PROVINCIAL GROWTH CONVERGENCE ANALYSIS IN TURKEY: SPATIAL ECONOMETRIC EXTENSIONS

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Aim and Motivation

Aim

How spatial interactions across the provinces and regions may affect the regional growth convergence dynamics in Turkey

- First law of geography: "*Everything is related to everything else, but near things are more related than distant things*" (Tobler, 1970).

Motivation

Why spatiality?

Economic Grounds:

1. Social, economic and even political conjunctures are more alike in the neighboring regions.
2. Most of the indicators that determine the growth of an economy are highly mobile across the regions.
3. Input-output linkages are likely to be more pronounced across the neighbors.
4. Proximity strengthens the spillover effects across the regions.
5. Any possible shock that affects a particular region has more severe and quick reflections on the adjacent regions.

Methodological grounds:

1. Biased and inconsistent estimates in the case of omitted spatiality in the dependent variables
2. Inefficient estimates in the case of discarded spatiality in the error terms

Regional Convergence Model Revisited
(Solow,1956; Swan,1956; Barro and Sala-i-Martin,1992)

- **Absolute Convergence:** Countries with initially lower levels of national income tend to grow faster than the others. All economies would reach to the same steady state which is the equilibrium.

$$\frac{1}{T}\ln\left[\frac{y_T}{y_0}\right] = \alpha + \beta \ln(y_0) + u_i$$

- **Conditional Convergence:** Removes the assumption of single steady state and hypothesizes that similar economies would constitute a homogeneous group which converges to their own steady state.

$$\frac{1}{T}\ln\left[\frac{y_T}{y_0}\right] = \alpha + \beta \ln(y_0) + \psi X_0 + v_i$$

- **Convergence Rate:**

$$\beta = -\frac{1-e^{bT}}{T} \quad \Longrightarrow \quad b = -\frac{\ln(1+\beta T)}{T}$$

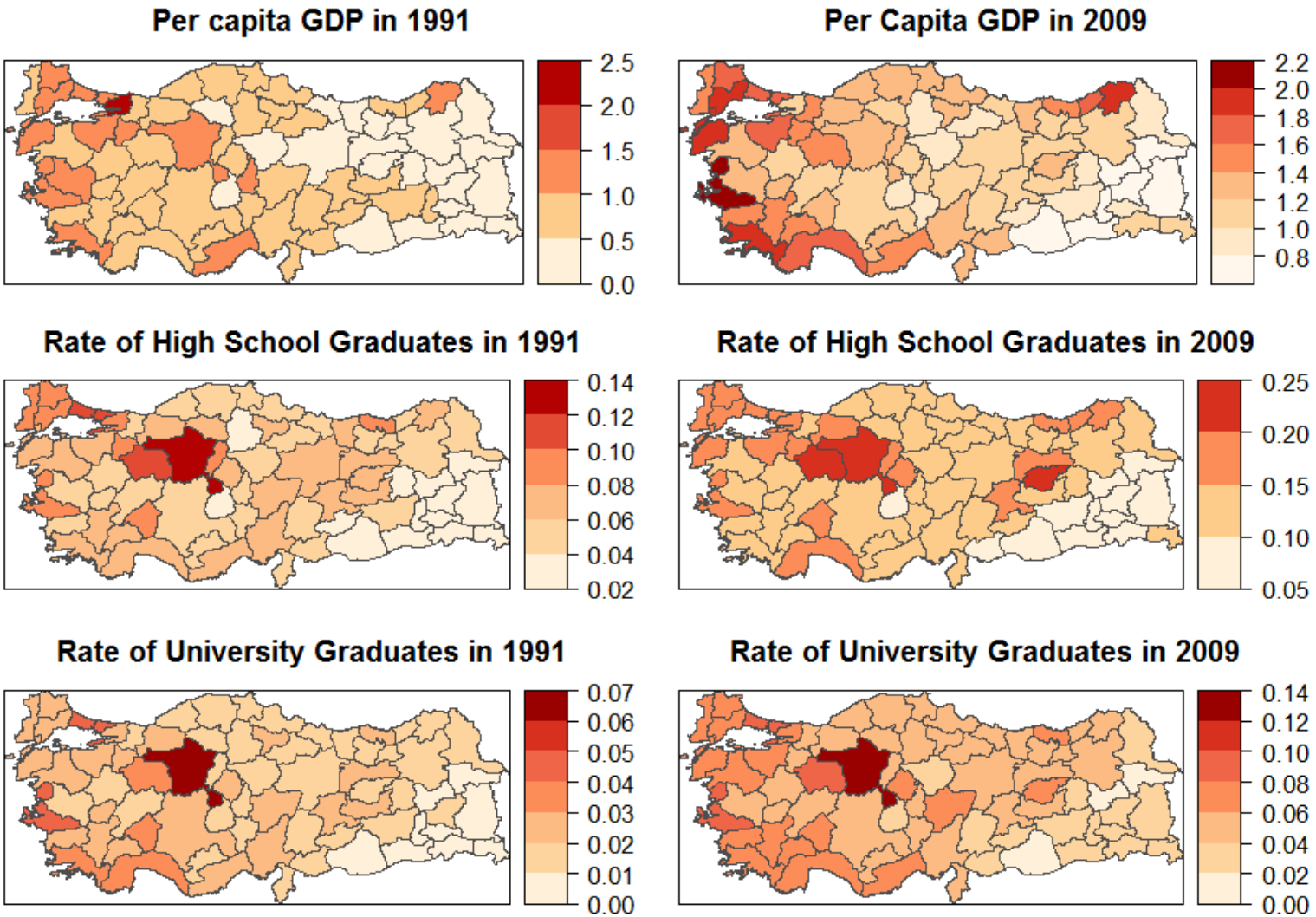
- **Half-life:**

$$\tau = -\frac{\ln(2)}{\ln(1+\beta)}$$

Part 1: Spatial Cross-Sectional Analysis of Regional Growth Convergence

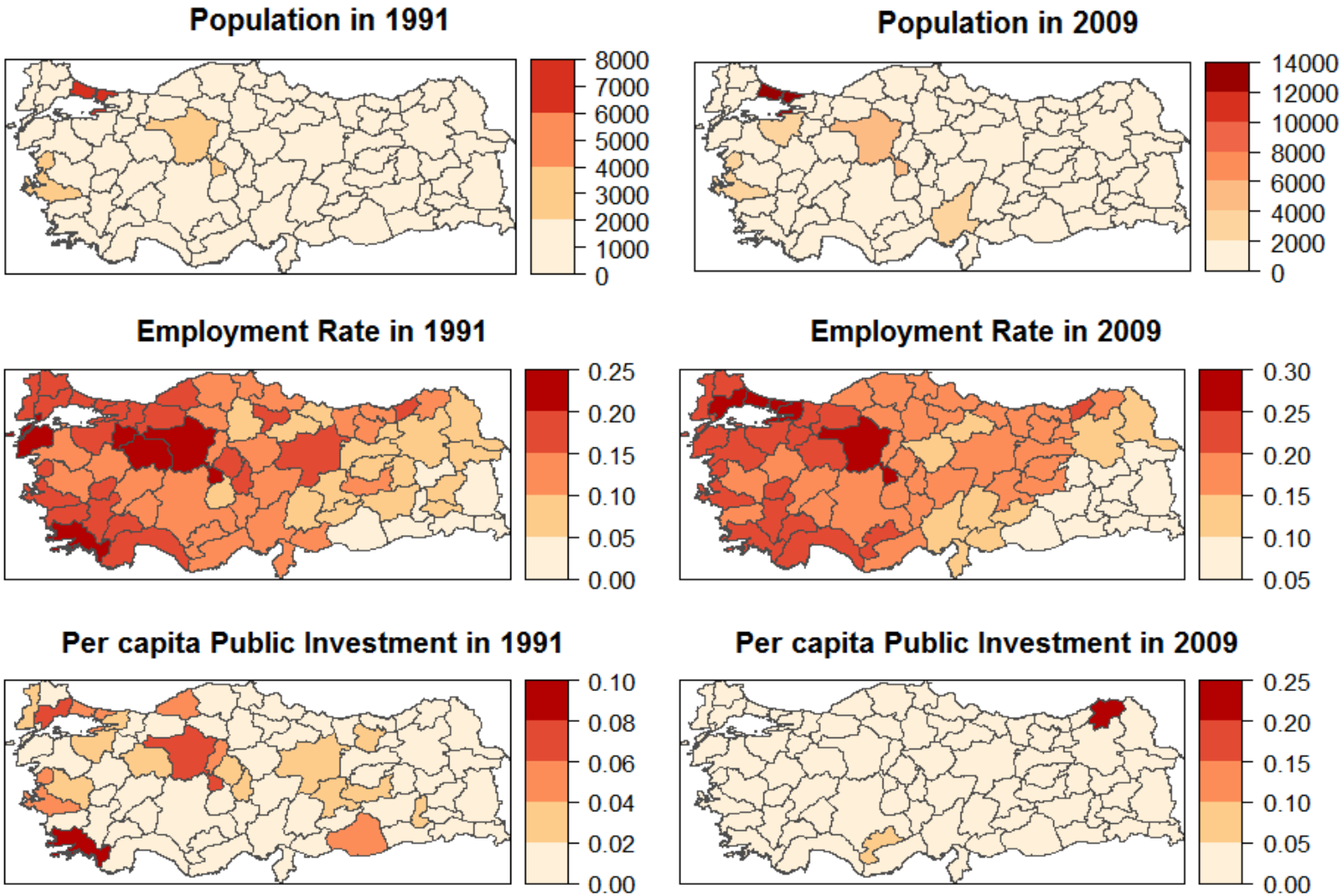
- **Aim:** Employing a comprehensive set of spatial econometric specifications to reveal provincial growth convergence dynamics in Turkey over 1991-2009 period.
- **Observation:** Adhering to only a few forms of specifications may lead to incorrect inferences in the estimation as they may not be able to catch the true form of spatiality inherent in the data.
- **Contributions:**
  1. Estimating entire set of spatial econometric specifications and applying a general-to-specific model selection procedure
  2. Six different spatial econometric models some of which being the first examples for Turkey's growth convergence problem
  3. Uncovering the true nature of the spatiality that characterizes the regional data
  4. The most recent data set available for Turkey

Regional Indicators: GDP and Human capital



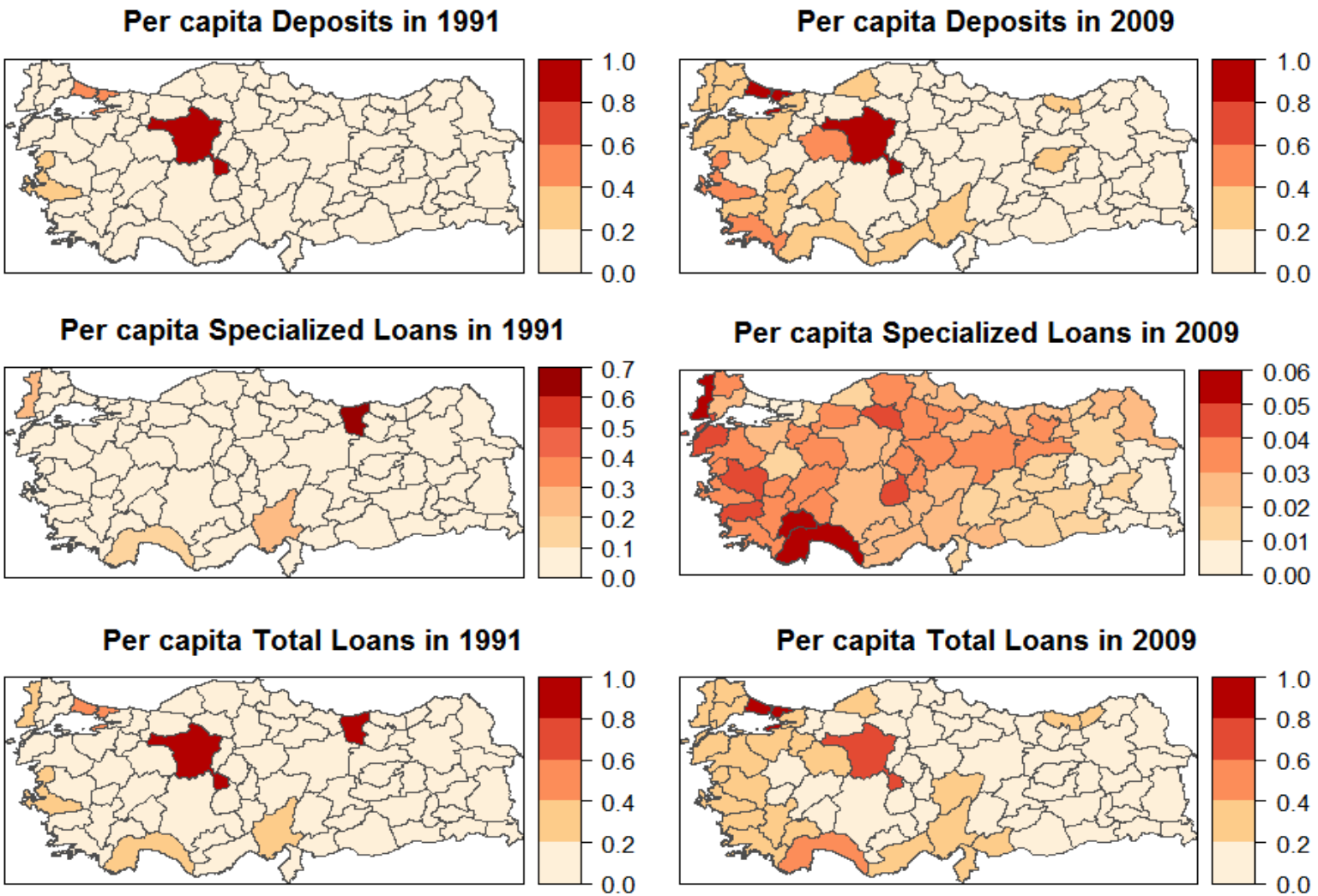
Notes: Population, and high school/university graduates are expressed in thousand person. Gross Domestic Product is based on 1998 prices and represented in million TL. The corresponding ratios are calculated based on these units.

Regional Indicators: Population, Employment and Public Investment



Notes: Population and number of employed people are expressed in thousand person. Public investment is based on 1998 prices and represented in million TL. The corresponding ratios are calculated based on these units.

Regional Indicators: Private Investment



Notes: Population is expressed in thousand person. Deposits, specialized loans and total loans are based on 1998 prices and represented in million TL. The corresponding ratios are calculated based on these units.

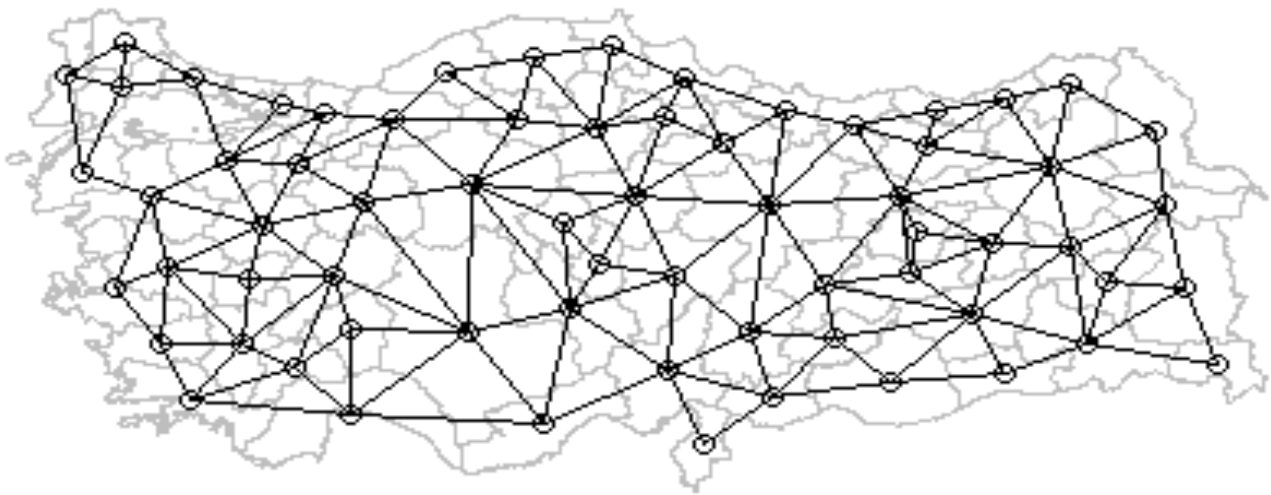
Data Description (Sample: 73 provinces, 1991-2009)

Variable	Entitlement	Explanation	Unit	Source
Real GDP	gdp	Real GDP in 1998 year prices	million TL	Turkish Statistical Institute (1991-2001), T.R. Ministry of Development (2002-2009)
Human Capital	hc1	Number of high school graduates*	thousand person	Turkish Statistical Institute
	hc2	Number of university graduates*	thousand person	Turkish Statistical Institute
Population	pop	Total population at provincial level*	thousand person	Turkish Statistical Institute
Employment	emp	Number of employees registered to a social security institution	thousand person	T.R. Social Security Institution
Real Public Investment	pinv	Real public investment in 1998 prices	million TL	T.R. Ministry of Development
Real Private Investment	depos	Total deposits in 1998 prices (Commercial deposits, Public sector deposits, Interbank deposits, Saving deposits, Other Inst. deposits)	million TL	The Banks Association of Turkey
	slen	Specialized loans in 1998 prices(agriculture, real estate, vocational, maritime, tourism, other)	million TL	The Banks Association of Turkey
	loan	Total loans in 1998 prices (specialized and non-specialized)	million TL	The Banks Association of Turkey

Neighborhood

Binary contiguity weights (1^{st} order):

- Provinces sharing a common border are considered as neighbors taking a value of 1 on the matrix.
- Non-neighboring regions take a value of zero.
- The elements on the diagonal are zero by definition - since a province cannot be a neighbor of itself.



Neighborhood in Turkey according to binary contiguity weights

Spatial Weights Matrix

- The elements of the $W_{N\times N}$ spatial weights matrix:

$$w_{ij} = \begin{cases} 1 & , \quad j \in N(i) \\ 0 & , \quad j \notin N(i) \end{cases} \qquad \eta_i = \sum_j w_{ij}$$

where N(i) is the set of all neighbors, W_{ij} is the elements of the weights matrix and η_i is corresponding to the row-sum.

- The weights matrix is row-standardized so that sum of the row elements adds up to one:

$$w^*_{ij} = \frac{w_{ij}}{\sum_j w_{ij}} = \frac{w_{ij}}{\eta_i} \qquad \sum_j w^*_{ij} = 1$$

- The rows in the matrix denote the effect of all the other provinces on any specified province
- The columns correspond to the converse, i.e. the effect of any specified province on all the other provinces.
- Row-standardization implies that for any specified province, the impact of neighboring provinces is equalized (Elhorst, 2010).

Tests for Spatial Autocorrelation in the OLS Estimated Model

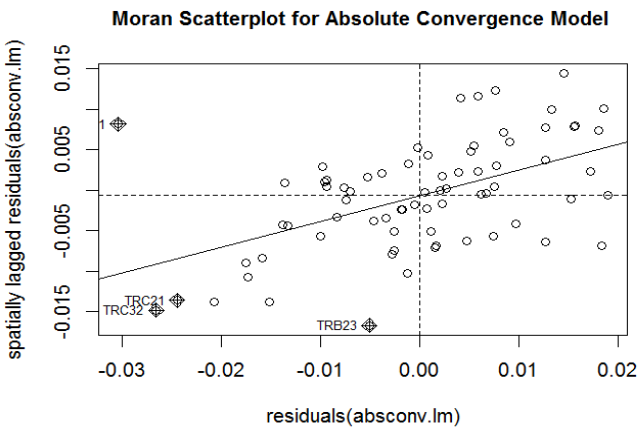
	Absolute Convergence	*Conditional Convergence*
Moran-I	0.3182***	0.1955***
	(0.0000)	(0.0008)
LMerr	17.1321***	6.4648**
	(0.0000)	(0.0110)
LMlag	0.9488	0.4344
	(0.3300)	(0.5098)
RLMerr	19.0920***	6.3556**
	(0.0000)	(0.0117)
RLMlag	2.9086*	0.3252
	(0.0881)	(0.5685)

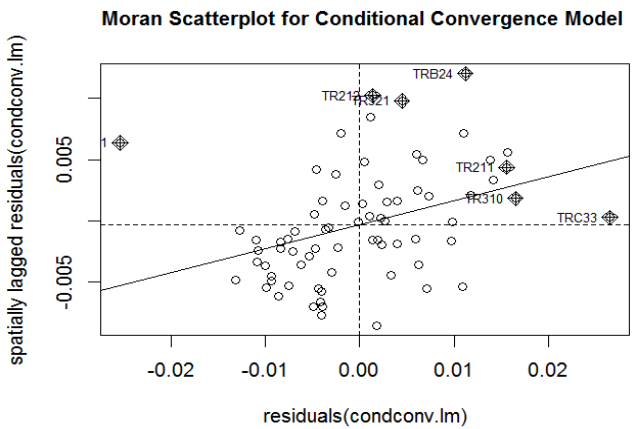
Note: The values in parentheses are p-values. (*), (**), (***) denote significance levels at 10 per cent, 5 per cent and 1 per cent, respectively.

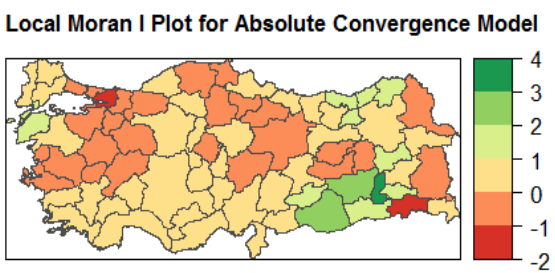
Moran I and Local Moran I Plots for OLS Estimated Models

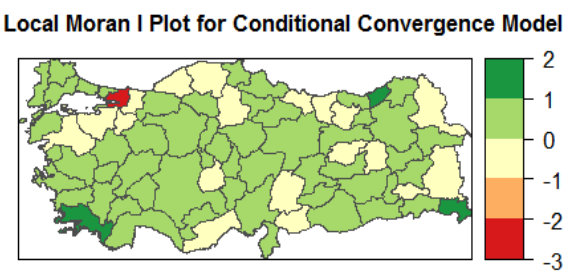
Moran I statistic: $I = \frac{\widetilde{u}' W \widetilde{u}}{\widetilde{u}' \widetilde{u}}$

- $\widetilde{u}$ represents the OLS residuals.
- Negative and significant values imply negative spatial correlation (dispersion) whereas positive and significant values imply positive spatial correlation (clustering).
- Under the null hypothesis, there is no spatial autocorrelation, hence Moran I equals to zero.





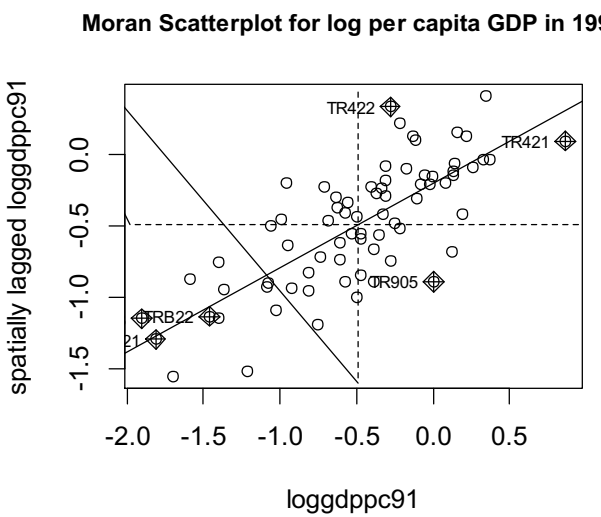


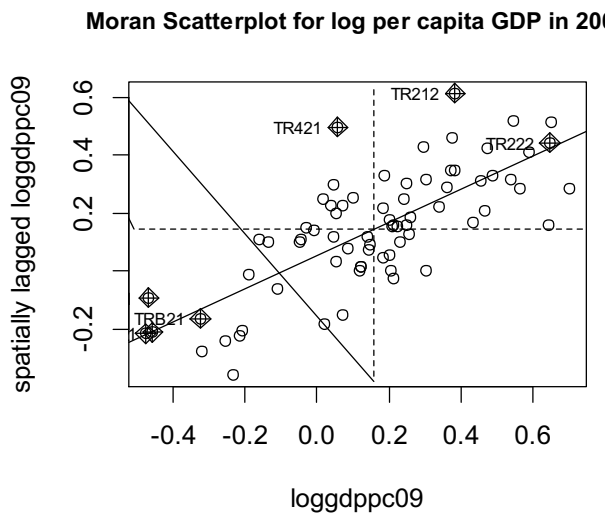


Tests for Spatial Autocorrelation in GDP per capita

Statistic	Log GDPPC 1991	Log GDPPC 2009
Global Moran I	0.5897***	0.5730***
	(0.0000)	(0.0000)
Geary's C	0.3757***	0.4131***
	(0.0000)	(0.0000)
Getis-Ord Global G	0.0732*	0.0673
	(0.0803)	(0.8714)

Notes: Moran I and Geary's C statistics are computed for log GDP per capita using row-standardized binary contiguity weights matrix. For the calculation of Getis-Ord Global G statistic, due to the nature of the test, GDP per capita variables are considered without logarithmic transformation (as they should be non-negative) and the spatial matrix is based on non-standardized binary contiguity weights.





Cluster Analysis of GDP per capita

LISA Local Moran I Cluster Maps for logGDPPC91 and logGDPPC09

Red:	High-High (12 provinces)
Blue:	Low-Low (12 provinces)
Purple:	Low-High (0)
Pink:	High-Low (1 province)
Not significant (48 provinces)	

Red:	High-High (10 provinces)
Blue:	Low-Low (11 provinces)
Purple:	Low-High (1 province)
Pink:	High-Low (0)
Not significant (51 provinces)	

Gi Cluster Maps for GDPPC91 and GDPPC09

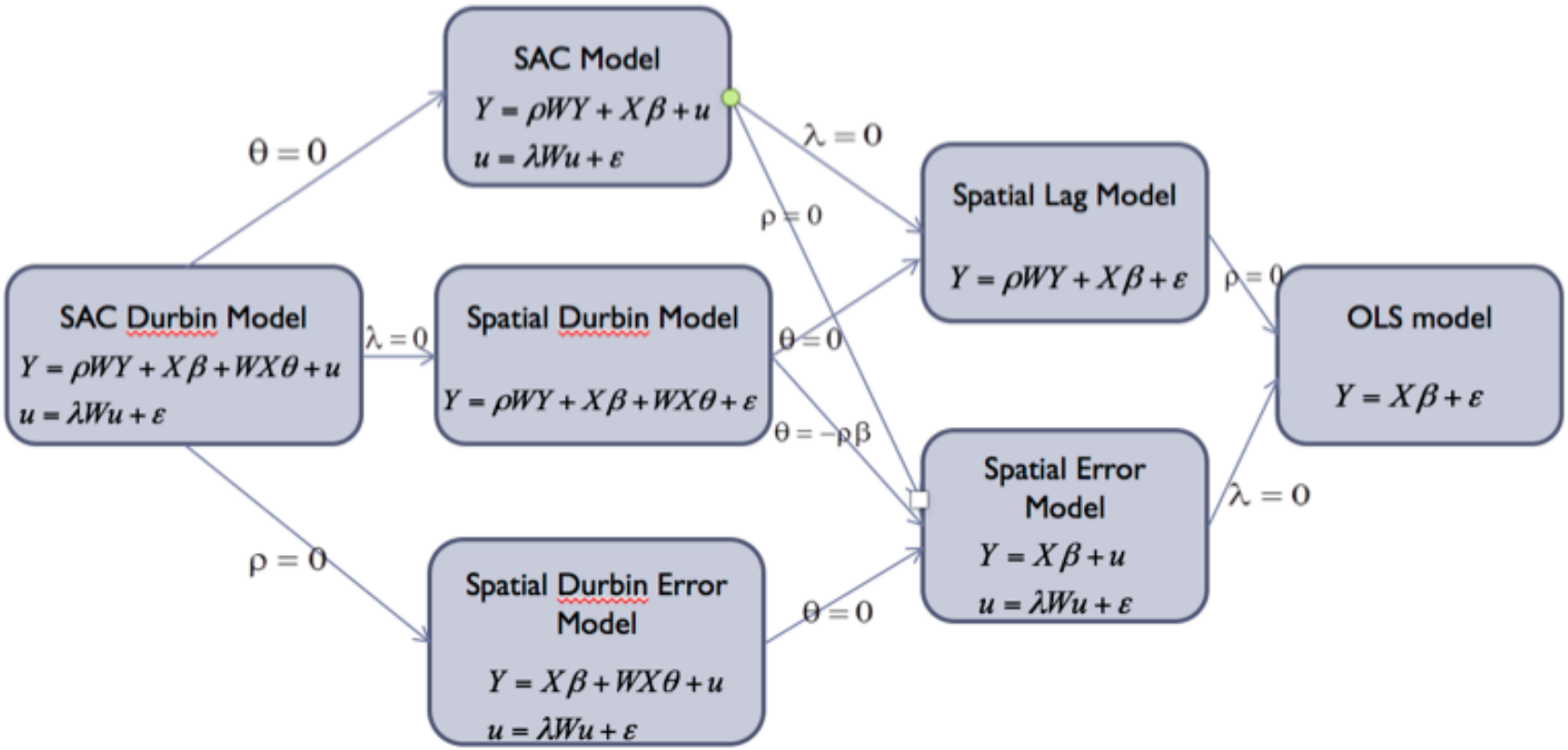
Red: High (9 provinces)
Blue: Low (14 provinces)
Not significant (50 provinces)

Red: High (10 provinces)
Blue: Low (11 provinces)
Not significant (52 provinces)

The Estimated Family of Models

Model	*Specification*
SAC Durbin Model (Manski model)	$Y = \rho WY + X\beta + WX\theta + u$ $u = \lambda Wu + \varepsilon$
SAC Model (Kelejian-Prucha model)	$Y = \rho WY + X\beta + u$ $u = \lambda Wu + \varepsilon$
Spatial Durbin Model	$Y = \rho WY + X\beta + WX\theta + \varepsilon$
Spatial Durbin Error Model	$Y = X\beta + WX\theta + u$ $u = \lambda Wu + \varepsilon$
Spatial Lag Model	$Y = \rho WY + X\beta + \varepsilon$
Spatial Error Model	$Y = X\beta + u$ $u = \lambda Wu + \varepsilon$
OLS Model	$Y = X\beta + \varepsilon$

Model Comparison (Elhorst, 2010)



Spatial Models Estimated for Absolute and Conditional Convergence Hypotheses (ML Estimation Results)

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
	SAC Durbin Model	SAC Model	Spatial Durbin Model	Spatial Durbin Error Model	Spatial Lag Model	Spatial Error Model
Intercept	0.0228**	0.0236***	0.0087***	0.0198***	0.0153***	0.0164***
	(0.0134)	(0.0002)	(0.0020)	(0.0000)	(0.0000)	(0.0000)
log(gdppc91)	-0.0425***	-0.0424***	-0.0436***	-0.0428***	-0.0355***	-0.0421***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
W*log(gdppc91)	0.0020		0.0287***	0.0079		
	(0.9126)		(0.0000)	(0.1194)		
ρ	-0.1508	-0.1960	0.5662***		0.0927	
	(0.7311)	(0.1471)	(0.0000)		(0.3489)	
λ	0.6649***	0.6877***		0.5770***		0.6097***
	(0.0052)	(0.0000)		(0.0000)		(0.0000)
Convergence rate	0.0805	0.0801	0.0854	0.0818	0.0567	0.0788
Half-life	15.95	15.99	15.55	15.84	19.15	16.11
AIC	-456.22	-458.21	-457.67	-458.14	-441.84	-457.82
Log likelihood	234.1115	234.1057	233.8358	234.0677	224.9205	232.9111
ML Residual Variance (σ^2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Number of observations	73	73	73	73	73	73
Number of parameters estimated	6	5	5	5	4	4
LM test for residual autocorrelation			0.0131		17.3660***	
			(0.9089)		(0.0000)	
Hausman test for spatial error				8.9972**		6.9888**
				(0.0293)		(0.0304)

Notes: The dependent variable is the provincial per capita GDP growth. The values in parentheses are p-values. (*), (**), (***) denote significance levels at 10 per cent, 5 per cent and 1 per cent, respectively. AIC=Akaike Information Criterion.

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
	SAC Durbin Model	SAC Model	Spatial Durbin Model	Spatial Durbin Error Model	Spatial Lag Model	Spatial Error Model
Intercept	0.0611	0.0802***	0.0444*	0.0759***	0.0787***	0.0786***
	(0.6124)	(0.0000)	(0.0517)	(0.0046)	(0.0000)	(0.0000)
log(gdp91)	-0.0509***	-0.0512***	-0.0509***	-0.0508***	-0.0490***	-0.0509***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
log(hc1pc91)	0.0238***	0.0219***	0.0234***	0.0240***	0.0225***	0.0218***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
log(emppc91)	0.0080*	0.0084**	0.0078*	0.0082**	0.0108***	0.0093**
	(0.0691)	(0.0293)	(0.0537)	(0.0430)	(0.0045)	(0.0147)
log(pinvpc91)	-0.0029	-0.0020	-0.0028*	-0.0031*	-0.0027*	-0.0021
	(0.1382)	(0.1317)	(0.0672)	(0.0664)	(0.0786)	(0.1247)
log(loanpc91)	-0.0033*	-0.0023	-0.0031*	-0.0034*	-0.0028	-0.0023
	(0.0995)	(0.1256)	(0.0640)	(0.0680)	(0.1150)	(0.1349)
W*log(gdppc91)	0.0156		0.0257***	0.0064		
	(0.8285)		(0.0031)	(0.3186)		
W*log(hc1pc91)	0.0031		-0.0013	0.0070		
	(0.9335)		(0.9086)	(0.5660)		
W*log(emppc91)	0.0007		-0.0016	0.0026		
	(0.9636)		(0.8382)	(0.7811)		
W*log(pinvpc91)	-0.0038		-0.0033	-0.0043		
	(0.5216)		(0.3666)	(0.3043)		
W*log(loanpc91)	-0.0030		-0.0023	-0.0036		
	(0.6345)		(0.5454)	(0.4122)		
ρ	0.1950	-0.0817	0.4111***		0.0519	
	(0.8942)	(0.4125)	(0.0031)		(0.5169)	
λ	0.2589	0.4992***		0.4218***		0.4340***
	(0.8554)	(0.0005)		(0.0023)		(0.0015)
Convergence rate	0.1380	0.1419	0.1379	0.1361	0.1187	0.1379
Half-life	13.26	13.18	13.26	13.30	13.80	13.27
AIC	-468.96	-476.53	-470.68	-470.80	-471.63	-477.86
Log likelihood	248.4807	247.2635	248.3389	248.4014	243.8152	246.9320
ML residual variance (σ^2)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
			0.8295		6.0014**	
LM test for residual autocorrelation			(0.3624)		(0.0143)	
				11.0410		6.1287
Hausman test for spatial error				(0.4398)		(0.4089)

Likelihood Ratio Test Results

				Absolute Convergence		*Conditional Convergence*	
Test	**Unrestricted model**	**Restricted model**	**Restriction**	**Likelihood ratio**	**p-value**	**Likelihood ratio**	**p-value**
(1)	SAC Durbin Model	SAC Model	$\theta = 0$	0.0116	0.9141	2.4344	0.7863
(2)	SAC Durbin Model	Spatial Durbin Model	$\lambda = 0$	0.5513	0.4578	0.2836	0.5944
(3)	SAC Durbin Model	Spatial Durbin Error Model	$\rho = 0$	0.0876	0.7673	0.1586	0.6905
(4)	SAC Model	Spatial Lag Model	$\lambda = 0$	18.3703	0.0000	6.8966	0.0086
(5)	SAC Model	Spatial Error Model	$\rho = 0$	2.3892	0.1222	0.6631	0.4155
(6)	Spatial Durbin Model	Spatial Lag Model	$\theta = 0$	17.8306	0.0000	9.0475	0.1072
(7)	Spatial Durbin Model	Spatial Error Model	$\theta = -\rho\beta$	1.8495	0.1738	2.8139	0.7286
(8)	Spatial Durbin Error Model	Spatial Error Model	$\theta = 0$	2.3132	0.1283	2.9389	0.7094

Model Selection

- We can eliminate SAC Durbin, SAC, spatial Durbin and spatial Durbin error specifications since we cannot reject null hypotheses of the likelihood ratio tests (1), (5), (7) and (8) respectively.
- Spatial lag model can be eliminated because:
  - The null hypothesis of LR test (4) is rejected : the eliminated SAC model is already better than the spatial lag model (SLM omits a relevant variable)
  - There exists remaining residual autocorrelation in spatial lag model
  - Based on the comparison of spatial lag and error specifications, the LM tests of Burridge (1980) and RLM tests of Anselin et al. (1996) have already pointed out the superiority of the error model

Selected Model

Spatial error specification can be chosen as the most appropriate model in explaining the absolute and conditional convergence hypotheses.

Evaluation

- There is evidence of absolute and conditional convergence across provinces of Turkey over 1991-2009 period
  - Absolute convergence: 7.88 per cent convergence rate, 16.11 years half-life
  - Conditional convergence: 13.79 per cent convergence rate, 13.27 years half-life
- There exists spatial heterogeneity: A possible shock that affects growth rates in any province also penetrate to the neighboring provinces similarly and significantly as compared to the non-neighboring counterparts.
- The main driving forces of provincial convergence remain to be human capital and employment in Turkey over 1991-2009.
- The insignificance of public investment: may be due to wrong policy instruments such that the distribution and operation mechanism is not governed well enough.
- The insignificance of private investment: it is likely that incentives provided to private sector may have been insufficient for convincing them to invest in PPDs due to geographical locations, ethnic disputes and low skilled labor.

Part 2: Spatial Dynamic Panel Data Analysis of Regional Growth Convergence

- **Aim:** Analyzing the provincial growth convergence of Turkey over the 1991-2009 period by means of spatial dynamic panel data models.
- **Observation:** If the data incorporates dynamics both at temporal and spatial level, ignorance of either effect may result in biased and inconsistent estimates.
- **Contributions:**
  1. A methodological departure from the existing empirical studies for Turkey
  2. Four different spatial dynamic panel data models estimated by GMM:
     - Dynamic fixed effects spatial lag
     - Dynamic random effects spatial lag
     - Dynamic fixed effects spatial error
     - Dynamic random effects spatial error
  3. Taking account of heterogeneity in both time and space
  4. Observing the effects of structural change in 2002-2007 period

Data Description (Sample: 73 provinces, 1991-2009)

Variable	Entitlement	Explanation	Unit	Source
Real GDP	gdp	Real GDP in 1998 year prices	million TL	Turkish Statistical Institute (1991-2001), T.R. Ministry of Development (2002-2009)
Human Capital	hc1	Number of high school graduates*	thousand person	Turkish Statistical Institute
	hc2	Number of university graduates*	thousand person	Turkish Statistical Institute
Population	pop	Total population at provincial level*	thousand person	Turkish Statistical Institute
Employment	emp	Number of employees registered to a social security institution	thousand person	T.R. Social Security Institution
Real Public Investment	pinv	Real public investment in 1998 prices	million TL	T.R. Ministry of Development
Real Private Investment	depos	Total deposits in 1998 prices (Commercial deposits, Public sector deposits, Interbank deposits, Saving deposits, Other Inst. deposits)	million TL	The Banks Association of Turkey
	slen	Specialized loans in 1998 prices(agriculture, real estate, vocational, maritime, tourism, other)	million TL	The Banks Association of Turkey
	loan	Total loans in 1998 prices (specialized and non-specialized)	million TL	The Banks Association of Turkey

The Estimated Models

Model	*Specification*
Dynamic Fixed Effects Spatial Error Model	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha_i + \beta \ln(y_{i,t-1}) + \theta X_{i,t} + u_{i,t}$ $u_{i,t} = \mu + v_{i,t}$ $v_{i,t} = \lambda \sum_{j=1}^{N} w_{i,j} v_{i,t} + \varepsilon_{i,t}$ t=1,...,T i=1,...,N
Dynamic Random Effects Spatial Error Model	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha_i + \beta \ln(y_{i,t-1}) + \theta X_{i,t} + u_{i,t}$ $u_{i,t} = \mu_i + v_{i,t}$ $v_{i,t} = \lambda \sum_{j=1}^{N} w_{i,j} v_{i,t} + \varepsilon_{i,t}$ t=1,...,T i=1,...,N
Dynamic Fixed Effects Spatial Lag Model	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha_i + \beta \ln(y_{i,t-1}) + \rho \sum_{j=1}^{n} w_{i,j} \ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) + \theta X_{i,t} + u_{i,t}$ $u_{i,t} = \mu + v_{i,t}$ t=1,...,T i=1,...,N
Dynamic Random Effects Spatial Lag Model	$\ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) = \alpha_i + \beta \ln(y_{i,t-1}) + \rho \sum_{j=1}^{n} w_{i,j} \ln\left(\frac{y_{i,t}}{y_{i,t-1}}\right) + \theta X_{i,t} + u_{i,t}$ $u_{i,t} = \mu_i + v_{i,t}$ t=1,...,T i=1,...,N

Note: The spatial weights matrices used in all specifications are based on row-standardized binary contiguity weights described in Part 1.

Diagnostic Tests for Panel Data

	Test Statistic	Alternative Hypothesis	Abs. Conv.	Conditional Convergence			
			Model 0	**Model 1**	**Model 2**	**Model 3**	**Model 4**
LM tests for individual effects compared to the pooled model	Breusch-Pagan (1980)	Significant effects	17.4770*** (0.0000)	5.3313** (0.0210)	6.0856** (0.0136)	5.1557** (0.0232)	5.9752** (0.0145)
	Honda (1985)	Significant effects	-4.1806*** (0.0000)	2.3090** (0.0210)	2.4669** (0.0136)	2.2706** (0.0232)	2.4444** (0.0145)
Cross-Section Dependence (CD) Test	Pesaran (2004)	CD in individual effects	59.0610*** (0.0000)	1.8871* (0.0591)	1.6941* (0.0903)	2.0595** (0.0394)	2.3412** (0.0192)

Tests for Spatial Autocorrelation

			Abs. Conv.	Conditional Convergence			
	Test Statistic	**Alternative Hypothesis**	**Model 0**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
LM tests of Baltagi, Song&Koh (2003)	LM-H one-sided joint test	Random Regional Effects and Spatial autocorrelation	155.1500*** (0.0000)	9.2337*** (0.0037)	10.2230*** (0.0022)	9.3110*** (0.0035)	10.3750*** (0.0020)
	LM*-lambda conditional LM test (assuming $\sigma_\mu^2 \geq 0$)	Spatial autocorrelation	2.3941** (0.0167)	1.3657 (0.1720)	1.3928 (0.1637)	1.2796 (0.2007)	1.2830 (0.1995)
LM tests of Baltagi, Song, Jung & Koh (2007)	C.2 conditional test	Serial correlation in error terms, under random effects and spatial dependence	0.1265 (0.7221)	2.1156 (0.1458)	1.3772 (0.2406)	2.0905 (0.1482)	1.5716 (0.2100)

Model Selection

Overall econometric analysis offers five main results:

1. Panel data specifications are preferred to the pooled OLS as the individual effects are found to be significant.
2. There is evidence of cross-section dependence in the panel data structure, which calls for the need for incorporating spatiality into the model.
3. Random effects are rejected in favor of the fixed effects models.
4. No apparent spatial correlation can be found in the error terms.
5. The spatial lag terms are positive and significant in general.

Selected Model

The dynamic fixed effects spatial lag models may be better characterizing the regional convergence dynamics of Turkey throughout the 1991-2009 period.

Dynamic Fixed Effects Spatial Lag Model

	Abs. Conv.	Conditional Convergence			
Coefficients	**Model 0**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
log(laggdppc)	-0.0501***	-0.1215***	-0.1244***	-0.1201***	-0.1224***
	(0.0002)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
log(hc1pc)		-0.0287	-0.0237		
		(0.2132)	(0.3014)		
log(hc2pc)				-0.0436*	-0.0413*
				(0.0667)	(0.0783)
log(emppc)		0.1745***	0.1409***	0.1812***	0.1509***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
log(pinvpc)		0.0084	0.0049	0.0080	0.0053
		(0.1509)	(0.4019)	(0.1692)	(0.3618)
log(depospc)		0.0048		0.0069	
		(0.7372)		(0.6350)	
log(loanpc)			0.0183**		0.0193**
			(0.0263)		(0.0191)
log(pop)		-0.0757**	-0.0803**	-0.0771**	-0.0789**
		(0.0291)	(0.0212)	(0.0207)	(0.0187)
dum		0.5756***	0.5436***	0.5977***	0.7264***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
log(laggdppc)*dum		-0.3374***	-0.3288***	-0.3356***	-0.3314***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
log(hc1pc)*dum		0.0414	0.1009***		
		(0.2318)	(0.0017)		
log(hc2pc)*dum				0.0265	0.1178***
				(0.4867)	(0.0003)
log(emppc)*dum		0.0134	0.0754***	0.0118	0.0355
		(0.6226)	(0.0032)	(0.7018)	(0.2573)
log(pinvpc)*dum		0.0352***	0.0384***	0.0357***	0.0387***
		(0.0000)	(0.0000)	(0.0000)	(0.0000)
log(depospc)*dum		0.0821***		0.0838***	
		(0.0000)		(0.0000)	
log(loanpc)*dum			0.0144		0.0155
			(0.1528)		(0.1199)
log(pop)*dum		-0.0079	0.0110	-0.0112	-0.0015
		(0.3502)	(0.1685)	(0.1838)	(0.8627)
rho	-0.6801	0.0940	0.2315***	0.1278*	0.2178***
	(0.1535)	(0.2220)	(0.0017)	(0.0871)	(0.0030)
Sigma-squared	0.0204	0.0083	0.0084	0.0083	0.0084

Results

- The corresponding tests confirm not only the validity but also the superiority of the SDPD specifications
- The expansion period 2002-2007 can be marked as a period of structural change.
- The crises experienced in 1994, 1999, 2001 and 2009 have significant effects on provincial growth.
- There is evidence of absolute and conditional convergence among the provinces of Turkey throughout the 1991-2009 period.
- The selected model has significantly positive spatial lag terms: The growth in one province is directly linked to the growth in the neighboring provinces.

Evaluation

- There is evidence of absolute and conditional convergence in all periods.
- The rate of university graduates are not effective in promoting provincial growth in the post-2002 period.
- The rate of high school graduates has contributed much to the provincial output growth such that it compensated for the insignificance in the base period.
- In the post-2002 period up until the global recession, the employment did not have a significant contribution.
- The insignificance of public investment variables in the entire period may be observed due to the wrong policy instruments put into practice. As the shares of the public investment have recovered after 2002, this conjuncture may have been reversed.
- The insignificant coefficients for the rate of deposits in the base year have been recovered by the highly significant and positive differential slope terms in the 2002-2007 period.

Concluding remarks

- Despite the presence of absolute and conditional convergence throughout 1991-2009 period, regional disparities still prevail.
- GDP per capita figures in 1991 and 2009
  - Marmara and Aegean regions: hot spot
  - Southeastern Anatolian regions: low spot
    - the most underdeveloped region in terms of the human capital indicators.
    - high rates of informal labor,
    - unpaid family work especially in the agriculture sector,
    - high population growth