optimum Currency Area Criteria, Intra-Industry Trade, and EMU Enlargement “, *Contemporary Economic Policy*, (22):1-12

Frankel J. A. and Rose A.K. 1998. “The Endogeneity of the Optimum Currency Area Criteria“, *Economic Journal*, 108(449): 1009-1025.

Gezici F. and Hewings G.J.D. 2004. “Regional Convergence and the Economic Performance of Peripheral Areas in Turkey“, *Review of Urban and Regional Development Studies*, 16(2): 113-132

Glaeser E., Kallal H., Scheinkman J. and Schleifer, A. 1992. “Growth in cities“, *Journal of Political Economy*, 100(6): 1126–1152.

Heathcote J. and Perri F. 2004. “Financial Globalization and Real Regionalization“, *Journal of Economic Theory*, (119): 207-243

Hodrick R. and Prescott E.C. 1997. “Postwar U.S. business cycles: an empirical investigation“, *Journal of Money, Credit and Banking,* 29(1): 1-16

Hughes Hallett A. and Richter C. 2004. “A time–frequency analysis of the coherences of the US business cycle and the European business cycle“, CEPR Discussion Paper No. 4751.

Hughes Hallett A. and Richter C. 2006. “Is the convergence of business cycles a global or regional issue? The UK, the US and Euroland “, *International Journal of Finance and Economics*, (11): 177–194.

Imbs J. 2004. “Trade, finance, specialization and synchronization“, *Review of Economics and Statistics,* (86): 723–734.

Inklaar R. Jong-A-Pin, R. and de Haan J. 2008. “Trade and Business Cycle Synchronization in OECD Countries – A Re-examination“, *European Economic Review*, (52): 646-666.

Kalemli-Ozcan S., Sorensen B.E. and Yosha O. 2001. “Economic integration, Industrial Specialization, and the Asymmetry of Macroeconomic Fluctuations“, *Journal of International Economics,* 55(1): 107-137.

Karaca O. 2004. "Türkiye'de bölgeler arası gelir farklılıkları: yakınsama var mı? ", Türkiye Ekonomi Kurumu tartışma metni 2004/7

Kasman A. and Turgutlu E. 2009. "Testing Stochastic Convergence Among the Regions of Turkey", *The International Journal of Emerging and Transition Economies*, 2 (1): 81-98.

Koopman S.J. and Azevedo J.V. 2003. "Measuring synchronization and convergence of business cycles", Tinbergen Institute Discussion Paper No. 2003-052/4.

Kose M.A. and Yi K. 2002. "The trade comovement problem in international macroeconomics", Federal Reserve Bank of New York Staff Report No. 155.

Krugman P.R. 1991. "Geography and Trade", Cambridge Mass: MIT Press

Lee M. 2005. "Trade Integration and Business Cycle Comovement: Evidence from the U.S"., *The International Trade Journal*, 24(4): 361-388

Magrini S., Gerolimetto M. and Duran H.E. 2013. "Business cycle dynamics across the US states", *The B.E. Journal of Macroeconomics*, 13(1): 795–822.

Martincus C.V. and Molinari A. 2007. "Regional Business Cycles and National Economic Borders: What Are the Effects of Trade in Developing Countries", *Review of World Economics (Weltwirtschaftliches Archiv),* 143(1): 140-178

Massmann M. and Mitchell J. 2004. "Reconsidering the evidence: are Eurozone business cycles converging? " *Journal of Business Cycle Measurement and Analysis,* 1(3): 275–308.

Obradovic S. and Mihajlovic V. 2013. "Synchronization of Business Cycles in the Selected European Countries", *Panoeconomicus*, 6: 759-773

Obstfeld M. 1994. "Risk-Taking, Global Diversification, and Growth", *American Economic Review,* (84): 1310-1329

Otto G., Voss G. and Willard L. 2001. "Understanding OECD output correlations", Reserve Bank of Australia Research Discussion Paper No. 2001-5.

Owyang M.T., Piger J.M. and Wall H.J. 2005. "Business Cycle Phases in U.S. States". *Review of Economics and Statistics*, (87): 604-616.

Özötün, E. 1980. İller itibariyle Türkiye gayri safi yurtiçi hasılası-kaynak ve yöntemler, 1975-1978. Yayın no: 907, Ankara, Devlet İstatistik Enstitüsü.

Özötün, E. 1988. Türkiye gayri safi yurtiçi hasılasının iller itibariyle dağılımı, 1979-1986. Yayın no: 1988/8, İstanbul, İstanbul Ticaret Odası Araştırma Bölümü.

Panteladis I. and Tsiapa M. 2012. "Fragmented Integration and Business Cycle Synchronization in the Greek Regions ", *European Planning Studies*, 1-20

Selover D., Jensen R. and Kroll J. 2005. " Mode-Locking and Regional Business Cycle Synchronization", *Journal of Regional Science*, 45(4): 703-745.

Van Biesebroeck, J. 2010. "Dissecting Intra-Industry Trade", *Economic Letters*, (110): 71-75.

Weyerstrass K., Aarle B., Kappler M. and Seymen A. 2011. "Business cycle Synchronisation with(in) the Euro Area: in search of a 'Euro Effect' ", *Open Economies Review*, 22(3): 427-446.

Yildirim J., Ocal N. and Ozyildirim S. 2009. "Income inequality and economic convergence in Turkey: A spatial effect analysis", *International Regional Science Review,* 32(2): 221-2

Tables

Table 1. Bilateral Business Cycle Correlations across regions, N=325

1975-2000	**Mean**	**SD**	**SD/Mean**
HP Cycles	0,33	0,23	0,70
GR Cycles	0,34	0,22	0,65
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 Ratio

Table 2. Three-Stage Least Squares Estimation

3SLS			1975-2000			2004-2010		
Dependent Variable:	ρ	Independent Variables:	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
		constant	1,2431***	1,2128***	1,3206***	-0,7587***	-0,7631***	-0,7503***
		S	-0,4453***	-0,4462***	-0,7097***	-2,1814***	-2,1764***	-2,7230***
		T	0,00012***	0,00012***	0,00012***	0,00009*	0,00009*	0,00006
		GDPprod	-0,0174**	-0,0166**	-0,0178**	0,6218***	0,6227***	0,6303***
		Aggl1	0,0001***			0,0008***		
		Aggl2		0,0002***			0,2744***	
		Urb			0,2171***			0,2396***
Dependent Variable:	S							
		constant	0,1937***	0,1938***	0,1976***	0,6167***	0,6166***	0,5359***
		T	-0,0130***	-0,0130***	-0,0129***	0,0352***	0,0352***	0,0289***

		Dist	-0,0177***	-0,0177***	-0,0175***	0,0477***	0,0477***	0,0391***
		GDPgap	0,2349***	0,2345***	0,2196***	0,1539***	0,1539***	0,1561***

Note: *** denotes significance at 1 %, ** at 5 %, * at 10 %.

Table 3. Share of sectors in Total Output (%)

	1987-2001, GDP			2004-2010, GVA		
NUTS2 Regions	**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**

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	-0,26
T	α_2	0,05	0,04
Aggl1	α_3	0,08	0,05
Aggl2	α_3	0,06	0,05
Urb	α_3	0,07	0,06

Note: For the parameters of S and T in model (1) and model(4) are referred.

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

3SLS			1975-2000			2004-2010		
Dependent Variable:	ρ	Independent Variables:	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
		constant	1,4062***	1,3710***	1,5090***	-1,4785***	-1,4939***	-1,4650***
		S	-0,4931***	-0,4941***	-0,8054***	-4,8696***	-4,8482***	-5,4146***
		T	0,0002***	0,0001***	0,0001***	0,0001	0,0001	0,0001
		GDPprod	-0,0197**	-0,0188**	-0,0206**	1,1556***	1,1584***	1,1438***
		Aggl1	0,0001***			0,0023***		
		Aggl2		0,0002***			0,8382***	
		Urb			0,2602***			0,4979***
Dependent Variable:	S							
		constant	0,1937***	0,1938***	0,1973***	0,5305***	0,5304***	0,4319***
		T	-0,0130***	-0,0130***	-0,0129***	0,0285***	0,0285***	0,0208***
		Dist	-0,0177***	-0,0177***	-0,0175***	0,0387***	0,0387***	0,0282***
		GDPgap	0,2350***	0,2347***	0,2208***	0,1628***	0,1628***	0,1633***

Note: *** denotes significance at 1 %, ** at 5 %, * at 10

Table 6. Equation-by-Equation; OLS Estimation

OLS			1975-2000			2004-2010		
Dependent Variable:	ρ	Independent Variables:	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)

		constant	0,8574***	0,8341***	0,6141**	-0,7370***	-0,7355***	-0,7256***
		S	-0,0763	-0,0773	-0,0647	-0,3887***	-0,3891***	-0,3669**
		T	0,0001***	0,0001***	0,0001***	0,0002***	0,0002***	0,0002***
		GDPprod	-0,0107	-0,0101	-0,0045	0,5114***	0,5110***	0,5123***
		Aggl1	0,0001***			-0,0002		
		Aggl2		0,0001***			-0,0669	
		Urb			0,0717			-0,0605
Dependent Variable:	S							
		constant	0,1927***	0,1927***	0,1927***	0,7119***	0,7119***	0,7119***
		T	-0,0130***	-0,0130***	-0,0130***	0,0425***	0,0425***	0,0425***
		Dist	-0,0177***	-0,0177***	-0,0177***	0,0576***	0,0576***	0,0576***
		GDPgap	0,2400***	0,2400***	0,2400***	0,1440***	0,1440***	0,1440***

Note: *** denotes significance at 1 %, ** at 5 %, * at 10

Figures

Figure 1. Business cycle of selected major regions

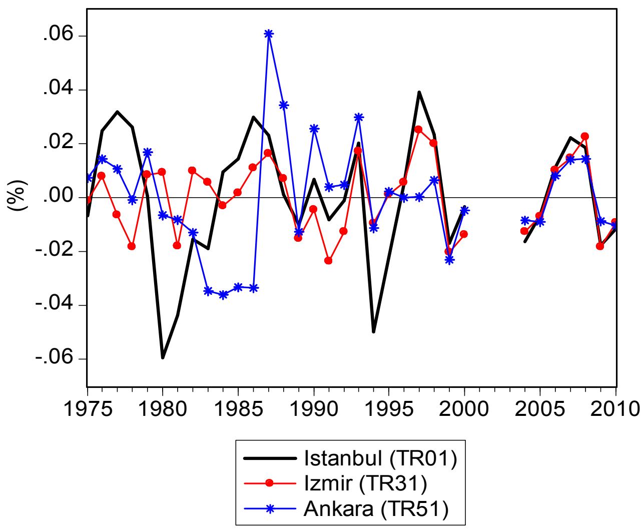
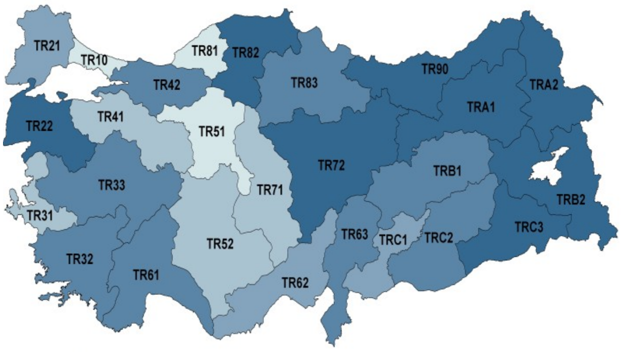
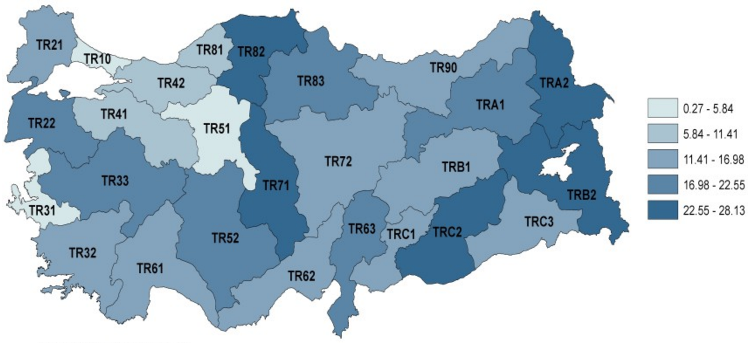


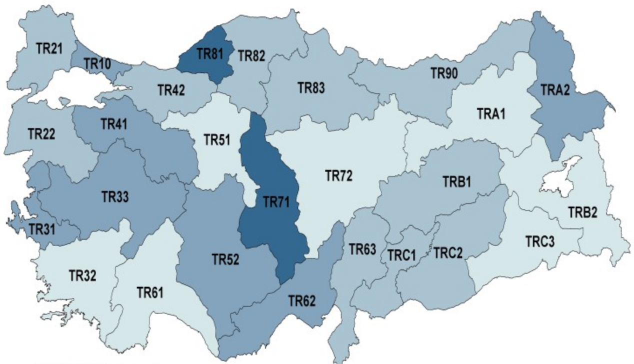
Figure. 2 Geographical Distribution of Sectoral Specialization in Turkey
(% shares of GDP (for 1987-2001) and GVA (for 2004-2010) for three sectors)



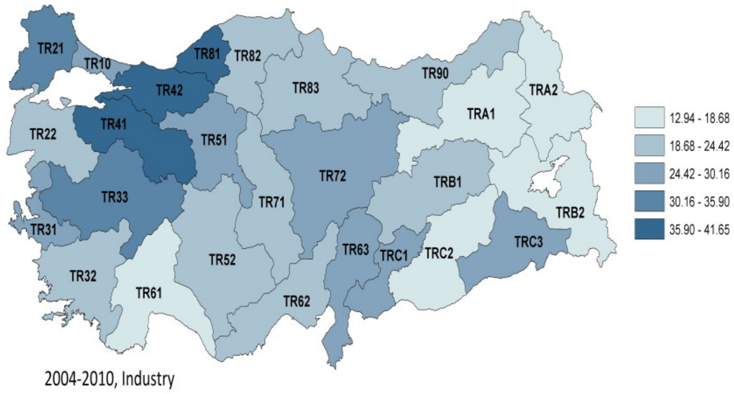
1975-2000,Agriculture



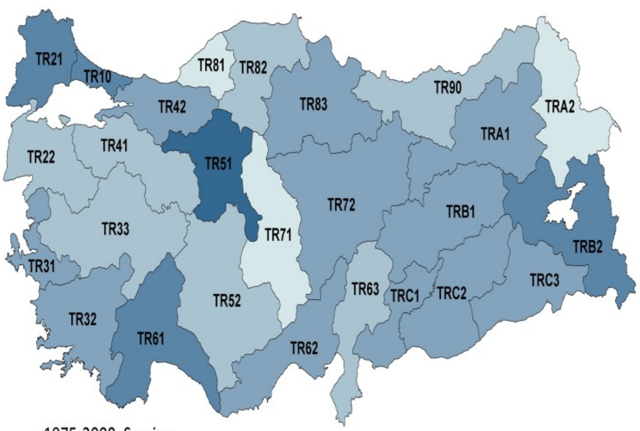
2004-2010, Agriculture



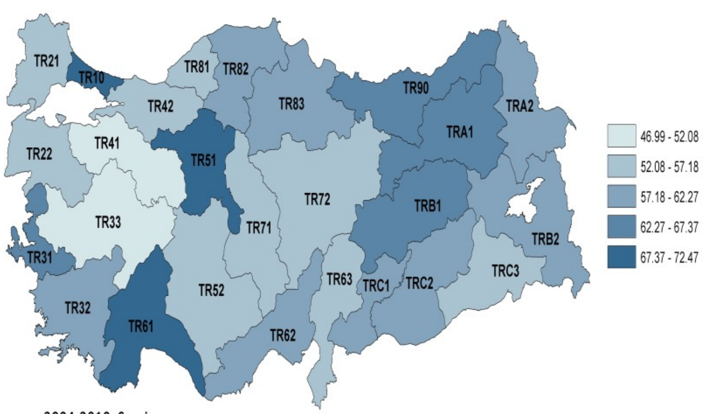
1975-2000, Industry



2004-2010, Industry



1975-2000, Service



2004-2010, Service

Appendix 1. Bilateral business cycle correlations among Nuts-2 regions, Average of 1975-2000 and 2004-2010

Nuts 2 Regions	TR10	TR21	TR22	TR31	TR32	TR33	TR41	TR42	TR51	TR52	TR61	TR62	TR63	TR71	TR72	TR81	TR82	TR83	TR90	TRA1	TRA2	TRB1	TRB2	TRC1	TRC2
TR21	0,78																								
TR22	0,54	0,47																							
TR31	0,67	0,52	0,49																						

TR32	0,70	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	0,30	0,55	0,64	0,62	0,65																		
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	0,70																
TR61	0,68	0,58	0,27	0,75	0,74	0,73	0,71	0,53	0,51	0,53															
TR62	0,56	0,58	0,28	0,58	0,56	0,51	0,54	0,67	0,62	0,56	0,63														
TR63	0,38	0,33	0,55	0,56	0,59	0,44	0,56	0,52	0,78	0,62	0,49	0,62													
TR71	0,84	0,69	0,54	0,63	0,59	0,81	0,80	0,61	0,46	0,70	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	0,67											
TR81	0,72	0,63	0,16	0,50	0,56	0,71	0,61	0,53	0,19	0,44	0,70	0,36	0,07	0,77	0,51										
TR82	0,55	0,53	0,18	0,51	0,34	0,45	0,47	0,34	0,30	0,39	0,59	0,43	0,26	0,61	0,45	0,44									
TR83	0,72	0,70	0,47	0,54	0,64	0,64	0,69	0,68	0,67	0,73	0,61	0,84	0,65	0,56	0,59	0,43	0,47								
TR90	0,62	0,52	0,55	0,48	0,61	0,64	0,79	0,54	0,59	0,64	0,58	0,49	0,57	0,71	0,53	0,55	0,35	0,68							
TRA1	0,37	0,14	0,00	0,15	0,36	0,20	0,38	0,15	0,32	0,25	0,18	0,17	-0,03	0,24	0,28	0,21	0,48	0,33	0,29						
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	0,29	0,13	0,56	0,22	0,03	0,30	0,20					
TRB1	0,64	0,55	0,42	0,52	0,44	0,71	0,74	0,50	0,40	0,51	0,60	0,46	0,28	0,72	0,59	0,65	0,35	0,52	0,77	0,15	0,39				
TRB2	0,23	0,26	0,05	-0,06	0,00	0,13	0,23	0,24	0,07	0,17	0,20	0,34	0,16	0,28	0,14	0,24	0,22	0,35	0,42	-0,06	0,45	0,47			
TRC1	0,44	0,35	0,19	0,20	0,51	0,38	0,54	0,48	0,58	0,38	0,49	0,58	0,50	0,38	0,26	0,38	0,28	0,58	0,57	0,15	0,30	0,39	0,67		
TRC2	0,24	0,06	-0,13	-0,07	0,28	0,05	0,24	0,31	0,14	-0,02	0,25	0,29	-0,02	0,12	0,04	0,25	0,11	0,26	0,26	0,26	0,47	0,25	0,60	0,70	
TRC3	0,37	0,28	0,02	0,24	0,50	0,39	0,49	0,58	0,43	0,27	0,54	0,57	0,27	0,32	0,30	0,41	0,24	0,51	0,52	0,22	0,33	0,46	0,53	0,73	0,69

Appendix 2. Definition of NUTS-2 Regions

NUTS-2 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