The Impact of Electricity Consumption on Economic Development in Turkey: A Geographically Weighted Regression Approach

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Abstract

In this study, for NUTS 3 level region of Turkey, the relation between economic development level and electricity consumption in 2000 has been reviewed. The geographically weighted regression (GWR) that deals with interregional differences was used in this study. Empirical analyses carried out in this paper indicate that the electricity consumption affected the economic development positively both in local and global level. When the indicators of production factors and human capital were included in the model, all of them affected the economic development positively, both in local and global level. When the spatial distribution of local parameters has reviewed, the largest effect of electricity consumption on the economic development level was seen in the provinces which are located in the middle section that close to the western side of Turkey. The lowest effect was in the provinces located in the eastern and especially in the Southern East.

Keywords: Geographically Weighted Regression, electricity consumption, Turkey, economic development

Jel Classification Codes: R11, Q43, R12.

Türkiye'de Elektrik Tüketiminin Ekonomik Gelişmeye Etkisi: Coğrafi Ağırlıklı Regresyon Yöntemi

Özet

Bu çalışmada Türkiye'nin 2000 yılındaki NUTS 3 düzey bölgeleri için ekonomik büyüme ve elektrik tüketimi arasındaki ilişki incelenmiştir. Bölgeler arası farklılık arz eden ilişkileri modelleyen Coğrafi Ağırlıklı Regresyon (CAR) kullanılmıştır. Amprik analiz sonucunda elektrik tüketimin ekonomik gelişmeyi hem local hem de global düzeyde pozitif olarak etkilediği belirlenmiştir. Modele dahil edilen üretim faktörleri ve beşeri sermaye göstergelerinin de ekonomik gelişmeyi hem local hemde global düzeyde pozitif yönde etkilediği tespit edilmiştir. Local parametrelerin mekansal dağılımı incelendiğinde elektrik tüketiminin ekonomik gelişmeyi en çok

etkilediği illerin Türkiye'nin batısına doğru orta yerde konumlanan illerdir. En düşük etki ise doğu ve güneydoğu bölgesindeki illerdir.

Anahtar Kelimeler: Coğrafi Ağırlıklı Regresyon, Elektrik Tüketimi, Ekonomik Gelişme, Türkiye

1. Introduction

Since the Industrial revolution, all of the world economies have been interested in having sufficient energy sources. With the realization of the increasing importance of the energy consumption on the economic development, the subject of energy took a part in the development programs. Even it seems that the petroleum crisis decreased the relationship between the economic development and energy consumption in the 1970s; since energy is the most important input of the economic and social development.

"The analysis regarding the energy are generally carried out according to the energy sources. Depending on the utilization step of the energy sources, it could be called as primary and secondary. In this case, the primary energy sources are hard coal, lignite, crude oil, natural gas, water, wind and nuclear energy. On the other hand, the secondary energy sources are; electricity, coke and town gas that are the derivatives of those. In addition, the wood, animal waste and plant wastes are also known as energy source." (Kepenek and Yentürk, 2007: 443).

Electricity is a secondary energy type that obtained from the primary energy sources and because of the reasons such as its comfort, quality, and environment friendly and it could be transformed to other energy types every time, it is in the forefront indeed. On the other hand; due to the increase in urbanization, technological improvements, income, needs of production sectors and the rapid increase in population, energy generation and consumption have been mostly increased.

In this study, the relationship between per capita electricity consumption and per capita income that is the indicator of economic development is investigated. In the following section, this relationship is explained in the theoretical framework. In the third section, the economic policies implemented in Turkey and inter-regional development differences are described. Later, the literature review, methodology and empirical findings are explained respectively. The conclusion is presented in the final section.

2. Electricity Consumption and Economic Development

Reliable and cost-effective electricity supply has conditioned the various goods and services as a result of technical development and it has played an important role in the economic development in 20th century (Joskow, 1998: 25).

After the petroleum crisis in 1970s, many countries faced with financial bottlenecks. Because of this, due to the fact that the requirement of electrical energy increased, the development and growth level of the countries has been measured with the amount of per capita electricity consumption.

The electricity provides input directly and indirectly to every sector in the economy. Due to the fact that the electrical energy has an important share among the production factors, its share within the national income is very high. Therefore, while per capita GDP which shows the development level of the countries, per capita energy consumption (so per capita electricity consumption) is one of the indicators that reflects the economic and welfare level of those countries.

"The increase in per capita electricity consumption can result from four factors. These are as follows: population growth, industrialization, urbanization and the diffusion of electric-powered home appliances. Depending on the electricity consumption, the industrialization causes to increase total electricity consumption and hence, the per capita electricity consumption. On the other hand, as urbanization increases the requirement of general lightening in provinces increases too. In addition, due to the development of trade, in addition to the buildings, the firms have started to consume electricity during both the days and nights. The activities having a purpose of entertainment and/or advertisement also increase the electricity consumption as well. Diffusion of using the electrical home appliances and electrical machine and equipment used for mending purpose play an important role for increasing the electricity consumption. In addition, depending on the new technologies, the reductions of sizes and the production costs of electrical home appliances are another factors that increase the electricity consumption." (Erol, 2007: 116-117).

3. The Economic Policies and Interregional Development Differences in Turkey

Particularly after the Second World War, the studies on economic development increased and in order to sustain a balanced development level, it was focused on the relevant economy policies. Relevant policies preferred in order to achieve and sustain a balanced development in Turkey since the proclamation of Republic, too.. For this aim, the statist policies applied in 1930s by the effect of 1929 depression, in 1934 and 1940 two industrial plans were implemented. However, the desired balanced development level in the economy was not provided.

After 1950, it was entered into the multi-party period. On the other hand, in the economic policies, statist policies had left its position to the very liberal policies and in accordance with this; the important changes had raised in the economic and social life.

At the end of 1950s, due to the retrogressive economic conditions, accelarating inflation and high external deficit, a series of decisions had to be taken in the economic policies and to achieve this aim, planned economy policies were preferred since 1963. In this direction, the development plains were implemented and they target not only the economic development but also social development. In order to achieve this purpose, the DPT was

established in 1961; since 1963, the development plans was entered into force and this momentum was accelerated.

"In the planned economy period, the regional development differences were seen as the most important problem of the country and "interregional balanced development" principle was taken part between the social targets of the planned economy." (DPT, 1996: 10).

In the regional development policies implemented after 1980 and particularly 2000; the integration activities with the foreign economies were drawn attention. However, in spite of the precautionary activities since the planned economy period up to day; the interregional development differences had not been decreased.

"Any inequality among the countries or the regions and provinces of a country is called as regional disequilibrium." (Şahin, 2002: 539). Since the "time" and "location" of the economic and social development differs from a country to another; countries are grouped as "developed", "developing" and "underdeveloped" according to their development level. This development differences can occur within a country and emerge as the reason of interregional development changes. (DPT, 1996:4)

Figure 1: 7 Geographical Regions of Turkey

The map belongs to the 7 geographical regions of Turkey is shown in Figure 1., Marmara, Aegean, Central Anatolia and Mediterranean regions are located in the west of the country and relatively known as developed regions. On the other hand, especially, Eastern Anatolia, the mountain regions of the Black Sea and some districts of Southeastern Anatolia are relatively underdeveloped in comparing with the average income, employment and welfare of Turkey (DPT, 2003: 12). From the western to eastern side of Turkey, the development differences increases; however, the inequalities within each regions also be appeared.

4. Literature Review

Various empirical analyses focused on the relationship between electricity consumption and economic development (or economic growth). Generally the causality test was used in these analyses. This causality relation was obtained in different directions; one-dimensional causality relation, two-dimensional causality relation or the circumstance where the causality is not available.

In one dimensional causality, researchers identified two different situations: causality from the electricity consumption to economic growth and from the economic growth to electricity consumption. When the causality is from the electricity consumption to economic growth, the decrease/increase in the electricity consumption decreased/increased the economic growth. The empirical studies that reached to this result are as follows: Yang (2000) for Taiwan , Shiu, Lam (2004) for China, Wolde-Rufael (2004) for Shanghai, Narayan and Singh (2007) for Fiji Island, Gupta and Sahu (2008) for India. Also Narayan and Prasad (2008) analysed 30 OECD countries and obtained the same results for Australia, Iceland, Italy, the Slovak Republic, the Czech Republic, Korea, Portugal, and the UK countries.

When the economic growth effects electric consumption energy conservation policies can be implemented with little or no adverse effects on economic growth. On the other hand, a continuous increase in the economic growth can induce a continious electricity consumption. Ghosh (2002) for India, Narayan and Smyth (2005) for Australia, Wolde-Rufael (2006) for Cameroon, Ghana, Nigeria, Senegal, Zambia and Zimbabwe of 17 African countries obtained the causality relation in this direction.

Furthermore, some of studies (eg.; Yoo (2005) for Korea, Jumbe (2004) for Malawi, Wolde-Rufael (2006) for Egypt, Gabonand and Morocco of 17 African countries) showed that electricity consumption and economic growth effects each other. Thus, there can be two dimensional causality relation between the electricity consumption and economic growth.

On the other hand, electricity consumption and economic growth may not be subject to any causality relation. This situation implies that energy conservation policies have little or no effect on economic growth. Wolde-Rufael (2006), analysed the 17 African countries and reached that the co-integration is not subject for the countries of Algeria, Congo (Rep), Kenya, South Africa and Sudan.

In Turkey, the relation between energy (and electricity) consumption and economic growth was mostly searched by the methods of time series analysis. As is explained above, various causality results were obtained., Şengül and Tuncer (2006) obtained one-way causality relation from commercial energy consumption to GDP by using the annual data over the

period 1960-2000. Erbaykal (2008) searched the co-integration relations between economic development and electricity consumption by using Bounds test approach for the years of 1970-2003.In this study, disaggregates using oil and electricity consumption were preferred as the indicator of energy consumption and at the end of the study it was seen that both indicators affects the economic growth in the short run. Regarding the period of 1975-2005, Kar and Kınık (2008) investigated the relations between the total electricity consumption, industrial electricity consumption, household electricity consumption and economic growth, by taking into the consideration of the development in the analysis of time series analysis. According to the achieved results, the direction of causality is from the electricity consumptions to economic growth. Altınay and Karagöl (2005) reviewed the causality relations between electricity consumption and reel GDP for the period 1950-2000. By means of Standard Granger Causality Test and Dolado-Lutkepohl test, They determined that the causality is towards to the income.

On the other hand, Terzi (1998) obtained two dimensional causality between the total electricity consumption and GDP over the period 1950-1991. Erdal et al. (2008), also obtained two dimensional causality for the years of 1970-2006.

As is explained above, in many studies time series analysis was used and it was determined that the causality is subject from electricity consumption to economic growth by using the. But Ağır and Kar (2010) reviewed the relation between electricity consumption and economic development by using the cross-section regression analysis for the NUTS 3 regional level (81 provinces) in 2001. The results of this study showed that electricity consumption affected the economic development level positively in 2000.

5. Methodology: Geographically Weighted Regression

In this study, the effect of electricity consumption to economic development level was investigated by the GWR models. Using of the GWR models to explain the interregional differences has increased recently. Eckey et al. (2007) estimated the regional convergence in Germany by means of GWR models and determined different regional convergence speed with the help of relevant estimations. In Turkey, this model was used by Işık and Pınarcıoğlu (2006), Öcal and Yıldırım (2010) and they obtained local coefficients.

Since the geographical regions are not similar to each other about economic, social and other factors, the relation between economic variables differs from one geography to another. This relation can be estimated by using GWR models. The global regression model (classic regression) that shows that this relation is fixed for each unit is as follows:

$$y_i = \beta_0 + \sum_{k=1}^{m} \beta_k x_{ik} + u_i \qquad (1)$$

In this equation, $i = 1,...,n$ and $\beta_k, (k = 1,2,...,m)$ are the global parameters and they are fixed for all units. As is known this model is estimated by ordinary least square (OLS) method. In GWR models, instead of global parameters, the local parameters are used and it is shown as follows:

$$y_i = \beta_{0i} + \sum_{k=1}^{3} \beta_{ik} x_{ik} + u_i \qquad (2)$$

The local parameter vector which belongs to $i.$ unit can be estimated as ;

$$\hat{\beta}_i = (x'W_i x)^{-1} x'W_i y \qquad (3)$$

In the statement of (3), W_i is a diagonal weights matrix with dimension of $(n \times n)$ and contains w_{ij} (j =1, 2…n).

$$W_i = \begin{bmatrix} w_{i1} & . & . & . & 0 & 0 \\ 0 & w_{i2} & . & . & . & 0 \\ . & . & . & & & . \\ . & . & & . & & . \\ . & . & & & . & . \\ 0 & 0 & . & . & . & w_{in} \end{bmatrix}$$

The weights in GWR changes according to the location of $i.$ unit and the weight matrix is calculated for each i (Fotheringham, Brunsdon and Charlton, 2002: 54). These weights show the nearest of each data for the location of i and the nearest locations are shown by further weights. The most commonly used function is Gaussion or approximate-Gaussion weight function and this function is as follows (Fotheringman ,2002, 56-57):

$$w_{ij} = \exp\left[-1/2(d_{ij}/b)^2\right] \qquad (4)$$

The expression of (4) is defined as a function of the distance between i and j. b is accepted as bandwidth. On the other hand, if i and j are neighbours of border, the weight in this point becomes 1 and the weights of other data decrease as the distance between i and j increase according to the Gaussion curve. The parameters estimated in the GWR models are the functions of these weights. Besides, when the bandwidth (b) goes to

infinite, the weights for each pair of point equals to 1 (Fotheringman, Charlton and Brunsdon, 1998:1910). In this way, the estimations of OLS and GWR be also equal. As the bandwidth becomes smaller, the estimations of parameters increase depending on the number of observations in the near neighborhood of i. For this reason, the selection of appropriate bandwidth is very important. The bandwidth is selected in accordance with the following criteria (Fotheringman et al., 2002:60) : 1) Cross validation (CV) that is known as Kernel density estimation or local regression approach, 2) minimizing the Akaike Information Criterion (AIC) thus, balance between goodness-of-fit and degrees of freedom 3) Schwartz Information Criterion (SIC).

In this study, for the bandwidth selection, the CV criteria were preferred. The formula for the CV score is:

$$CV = \sum_{i=1}^{n} \left[y_i - \hat{y}_i(b) \right]^2 \qquad (5)$$

Where y_i is the observed value and $\hat{y}_i(b)$, is the value of y_i in accordance with the selected bandwidth. The bandwidth that provides the smallest CV value is the most appropriate bandwidth.

Testing of compatibility of GWR model is important for the empirical analysis. An approximate likelihood rate test, based on the F-test, which can be used to compare the abilities of the GWR and global models to replicate the observed data set (Fotheringam, Brunsdon and Charlton, 2002, s.92). Thus;

$$F = \frac{RSS_0 / d_0}{RSS_1 / d_1} \qquad (6)$$

Where RSS_0 ; shows the residual sum of squares of the global model, d_0 ;shows degrees of freedom, RSS_1; shows residual sum of squares of the GWR and d_1 ; shows the degrees of freedom.

6. Data and Results

The relations between electricity consumption and national income for 81 provinces of Turkey in the level of NUTS 3[10] were reviewed for the year of 2000[11]. The map of the NUTS 3 level for Turkey is given in Figure

[10] As a candidate country of the European Union, Turkey (TR) is included in the Nomenclature of Territorial Units for Statistics (NUTS). The three NUTS levels are: NUTS 1 (12 region), NUTS 2 (26 sub-region) and NUTS 3 (81 provinces).

[11]After 2000, due to the fact that the national income data are not available in the regional base, the year of 2000 was preferred for this analysis.. Also, in Turkey,

2. The data were extracted from the State Planning Organization. As the GWR models consider the spatial heterogeneity it is preferred.

Figure 2: The regional map of NUTS 3 level (81 provinces) of Turkey

As we stated in the last paragraph of the literature section, Ağır and Kar (2010) investigated the relation between the electricity consumption and economic development by using cross-section analysis. They determined that the electricity consumption affects the economic development level positively. By using OLS method, they estimated a global coefficient. Different from the study of Ağır and Kar (2010), the purpose of this study is to reveal the relation between the electricity consumption and economic development level locally. By taking into the consideration of Ağır and Kar (2010), the dependent variable y_i is logarithmic reel per capita GDP.Also, in many studies that investigate the causality between the electricity consumption and economic growth (eg. Shiu and Lam (2004), Narayan and Singh (2005) and Wolde-Rafael (2005)) GDP or reel GDP is preferred as dependent variable. x_{i1} shows the logarithmic per capita electricity consumption (EC), x_{i2} shows the logarithmic reel service sector production value (SPV) as an indicator of production factor and lastly x_{i3} shows the high school enrollment rate (HSE) as a human capital indicator.

As a matter of fact, Karaca (2004) and Vreyer&Spielvogel (2005) searched the effects of agriculture, industry and service sectors on the economic development. On the other hand, Mankiw, Romer and Weil (1992) prefered the rate of 15-19 years old students enrolled at secondary school to

there aren't many regional economic and social data. For this reason, our study was limited by this time period.

the active total population as a measure of human capital. Barro-Lee (2000) used the school attendance for the population over 25 years. Apart from these, in various studies, the schooling rate was used as human capital.

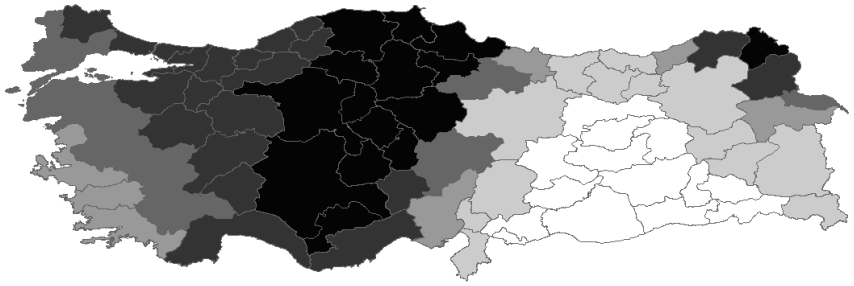
Table 1: Global and local parameter estimates

Variables	Global	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
Constant	6.4214*** (9.021)	5.5340	7.2350	7.7990	8.2180	9.4310
EC	0.5174*** (7.601)	0.1907	0.3355	0.4341	0.4494	0.4848
SPV	0.1402*** (4.229)	0.0581	0.1038	0.1164	0.1526	0.2014
HSE	0.0088* (2.512)	0.0032	0.0051	0.0069	0.0110	0.0188
R_i^2	0.7746	0.6091	0.6828	0.7007	0.7928	0.8252
Bandwidth = 2.6302		CV Score = 5.7643		Global test of nonstationarity F =1.6221 p-value = 0.0219		

*The expressions within the bracket in the table show the t values of the parameters, *** shows the significance level of % 1 and *, % 5.*

As is known, the global model estimates only one parameter for each province. As we see in the table, due to the fact that the null hypothesis which assumes the validity of the global model is refused, GWR model is appropriate for our data set. As is expected, the signs of both the global and local coefficients are positive. The spatial distribution of the obtained local coefficients is made on the map. While the highest valued coefficients, namely the highest effects are shown by black colors, the less effects are shown by the light colors (light tones of the black). In a nutshell, if the affect is lessen, the color is whiten. As it is seen, per capita electricity consumption (EC) affects the per capita GDP positively. The range of this coefficient is $[0.1907 - 0.4848]$ and its distribution on the map is shown in Figure 3. The signs of the service sector production value and high school enrollment rate are as expected. The range of local coefficient of SPV is $[0.0581 - 0.2014]$ and the spatial distribution of this local coefficient is shown in Figure 4. The range of the local coefficient of HSE is $[0.0032 - 0.0188]$ and the spatial distribution of this coefficient is shown in the Figure 5.

Figure 3: Spatial distribution of the coefficients of EC



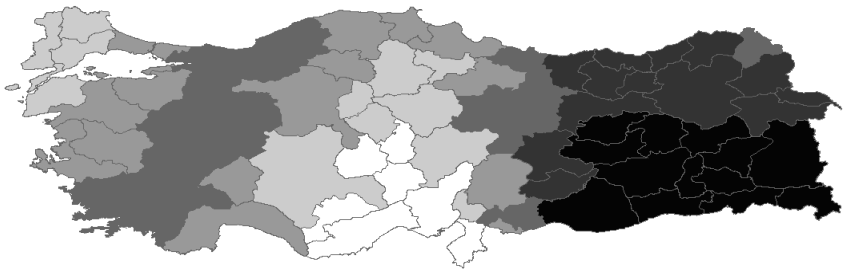
As it is seen in Figure 3, the region where the most effect of per capita electricity consumption to per capita GDP is from north to south; the central parts of Black Sea, provinces in Middle Anatolia and some provinces located in the South. In provinces located in central Black Sea and in Mediterranean, the agriculture based industry is on the foreground. Some of the provinces (Kırıkkale, Nevşehir and Kırşehir) located in Central Anatolia are on the forefront in accordance with the development level by taking into the consideration per worker value added in manufacturing industry. In this region, the highest value added is obtained in oil products industry relative to other industries. Other industry branches are basic chemical products, wooden furniture, iron-steel, distilled alcoholic beverage, sugar, other machine and equipments, carpet and rug, soap, cleaning and cosmetic products and railway vehicles. As is known, energy provides input for each sector in the economy. Due to the fact that energy (so the electricity) is a indispensible input in the industry production and precondition of industrialization process, the energy consumption has been increased. For this reason, electricity consumption affects the per capita GDP to much.

In Artvin; located in the northern east of Anatolia, since public investment and income level are high; in Kars Ardahan and Iğdır ; unemployment rate is low, all individuals participated in the employment increase the electricity consumption in the wide area from the lightning to the domicile. On the other hand, the transportation sector has developed in this region. Like industry sector, the transportation sector needs energy so that per capita GDP increased in accordance with this. Owing to the fact that Marmara region and western regions are the most developed regions in terms of industry, GDP is affected positively. However, recently the investments in the hinterlands and provinces where the transportation is easy have increased and because of this the electricity consumption of that region increased too.

On the other hand, if we compare the effects of the electricity consumption to the economic development level, it is relatively less in the west of Turkey in Izmir and Muğla since the summer tourism is basic

economic activity source in this provinces. In the Southern East Anatolian Region, the agriculture activities are essential and in the Eastern provinces, the animal husbandry activities are essential, for this reason, these factors cause the effects of electricity consumption on economic development to be unimportant. In addition to the high welfare level and the important role of service sector, moving of the industry to surrounding provinces, the requirement for electricity consumption is relatively less In Western Region and especially Marmara Region.

Figure 4: Spatial distribution of the coefficients of SPV

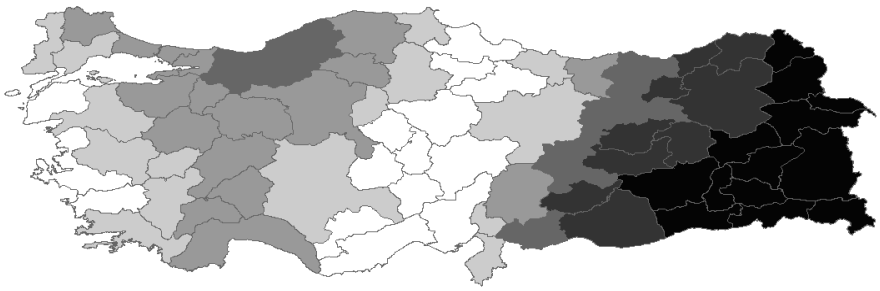


When we review Figure 4, it is seen that the highest effect of service sector to per capita GDP is the Southern East and the central side of Aegean Region. Denizli, Eskişehir, Afyon, Sakarya and Bolu that are the most developed provinces in the west of Turkey have considerably developed both in textile and industry. In addition to industry based activities have been dominant for long years, because of the high economic development and income levels of the region and country, the importance of the service sector has been recently increased. Also in this region as well as the rapid increase of population, the urbanization rate, education level and cultural activities are very high. In this study it is observed that the effect of the service sector to GDP is as important as it is expected. In addition, in the Southern East, due to the fact that it is the most supported region by the government and thus the increase in government and private sector investments, fields especially education, health, trade, engineering and the service sector have been developing accordingly. Besides, in this region Urfa and Mardin are among the important provinces in tourism sector. Nevertheless, Malatya, Elazıg, Diyarbakır, Urfa, Van are the main provinces in the region developed in industry, trade and transportation. As a result of this, service sector has also been developing in these provinces recently.

In addition to being the most developed province of the East Anatolian region, the increasing prestige of winter tourism in Erzurum GDP is positively affected. On the other hand, in this region, the main reason of

the increase in GDP due to the contribution of service sector, is the provinces located on Eurasia transportation corridor are subject to the improving trade potential arising from transportation sector and the export incomes. Particularly in Artvin, the productivity of agriculture is slightly more than other provinces and the export incomes are high. In the Aegean region, industry, service and turism sectors are very developed so the per capita income is high. On the other hand, the effects of service sector to GDP are less in the Middle Anatolian region. In this region especially in Niğde, Aksaray and Karaman, because the industry, trade and tourism activities are limited, the income level is very low. Besides, since the unemployment rate and rural population is high, service sector is not much developed. In Adana and Mersin, since the agricultural activities are popular, the service sector is not important.

Figure 5: Spatial distribution of the coefficients of HSE



As is seen in Figure 5, there are important developing differences among the regions in terms of performance of education sector. However, it is seen that the high school enrollment rate in East and Southern East Anatolian regions and Central West regions affects the per capita GDP too much. Eastern Region is underdeveloped and its geographic conditions are very harsh as well as high school graduated population is inadequate, the possibility of participating in labor force of high school education to.

Besides, due to low literacy rate, the educated workforce relatively insufficient. Recently, by taking into the consideration of the supports given to the education sector in the region and the current government investments, it is seen that the enrollment rate increased in the high schools and it affected per capita GDP too much. Over and above, the lack of the contribution of high educated workforce means that the few people who graduated from high schools can easily participate in the employment and so contributes to the national income. Although this affect is high too in the western regions, in those regions, the labor force graduated from various universities and

departments are adequate and requirement for the qualified labor force is high. This means that, the high school enrollment rate doesn't increase the GDP as in Eastern and Southern East Anatolia regions. However, although Marmara and Middle-West regions are abundant in qualified labor force, the contribution of high school education to the national income is very important. Because, the industrial and service sectors are developed, apart from qualified workforce (graduated from university), the subworkers from vocational high school are also needed. Otherwise, in the central side of the Middle Anatolia and Black Sea, the contribution of high school education to GDP is not important. Because, in these regions, the cereal production is the main economic activity and the university men are abundant. Also, due to the lack of service and industry sectors, these regions do not need subworkers. On the other hand, In Mersin and Adana where the main economic activity is agriculture, the contribution of high school education to GDP is unimportant. In Izmir and Muğla, the similar result is seen since the economic activities depend on the tourism sector.

7. Conclusion

In this study, the impact of electricity consumption to the economic development level for NUTS 3 region in Turkey was searched. Due to the differences between the provinces in terms of economic, social, cultural and human aspects, the relations among the variables varied from one province to another. This alternating relation was investigated through GWR models and the local parameters were estimated. As a result of empirical findings, we determined that the electricity consumption affected the development level positively for each province. In addition, it is seen that service sector production value (indicator of production factor) and enrollment rate in the high schools (indicator of human capital) have also positive effect on the economic development level.

The distribution of local parameters obtained through GWR models are shown on the map. The most effect of electricity consumption to the economic development is seen in the provinces of Middle and western regions. Because, electricity consumption is much more than other regions in complying with the industrialization and transportation sector as well as the investments made in these regions.

On the other hand, it is seen that effects of service sectors to the economic development level is generally parallel to the high school education level. The less effect of these variables is determined in the hinterlands where the population density and urbanization is low. The region where the effect of schooling rate in the high schools to the economic development level is greater in the eastern and southern east Anatolian region since they are the underdeveloped regions of Turkey.

Consequently, in this study, the interregional development differences have been clearly revealed. Accordingly, the importance of

regional development policies is being important. For this reason, the government should increase the investments and supports especially for the Middle region of Turkey to achieve the target of decreasing the interregional developing differences.

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