review of urban & regional development studies

RURDS Vol. 25, No. 3, November 2013 doi: 10.1111/rurd.12015

CONVERGENCE OF REGIONAL ECONOMIC CYCLES IN TURKEY

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Dissimilar economic fluctuations and asymmetric shocks across the regions of a country might create severe policy distortions that, under these circumstances, aggregate policy interventions (such as taxation and interest rates), are likely to be sub-optimal for at least a fraction of the regions. For instance, monetary policy can hardly satisfy the needs of all regions when some of the regions are experiencing a boom while others are in a recession phase. For these reasons, similarity of regional business cycles and their convergence are highly desirable from a policy viewpoint. The aim of this paper is, therefore, to provide empirical evidence and policy implications in that context. In particular, I analyze business cycle correlations across Turkish provinces and the tendency of these cycles to converge over the period of analysis between 1975–2000 and 2004–2008 (for Nomenclature of Territorial Units for Statistics [NUTS]-2 regions). I find that regional business cycle asymmetries have tended to decrease in recent decades. This result, although it seems to provide evidence in favor of rising correlations, shows that the convergence process is rather slow and there still exist asymmetries across the regional business cycles.

1. Introduction

Dissimilar economic fluctuations and asymmetric shocks across the regions of a country might create severe policy distortions that, under these circumstances, aggregate policy interventions (such as taxation and interest rates), are likely to be sub-optimal for at least a fraction of the regions (Mundel 1961; Frankel & Rose 1998; Weyerstrass *et al*. 2011). For instance, monetary policy can hardly satisfy the needs of all regions when some of the regions are experiencing a boom while others are in a recession phase. For these reasons, similarity of regional business cycles and their convergence are highly desirable from a policy viewpoint.

With regard to the existing literature in this field, the majority of studies focus on the similarity of business cycles within the European Union. However, scholars are far from reaching a consensus. On the one hand, several authors argue that co-movements of the business cycles within Europe have tended to increase recently, particularly after the introduction of the European Exchange Rate Mechanism (Fatás 1997; Montoya & De Haan 2008; Ferreira-Lopes & Sequeira 2011). On the other hand, others adopt a pessimistic

view and point to the presence of idiosyncratic shocks and the low degree of business cycle synchronization (Clark & Van Wincoop 2001; Belke & Heine 2006).

From a theoretical point of view, lack of synchronization is mostly explained by inadequate cross-border trade and financial linkages, dissimilarities in the industrial structure and labor market arrangements. Moreover, different responses of the regions to common shocks, such as unanticipated changes in interest rates, commodity prices and productivity shocks might contribute to the process of cyclical divergence (Carlino & DeFina 1998; Imbs 2004; Selover *et al*. 2005).

In contrast to the European case, it has been widely accepted that US states have been characterized by highly similar economic fluctuations, and, therefore, the US is often regarded as a benchmark for the Eurozone as an optimal currency area (Carlino & Sill 2001; Owyang *et al*. 2005).

Although the issues above have been thoroughly and heatedly discussed in regard to the Eurozone (i.e. Darvas & Szapary 2008, Weyerstrass *et al*. 2011; Ferreira-Lopes & Sequeira 2012 [for Swiss regions]) and the US (Carlino & Sill 2001; Ferreira-Lopes & Pina 2011), little attention has been devoted to developing countries (Calderon *et al*. 2007).

Turkey is one of the developing countries in which there are sizable differences across regions and provinces in the socio-economic and geographical structure, which makes Turkey an interesting place for study (Yildirim *et al*. 2009).

There is only one study in the literature, by Filiztekin (2004), regarding Turkey in the context of regional business cycles. There are other papers dealing with the business cycle of the Turkish economy at the aggregate level. One particular study was implemented by Alp *et al*. (2012), characterizing the stylized facts and main features of the national business cycle, such as its volatility, timing, and persistence.

Filiztekin (2004) analyzes the co-movements across the business cycles of Turkish regions from 1975 to 2000.[1] He concludes that symmetries across regional cyclical movements are low during the 1980s, but higher during the 1990s. Moreover, he reports evidence in favor of the significant impact of regional differences in industrial specialization on the asymmetric evolution of business cycles.

It is important to emphasize that there are several differences between my study and Filiztekin's (2004). First, in addition to the analysis of synchronization during 1975–2000, I also provide evidence from a recent dataset which covers the period of 2004–2008 for Nomenclature of Territorial Units for Statistics (NUTS)-2 level regions.

Second, in addition to Filiztekin (2004), I analyze in detail the timing of the business cycle phases of provinces, explore the diffusion of recessions within the country, and also calculate precisely the idiosyncratic component of provincial business cycles.

Third, I measure the business cycles, not by using simple growth rates of regional economies (as in Filiztekin [2004]), but rather adopt various filtering techniques in order to estimate the deviation cycles of regions. De-trending techniques are, in general, more accurate than simple growth rates as the GDP might be growing below or above its potential, and simple growth rates do not capture these movements.

The aspects above constitute my contribution to the existing literature in this field. My set of research questions is summarized as follows:

[1] Filiztekin's study is written in Turkish, which is the only version of the article available. To the best of my knowledge, there appear to be no other papers written in English in this field.

(i) What is the degree of business cycle synchronization (co-movement) across provinces in Turkey? Do recessions diffuse homogenously across the provinces? Do idiosyncratic components cover a large share of total variability in provincial business cycles?
(ii) Do province-level business cycles tend to converge over time? How about the level of synchronization recently? How can I explain, theoretically, the observed patterns?

What are the implied economic policies?

Data availability is my major concern in selecting the variable of interest, as well as the time period. The Turkish Statistical Institute does not publish any regional GDP data for the 2001–2004 period. It has published GDP data for 67 provinces from 1975 to 2000, and gross value added data for 27 NUTS-2 regions from 2004 to 2008. Therefore, I am bound to analyze these periods separately using different variables.

The organization of my paper is as follows: In Section 2.1 I analyze the synchronization across provincial business cycles, explore the diffusion of recessions within the country, and show the importance of idiosyncratic movements of provincial economies. Section 2.2 is devoted to understanding whether provincial business cycles tend to converge over time, and to providing evidence on synchronization from the most recent dataset (2004–2008) for NUTS-2 level regions. In Section 3, I conclude my study.

2. Empirical Analysis

2.1. Analysis of Business Cycle Synchronization, 1975–2000

Estimating the business cycles of provinces and the aggregate economy is the essential first step in my empirical analysis. A variety of methodologies have been employed in the literature in order to measure the economic cycles (Hodrick & Prescott [hereafter referred to as HP] 1997; Baxter & King [hereafter referred to as BK] 1999). Among others, I would like to employ two of the most commonly adopted methodologies (HP and BK) because of their simplicity and wide use in the literature.

In terms of provincial data, I employ per capita real gross regional product (at 1987 prices) for 67 provinces and the aggregate economy from 1975 to 2000. The dataset has been obtained from Karaca (2004) and Kasman and Turgutlu (2009), who constructed and used a dataset using resources from SPO and Turkstat.[2]

With regard to the choice of spatial units, it is worth noting that although new provinces emerged recently, I consider these provinces as belonging to the initial provinces, which results in 67 provinces in total.

The first filtering methodology that I use is that developed by HP (1997), which aims at estimating long-term trends of the economy and then calculating the deviations of the actual output from the trends. Therefore, the years in which the economy is growing faster (or slower) than its trend are referred to as expansion (or recession) periods. Specifically, the HP filter minimizes in trend (τ_t) the following expression:

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

[2] I am heartily grateful to Orhan Karaca, Adnan Kasman, and Evrim Turgutlu for sharing their dataset with me. SPO, State Planning Organization; Turkstat, Turkish Statistical Institute.

y is the actual output and λ is a penalty parameter which captures the smoothness of the trend, τ_t. The filter produces smoother estimates of τ_t as λ increases. For annual data, I set $\lambda = 100$, as recommended by HP (1997). Having estimated τ_t, I simply calculate the deviations of the output from its trend.

An alternative way of estimating the business cycles is to employ the Band-Pass filtering developed by BK (1999). Specifically, it removes low- and high-frequency movements in the data and directly extracts the cyclical fluctuations, with their periodicity in a certain range. Specifically, I use 1.5 and 8 years for low (L) and high (H) frequency parameters in BK filtering. Moreover, the number of lags adopted in BK filtering is selected on a basis of Akaike (AIC) criterion for each province.

The resulting estimation of the business cycles for the Turkish economy is depicted in Figure 1, from which it can be immediately noted that the two measures seem to be consistent with each other, as they exhibit highly synchronous oscillations.

2.1.1. Business cycle co-movements across provinces

In order to analyze the degree of business cycle co-movement among provinces, I calculate the Pearson correlation coefficient between the business cycles of each province and the aggregate economy. Because the aggregate economy is interpreted as the weighted average of all provinces, pairwise correlations between provinces and the aggregate economy are useful to understand the level of synchronization within the country. The geographical distribution of these correlations, as well as their cross-sectional mean and standard deviation, are presented in Figure 2 and Table 1.

At a glance, in Figure 2 I observe that provinces located in the Black Sea region and eastern Anatolia are characterized by business cycles that are less correlated with the aggregate economy, and, therefore, seem to be less tied to national market forces, most probably as a result

Figure 1. Aggregate Business Cycles in Turkey, 1975–2000

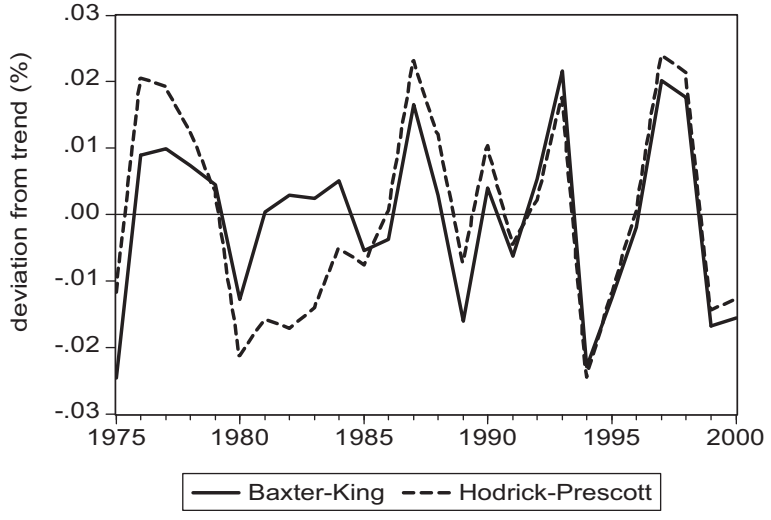
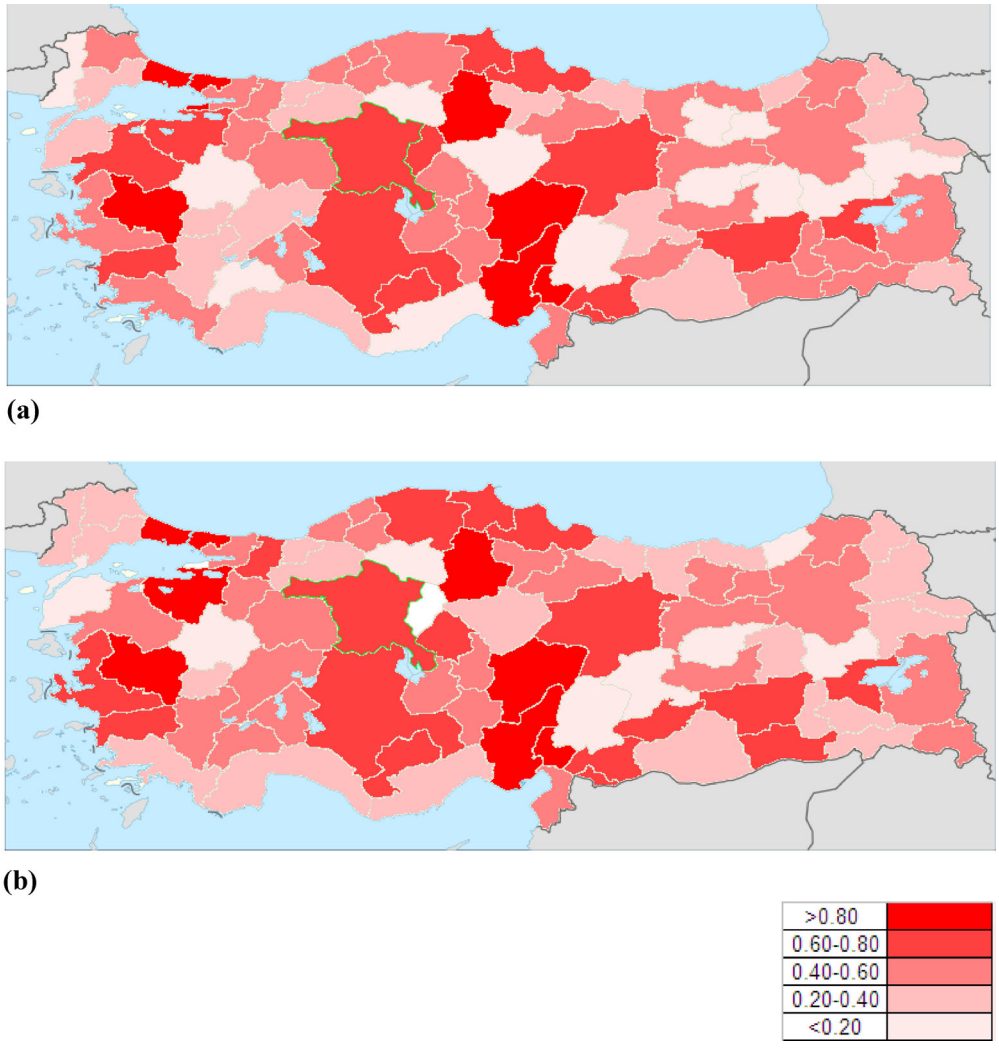


Figure 2. Business cycle correlation between provinces and the aggregate economy. (a) Hodrick–Prescott filtering used. (b) Baxter–King filtering used



of the presence of idiosyncratic shocks and an arbitrary industrial structure. In contrast, provinces in the Marmara region, and middle and western Anatolia, exhibit high correlation with the aggregate economy. In detail, provinces that have business cycles that are the most correlated with the aggregate economy are: Kayseri (0.86 correlation), Adana (0.85), and Istanbul (0.85) for HP cycles, and Manisa (0.90), Istanbul (0.89), and Kayseri (0.84) for BK cycles. Conversely, the ones with the lowest correlation are: Kahramanmaraş (−0.09), Yozgat (−0.10), and Içel (−0.12) for HP cycles, and Kütahya (0.02), Çanakkale (0.02), and Kahramanmaraş (−0.05) for BK cycles. The cross-sectional average of the correlations is 0.43 for HP and 0.47 for BK filtering.

Table 1. Business cycle correlation between provinces and aggregate economy

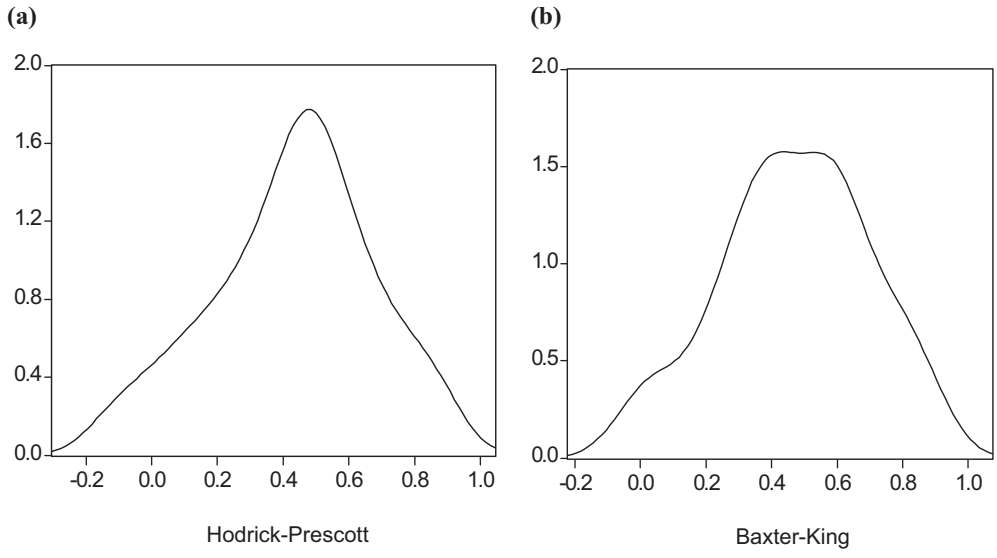
Provinces	HP	BK	Provinces	HP	BK
Adana	0.85	0.80	Kahramanmaraş	−0.09	−0.05
Adıyaman	0.44	0.64	Kars	0.26	0.23
Afyon	0.36	0.43	Kastamonu	0.46	0.73
Ağrı	0.10	0.25	Kayseri	0.86	0.84
Amasya	0.37	0.53	Kırklareli	0.53	0.35
Ankara	0.62	0.61	Kırşehir	0.49	0.64
Antalya	0.31	0.25	Kocaeli	0.41	0.53
Artvin	0.43	0.44	Konya	0.73	0.78
Aydın	0.68	0.60	Kütahya	−0.01	0.02
Balıkesir	0.61	0.40	Malatya	0.29	0.03
Bilecik	0.50	0.47	Manisa	0.85	0.90
Bingöl	0.12	0.39	Mardin	0.57	0.60
Bitlis	0.69	0.73	Muğla	0.52	0.37
Bolu	0.32	0.36	Muş	0.13	0.19
Burdur	0.17	0.43	Nevşehir	0.55	0.41
Bursa	0.78	0.82	Niğde	0.51	0.58
Çanakkale	0.22	0.02	Ordu	0.25	0.25
Çankırı	0.08	0.14	Rize	0.37	0.13
Çorum	0.84	0.83	Sakarya	0.55	0.61
Denizli	0.39	0.53	Samsun	0.63	0.71
Diyarbakır	0.65	0.62	Siirt	0.42	0.32
Edirne	0.05	0.31	Sinop	0.69	0.78
Elazığ	0.48	0.58	Sivas	0.65	0.67
Erzincan	0.48	0.42	Şanlıurfa	0.24	0.34
Erzurum	0.49	0.46	Tekirdağ	0.24	0.38
Eskişehir	0.57	0.58	Tokat	0.40	0.56
Gaziantep	0.72	0.71	Trabzon	0.47	0.35
Giresun	0.54	0.39	Tunceli	0.01	0.05
Gümüşhane	0.16	0.44	Uşak	0.38	0.25
Hakkari	0.29	0.45	Van	0.51	0.59
Hatay	0.50	0.50	Yozgat	−0.10	0.32
Isparta	0.46	0.56	Zonguldak	0.48	0.56
İçel	−0.12	0.27			
İstanbul	0.85	0.89	**Mean**	**0.43**	**0.47**
İzmir	0.46	0.63	**Weighted Mean**	**0.51**	**0.55**

BK, Baxter–King; HP, Hodrick–Prescott.

It is well known that there are important differences in the economic sizes of provinces. Therefore, the unweighted average of correlations might be spurious for the implied policies. Thus, I also need to calculate the weighted average of correlations using populations of provinces relative to the aggregate population. The resulting calculations are presented in the last row of Table 1, where the cross-sectional weighted average of the correlations now becomes 0.51 for HP and 0.55 for BK filterings. Although these values indicate higher synchronization compared to the initial (unweighted) case, the average degree of synchronization is still far below 1 (perfect correlation), and one may consequently argue that there are considerably large cyclical asymmetries across the provinces.

Also, to support these results from a methodological point of view, I present the empirical distributions of the correlations in Figure 3 using kernel density estimations. I observe that

Figure 3. Kernel density estimation: distribution of business cycle correlations. (a) Hodrick–Prescott. (b) Baxter–King



probability mass is mostly concentrated around 0.40–0.50 in all business cycle types with a reasonably dispersed distribution (expect for the HP filtering). In total, these results confirm once more the presence of low synchronization and sizable asymmetries across cyclical fluctuations of the provinces.

One of the most plausible explanations of the observed asymmetries is the dissimilarity in the industrial structure of the provinces. As anticipated, if provinces differ largely in their industrial specialization, they will react differently to the common and sector-specific shocks and, therefore, experience dispersed cyclical movements (Krugman 1991; Kalemli-Özcan *et al*. 2001; Selover *et al*. 2005). In my case, for instance, provinces with a high share of agricultural employment in east and northern Anatolia are likely to be less influenced by the common shocks (Filiztekin 2004). In contrast, those provinces which specialize in manufacturing, particularly in durable and intermediate goods, are likely to respond more promptly to unanticipated economic circumstances, such as changes in prices, interest rates, and technological developments. Consequently, it is natural to observe distinct stochastic developments across the provinces. To support these interpretations, I find it useful to present the sectoral specialization of provinces in Table 2.

Two important points appear to emerge from Table 2. First, there is a substantial heterogeneity among sectoral specialization of provinces that possibly plays a key role in the emergence of asymmetric business cycles. This heterogeneity is present in almost all sectors, but more acute in industrial production (the cross-sectional standard deviations of sectoral shares are summarized in the last row). Second, western Anatolian provinces tend to specialize more in service, trade, and industry, while eastern provinces concentrate mostly on agriculture, which provides a further support for differential business cycles and the significance of east–west dualism.

Table 2. Share of sectors in gross domestic product (%), 1987 values

Provinces	Agriculture	Industry	Trade	Services	Provinces	Agriculture	Industry	Trade	Services
Adana	19.3	28.3	17.3	35.1	Kars	50.8	5.2	8.4	35.6
Adıyaman	37.4	21.9	10	30.7	Kastamonu	43.4	7.9	7.2	41.5
Afyon	33.4	14.5	14.6	37.5	Kayseri	14.6	17.1	28.6	39.7
Ağrı	42.5	4.7	11.1	41.7	Kırklareli	19.6	38.6	10.8	31.0
Amasya	36.7	10.7	12.8	39.8	Kırşehir	37.6	8.2	13.8	40.4
Ankara	6.9	15	23.3	54.8	Kocaeli	2.4	57.8	9.7	30.1
Antalya	27.7	10	24.4	37.9	Konya	35.2	17.3	14.7	32.8
Artvin	27.5	28.5	9.6	34.4	Kütahya	16.2	49.3	8.2	26.3
Aydın	35.7	10.9	24.5	28.9	Malatya	22	26.4	18	33.6
Balıkesir	27	22.5	12.5	38.0	Manisa	36.6	23.5	17	22.9
Bilecik	21.3	45.3	5.2	28.2	K. Maras	29.3	23.2	17.5	30.0
Bingöl	48.2	4	5.9	41.9	Mardin	39.6	7.9	14.8	37.7
Bitlis	36.1	8.9	7.9	47.1	Muğla	25.6	25.9	23.3	25.2
Bolu	30.4	21.1	14	34.5	Muş	49.7	4.3	4.8	41.2
Burdur	39.2	7.3	13	40.5	Nevşehir	57.4	4.2	9.9	28.5
Bursa	16.5	33.4	18.2	31.9	Niğde	41.5	12	10.4	36.1
Çanakkale	35.4	23.6	10.4	30.6	Ordu	37.4	10.2	16	36.4
Çankırı	46.2	4.6	10.4	38.8	Rize	30.4	21.8	15.6	32.2
Çorum	28.8	9.4	32.4	29.4	Sakarya	29.4	16	18.2	36.4
Denizli	34.1	14	21.2	30.7	Samsun	29.6	16.2	24.3	29.9
Diyarbakır	20.1	29.4	18.3	32.2	Siirt	22.9	43.5	2.5	31.1
Edirne	40.5	14.2	13.6	31.7	Sinop	38.9	10.9	10.4	39.8
Elazığ	15.5	40.1	11.5	32.9	Sivas	27.3	10.7	16.2	45.8
Erzincan	35.9	13.2	18.7	32.2	Tekirdağ	25	29.9	10.9	34.2
Erzurum	23	11	18	48.0	Tokat	28.4	25.2	10.5	35.9
Eskişehir	14.7	24.3	26.1	34.9	Trabzon	41.8	3.5	9.3	45.4
Gaziantep	18.7	18.7	27.8	34.8	Tunceli	26.4	18.3	18	37.3
Giresun	36.4	13.3	12	38.3	Şanlıurfa	54.8	1.1	6	38.1
Gümüşhane	37.5	4.3	10.1	48.1	Uşak	38.7	10.3	20.4	30.6
Hakkari	46.4	1.3	4.3	48.0	Van	22.7	6.2	13.4	57.7
Hatay	19.8	18.9	25.4	35.9	Yozgat	45.6	12.4	8.8	33.2
Isparta	29.9	20.4	12.2	37.5	Zonguldak	13.7	45.5	8.6	32.2
İçel	22	29.9	16.5	31.6					
İstanbul	1.2	33.4	28.1	37.3	**Mean**	**30.4**	**18.7**	**14.8**	**36.2**
İzmir	10.4	29.9	22.1	37.6	**SD**	**12.1**	**12.7**	**6.7**	**6.6**

Source: Turkish Statistical Institute (TURKSTAT). SD, standard deviation.

2.1.2. Diffusion of recessions

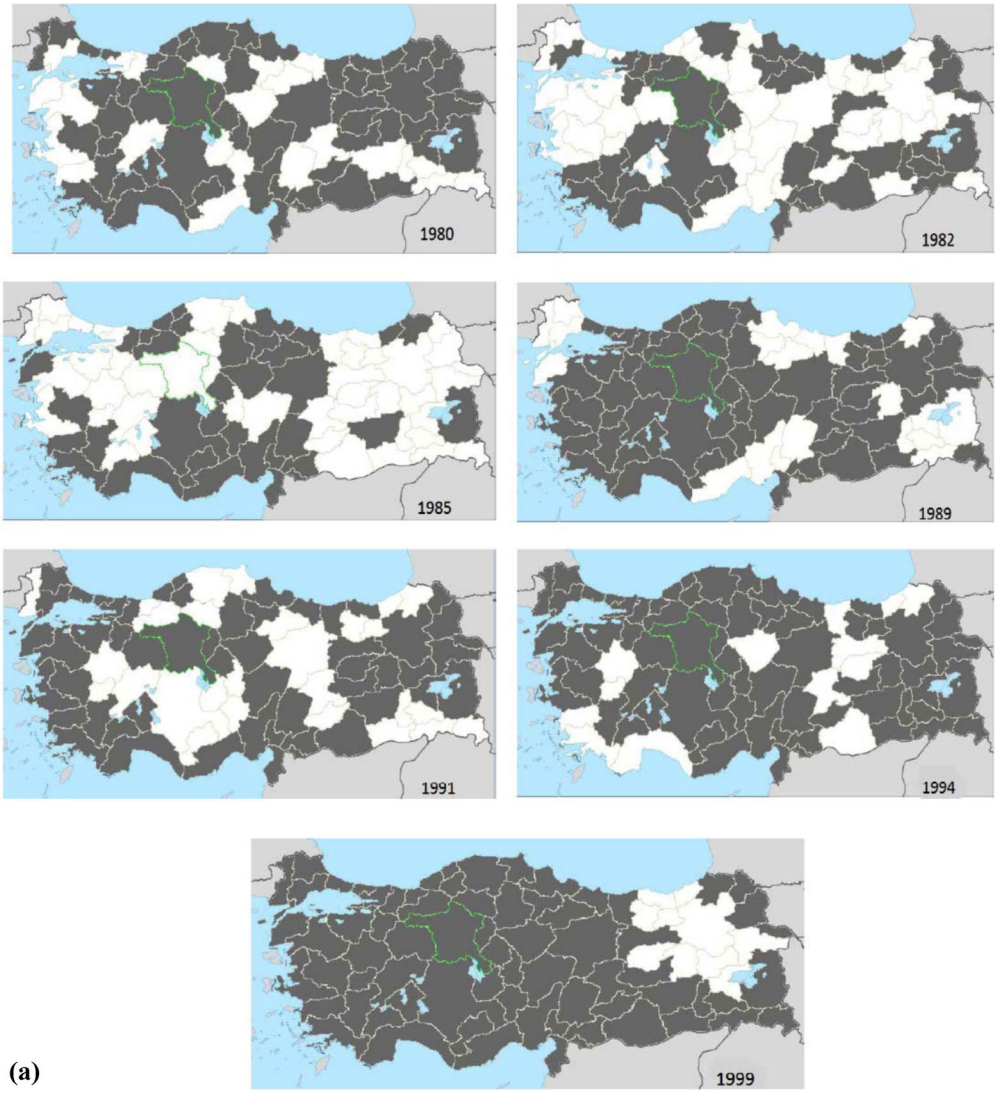
Another way of investigating the synchronicity of regional business cycles is through the analysis that explores the timing of business cycles and diffusion of phases within the country. The Turkish economy experienced several recessions during the 1980s and 1990s. In Figure 1, I clearly observe the times of economic downturns and expansions that depict the business cycle of the Turkish economy. Some of these recessions lasted only one year and some of them were more prolonged, lasting up to a few years.

Regarding the way I determine the timing of recessions and expansions, the years in which the national economy grows faster than its trend are defined as expansions and, by contrast, periods during which the economy grows slower than its trend are referred to as downturns.

To illustrate how recessions are distributed within the country, I map the provinces that experience expansions and downturns in Figure 4 at the most severe year of the national recession, that is, the year with the lowest national economic growth (relative to trend) during the recession.

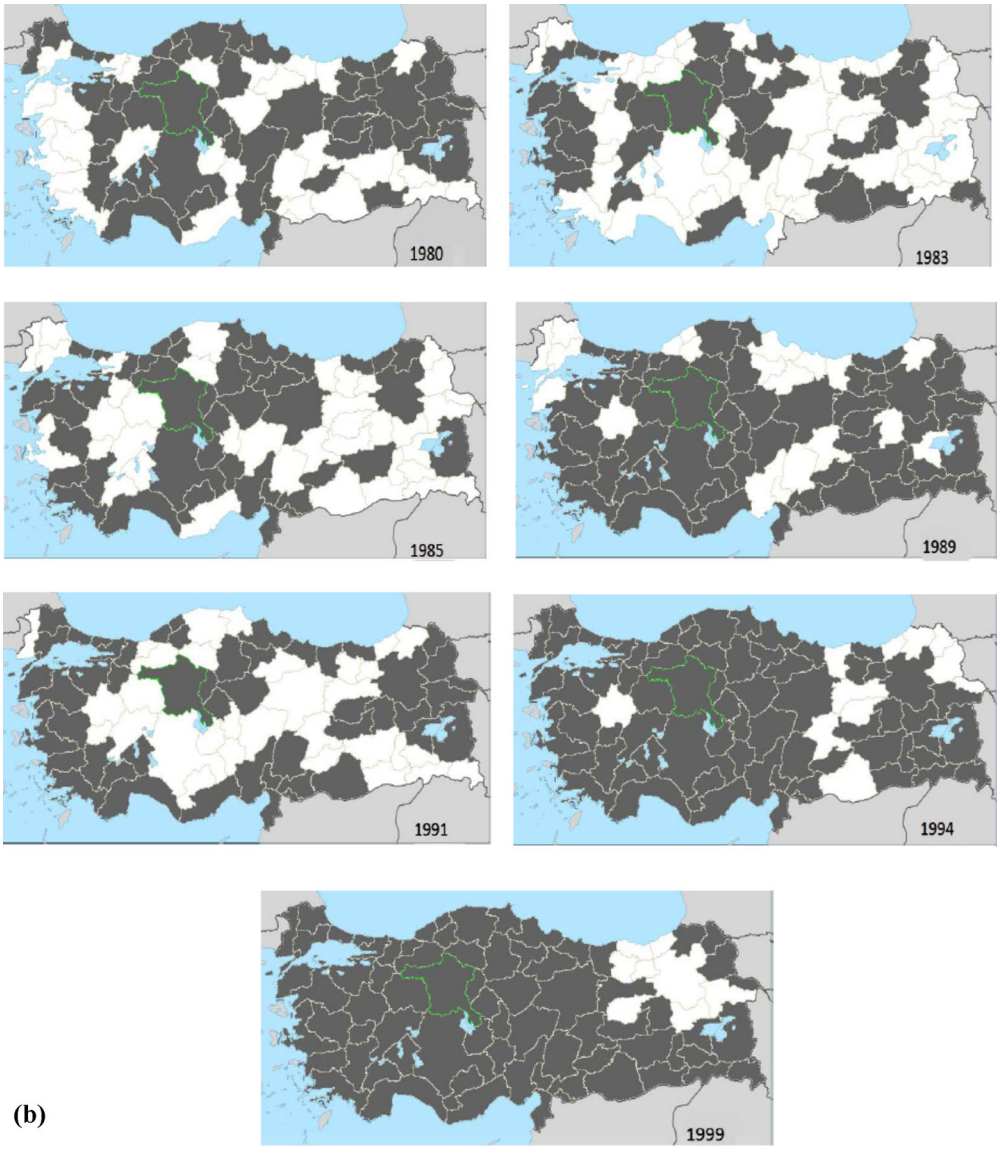
Provinces that grow below their trend growth are labeled in gray, which represent downturns. I use both HP and BK filtering in estimating the trend of national and provincial economies.

Figure 4. Diffusion of Recessions within the country. (a) Baxter–King filtering used. (b) Hodrick–Prescott filtering used



(a)

Figure 4. Continued



(b)

At a glance, I observe that recessions are weakly diffused during the 1980s (such as in 1980, 1982–1983, 1985), as many provinces remain in an expansion phase when the aggregate economy is already in recession. However, from the mid-1990s onwards I observe a more homogenous and strong diffusion of recessions within the country, particularly in 1994 and 1999. In total, these results point to the increasing co-movement and synchronization among provincial business cycles while idiosyncratic movements seem to fade out. These results hold true for both HP and BK types of business cycles.

2.1.3. Idiosyncratic components of provincial business cycles

Idiosyncratic movement of provincial economies is an important indicator that shows the extent to which provinces are untied to national market forces. In other words, a relatively higher idiosyncratic component implies higher business cycle asymmetry between provinces and the national economy. To shed light on this issue, I follow Ferreira-Lopes and Sequeira (2011) to precisely calculate the variability in idiosyncratic movements of provinces relative to total variability in their business cycles. This task has been achieved in two steps:

First, I calculate the idiosyncratic component of each provincial business cycle by using the following formula:

$$Pcyc_t = \delta + Pcyc_{t-1} + Pcyc_{t-2} + Ncyc_t + Ncyc_{t-1} + Ncyc_{t-2} + \gamma \quad (2)$$

Pcyc and *Ncyc* denote the provincial and national business cycles, respectively. I use up to two-year time lags, as in Ferreira-Lopes and Sequeira (2011). Residual terms represent the idiosyncratic component of the provincial business cycle.

As a second step, I calculate the variability in idiosyncratic movements relative to the total variability in business cycles of provinces using the standard deviation as a measure of variability; $\sigma(\gamma)/\sigma(Pcyc)$ where σ denotes the standard deviation. The resulting estimations are summarized in Table 3.

It can be immediately noted that idiosyncratic variability covers an important share of total variability. Such as, on average, 74% (HP) or 70% (BK) of the business cycle variability of a province is a result of idiosyncratic movements. These values are far above the values calculated in Ferreira-Lopes and Sequeira (2011) for German Länder, which range between 21% and 46%. Therefore, my analysis suggests that business cycle asymmetries and idiosyncratic movements in Turkey are very important and one should consider the severity of this fact for the possible policy distortions.

2.2. Convergence of Business Cycles

The tendency of province-level business cycles to converge is also crucial from a policy standpoint. As mentioned earlier, aggregate policy interventions, such as changes in interest rates, might create sizable distortions in cases where regions within a country experience different cycle phases. However, the distortions are likely to decrease if the business cycles of provinces tend to become more similar over time. The present section is devoted to analyzing the convergence patterns across the business cycles of provinces. In order to do so, using HP (1997) and BK's (1999) de-trended business cycles, I adopt the criterion for cyclical convergence put forward by Weyerstrass *et al*. (2011). They state that if all regions within a country tend to have business cycles perfectly correlated with the aggregate economy, one may speak of a cycle convergence. In other words, the cross-sectional average of the correlations between provinces and the aggregate economy should approach 1, while the cross-sectional variance of these correlations should approach 0.

To implement such a convergence analysis, I adopt three types of methodologies. First, I chart the evolution of business cycle correlations between provinces and the aggregate economy, using rolling window time intervals of six years, rather than the entire period. Second, I employ a more comprehensive approach (conditional kernel density estimations) in order to directly observe the evolution of the distributions of business cycle correlations between

Table 3. Variability of the idiosyncratic component/total variability of the business cycle

Provinces	BK	HP	Provinces	BK	HP
Adana	0.494	0.394	İzmir	0.606	0.754
Adıyaman	0.710	0.633	Kars	0.948	0.939
Afyon	0.690	0.773	Kastamonu	0.534	0.673
Ağrı	0.758	0.960	Kayseri	0.423	0.457
Amasya	0.754	0.923	Kırklareli	0.740	0.674
Ankara	0.686	0.653	Kırşehir	0.715	0.762
Antalya	0.787	0.743	Kocaeli	0.585	0.755
Artvin	0.878	0.763	Konya	0.431	0.598
Aydın	0.835	0.744	Kütahya	0.826	0.895
Balıkesir	0.787	0.716	Malatya	0.833	0.921
Bilecik	0.738	0.762	Manisa	0.408	0.460
Bingöl	0.639	0.866	Kahramanmaraş	0.814	0.874
Bitlis	0.600	0.687	Mardin	0.537	0.577
Bolu	0.800	0.750	Muğla	0.789	0.825
Burdur	0.770	0.806	Muş	0.927	0.981
Bursa	0.513	0.482	Nevşehir	0.833	0.723
Çanakkale	0.891	0.964	Niğde	0.763	0.824
Çankırı	0.956	0.960	Ordu	0.708	0.856
Çorum	0.495	0.482	Rize	0.880	0.852
Denizli	0.782	0.898	Sakarya	0.648	0.777
Diyarbakır	0.632	0.594	Samsun	0.613	0.697
Edirne	0.895	0.861	Siirt	0.867	0.850
Elazığ	0.635	0.828	Sinop	0.351	0.569
Erzincan	0.486	0.561	Sivas	0.536	0.657
Erzurum	0.820	0.740	Tekirdağ	0.656	0.754
Eskişehir	0.714	0.751	Tokat	0.576	0.726
Gaziantep	0.544	0.557	Trabzon	0.745	0.772
Giresun	0.637	0.610	Tunceli	0.774	0.886
Gümüşhane	0.745	0.748	Şanlıurfa	0.659	0.796
Hakkari	0.796	0.897	Uşak	0.794	0.725
Hatay	0.690	0.719	Van	0.772	0.694
Isparta	0.703	0.780	Yozgat	0.850	0.778
İçel	0.818	0.788	Zonguldak	0.759	0.689
İstanbul	0.393	0.437	Mean	0.701	0.740

BK, Baxter–King; HP, Hodrick–Prescott.

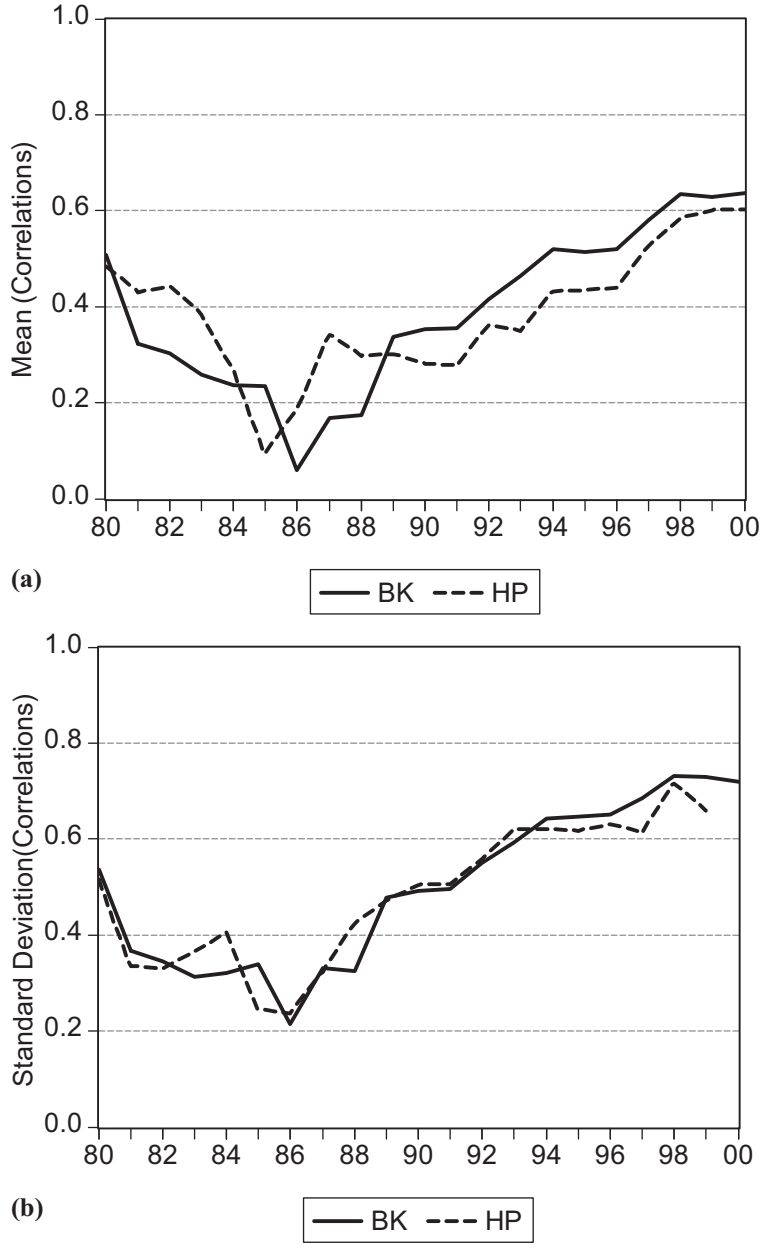
provinces and the aggregate economy. Third, I evaluate bilateral (pairwise) business cycle correlations among provinces over the sub-periods.

2.2.1. Rolling window business cycle correlations

As a first methodology, I present the evolution of cross-sectional average of business cycle correlations between provinces and the aggregate economy in Figure 5, which helps in observing the evolution of the average degree of synchronization within the country. The time horizon displays the end points of the rolling window time intervals, such that 1980 actually represents the period from 1975–1980.

At a glance in Figure 5a, an increasing synchronization over time is clearly observable. This pattern is consistent across different types of business cycles. While during the 1975–1980

Figure 5. Average of rolling window business cycle correlations between provinces and the aggregate economy. (a) Unweighted values. (b) Population weighted values



period a province, on average, has a business cycle correlation of 0.50 with the aggregate economy, this value reduces to 0.10–0.20 for the 1981–1986 period and steadily increases and reaches levels of 0.6–0.7 in 1995–2000. With regard to the second moment of the correlations, Figure 6a displays the cross-sectional standard deviation. The dispersion of the correlations tends to reduce over time. Initially, for the period of 1975–1980, the standard deviation is between 0.40 and 0.50, which increases to the level of 0.60 in the period of 1982–1987 and reduces to below 0.40 during the late 1990 s.

The values in Figures 5a and 6a, however, are in an unweighted form. As anticipated, unweighted values might distort the results as provinces differ largely in their economic sizes. To address this issue, I also present the same graphs using population-weighted values. As an outcome, rising synchronization and declining dispersion of correlations have been observed once more, as Figures 5b and 6b exhibit similar patterns to Figures 5a and 6a.

In total, I observe a tendency of provincial business cycles to converge, as the correlations tend to increase over time with a lower cross-sectional dispersion. However, this process seems to be rather slow and cycle asymmetries are still present.

2.2.2. Conditional kernel density estimation

As a second approach, I estimate the conditional kernel density estimations of the correlations presented in Figures 5 and 6. Conditional density estimation is a tool that specifically allows me to observe the evolution of the distribution of correlations, the concentration of probability mass, and the main features of the distribution, such as its first and second moment.[3]

In Figure 7, the estimations tell more or less the same story for each business cycle type. In line with the first approach, the probability mass tends to accumulate around higher values after the mid-80s, which indicates the increasing correlations between provinces and the aggregate economy. Furthermore, the distributions experience a transformation in their shape, switching from bi-modal to uni-modal and a more homogenous form. Overall, an increasing pattern of synchronization within the country is once more confirmed using an alternative approach.

The trade and financial liberalization process in Turkey in recent decades most probably motivates economic explanations of the observed patterns. As is well known, after 1980, macroeconomic policies in Turkey underwent an important transformation; in particular, from an approach based on the import substitution to an economic model that favors economic and financial liberalization, such as increasing trade ties and factor flows in the international context, and also among the regions of the country (Gezici & Hewings 2004). Rising synchronization, therefore, might be seen as a consequence of two main components of this integration process.

The first component is the intense cross-border trade linkages across provinces. Consistent with the existing literature in this field, strong trade ties among the regions might lead to the spillover of business cycles caused by input–output relations, which, in turn, foster the convergence of economic cycles across spatial units (Frankel & Rose 1998; Baxter & Kouparitsas 2005). In other words, declining asymmetries in the cycles serve as anecdotal evidence in support of the conventional argument that trade openness creates strong linkages across regional economies that share similar economic shocks (Lee 2005).

[3] Conditional kernel density estimations have been implemented using the "hdrcde" R 2.13 package. The main parameters: degree of local polynomial is 0 and link function is specified as "identity."

Figure 6. Cross sectional standard deviation of business cycle correlations between provinces and the aggregate economy. (a) Unweighted values. (b) Population weighted values

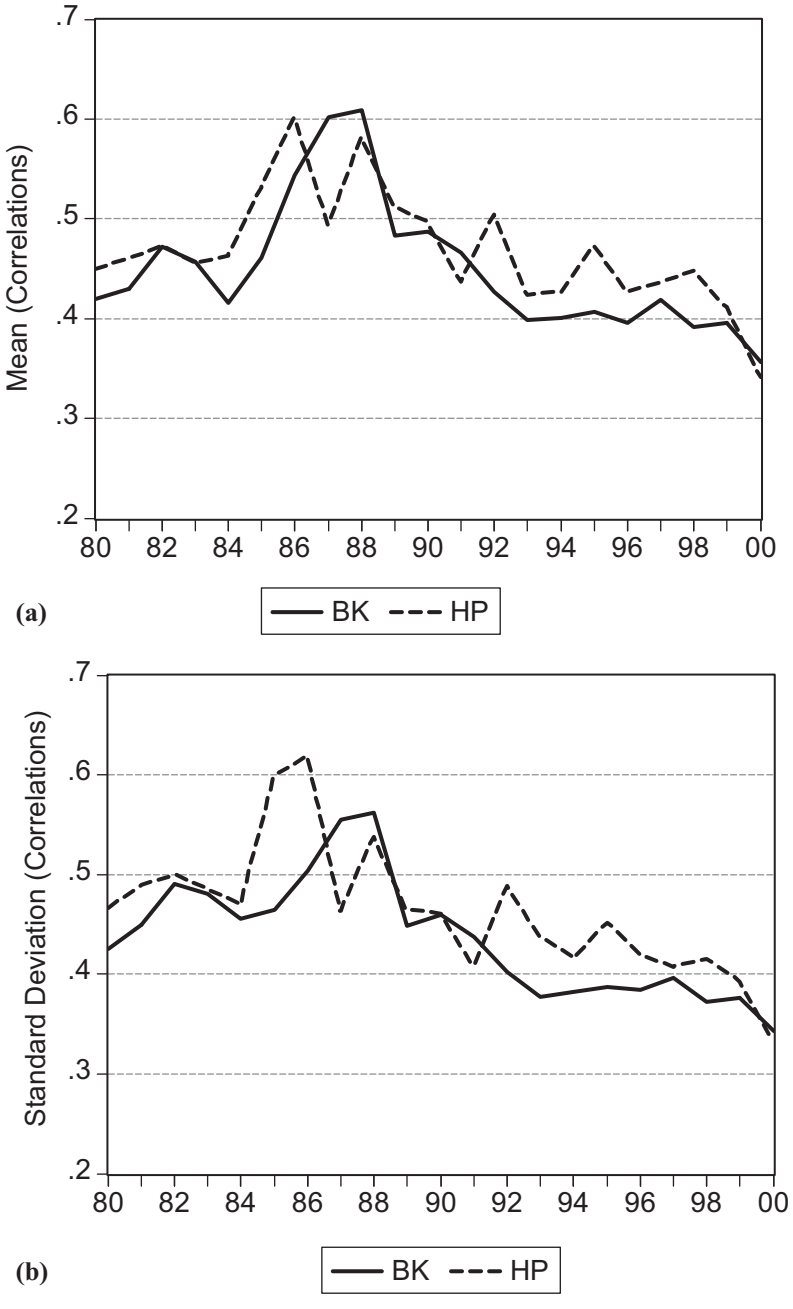
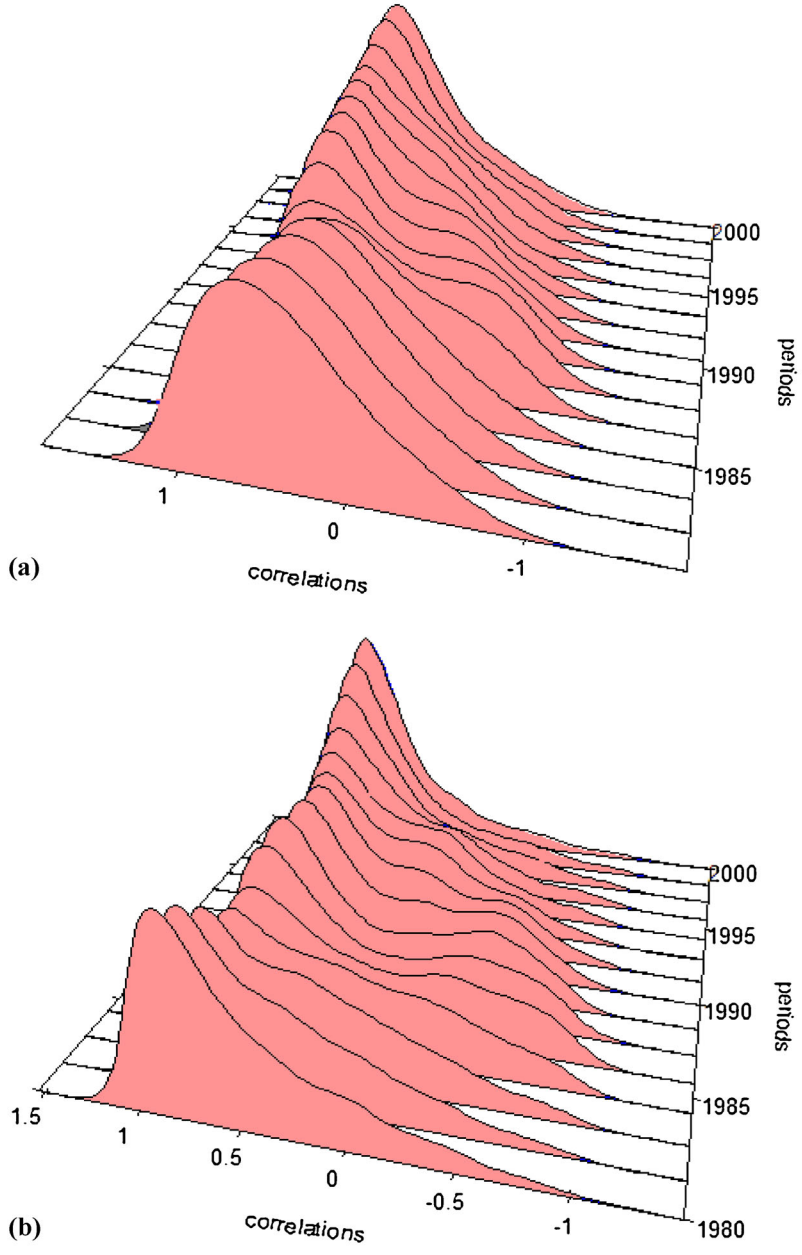


Figure 7. Convergence of provincial business, conditional kernel density estimation. (a) Hodrick–Prescott filtering used. (b) Baxter–King filtering used



The second important component of the economic integration is the transfer of factors, such as capital integration and interregional risk sharing that might play important roles in the convergence process of business cycles (Imbs 2004). The limited ability of provinces to borrow and lend hampers the transfer of resources that creates interregional risk sharing against economic shocks and, in that case, provinces are likely to have more correlated shifts in their business cycles (Imbs 2004).

Besides these forces, development of interprovincial networks, such as transportation and communication services, knowledge spillovers, and migration might contribute to the process of business cycle convergence.

2.2.3. Pairwise business cycle correlations

Besides correlations between provinces and the aggregate economy, it is also important to analyze the extent of bilateral business cycle correlations among provinces, as well as their evolution over time. Doing so might, in fact, be useful to help understand whether synchronization is rising within the country. To do so, I present a table of pairwise business cycle correlations among 67 provinces in Appendix I. In addition, Table 4 summarizes cross-sectional averages of these correlations during four sub-periods. These equally long four sub-periods are used because the time period (1975–2000) is not long enough to allow for more than four sub-periods.

I observe that bilateral correlations decrease until the mid-1980s, but tend to increase afterwards and hit the highest level during the most recent period, which is firmly consistent with my previous analysis.

2.2.4. Evidence from the 2004–2008 period

It is well known that the Turkish economy has been going through a structural transformation since the severe crisis in 2001 (Akkoyun *et al*. 2012). For instance, its share in world exports has doubled, it has attracted a large amount of foreign investors, and the banking and financial sectors have been regulated (Akkoyun *et al*. 2012).

Under these circumstances, it is natural to ask whether rising synchronization of regional business cycles is still present. To understand this, I analyze the level of business cycle synchronization during the period of 2004–2008 compared to the period of 1975–2000. As mentioned in the introduction, no available regional data exists for the period of 2001–2004. TURKSTAT publishes GDP data for 67 provinces from the 1975–2000 period and gross value added data for 27 NUTS-2 regions from the 2004–2008 period. Therefore, these periods must be analyzed separately using different variables.

For both periods, NUTS-2 level regions are used because for the 2004–2008 period, regional data is only available at NUTS-2 level. In terms of the type of data, real gross value

Table 4. Average of pairwise correlations among provincial business cycles

Period	BK	HP
1975–1980	0.25	0.26
1981–1986	−0.01	0.05
1987–1993	0.19	0.14
1994–2000	0.41	0.38

Note: Number of observations; 2,211 pairs of provinces. BK, Baxter–King; HP, Hodrick–Prescott.

Table 5. Business cycle correlation between Nomenclature of Territorial Units for Statistics (NUTS)-2 regions and the aggregate economy

Nuts-2 Regions		2004–2008	1975–2000
TR10	İstanbul	0.90	0.85
TR21	Tekirdağ, Edirne, Kırklareli	0.92	0.42
TR22	Balıkesir, Çanakkale	−0.81	0.48
TR31	İzmir	0.99	0.46
TR32	Aydın, Denizli, Muğla	0.88	0.71
TR33	Manisa, Afyon, Kütahya, Uşak	0.88	0.76
TR41	Bursa, Eskişehir, Bilecik	0.99	0.88
TR42	Kocaeli, Sakarya, Düzce, Bolu, Yalova	0.91	0.52
TR51	Ankara	0.89	0.62
TR52	Konya, Karaman	0.56	0.73
TR61	Antalya, Isparta, Burdur	0.98	0.58
TR62	Adana, Mersin	0.98	0.43
TR63	Hatay, Kahramanmaraş, Osmaniye	−0.76	0.37
TR71	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir	0.42	0.65
TR72	Kayseri, Sivas, Yozgat	0.38	0.47
TR81	Zonguldak, Karabük, Bartın	0.95	0.48
TR82	Kastamonu, Çankırı, Sinop	−0.61	0.48
TR83	Samsun, Tokat, Çorum, Amasya	0.45	0.74
TR90	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane	0.74	0.60
TRA1	Erzurum, Erzincan, Bayburt	−0.26	0.58
TRA2	Ağrı, Kars, Iğdır, Ardahan	0.87	0.22
TRB1	Malatya, Elazığ, Bingöl, Tunceli	0.36	0.57
TRB2	Van, Muş, Bitlis, Hakkari	−0.12	0.61
TRC1	Gaziantep, Adıyaman, Kilis	0.91	0.66
TRC2	Şanlıurfa, Diyarbakır	0.99	0.66
TRC3	Mardin, Batman, Şırnak, Siirt	0.97	0.54
	Weighted mean:	**0.65**	**0.62**

added per capita has been employed for the recent period, while per capita real GDP has been used for the former. Regarding the business cycle measurement, I use the (logged) HP detrended series for both periods.

Table 5 summarizes pairwise business cycle correlations between NUTS-2 regions and the aggregate economy for both periods: 1975–2000 and 2004–2008. Cross-sectional weighted averages of these correlations point to a further increase in the synchronization, as it is 0.62 for 1975–2000 and 0.65 for 2004–2008. In other words, recently I observe more symmetric cycles within the country.

Finally, the results so far obtained have important implications for economic policies. Perhaps the most important lesson from this investigation is the fact that economic integration across provinces should indeed be promoted by strengthening the trade and financial linkages and removing all types of barriers that create cyclical asymmetries. Doing so might, in fact, help deal with the possible distortions in aggregate economic policies caused by asymmetric shocks.

3. Conclusions

The present paper has investigated business cycle synchronization in Turkey, as well as its recent tendencies and implied policies.

The results can be summarized in two parts: first, the level of business cycle correlations between provinces and the aggregate economy is far below 1, which indicates the presence of considerable asymmetries in the economic shocks and business cycles across the provinces.

Second, from the 1990s onwards, cyclical asymmetries tend to decrease as higher and more homogenous business cycle correlations between provinces and the aggregate economy are observed. For the most recent time period (2004–2008), NUTS-2 level regions exhibit even higher correlations compared to the 1975–2000 period. These results, although they seem to provide evidence in favor of rising synchronization, show that convergence of cycles is rather slow, as regional asymmetries in the business cycles still exist.

Finally, from a policy point of view, the most important message of these results is the fact that interregional economic linkages should be further strengthened so as to avoid idiosyncratic cyclical movements across the provinces that might create sizable distortions in economic policies.

Acknowledgement

The author thanks the referees for their comments.

Submitted 9 December 2012.
Final version received 18 July 2013.

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References

Akkoyun, H.Ç., Mahmut, G. and Bahar, Ş.D. 2012. Business Cycle Synchronization of Turkey with Euro Area and the US: What Has Changed After 2001? Working Paper 12/15, Central Bank of the Republic of Turkey.

Alp, H., Baskaya, Y.S., Kilinç, M. and Yüksel, C. 2012. Stylized Facts for Business Cycles in Turkey, Working Paper 12/02, Central Bank of the Republic of Turkey.

Baxter, M. and King, R.G. 1999. Measuring Business Cycles: Approximate Bandpass Filters. *The Review of Economics and Statistics* 81(4), 575–593.

Baxter, M. and Kouparitsas, M.A. 2005. Determinants of Business Cycle Comovement: A Robust Analysis. *Journal of Monetary Economics* 52(1), 113–157.

Belke, A. and Heine, J. 2006. Specialisation Patterns and the Synchronicity of Regional Employment Cycles in Europe. *International Economics and Economic Policy* 3(2), 91–104.

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. *The Review of Economics and Statistics* 80(4), 572–587.

Carlino, G. and Sill, K. 2001. Regional Income Fluctuations: Common Trends and Common Cycles. *The Review of Economics and Statistics* 83(3), 446–456.

Clark, T. and van Wincoop, E. 2001. Borders and Business Cycles. *Journal of International Economics* 55(1), 59–85.

Darvas, Z. and Szapáry, G. 2008. Business Cycle Synchronization in the Enlarged EU. *Open Economies Review* 19(1), 1–19.

Fatás, A. 1997. EMU: Countries or Regions? Lessons From the EMS Experience. *European Economic Review* 41(3–5), 743–751.

Ferreira-Lopes, A. and Pina, M.A. 2011. Business Cycles, Core, and Periphery in Monetary Unions: Comparing Europe and North America. *Open Economies Review* 22(4), 565–592.
Ferreira-Lopes, A. and Sequeira, T. 2011. Business Cycles in Re-Unified Germany: Closer Together or Further Apart? *Review of Urban and Regional Development Studies* 23(2/3), 94–113.
Ferreira-Lopes, A. and Sequeira, T. 2012. Business Cycles Association in a Small Monetary Union: The Case of Switzerland. *Spatial Economic Analysis* 7(1), 9–30.
Filiztekin, A. 2004. Bölgesel Büyüme, Eş-hareketlilik ve Sektörel Yapı, Sabancı University.
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.
Hodrick, R. and Prescott, E.C. 1997. Postwar US Business Cycles: An Empirical Investigation. *Journal of Money, Credit and Banking* 29(1), 1–16.
Imbs, J. 2004. Trade, Finance, Specialization, and Synchronization. *The Review of Economics and Statistics* 86(3), 723–734.
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.
Krugman, P.R. 1991. *Geography and Trade*. Cambridge, MA, MIT Press.
Lee, M. 2005. Trade Integration and Business Cycle Comovement: Evidence from the US. *The International Trade Journal* 24(4), 361–388.
Montoya, L. and De Haan, J. 2008. Regional Business Cycle Synchronization in Europe? *International Economics and Economic Policy* 5(1), 123–137.
Mundell, R.A. 1961. A Theory of Optimum Currency Areas. *American Economic Review* 51(4), 657–665.
Owyang, M.T., Piger, J.M. and Wall, H.J. 2005. Business Cycle Phases in US States. *The Review of Economics and Statistics* 87(4), 604–616.
Selover, D., Jensen, R. and Kroll, J. 2005. Mode-Locking and Regional Business Cycle Synchronization. *Journal of Regional Science* 45(4), 703–745.
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), 221–254.

Appendix I. Pairwise business cycle correlations among provinces

Provinces	Adana	Adıyaman	Afyon	Ağrı	Amasya	Ankara	Antalya	Artvin	Aydin	Balıkesir	Bilecik	Bingöl	Bitlis
Adıyaman	0.44												
Afyon	0.03	0.22											
Ağrı	0.41	0.16	−0.08										
Amasya	0.48	0.00	0.28	−0.10									
Ankara	0.31	0.72	0.06	−0.06	0.06								
Antalya	0.23	0.26	−0.43	−0.09	0.00	0.54							
Artvin	0.60	0.17	−0.14	−0.10	0.38	0.29	0.34						
Aydın	0.59	0.20	0.22	0.06	0.35	0.39	0.10	0.57					
Balıkesir	0.31	0.16	0.17	−0.26	0.34	0.31	0.11	0.57	0.78				
Bilecik	0.22	0.41	0.48	0.00	−0.18	0.46	0.26	0.02	0.24	0.03			
Bingöl	0.29	0.14	0.28	0.54	0.27	0.01	−0.23	−0.02	0.06	0.10	−0.06		
Bitlis	0.70	0.30	0.38	0.31	0.66	0.17	−0.20	0.32	0.38	0.20	0.10	0.58	
Bolu	0.47	0.19	−0.16	0.04	0.14	0.40	0.23	0.39	0.48	0.27	0.00	−0.13	0.28
Burdur	0.03	0.10	0.77	−0.03	0.37	0.04	−0.15	−0.11	0.13	0.21	0.36	0.32	0.32
Bursa	0.75	0.54	0.18	0.39	0.44	0.45	0.10	0.26	0.51	0.35	0.19	0.32	0.66
Çanakkale	0.09	0.03	0.04	−0.03	−0.19	−0.28	−0.04	−0.11	0.09	0.26	0.14	0.01	−0.17
Çankırı	−0.04	0.24	0.52	−0.18	0.25	−0.22	−0.27	−0.07	−0.08	0.14	0.02	0.04	0.07
Çorum	0.78	0.46	0.17	0.15	0.55	0.59	0.14	0.62	0.65	0.45	0.20	0.26	0.74
Denizli	0.27	0.53	0.31	0.32	−0.04	0.41	0.50	−0.09	0.14	−0.02	0.62	0.13	0.04
Diyarbakir	0.56	0.38	−0.04	0.01	0.45	0.60	0.30	0.52	0.64	0.43	0.07	−0.05	0.54
Edime	0.26	−0.02	0.59	0.28	0.44	−0.37	−0.48	0.07	0.13	0.14	−0.09	0.44	0.37
Elazığ	0.39	0.53	0.34	0.23	0.20	0.45	0.11	0.23	0.50	0.42	0.39	0.29	0.36
Erzincan	0.53	0.02	0.11	0.32	0.57	−0.02	−0.17	0.53	0.38	0.19	−0.12	0.34	0.74
Erzurum	0.52	0.41	0.22	0.49	0.00	0.26	−0.31	0.19	0.44	0.19	0.21	0.31	0.52
Eskisehir	0.31	0.50	0.55	0.14	0.23	0.35	0.01	0.39	0.42	0.37	0.36	0.12	0.30
Gaziantep	0.65	0.40	0.03	−0.06	0.50	0.64	0.36	0.58	0.56	0.30	0.25	−0.04	0.59
Giresun	0.48	−0.03	0.30	0.32	0.53	−0.18	−0.28	0.32	0.31	0.21	−0.01	0.39	0.72
Gümüşhane	0.26	0.28	0.61	0.33	0.32	0.03	−0.49	0.00	0.14	0.05	0.15	0.47	0.59
Hakkari	0.20	0.44	0.17	0.07	0.27	0.49	0.01	0.16	0.22	0.29	−0.07	0.37	0.45
Hatay	0.48	0.52	−0.34	0.04	0.13	0.77	0.83	0.36	0.33	0.16	0.29	−0.17	0.12
Isparta	0.33	0.37	0.51	0.38	0.39	0.07	−0.04	−0.07	0.02	−0.12	0.30	0.39	0.51
İçel	−0.10	0.04	0.34	−0.42	0.56	0.40	0.09	0.01	0.22	0.35	0.01	0.20	0.26
İstanbul	0.75	0.53	0.49	0.33	0.41	0.35	−0.05	0.32	0.44	0.27	0.41	0.46	0.74
İzmir	0.30	0.52	0.17	0.13	0.28	0.58	0.43	0.10	0.29	0.33	0.26	0.38	0.21
Kars	0.37	0.02	0.37	0.59	0.05	−0.18	−0.42	0.15	0.34	0.06	0.19	0.39	0.27
Kastamonu	0.43	0.43	0.72	0.13	0.42	0.26	−0.15	0.14	0.19	0.10	0.53	0.36	0.69
Kayseri	0.60	0.69	0.31	0.52	0.22	0.62	0.21	0.22	0.35	0.19	0.42	0.51	0.61
Kırklareli	0.47	−0.04	0.40	0.12	0.29	−0.23	−0.33	0.30	0.22	0.14	0.22	0.43	0.50
Kırşehir	0.73	0.14	0.26	0.28	0.58	0.09	0.02	0.34	0.48	0.10	0.15	0.19	0.58
Kocaeli	0.32	0.12	0.48	0.03	0.45	0.28	0.04	0.04	0.31	0.03	0.33	0.14	0.42
Konya	0.67	0.70	0.21	0.27	0.35	0.56	0.41	0.36	0.49	0.32	0.32	0.16	0.47
Kütahya	−0.20	0.36	0.17	0.04	−0.57	0.28	0.24	−0.18	−0.21	−0.09	0.49	0.09	−0.37
Malatya	0.07	−0.34	0.33	−0.27	0.19	−0.24	−0.37	0.06	0.30	0.13	0.08	−0.27	0.19
Manisa	0.78	0.52	0.36	0.07	0.66	0.50	0.16	0.43	0.67	0.55	0.25	0.32	0.76
K. Maras	−0.09	−0.01	−0.10	−0.38	0.12	0.23	0.40	0.10	−0.20	−0.08	0.15	−0.02	−0.17
Mardin	0.16	0.64	0.55	0.00	0.21	0.61	0.02	0.15	0.26	0.34	0.33	0.42	0.43
Muğla	0.33	0.40	−0.21	−0.14	−0.01	0.52	0.82	0.36	0.31	0.40	0.32	−0.11	−0.08
Muş	0.19	0.04	0.47	0.64	0.03	−0.37	−0.61	−0.21	0.10	−0.15	0.06	0.46	0.37
Nevşehir	0.25	0.57	0.51	0.21	−0.11	0.10	−0.21	0.11	0.06	0.03	0.42	0.18	0.25
Nİğde	0.56	0.40	0.38	0.18	0.46	−0.01	−0.12	0.13	0.35	0.21	0.15	0.20	0.59
Ordu	0.43	−0.25	0.17	0.06	0.50	−0.30	−0.17	0.18	0.38	0.16	0.00	0.03	0.52
Rize	0.30	0.44	−0.22	0.53	−0.43	0.20	0.17	0.13	−0.04	−0.24	0.26	0.02	−0.06
Sakarya	0.46	0.14	0.35	−0.29	0.55	0.41	0.22	0.48	0.59	0.45	0.38	0.00	0.50
Samsun	0.53	0.39	0.30	0.25	0.39	0.43	0.41	0.26	0.26	0.20	0.50	0.37	0.43
Siirt	0.08	−0.06	0.25	−0.16	0.45	0.24	0.09	0.18	0.12	0.14	0.08	0.21	0.50
Sinop	0.67	0.45	0.19	0.41	0.63	0.37	0.19	0.35	0.29	0.15	0.10	0.50	0.78
Sivas	0.65	0.71	0.17	0.39	0.25	0.51	0.17	0.43	0.36	0.08	0.25	0.21	0.47
Tekirdağ	0.07	0.28	0.64	−0.07	0.27	0.04	0.07	−0.29	−0.12	0.00	0.48	0.27	0.20

Appindix I. Continued.

Provinces	Adana	Adıyaman	Afyon	Ağrı	Amasya	Ankara	Antalya	Artvin	Aydin	Balıkesir	Bilecik	Bingöl	Bitlis
Tokat	0.43	0.09	0.35	0.03	0.78	0.15	0.01	0.47	0.34	0.35	−0.07	0.36	0.67
Trabzon	0.33	0.53	−0.21	0.45	−0.11	0.47	0.57	0.01	−0.18	−0.26	0.38	0.19	0.12
Tunceli	−0.12	0.11	0.15	0.38	0.10	−0.04	−0.12	−0.21	−0.35	−0.43	−0.07	0.23	0.21
Şanlıurfa	0.25	−0.21	0.42	0.06	0.39	−0.03	−0.33	0.25	0.58	0.34	0.02	0.15	0.52
Uşak	0.06	0.39	0.39	0.09	−0.07	0.01	0.02	0.01	−0.04	−0.02	0.36	0.01	−0.05
Van	0.56	0.50	−0.11	0.27	0.32	0.65	0.48	0.46	0.37	0.34	0.05	0.39	0.44
Yozgat	0.24	0.05	0.20	−0.02	0.33	0.27	−0.31	0.28	0.48	0.38	−0.15	0.26	0.40
Zonguldak	0.55	0.30	0.40	0.36	0.24	−0.10	−0.07	0.11	0.14	−0.05	0.29	0.25	0.49

Provinces	Bolu	Burdur	Bursa	Çanakkale	Çankin	Çorum	Denizli	Diyarbakir	Edirne	Elazığ	Erzincan	Erzurum	Eskişehir
Burdur	−0.30												
Bursa	0.46	0.13											
Çanakkale	−0.19	0.04	0.12										
Çankin	−0.49	0.48	0.05	0.43									
Çorum	0.56	0.16	0.72	−0.24	−0.18								
Denizli	−0.11	0.39	0.32	0.25	0.28	0.05							
Diyarbakir	0.71	−0.05	0.62	−0.32	−0.26	0.77	0.04						
Edirne	−0.21	0.48	0.31	0.23	0.57	0.11	0.14	−0.23					
Elazığ	−0.20	0.48	0.37	0.05	0.28	0.42	0.49	0.21	0.19				
Erzincan	0.15	0.16	0.31	−0.38	0.00	0.59	−0.15	0.49	0.29	0.33			
Erzurum	0.26	0.14	0.45	−0.15	−0.14	0.62	−0.04	0.31	0.14	0.48	0.47		
Eskişehir	−0.10	0.58	0.28	−0.09	0.47	0.43	0.46	0.21	0.45	0.73	0.43	0.43	
Gaziaiitep	0.61	0.03	0.55	−0.31	−0.23	0.86	0.10	0.89	−0.22	0.23	0.48	0.32	0.26
Giresun	0.20	0.30	0.43	−0.17	0.12	0.38	−0.09	0.33	0.46	0.22	0.78	0.35	0.28
Gümüşhane	−0.17	0.68	0.29	−0.22	0.35	0.37	0.08	0.09	0.51	0.51	0.57	0.64	0.62
Hakkari	0.47	0.06	0.46	−0.22	−0.08	0.50	0.04	0.54	0.09	0.04	0.29	0.20	0.22
Hatay	0.47	−0.27	0.47	−0.19	−0.37	0.50	0.43	0.63	−0.47	0.23	0.01	0.05	0.05
Isparta	−0.37	0.55	0.41	0.08	0.55	0.21	0.62	−0.02	0.56	0.55	0.34	0.16	0.60
İçel	−0.02	0.43	0.04	−0.34	−0.02	0.33	−0.01	0.28	−0.02	0.27	0.12	−0.08	0.17
İstanbul	0.22	0.48	0.75	0.19	0.24	0.75	0.39	0.38	0.47	0.48	0.38	0.56	0.53
İzmir	−0.12	0.28	0.51	0.24	0.28	0.32	0.66	0.20	0.16	0.55	−0.04	−0.03	0.38
Kars	−0.13	0.19	0.19	−0.01	0.08	0.18	0.09	−0.16	0.57	0.31	0.32	0.57	0.37
Kastamonu	−0.06	0.72	0.47	−0.02	0.42	0.54	0.37	0.23	0.43	0.50	0.45	0.45	0.65
Kayseri	0.28	0.41	0.70	−0.12	−0.01	0.69	0.55	0.49	0.18	0.53	0.38	0.57	0.57
Kırklareli	0.07	0.25	0.22	0.29	0.14	0.28	−0.04	−0.12	0.57	0.15	0.27	0.23	0.13
Kırşehir	0.35	0.24	0.50	0.01	0.16	0.55	0.24	0.45	0.33	0.19	0.48	0.30	0.24
Kocaeli	0.40	0.16	0.50	−0.17	−0.03	0.37	0.29	0.37	0.31	−0.08	0.09	−0.04	0.06
Konya	0.41	0.30	0.63	−0.02	0.19	0.57	0.62	0.66	0.10	0.48	0.36	0.32	0.53
Kütahya	−0.38	0.18	−0.16	0.20	0.11	−0.25	0.49	−0.45	−0.04	0.28	−0.45	0.05	0.23
Malatya	0.40	−0.02	0.15	0.05	0.01	0.08	−0.30	0.21	0.20	−0.35	0.11	−0.02	−0.16
Manisa	0.42	0.37	0.78	0.07	0.13	0.85	0.29	0.65	0.27	0.53	0.40	0.44	0.44
K. Maras	−0.07	−0.17	−0.17	−0.11	−0.05	−0.14	0.06	−0.18	−0.20	−0.07	−0.28	−0.47	−0.25
Mardin	0.13	0.50	0.35	−0.23	0.21	0.44	0.34	0.40	0.14	0.44	0.27	0.31	0.57
Muğla	0.27	−0.11	0.30	0.26	−0.07	0.16	0.53	0.30	−0.25	0.22	−0.24	−0.24	0.06
Muş	−0.26	0.38	0.19	0.20	0.38	0.00	0.21	−0.16	0.61	0.33	0.36	0.41	0.36
Nevşehir	−0.21	0.28	0.27	0.29	0.57	0.16	0.41	−0.04	0.43	0.28	0.14	0.35	0.58
Niğde	0.02	0.31	0.52	0.38	0.60	0.33	0.39	0.33	0.42	0.38	0.43	0.23	0.38
Ordu	0.25	0.11	0.31	0.12	0.11	0.21	−0.06	0.33	0.25	0.07	0.52	0.06	−0.04
Rize	0.03	−0.24	0.15	−0.02	−0.05	0.04	0.30	0.04	−0.15	0.15	0.09	0.40	0.16
Sakarya	0.60	0.22	0.41	−0.09	−0.05	0.59	0.13	0.68	0.01	0.09	0.32	0.01	0.16
Samsun	0.02	0.57	0.50	−0.02	0.05	0.47	0.58	0.21	0.24	0.64	0.23	0.21	0.45
Siirt	0.40	0.21	0.25	−0.47	−0.25	0.39	−0.10	0.53	−0.02	−0.19	0.40	−0.06	−0.01
Sinop	0.13	0.32	0.69	−0.20	0.14	0.68	0.37	0.57	0.30	0.46	0.70	0.34	0.46
Sivas	0.23	0.13	0.46	−0.27	0.10	0.61	0.40	0.47	0.18	0.51	0.51	0.57	0.63
Tekirdağ	−0.41	0.69	0.20	0.33	0.57	−0.08	0.62	−0.27	0.43	0.35	−0.18	−0.15	0.28

(*continued.*)

Appindix I. Continued.

Provinces	Bolu	Burdur	Bursa	Çanakkale	Çankin	Çorum	Denizli	Diyarbakir	Edirne	Elazığ	Erzincan	Erzurum	Eskişehir
Tokat	0.20	0.52	0.38	−0.37	0.09	0.62	0.01	0.53	0.40	0.27	0.72	0.21	0.44
Trabzon	0.01	−0.01	0.34	−0.16	−0.18	0.15	0.55	0.09	−0.21	0.31	0.03	0.17	0.13
Tunceli	−0.47	0.33	−0.02	−0.42	0.28	−0.09	0.23	−0.09	0.18	0.34	0.41	0.09	0.40
Şanlıurfa	0.31	0.38	0.22	−0.23	−0.13	0.51	−0.17	0.42	0.30	0.19	0.53	0.39	0.35
Uşak	−0.38	0.36	0.08	0.40	0.78	−0.20	0.61	−0.19	0.35	0.31	−0.05	−0.12	0.52
Van	0.53	−0.04	0.55	−0.38	−0.34	0.64	0.19	0.58	−0.10	0.26	0.28	0.35	0.18
Yozgat	0.36	0.21	0.25	−0.29	−0.10	0.54	−0.32	0.42	0.10	0.30	0.42	0.47	0.23
Zonguldak	−0.10	0.42	0.45	0.37	0.55	0.27	0.48	0.03	0.51	0.34	0.29	0.29	0.44

Provinces	Gaziantep	Giresun	Gümüşhane	Hakkari	Hatay	Isparta	İçel	İstanbul	İzmir	Kars	Kastamonu	Kayseri	Kırklareli
Giresun	0.21												
Gümüşhane	0.10	0.59											
Hakkari	0.40	0.22	0.22										
Hatay	0.6?	−0.15	−0.33	0.24									
Isparta	0.10	0.31	0.52	0.12	0.02								
İçel	0.33	−0.04	0.16	0.40	0.16	0.11							
İstanbul	0.54	0.37	0.56	0.34	0.18	0.59	0.08						
İzmir	0.24	−0.13	0.04	0.36	0.47	0.55	0.38	0.46					
Kars	−0.12	0.37	0.48	−0.21	−0.28	0.28	−0.27	0.35	−0.07				
Kastamonu	0.42	0.47	0.74	0.25	−0.02	0.71	0.22	0.81	0.31	0.26			
Kayseri	0.53	0.30	0.54	0.59	0.42	0.54	0.16	0.79	0.56	0.24	0.67		
Kırklareli	0.07	0.44	0.30	−0.06	−0.32	0.23	−0.08	0.55	−0.05	0.46	0.42	0.13	
Kırşehir	0.57	0.44	0.35	0.03	0.19	0.33	0.01	0.62	0.18	0.33	0.46	0.36	0.40
Kocaeli	0.39	0.26	0.03	0.33	0.28	0.29	0.27	0.37	0.28	0.14	0.32	0.28	0.23
Konya	0.60	0.34	0.35	0.44	0.57	0.40	0.09	0.58	0.48	0.05	0.46	0.74	−0.04
Kütahya	−0.37	−0.38	0.04	−0.16	0.08	0.09	−0.14	0.01	0.31	0.09	0.08	0.17	−0.09
Malatya	0.14	0.38	−0.03	−0.02	−0.22	−0.18	−0.10	0.05	−0.38	0.08	0.08	−0.29	0.29
Manisa	0.72	0.36	0.35	0.44	0.44	0.43	0.42	0.81	0.53	0.12	0.60	0.67	0.36
K. Maras	−0.02	−0.16	−0.39	−0.19	0.26	−0.11	0.21	−0.23	0.20	−0.24	−0.14	−0.27	0.13
Mardin	0.33	0.26	0.56	0.72	0.17	0.31	0.45	0.45	0.46	0.00	0.55	0.69	−0.01
Muğla	0.26	−0.16	−0.46	0.09	0.73	0.00	0.02	0.10	0.53	−0.30	−0.10	0.22	−0.12
Muş	−0.18	0.41	0.62	−0.05	−0.52	0.54	−0.28	0.42	−0.01	0.64	0.42	0.29	0.40
Nevşehir	0.05	0.10	0.45	0.17	−0.11	0.53	−0.29	0.54	0.24	0.39	0.58	0.46	0.20
Niğde	0.32	0.44	0.41	0.20	0.06	0.60	−0.02	0.58	0.35	0.14	0.54	0.38	0.24
Ordu	0.26	0.72	0.17	−0.11	−0.06	0.15	−0.05	0.20	−0.17	0.11	0.23	−0.09	0.39
Rize	0.03	0.06	0.17	−0.14	0.25	0.03	−0.66	0.12	−0.01	0.35	0.05	0.32	−0.14
Sakarya	0.73	0.40	0.04	0.36	0.36	0.02	0.39	0.42	0.16	−0.12	0.41	0.28	0.33
Samsun	0.33	0.34	0.37	0.03	0.39	0.49	0.26	0.60	0.51	0.18	0.58	0.61	0.36
Siirt	0.46	0.49	0.14	0.57	0.19	0.01	0.46	0.14	0.00	−0.24	0.31	0.28	0.01
Sinop	0.59	0.56	0.51	0.48	0.41	0.64	0.25	0.66	0.53	0.13	0.62	0.75	0.11
Sivas	0.52	0.26	0.51	0.36	0.43	0.41	0.02	0.55	0.33	0.35	0.44	0.69	0.07
Tekirdağ	−0.15	0.12	0.30	−0.07	−0.04	0.63	0.26	0.37	0.45	0.05	0.55	0.25	0.26
Tokat	0.51	0.64	0.55	0.43	0.10	0.31	0.49	0.45	0.14	0.10	0.52	0.45	0.23
Trabzon	0.13	0.11	0.11	0.06	0.59	0.31	−0.18	0.20	0.37	0.01	0.20	0.54	−0.15
Tunceli	−0.10	0.28	0.54	0.01	−0.14	0.62	0.02	0.05	0.14	0.11	0.35	0.27	−0.20
Şanlıurfa	0.41	0.40	0.37	0.24	−0.16	0.16	0.32	0.38	−0.12	0.28	0.36	0.25	0.31
Uşak	−0.14	0.05	0.25	−0.09	−0.13	0.56	−0.32	0.29	0.37	0.16	0.40	0.22	0.09
Van	0.53	0.25	0.10	0.51	0.67	0.04	0.25	0.34	0.38	0.08	0.15	0.63	−0.03
Yozgat	0.38	0.33	0.47	0.31	−0.08	−0.14	0.35	0.32	0.03	0.12	0.23	0.21	0.23
Zonguldak	0.18	0.34	0.45	−0.11	−0.03	0.71	−0.31	0.71	0.28	0.33	0.68	0.43	0.41

Provinces	Kırşehir	Kocaeli	Konya	Kütahya	Malatya	Manisa	K. Maraş	Mardin	Muğla	Muş	Nevşehir	Nİğde	Ordu
Kocaeli	0.48												
Konya	0.57	0.30											
Kütahya	−0.34	−0.14	0.04										
Malatya	0.32	0.57	−0.10	−0.37									
Manisa	0.58	0.43	0.66	−0.24	0.09								

Appindix I. Continued.

Provinces	Kırşehir	Kocaeli	Konya	Kütahya	Malatya	Manisa	K. Maraş	Mardin	Muğla	Muş	Nevşehir	Nİğde	Ordu
K. Maras	−0.07	0.24	−0.19	0.21	−0.03	−0.10							
Mardin	0.11	0.27	0.61	0.29	−0.12	0.45	−0.08						
Muğla	−0.01	0.17	0.47	0.32	−0.15	0.33	0.36	0.14					
Muş	0.35	0.00	0.13	−0.07	0.04	0.09	−0.55	0.10	−0.51				
Nevşehir	0.17	0.10	0.38	0.41	−0.02	0.20	−0.34	0.45	−0.01	0.47			
Nİğde	0.64	0.25	0.64	−0.19	0.17	0.57	−0.33	0.31	0.09	0.49	0.55		
Ordu	0.61	0.36	0.23	−0.51	0.64	0.32	−0.04	−0.13	−0.04	0.28	−0.12	0.56	
Rize	0.18	−0.19	0.38	0.43	−0.25	−0.17	−0.12	0.10	0.11	0.21	0.46	0.12	−0.12
Sakarya	0.57	0.65	0.47	−0.33	0.53	0.62	0.23	0.37	0.31	−0.18	−0.04	0.33	0.54
Samsun	0.36	0.25	0.52	0.26	−0.24	0.56	0.25	0.35	0.39	0.10	0.08	0.21	0.18
Siirt	0.13	0.56	0.22	−0.29	0.38	0.28	0.11	0.46	0.06	−0.23	−0.12	0.02	0.31
Sinop	0.56	0.34	0.70	−0.14	−0.15	0.65	−0.14	0.52	0.15	0.25	0.32	0.61	0.32
Sivas	0.51	0.17	0.77	0.14	−0.24	0.50	−0.20	0.55	0.12	0.25	0.52	0.48	0.00
Tekirdağ	0.13	0.32	0.26	0.39	−0.07	0.30	0.22	0.32	0.23	0.18	0.35	0.41	0.11
Tokat	0.45	0.30	0.50	−0.31	0.08	0.55	−0.16	0.50	−0.04	0.12	0.06	0.36	0.38
Trabzon	0.02	0.02	0.44	0.43	−0.49	0.11	0.26	0.22	0.43	−0.11	0.12	0.00	−0.17
Tunceli	0.03	−0.12	0.13	0.06	−0.33	−0.13	−0.13	0.23	−0.34	0.43	0.19	0.16	−0.01
Şanlıurfa	0.33	0.30	0.11	−0.47	0.43	0.47	−0.48	0.16	−0.25	0.33	−0.02	0.18	0.37
Uşak	0.22	0.01	0.38	0.35	−0.09	0.02	−0.03	0.28	0.15	0.42	0.70	0.53	0.00
Van	0.20	0.28	0.57	0.00	−0.25	0.56	0.18	0.45	0.49	−0.29	−0.07	−0.01	−0.09
Yozgat	0.41	0.10	0.18	−0.22	0.23	0.37	−0.06	0.38	−0.27	0.13	−0.16	0.07	0.26
Zonguldak	0.63	0.21	0.46	0.09	0.12	0.44	−0.23	0.11	0.06	0.56	0.62	0.73	0.39

Provinces	Rize	Sakarya	Samsun	Siirt	Sinop	Sivas	Tekirdağ	Tokat	Trabzon	Tunceli	Şanlıurfa	Uşak	Van	Yozgat
Sakarya	−0.24													
Samsun	0.11	0.36												
Siirt	−0.29	0.65	0.18											
Sinop	0.19	0.36	0.58	0.43										
Sivas	0.55	0.18	0.38	0.01	0.67									
Tekirdağ	−0.15	0.14	0.58	0.07	0.25	0.05								
Tokat	−0.19	0.51	0.49	0.63	0.73	0.44	0.19							
Trabzon	0.60	−0.09	0.59	0.04	0.44	0.43	0.27	0.02						
Tunceli	0.23	−0.33	0.20	0.04	0.45	0.30	0.16	0.25	0.36					
Şanlıurfa	−0.43	0.41	0.05	0.37	0.22	0.09	−0.15	0.50	−0.48	0.00				
Uşak	0.38	−0.03	0.17	−0.29	0.18	0.29	0.47	−0.08	0.17	0.35	−0.26			
Van	0.20	0.34	0.46	0.41	0.53	0.49	−0.04	0.41	0.53	−0.05	0.07	−0.25		
Yozgat	−0.09	0.38	0.16	0.20	0.24	0.26	−0.28	0.42	−0.25	0.02	0.44	−0.22	0.21	
Zonguldak	0.29	0.14	0.38	−0.13	0.50	0.39	0.46	0.20	0.16	0.28	0.17	0.61	−0.04	−0.01