Convergence of Agricultural Sector, Non-Agricultural Sector, Public Expenditures and Migration in Turkey: A Spatial Panel Approach

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Abstract

Purpose: The aim of this study is to investigate the spatial dimensions of the convergence process in the agricultural and non-agricultural sectors, public expenditures, and migration in 81 provinces of Turkey for the 2008-2018 period.
Design/Methodology/Approach: For this purpose, spatial panel data estimation methodology with Driscoll-Kraay estimator is used to capture the effect of space, which is a necessary condition to prevent biased estimates of convergence.
Findings: It is clear that structural problems in the agricultural sector restrict interaction with the non-agricultural sector in the provinces and this limits the convergence effect on the agricultural sector. Limited convergence in agricultural sector causes continued income gap between rich and poor provinces in Turkey. In addition to this, migration from the agricultural sector to the non-agricultural sector has an impact on the convergence of both sectors between provinces. Moreover, public expenditures appears to have no direct, indirect or total effect on both agriculture and non-agricultural sectors.
Originality/Value: To the best of our knowledge, this study is the first to show the spatial dimensions of convergence at sectoral level for provinces of Turkey with relation to public expenditures and migration across agricultural and non-agricultural sectors.
Key words: Convergence Analysis, Agricultural Development, Spatial Analysis

Türkiye'de Tarım ve Tarım Dışı Sektörlerde Yakınsama, Kamu Harcamaları ve Göç: Mekansal Panel Veri Yaklaşımı
Özet

Amaç: Bu çalışmada Türkiye'de 81 il bazında 2008-2018 yılları arası verileri kullanılarak tarım ve tarımdışı sektörler ile kamu harcamaları ve göç arasındaki ilişkilerin incelenmesi amaçlanmaktadır.
Tasarım/Metodoloji/Yaklaşım: Yakınsama analizine ilişkin sapmasız tahminciler elde edebilmek için Driscoll-Kraay tahmincisiyle mekansal panel veri analizi yöntemi kullanılmıştır
Bulgular: Araştırma sonuçları, tarım sektöründeki yapısal problemler, tarım dışı sektörler ile tarım sektörünün etkileşimini iller bazında kısıtladığını ve bu durumun tarım sektöründeki yakınsamayı sınırlandırdığını ortaya koymaktadır. Tarımdaki sınırlı yakınsama zengin ve fakir iller arasındaki gelir farklılığının devam etmesine neden olmaktadır. Bunun yanında araştırma sonuçları, tarım sektöründen tarım dışı sektörlere yönelik göç olgusu iller arasında sektörler bazında yakınsama üzerinde etkili olduğunu ortaya koymaktadır. Ayrıca kamu harcamalarının tarım ve tarım dışı sektörler üzerindeki etkisinin istatistiksel olarak anlamlı olmadığı tespit edilmiştir.
Özgünlük/Değer: Bu çalışmanın özgünlüğü, Türkiye'de iller bazında sektörel yakınsamanın mekansal boyutları ve bunun göç ve kamu harcamaları ile ilişkisinin ilk defa ele alınmasıdır.
Anahtar kelimeler: Yakınsama Analizi, Tarımsal Büyüme, Mekansal Analiz

1. INTRODUCTION

Some countries being wealthy and some being poor constitutes the most fundamental question of macroeconomics and growth theory. Finding an answer to this question is one of the most pressing subjects of both academics working in the field and policy makers. For this reason, the issue of convergence has long been debated in the literature. The word "convergence" has simultaneously been given the following two meanings by neo-classical theory: a) tendency for the poorer economies to grow faster, and b) eventual equality of all countries' per capita incomes (Kant, 2019). Existence of convergence is important because it contributes to the reduction of provincial per capita income differences. As DiCecio and Gascon (2010) mentioned "the study of convergence of living standards within a given country is one of the most important and fascinating issues in economics".

Some studies have findings for the existence of inter-country and intra-country convergence, but some do not. Inter-country and intra-country convergence may have different drivers. Policy makers should take this matter into consideration. For this reason, the subject of the drivers of convergence should be studied for individual or groups of countries, especially for countries with featured economic structures. In this study, the existence of convergence in Turkey which has structural problems especially in the agricultural sector, and the reasons for such convergence are examined. It is clear that these structural problems restrict interaction between agricultural sectors in the provinces and this limits the convergence effect of spatial effects on the agricultural sector. Along with that, migration from the agricultural sector to the non-agricultural sector has an impact on the convergence of both sectors between provinces.

Aramovitz (1986) and Baumol (1986) are among the first studies in the area of absolute convergence. However, the distinction between absolute and conditional convergence emerged after Mankiw, Romer, and Weil (1982) and Barro and Sala-i-Martin (1992). First studies concentrated on convergence in aggregated levels. Among these studies, De Long (1988), Baumol and Wolff (1988), Dowrick and Nguyen (1989), Grier and Tullock (1989), Mankiw, Romer, and Weil (1992), Barro and Sala-i-Martin (1992), Quah (1993), Bernard and Durlauf (1995), Islam (1995), Evans and Karras (1996), Sala-i-Martin (1996a), and Sala-i-Martin (1996b) are worth mentioning. Bernard and Jones (1996) brought convergence studies to a sectoral level. Almost all sectoral convergence studies (Bernard and Jones 1996; Frantzen 2004; Ulusoy and Yalçın 2011; Mahmood 2012) focused on developed nations due to the lack of available sectoral data in developing countries. An exception is Castellacci, Los, and De Vries (2014) who expanded Bernard and Jones's (1996) sample from 14 developed nations to 65 developed and developing nations.

Important progress was made by incorporating spatial analysis into convergence studies. De Long and Summers (1991) were among the first to highlight the importance of neighborhood effects in convergence studies. Armstrong (1995), Rey and Montouri (1999), Lopez-Bazo et al. (1999), Arbia and Paelinck (2003), Le Gallo and Ertur (2003), Lopez-Bazo, Vaya and Artis (2004), Dall'erba (2005), Fingleton and Lopez-Bazo (2006) and Ertur and Koch (2007) made valuable contributions in the area of spatial convergence literature.

In Turkey, empirical studies concerning convergence emerged after the 1990s. Similar to the literature on other countries, while some of the studies find evidence of convergence among the regions or provinces of Turkey (Filiztekin 1998; Yıldırım 2005; Yıldırım and Öcal 2006; Kılıçaslan and Özatağan 2007; Yıldırım, Öcal, and Özyıldırım 2008; Önder, Deliktaş, and Karadağ 2010; Zeren and Yılancı 2011; Özgül and Karadağ 2015), some of them do not (Temel, Tansel, and Albersen 1999; Gezici and Hewings 2004; Karaca 2004; Temel, Tansel, and Güngör 2005; Aldan and Gaygısız 2006; Abdioğlu and Uysal 2013). Most of the convergence studies for Turkey address the convergence issue in aggregated terms except for Filiztekin (1998), Temel, Tansel, and Albersen (1999), Temel, Tansel, and Güngör (2005), and Baypınar (2010). Among these four studies, Baypınar's (2010) study is the only one dealing with the spatial dimensions of sectoral convergence. Even though he argues the different spatial aspects of sectors, he does not explicitly show these differences in his analysis.

Migration is one important option for people who want to improve their economic prospects and overall quality of life (Enflo et al., 2013). Migration is thought to bring spatial disequilibrium caused by some type of labor supply or demand shock in some particular region back to a state of equilibrium (Shumway and Otterstrom, 2015). The use of migration measures allows us to evaluate income redistribution across space. To the best of our knowledge, this study is the first to show the spatial dimensions of convergence at sectoral level for provinces of Turkey with relation to migration across agricultural and non-agricultural sectors.

2. MATERIAL and METHOD

Data

Most of the data we used were from the Turkish Statistical Institute (Turkstat). The Turkstat data set includes nominal gross domestic product (GDP), working age population, rural population, urban population, number of faculty and vocational school graduates and consumer price index (2003=100). Working age population is defined as the population between 15 and 64 years. An additional variable for public expenditure is taken from the Republic of Turkey, Ministry of Treasury and Finance. The data cover the 2008-2018 period and are all annual. Our data are limited to the 2008-2018 period because Turkstat changed the method of census from traditional to an address-based population registration system in 2007. Therefore, annual population data for the provinces do not exist prior to 2007 and educational data such as the number of primary, secondary, high school and faculty graduates do not exist prior to 2008. We used natural logarithms of all the dependent and independent variables except for the growth of working age population, due to the negative values.

In order to measure the annual growth of real GDP per capita for the agricultural sector, nominal GDP values are deflated by consumer price index (2003=100). Afterwards, real GDP for the agricultural sector is divided by rural population. Since Turkstat does not report any population or labor force statistics at the sectoral level for provinces, we used rural population as a proxy for agricultural population. For non-agricultural sectors, we first sum up nominal GDP values for the industry and services sectors and then deflate by consumer price index. Per capita values for the non-agricultural sector are derived from real non-agricultural GDP divided by urban population. Since almost all non-agricultural economic activities are located in urban areas, this would be a valid proxy for the non-agricultural labor force. Rural and urban population data are missing for 60 observations.

Following Mankiw, Romer, and Weil (1992) and Islam (1995), we used three additional control variables. The first one is real public expenditure per capita. Unlike Mankiw, Romer, and Weil (1992) we preferred to use public expenditure instead of public investment. The data for public investment at the provincial level in Turkey have some shortcomings. First, a significant portion of aggregate public investment is classified as "miscellaneous provinces", that is, if an investment project involves more than one province, that project is classified as miscellaneous provinces. Second, miscellaneous provinces comprise almost 40-50% of all public investment and almost all are productive such as electric transmission lines, railway and highway investments. Excluding the miscellaneous provinces component from the provincial public investment data will cause important loss of information. Our second control variable is the growth of the working age population which measures the growth of the labor force for each province. The third control variable is a proxy for human capital and is measured as the number of faculty and vocational school graduates. Summary statistics for our variables are given in Table 1.

Table 1. Descriptive Statistics

	Obs	Mean	Standard dev.	Min	Max	Variable definitions
$ln(y_{it+1}/y_{it})$ [non-agri]	891	0.024	0.060	-0.389	0.453	Annual growth of real GDP per capita for non-agriculture sector
$ln(y_{it+1}/y_{it})$ [agri]	891	0.030	0.196	-0.816	2.269	Annual growth of real GDP per capita for agriculture sector
lny_{it} [non-agri]	891	9.001	0.341	8.048	9.878	Real GDP per capita for non-agriculture sector
lny_{it} [agri]	891	7.989	0.551	6.102	9.419	Real GDP per capita for agriculture sector
$popgr_{it}$	891	0.014	0.024	-0.131	0.185	Working age population growth
$lnfaculty_{it}$	891	10.530	1.106	7.756	14.593	Number of faculty and vocational school graduates
$lnpub_{it}$	891	20.151	0.889	18.096	23.664	Real public expenditures per capita

Estimation Methodology and Preliminary Test Results

Regional disparities in income and human capital have long been an important issue for Turkey. Given these disparities, we used conditional beta convergence methodology for our analysis with the intent of incorporating the structural characteristics of the provinces. Following Barro et al. (1991) and Mankiw, Romer, and Weil (1992) which are based on Solow's (1956) model, we estimate the conditional beta convergence model as below.

$$\ln(\frac{y_{it1+}}{y_{it}}) = \beta_0 + \beta_1 \ln(y_{it}) + \beta_2 \ln pub_{it} + \beta_3 \ln faculty_{it} + \beta_4 popgr_{it} + \omega_{it} \qquad (1)$$

In equation (1), the dependent variable is the natural logarithm of real GDP per capita in year t+1 divided by real GDP per capita in year t. On the right hand side, ln(yit) is the natural logarithm of initial real GDP per capita in year t, and lnpubit and lnfacultyit are the natural logarithms of real public expenditure per capita and number of faculty and vocational school graduates in year t, respectively. Popgrit is the growth rate of working age population between t+1 and t.

We also employed the spatial panel model of convergence. Piras and Arbia (2007) argue that the spatial panel data model provides a suitable choice for estimation of regional convergence for at least two reasons. First, it explicitly accounts for the effect of space, which is a necessary condition to prevent biased estimates of convergence as addressed in Elhorst, Piras, and Arbia (2010). Second, the inclusion of regional specific fixed effects in the model reflects the possible presence of omitted variables with spatial dimensions, which reflects the differences in initial conditions. We considered three spatial models in our analysis, namely, Spatial Lag Model (SAR), Spatial Error Model (SEM), and Spatial Durbin Model (SDM) which are widely used in applied spatial econometrics. Based on the Wald test statistics which are reported in the proceeding section, we decided to use Spatial Lag Model (SAR). SAR includes the spatially lagged dependent variable on the right hand side of the model. Thereby, our spatial beta convergence model is as follows.

$$\ln(\frac{y_{i,t+1}}{y_{i,t}}) = \beta_0 + \rho W \ln(\frac{y_{i,t+1}}{y_{i,t}}) + \beta_1 \ln(y_{i,t}) + \beta_2 X_{i,t} + \omega_{i,t} \qquad (2)$$

Equation (2) is the spatially extended version of the model in equation (1). X represents three control variables namely lnpubit, lnfacultyit, and popgrit. W is the spatial weight matrix used in our analysis. W is a square matrix with i x i dimension where i is the number of geographical units.

An important subject that has been discussed in spatial econometrics literature is the specification of spatial weight matrix. Researchers generally use two fundamental spatial matrices, contiguity and distance, as well as varieties of them in applied spatial analysis.

Bell and Bockstael (2000) and Stakhovych and Bijmolt (2008) argue that a correctly specified weight matrix is important for parameter estimates and inferences. Stakhovych and Bijmolt (2008) propose a goodness of fit criteria which increases the probability of selecting the true specification of spatial weight matrix. In contrast, Lesage and Pace (2014) and Lesage (2014) state that the arguments in support of the sensitivity of parameter estimates to weight matrix specification are historically mistaken beliefs. In light of these discussions, we specified three spatial weight matrices in our analysis. These matrices are queen contiguity matrix, inverse distance matrix with a cut-off point of 200 kilometers, and k nearest neighbor matrix with k=5. We used Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC) to determine the most compatible spatial matrix to our data.

In an effort to address the problem of non-spherical errors in our data, we employed cross sectional dependency, which has recently gained attention in the literature, as well as heteroskedasticity, and autocorrelation tests. In order to overcome cross sectional dependency, heteroskedasticity, and autocorrelation problems, which are present in many applied studies, three main approaches have been suggested in the literature. Parks-Kmenta suggested Feasible Generalized Least Square (FGLS) estimation, which is appropriate when the number of time periods is greater than the number of cross sectional units, T>N (Reed and Ye, 2011; Hoechle, 2007). The second approach was proposed by Beck and Katz which is known as Panel Corrected Standard Errors (PCSE). PCSE performs better than FGLS and can be used where N>T. However, the PCSE approach underestimates the standard errors when N gets bigger (Reed and Ye, 2011). The third approach was developed by Driscoll-Kraay and performs better than PCSE if the cross sectional unit, N, is large compared to the time dimension, T (Driscoll and Kraay, 1998; Hoechle, 2007). In this respect, we first check for cross sectional dependency issues, heteroskedasticity, and autocorrelation . The results are given in Table 2.

Table 2. Diagnostic Tests for Non-agricultural and Agriculture sectors

	Non-agricultural Sector	Agriculture Sector
Pesaran (2015) test	164.79 (0.00)	78.53 (0.00)
Modified Wald test for groupwise heteroskedasticity	755.87 (0.00)	2677.20 (0.00)
BFN Autocorrelation test	1.28	1.63
Wooldridge Autocorrelation test	210.86 (0.00)	130.87 (0.00)

Significance levels are given in parenthesis. Upper and lower statistics for BFN are dPL=1.83, dPU=1.88. H=50, T=10 and n=5. BFN, stands for Bhargava, Franzini, and Narendranathan.

From the diagnostic tests results, it is clear that there exist cross sectional dependency and heteroskedasticity for both the non-agricultural and agricultural sectors. We employed two autocorrelation tests. Wooldridge and BFN test statistics indicate significant autocorrelation for the non-agricultural and agricultural sectors. Therefore, we conclude in favor of autocorrelation for both sectors. In order to deal with multicollinearity issues, we check for pairwise correlations among independent variables and variance inflation factor (VIF) and tolerance values.

Table 3. Correlations among Independent Variables

	lny_{it} [non-agri]	lny_{it} [agri]	$popgr_{it}$	$\ln faculty_{it}$	$\ln pub_{it}$
lny_{it} [non-agri]	1.000				
lny_{it} [agri]	0.147	1.0000			
$popgr_{it}$	-0.030	-0.110	1.000		
$\ln faculty_{it}$	0.426	0.264	0.053	1.000	
$\ln pub_{it}$	0.098	0.103	-0.039	-0.08	1.000

As seen in Table 3, independent variables do not show strong correlations which is an indication of no collinearity. Other test statistics for detecting collinearity in the literature are VIF and tolerance values. Many statistics and econometrics textbooks adopt the rule of thumb of 10 for VIF and 0.10 for tolerance (O'Brian, 2007). Allison (2012) suggests a strict criteria whereby VIF greater than 2.5 or tolerance less than 0.4 may indicate multicollinearity. Based on the VIF and tolerance values in Table 4, neither the agricultural nor non-agricultural sectors seem to indicate multicollinearity.

Table 4. VIF and Tolerance: Agriculture and Non-agricultural Sectors

	Non-agricultural sector		Agricultural sector	
	VIF	Tolerance	VIF	Tolerance
$popgr_{it}$	1.01	0.99	1.02	0.98
$\ln faculty_{it}$	1.25	0.80	1.10	0.91
$\ln pub_{it}$	1.03	0.97	1.02	0.97
lny_{it} [agri]			1.11	0.90
lny_{it} [non-agri]	1.25	0.80		
Mean VIF	1.14		1.06	

One way of comparing SDM, SAR, and SEM is to carry out Wald tests for these models. In Table 5, Wald test statistics for SDM and SAR, and SDM and SEM are given for both the agricultural and non-agricultural sectors.

Table 5. Wald Tests for Non-agricultural Sector (SDM/SAR and SDM/SEM)

	Spatial matrix: contiguity (queen)	Spatial matrix: inverse distance (200km)	Spatial matrix: k nearest neighbor (5)
Agriculture Sector			
SEM	3.69 (0.06)	0.52 (0.47)	2.50 (0.11)
SAR	10.48 (0.00)	26.00 (0.00)	7.30 (0.01)
Non-agricultural Sector			
SEM	0.15 (0.70)	0.02 (0.88)	0.77 (0.37)
SAR	28.98 (0.00)	26.86 (0.00)	18.87 (0.00)

Significance levels are given in parenthesis.

Wald statistics in Table 5 strongly indicate SAR model as the best fitting model for all three spatial weight matrices in the agricultural and non-agricultural sectors. By using SAR as our spatial model, finally we check for the best spatial weight matrix specification for analysis. In Table 6, AIC and SIC values are reported for contiguity, inverse distance and k nearest neighbor matrices. Smallest AIC and SIC values are derived from an inverse distance matrix with a 200 kilometer cut-off for the non-agricultural sector and queen contiguity matrix for the agricultural sector.

Table 6. AIC and SIC results for SAR

	Non-agricultural sector	Agriculture sector
Spatial matrix: contiguity (queen)		
AIC	-3086.13	-888.66
SIC	-3057.38	-859.91
Spatial matrix: inverse distance (200km)		
AIC	-3252.96	-854.11
SIC	-3224.20	-825.35
Spatial matrix: k nearest neighbor (5)		
AIC	-3080.66	-839.90
SIC	-3051.91	-811.15

3.RESULTS

In summary, the test statistics reported above in the preliminary test results section suggest that there exist cross sectional dependency, heteroskedasticity and autocorrelation in our data. Since the number of cross sections, N, is 81 and the number of time periods, T, is 11 for our data set, we conclude that the Driscoll-Kraay estimator is the best estimator for our analysis. Furthermore, it appears that SAR with a spatial weight matrix of contiguity is the most suitable spatial model. Table 7 reports the analysis results for SAR and non-spatial models based on Driscoll-Kraay estimators for the agricultural and non-agricultural sectors.

Table 7. Main Estimation Results

	Agriculture (non-spatial Driscoll-Kraay)	Non-agriculture (non-spatial Driscoll-Kraay)	Agriculture (SAR Driscoll-Kraay)	Non-agriculture (SAR Driscoll-Kraay)
Main				
$\ln faculty_{it}$	-0.24*** (0.00)	-0.04** (0.03)	-0.14*** (0.00)	-0.04*** (0.00)
$\ln pub_{it}$	0.00 (0.61)	0.00* (0.08)	-0.00 (0.18)	-0.00(0.35)
lny_{it} [agri]	0.57*** (0.00)		-0.15*** (0.00)	
$popgr_{it}$	-1.01** (0.02)	-0.80*** (0.00)	-0.76*** (0.00)	-0.72*** (0.00)
lny_{it} [non-agri]		0.26*** (0.00)		-0.19*** (0.00)
constant	-1.99** (0.03)	-1.87** (0.03)		
Spatial				
rho			0.50*** (0.00)	0.57*** (0.00)
Direct effects				
$\ln faculty_{it}$			-0.15*** (0.00)	-0.05*** (0.00)
$\ln pub_{it}$			-0.00 (0.16)	-0.00 (0.33)
lny_{it} [agri]			-0.19*** (0.00)	
$popgr_{it}$			-0.80*** (0.00)	-0.80*** (0.00)
lny_{it} [non-agri]				-0.21*** (0.00)
Indirect effects				
$\ln faculty_{it}$			-0.12*** (0.00)	-0.06* (0.05)
$\ln pub_{it}$			-0.00 (0.18)	-0.00** (0.50)
lny_{it} [agri]			-0.12*** (0.00)	
$popgr_{it}$			-0.69*** (0.00)	-0.99** (0.03)
lny_{it} [non-agri]				-0.25*** (0.00)
Total effects				
$\ln faculty_{it}$			-0.27*** (0.00)	-0.10** (0.01)
$\ln pub_{it}$			-0.00 (0.17)	-0.00 (0.41)
lny_{it} [agri]			-0.31*** (0.00)	
$popgr_{it}$			-1.50*** (0.00)	-1.80*** (0.00)
lny_{it} [non-agri]				-0.47*** (0.00)

*, **, *** *show significance at 0.10, 0.05 and 0.01, respectively. Probabilities are given in parenthesis.*

In Table 7, spatial rho coefficients for the agricultural and non-agricultural sectors indicate that growth of real GDP per capita in neighboring provinces positively affects growth of real GDP per capita in a specific province. That is to say, growth of real GDP per capita in a province depends partially on growth of real GDP per capita in neighboring regions for both the agricultural and non-agricultural sectors. It appears from Table 7 that spatial interactions play an important role in the variation of dependent variable for both sectors. Similar inferences can be derived when we check for the indirect effects which reflect the spatial spillover effects. The spatial spillovers generated by independent variables are all significant for both sectors except for public expenditure.

Lesage and Pace (2014) draw special attention to the misinterpretation of spatial model estimates. In an Ordinary Least Square (OLS) estimation, partial derivatives of independent variables with respect to dependent variable reflect the changes of independent variables on dependent variable. However, this is not the case for spatial regression. Lesage and Pace (2014), Elhorst (2014), and Lesage (2014) show that a unit change of an independent variable in a particular geographical unit not only causes a change to the dependent variable in that geographical unit (direct effect), but also changes the dependent variable in neighboring units (indirect effect). For valid interpretation of spatial regression results, one has to check for direct and indirect effects. It turns out that the coefficient of initial real GDP per capita (lnyit) for the non-agricultural sector is negative and significant for all direct, indirect and total effects indicating convergence for the non-agricultural sector. For the agricultural sector, initial real GDP per capita (lnyit) is also significant for all direct, indirect and total effects with a negative sign. These findings suggest that the initial values of real GDP per capita of a particular province and its neighbors affect the convergence process of the agricultural and non-agricultural sectors.

Estimation results for our three control variables are as follows. First, the number of faculty and vocational school graduates (lnfacultyit) shows negative and significant direct, indirect, and total effect on growth of agricultural and non-agricultural real GDP per capita. Second, working age population growth (popgrit), which reflects growth of the labor force, has a negative and significant direct, indirect, and total effect on growth of real GDP per capita in both sectors. Finally, public investment (lnpubit) appears to have no direct, indirect or total effect on either the agricultural or non-agricultural sectors.

Spatial interactions in convergence of the agricultural sector seem weaker than in the non-agricultural sector. The reason behind this might be the structural problems that the agricultural sector faces in Turkey. First, according to the Turkish Agricultural Report 2013 by the Turkish Union of Chambers and Commodity Exchanges, almost all agricultural research and development activities in Turkey are carried out by universities unlike developed counterparts where research and development activities are carried out mostly by the private sector. Additionally, research-extension-farmer linkage is very poor for effective technology transfer in the Turkish agricultural sector. This argument also coincides with the finding of insignificant effect of human capital on agricultural real GDP growth as shown in Table 7. Second, agricultural activities are mostly carried out on small-scaled and partitioned agricultural lands which are mostly inherited. Consequently, employment on these farms is mostly comprised of self-employed or unpaid family workers. The Turkish Agricultural Report 2013 also states that the share of unpaid family workers and self-employed workers to total agricultural employment is about 90% while salaried or paid workers comprise only about 9%. Furthermore, it reveals that salaried or paid workers constitute 60% and unpaid family workers about 12% for all sectors. This structure of employment causes immobility of the labor force within the agricultural sectors of provinces. If the afore-cited immobility in the agricultural sector is the case, then what makes the agricultural sector convergent in Turkey?

4. CAN MIGRATION BE a SOURCE of CONVERGENCE in TURKEY?

Filiztekin (1998) asserts that migration from rural to urban areas has been a major problem in Turkey since the 1950s. People tend to migrate from low capital-labor ratio regions to high capital-labor ratio regions and this generates important economic, social, and political problems in Turkey. Conviction for the migration phenomenon maintained by Filiztekin (1998) can be seen in the Turkstat data. According to Turkstat, the agricultural labor force decreased by 8% from 2004 to 2014 while the non-agricultural labor force increased by the same amount in the same period. Instead of the Turkstat data above, we need stronger evidence to confirm Filiztekin's (1998) arguments.

$$population_{t+1} = population_t + births_{t+1} - deaths_{t+1} + net\ migration_{t+1} \qquad (3)$$

$$crude\ pop_{t+1} = population_t + net\ migration_{t+1} = population_{t+1} - births_{t+1} + deaths_{t+1} \qquad (4)$$

$$rural\ crude\ pop_{t+1} = crude\ pop_{t+1}\ x\ proportion\ of\ rural\ population\ in\ total\ population_{t+1} \qquad (5)$$

$$urban\ crude\ pop_{t+1} = crude\ pop_{t+1}\ x\ proportion\ of\ urban\ population\ in\ total\ population_{t+1} \qquad (6)$$

$$rural\ net\ migration_{t+1} = rural\ crude\ pop_{t+1} - rural\ crude\ pop_t \qquad (7)$$

$$urban\ net\ migration_{t+1} = urban\ crude\ pop_{t+1} - urban\ crude\ pop_t \qquad (8)$$

From the general population formula in equation (3), we derive the crude population (crude pop), where crude pop represents the sum of the previous year's population and current net migration. By multiplying crude population with the proportion of rural and urban population in the total population, we obtain the rural and urban populations in equations (5) and (6), respectively. Finally, rural and urban net migration in equations (7) and (8) are derived by subtracting the previous year's rural and urban crude population from the current year's rural and urban crude population. We take the number of deaths and births for the provinces and the proportion of rural population in total population from Turkstat. As the summary statistics show, mean rural net migration is negative, which indicates emigration, and mean urban net migration is positive, indicating immigration, for the sample period studied in this paper.

**Table 8.** Summary Statistics for Rural and Urban Migration

	Obs	Mean	Standard dev.	Min	Max
Urban net migration	729	12765	30278	-30271	353759
Rural net migration	729	-75	7439	-73567	44532
Urban net migration rate	729	0.018	0.028	-0.376	0.251
Rural net migration rate	729	-0.005	0.053	-0.583	0.540

Derived statistics for rural and urban net migration show evidence of migration from rural areas to urban areas. Yet, mean statistics for urban migration (12.765) and rural migration (-75) do not match each other in absolute terms. Urban migration is higher than rural migration on average, which indicates that the major problem denoted by Filiztekin (1998) is incomplete. That is, there exists rural to urban migration along with urban to urban migration. Summary statistics in Table 8 also reveal that the rural net migration rate, which shows the rate of rural net migration to rural population, is negative and lower than the urban net migration rate, which shows the rate of urban net migration to urban population, in absolute terms. Thus, it can readily be said that the proportion of population emigrating from rural areas is lower than the proportion of population immigrating to urban areas.

Combining immobility of labor force within the agricultural sectors of provinces and rural to urban migration, one important aspect comes to light. The agricultural labor force does not emigrate on average to other provinces to participate in the agricultural sector, instead they emigrate to become involved in non-agricultural sectors where capital-labor ratio and real GDP per capita are high. This can be seen from Figure 1, Figure 2 and Figure 3 below.

Figure 1. Mean Real Non-agricultural GDP Per Capita
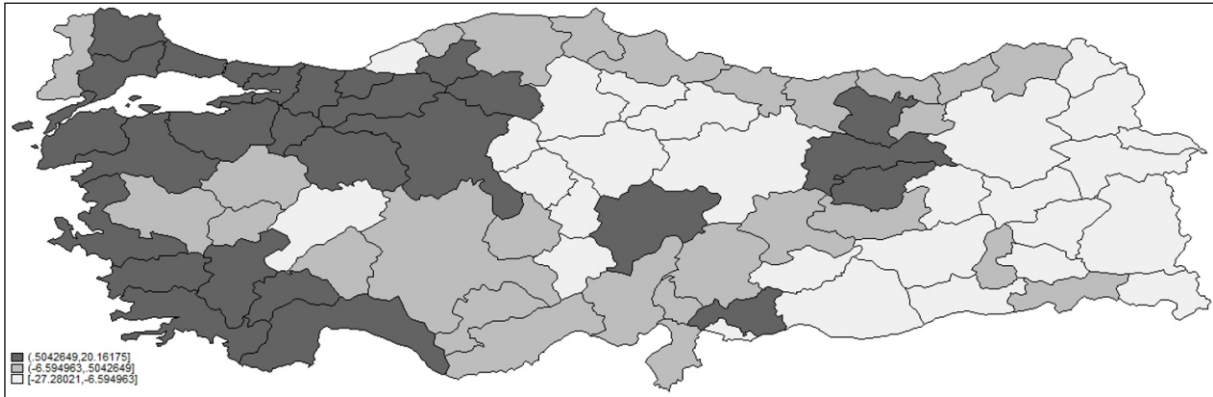
Figure 2. Mean Net Migration Rate
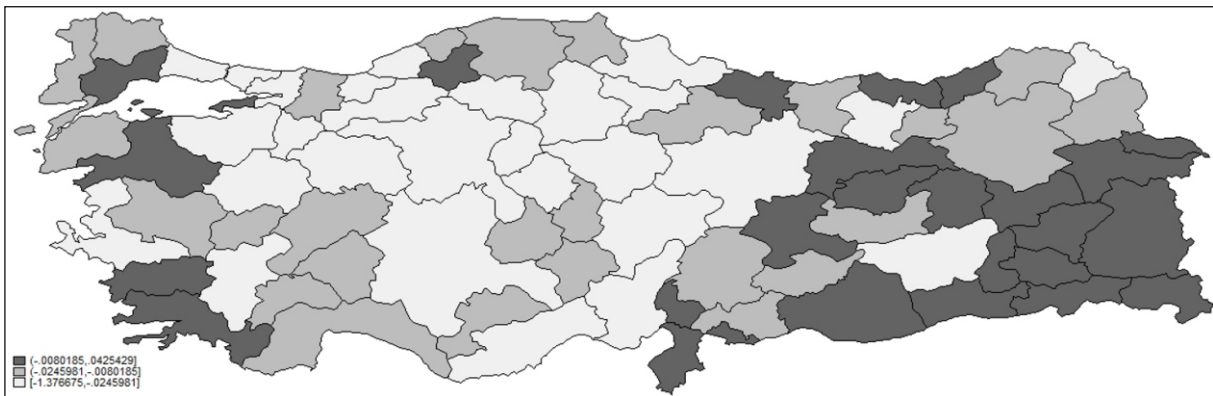
Figure 3. Mean Rural Migration Rate

Figure 1 and Figure 2 show that the provinces where real non-agricultural GDP per capita are the highest almost perfectly coincide with the main recipient provinces of migration. Besides, it is clearly shown in the figures that the provinces with the lowest non-agricultural GDP per capita are also the provinces where rural emigration is the highest.

This phenomenon causes, ceteris paribus, a decrease in the agricultural labor force and hence a relative increase in real GDP per capita for the agricultural sector compared to provinces where the occurrence of emigration is relatively low. This mechanism works the other way around as well for the non-agricultural sector.

5. CONCLUSIONS and RECOMMENDATIONS

Convergence among the provinces and regions of Turkey has long been a controversial issue since the first studies were carried out in the 1990s. From these years onward, while some studies have found no evidence of convergence, other studies have. Almost all of these studies address convergence in aggregated terms and most of them employ non-spatial econometric methodologies. This study aims to investigate different aspects of the convergence processes of the agricultural and non-agricultural sectors of the provinces by using a spatial panel data approach. Two important conclusions can be drawn for the agricultural sector. First, spatial interactions have little effect on convergence in real GDP per capita convergence within the agricultural sector. Second, labor force mobility between the agricultural and non-agricultural sectors constitutes an element of convergence in the agricultural sectors of the provinces. As for the non-agricultural sector, spatial interactions play a more important role on convergence compared to the agricultural sector. Besides, migration from rural areas as well as from urban areas where real non-agricultural GDP per capita is low, to urban areas with high real non-agricultural GDP per capita, helps non-agricultural sectors of provinces to converge. The main reason of migration, especially the youth and educated migration, from agricultural sector to non-agricultural sectors is the wage differential between these sectors. Average earnings of a farmer are less than that of an industrial occupation in Turkey and in most of the developing countries.

Correctly understanding the convergence processes of the agricultural and non-agricultural sectors is crucial. Spatial interactions and the importance of migration between the agricultural and non-agricultural sectors must be considered for a successfully implemented regional or sectoral development strategy in Turkey. Further studies incorporating migration in spatial convergence models can be carried out but one has to take into consideration the endogeneity of migration. Such an analysis could be carried out by combining spatial econometrics and instrumental variable estimation. Another important conclusion can be derived from the figures. While evidence of convergence for the agricultural and non-agricultural sectors has been obtained, there is obviously a high economic disparity between the southeastern and western parts of Turkey. Reducing the severity of this disparity will solve many important economic, political, and social problems in Turkey.

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