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THE IMPACTS OF REGIONAL PUBLIC POLICIES ON EFFICIENCY IN TURKEY*

Lütfi ERDEN**
Hatice KARAÇAY ÇAKMAK***

Abstract

This study empirically examines the role of government policies on regional efficiency/productivity in Turkey, with the emphasis on the effects of two major policy instruments: investment subsidy and public investment. Moreover, it investigates whether these public policies are subject to an equity-efficiency tradeoff. To this end, the study models the technical inefficiency component of total factor productivity that embodies these policy variables within the framework of a stochastic production frontier analysis. The results suggest that the policy tools are both successful in reducing technical inefficiencies and thus bring about an increased productivity in provincial manufacturing sector. The findings also show that the regional policies have a positive but negligible impact on the efficiency of the provinces with low performance while their efficiency impact is the highest on the provinces with medium performance, a result that points to the presence of an equity-efficiency tradeoff.

Keywords: Investment subsidy, public investment, technical efficiency, regional development.

Öz

Türkiye'de Bölgesel Kamu Politikalarının Etkinlik Üzerine Etkileri

Bu çalışma yatırım teşvikleri ve kamu yatırımları gibi iki önemli kamu politikasının Türkiye'de bölgesel etkinlik/verimlilik üzerine etkilerini ampirik olarak incelemektedir. Bunula birlikte çalışmada, kamu politikalarının eşitlik-etkinlik ödünlemesine maruz kalıp kalmadığı araştırılmaktadır. Bu amaçla

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** Doç.Dr., Hacettepe Üniversitesi, İktisat Bölümü, 06800, ANKARA, lerden@hacettepe.edu.tr
*** Doç.Dr., Hacettepe Üniversitesi, İktisat Bölümü, 06800, ANKARA, hatice@hacettepe.edu.tr

çalışma, stokastik üretim sınırı analizi çerçevesinde, teknik etkinlik bileşenini kamu politikalarının etkilerini içerecek şekilde modellemektedir. Bulgular, her iki kamu politikasının teknik etkinsizliği azaltıcı nitelikte rol oynadığını ve dolayısıyla il bazında imalat sektörünün verimliliğine olumlu katkılar sunduğunu göstermektedir. Bununla birlikte bulgular, kamu politikalarının düşük performanslı illerde düşük, orta performanslı illerde ise en yüksek etkinlik etkileri olduğunu ortaya koymaktadır. Bu ise, kamu politikalarının eşitlik-etkinlik ödünlemesine maruz kaldığına işaret etmektedir.

Anahtar Sözcükler: Yatırım teşvikleri, kamu yatırımları, teknik etkinlik, bölgesel kalkınma.

INTRODUCTION

One of the most difficult issues facing the European Union (EU) is national income disparities between the Old (EU-15) and New Member States as well as regional income inequalities within the New Members. The EU allocates the majority of funds to address this issue, using several regional policy tools, especially infrastructure investment as stated in the “New Cohesion Policy for 2007-2013”. The economic rationale behind directing the funds to less developed states or regions is mostly justified on the grounds that lagging regions might catch up, leading to a better integration and thus benefitting the EU as a whole. However, even if the regional policies following the redistribution purposes produce a desirable outcome, they might do this at the expense of efficiency losses, a well-known tradeoff between equity and efficiency facing the provision of virtually all public support.

The studies by Martin (1998, 1999, and 2000) and Baldwin *et al*. (2003), developing models based on a combination of endogenous growth theories and new economic geography approaches, suggest that subsidy or transfer policies geared toward regional cohesion might alleviate the problem of regional disparities while they are likely to reduce the rate of national growth at the same time. More interestingly, these models also show that public infrastructure investment in lagging regions that provides them with an access to developed regions might result in more agglomeration and thus not only circumvent the issue of disparities but also lower the rate of overall growth. According to these models, the equality-efficiency tradeoff facing subsidy or infrastructure policies is almost inevitable. Nevertheless, the study by Barro (2000), demonstrating that income inequalities might be detrimental to national growth, imply that public polices ought to be geared towards income cohesion.

Regional income inequality is an ongoing problem which is not reserved only to the EU members as it is also tackled by many countries including an

EU-candidate country, Turkey. To be politically acceptable, the stated goal of the governments in Turkey, like most governments, is to reduce regional inequalities through transfer policies such as infrastructure or subsidy. However, in most cases, the underlying intension can be to create efficiency and thus boost productivity nationwide. When we look at some descriptive statistics on the Turkish provinces, dividing them into low, medium and high performance groups on the basis of their socioeconomic development levels, the governments in Turkey seem to follow efficiency criteria more than equality criteria. For instance, while the share of low performance provinces in total investment subsidy is only 17.1%, this ratio is 41.7% for medium and 40.5% for high performance provinces. Also, the share of low performance provinces in total public investment is 27.7% whereas it is 38.8% for medium and 33.3% for high performance provinces.[1] Clearly, the major bulk of these public supports are allocated to the medium performance, whereas the smallest share to the low performance provinces. Given these basic statistics, the first interesting question to ask is whether the provision of such public supports brings about an increase in provincial efficiency and, if so, the second is whether there exists an equality-efficiency tradeoff facing the policy makers.

Motivated by these considerations, this paper aims to contribute to the empirical literature on the role of public policies in fostering regional efficiency and thus productivity growth. To this end, we first incorporate investment subsidy and public investment variables into the framework of a stochastic production frontier model and then apply it to the panel data from 58 Turkish provinces over the periods of 1986-2000. Further, in order to check whether there exists an efficiency-equity tradeoff, we use an empirical method, essentially based on a combination of the K-means clustering technique and stochastic frontier analysis. To do so, we first group the provinces into low, medium and high performances with respect to their socioeconomic development levels with an application of a K-means clustering algorithm. Then, we incorporate two dichotomous variables representing these clusters into the technical efficiency equation, in order to see if the impacts of policy tools in question alter in provinces with respect to their performances.

The findings of this study indicate that both public policies are successful in bringing about productivity growth through reducing technical inefficiencies in Turkish provinces. Besides, although the medium performance provinces get benefited the most, these policies fail to deliver the intended stimulus to low performance provinces, providing some evidence on the presence of equity-efficiency tradeoff facing regional policies in Turkey. The rest of the paper is

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[1] Authors' own calculations.

organized as follows. The second section discusses the conceptual linkages between subsidy and public investment policies and productivity as well as the empirical literature on the subject. The theoretical framework and empirical methodology are presented in the third section. The fourth section describes the data and presents empirical results. The last section concludes.

1. LITERATURE REVIEW

There are several conceptual channels identified in the related literature through which investment subsidies and public investment affect productivity and output. On the one hand, public investment in infrastructure such as highways, energy systems, water and sewage systems, education and health may increase the productivity of inputs i.e., private capital through reducing the costs that would otherwise have to be incurred by the private sector (Aschauer, 1989). On the other hand, public and private sectors may compete for the limited resources, increasing the costs of borrowing while reducing the volume of credits, which in turn may hinder the private sector productive activities. Investment subsidy has also competing effects on productivity. Such government transfers may not only prevent divergence and polarization process between regions but also give rise to productivity of inputs necessary for long run and sustainable growth. There are several conceptual links between subsidy and productivity identified in the literature (Beason and Weinstein 1996, Lee 1996, Bergstrom 2000). Subsidies may enable private sector to allocate more spending on R&D, which may lead to technological improvement or at least technology transfers. Moreover, especially investment subsidies may facilitate the enlargement of firms' capacity, leading them to better exploit the scale economies. These may generate a productivity boost. On the other side of the coin, however, government grants may have an adverse influence on productivity for at least three reasons. One of the arguments is that subsidies may provide an incentive for rent seeking behavior, in which case the limited resources may be allocated to nonproductive areas. Another argument is that subsidies are likely to affect capital-labor ratio in the production and thus may result in inefficient allocation of resources. Finally, if the firms that benefit from the grants make high profits, they may have a tendency to put less effort to develop cost reducing techniques and organizational methods. In short, because the impacts of both public investment and subsidies on productivity appear ambiguous on theoretical grounds, the issue at hand is an empirical one.

To examine the issue empirically, the previous studies took three main routes: i) investment subsidy or public investment is incorporated as one of the inputs into the neoclassical production function in order to examine whether they have direct effects on production, ii) to see their potential effect on economic growth indirectly through productivity, subsidy or public investment is added to a productivity function in which productivity is measured by Solow residuals from a growth accounting equation and iii) either one of these policies is included into a model for technical inefficiencies within the framework of stochastic production frontier analysis.

1.1. Empirical Literature on Subsidy-Productivity Link

While the majority of the previous studies point to a significant and positive role of subsidies in output, TFP and/or technical efficiency growth, there are a few studies finding no link between subsidy and productivity. For examples, Beason and Weinstein (1996) for several Japanese sectors and Lee (1996) for South Korean manufacturing industry document no empirical linkage between subsidies and total factor productivity. Bergstrom (2000) for Sweden finds a positive effect of investment subsidies on the value added production although it takes one year to realize such an effect. Further, the results indicate that the effect of subsidy on TFP turns into a negative one after two years. Hence, she concludes that investment subsidies may have a direct and favorable impact on output, but the rise in TFP is not a channel through which this occurs. This result is attributed to the existence of interest groups and rent seeking behavior that lead to inefficient allocation of resources. Hart *et al*., (2000) for the UK report evidence in favor of selective investment subsidy programs. They find that these programs result in not only output growth directly but also a rise in employment indirectly. Also, Girma *et al.,* (2007) for Ireland analyze the effects of several government subsidy programs, showing that only investment subsidy is related positively to the TFP growth. Harris and Robinson (2004) compare the productivity performances of subsidized and nonsubsidized Irish firms. They find that the effects of subsidy differ from one sector to another. More specifically, while subsidized firms in machinery and textile industries perform better, those firms in chemical industry perform worse. They suggest that the government support be increased for firms and sectors with low productivity. Tzelepis and Skuras (2004) for Greece investigate the effects of regional subsidy policy on several performance measures of firms such as output growth, productivity, profitability and capital structure. They conclude that subsidies are related only with output growth. Skuras *et al*., (2006) for food and beverages sector in Greece, employing a stochastic frontier analysis, find that investment subsidies positively influence TFP through giving rise to technical efficiency. Another important finding of this study is that investment subsidies have a larger impact on financially constrained firms.

1.2. Empirical Literature on Public Investment-Productivity Link

A renewed interest in the effect of public investment on economic growth and productivity started in late 1980s with the pioneering work of Aschauer (1989). As is well-known, the US economy experienced a productivity slowdown throughout 1970s and 1980s. According to Aschauer, one of the main reasons for the slowdown is the steady decline in public investment spending in these years. Earlier results of Aschauer (1989) and Munnell (1990) from the US annual and state level data respectively indicate that public non-military investment spending, particularly on core infrastructure such as roads, highways, port facilities, education, sewer and water systems, has a substantial influence on output and productivity of the private capital. However, the unusually high output elasticity of public capital estimated between 0.15-0.39 has led many researchers to further scrutinize the empirical implementations of the earlier work. For instance, Tatom (1991), Holtz-Eakin (1994), Evans and Karras (1994), and Holtz-Eakin and Schwartz (1995) find that public investment plays a negligible role in the US private production process**.** Nevertheless, the analyses by Aschauer (1990) from data on industrial countries, Easterly and Rebelo (1993) and Cashin (1995) from cross-country data provide some support for the earlier works. Furthermore, Khan and Reinhart (1990) and Khan and Kumar (1997) for developing countries found some evidence that although public investment contributes to the productive performance of the economies, private investment has more influence on economic growth. There are also a few studies in this vein employing regional data (Picci, 1995; Bonaglia and Ferrara, 2000; Ezcurra *et al*., 2005; Salinas-Jimenez, 2004). While these studies report a positive and high correlation between public capital and productivity, the study by Salinas-Jimenes (2004) for Spain find a negligible effect of public infrastructure on TFP growth. Another strand of studies focuses on the role of public investment in reducing technical inefficiency in the production of private sector. For instance, Mullen *et al*., (1996) for a panel of the manufacturing sector in the US states, Puig-Junoy (2001) for a panel of 48 US states and Delorme *et al*., (1999) using time series data for the private U.S. economy documented that public capital has a favorable impact on technical efficiency while its direct impact on output growth is negligible. Also, Kim *et al*., (1999) for a panel of 11 Korean regions find that technical inefficiency in the production of private manufacturing industry is negatively related to the provision of public capital.

2. METHODOLOGY

In an effort to examine the potential effects of investment subsidy and public investment on productivity, we begin by defining a production function that embodies the externalities that these policies may generate as the following,

$$Y_{it} = A_t F(L_{it}, K_{p,it}, K_{g,it}, S_{it}) \qquad (1)$$

where Y_{it} is output (value added), L_{it} labor, $K_{p,it}$ private capital stock, $K_{g,it}$ public capital stock and S_{it} investment subsidy variables. *A* represents a measure of productivity. Since these policy instruments enter into the production function to represent their externality effects, they can be taken as shifting factors of the production function. Thus, the production function can be rewritten as,

$$Y_{it} = A_t K_{g,it}^{\delta_1} S_{it}^{\delta_2} F(L_{it}, K_{p,it}) \qquad (2)$$

where the term, $A_t K_{g,it}^{\delta_1} S_{it}^{\delta_2}$, represents total factor productivity (TFP). In this model TFP is determined by exogenously given technology, public investment and investment subsidy. As mentioned before, both of these policy instruments may have competing impacts on the marginal productivities of capital and labor (Hulten, Schwab, 1993, Mastromarco, Woitek, 2004). TFP consists of technological change and technical efficiency components. The aim here is to separate out the technical efficiency component of TFP with an application of stochastic production frontier analysis in an effort to investigate the potential impacts of the two policy variables on technical efficiency. To this end, following the lead of the studies by Coelli and Battese (1995) and Hadri et al., (2003), we can define the stochastic production frontier function in which TFP is expressed in terms of technological change, technical efficiency and random factor as the following,

$$Y_{it} = A_t e^{v} e^{-u} F(L_{it}, K_{p,it}) \qquad (3)$$

Using the functional form of translog production for empirical purposes, the model can be expressed as,

$$y_{it} = \beta_0 + \sum_{j=1}^{2} \beta_j x_{jit} + \beta_t t + \sum_{j=1}^{2} \sum_{k=1}^{2} \beta_{jk} x_{jit} x_{kit} + \beta_{tt} t^2 + \sum_{j=1}^{2} \beta_{jt} x_{jit} t + v_{it} - u_{it}$$

$$i = 1,2,\ldots,N;\ t = 1,2,\ldots,T \qquad (4)$$

where x is the input vector (L_{it}, $K_{p,it}$). v_{it} and u_{it} are independently distributed random disturbances. v_{it} is distributed normally with a mean of zero and a variance of σ_v^2 while u_{it} is normally distributed random term with a mean of m_{it} and a variance of σ_u^2 v that is truncated at zero with nonnegative values. Here u_{it} represents technical inefficiencies that are the cross section and time specific deviations from the production frontier. Next, we model technical inefficiencies as the following,

$$E(u_{it}) = m_{it} = Z_{it}\delta + \lambda_t + \varepsilon_{it} \quad (5)$$

where λ_t controls for time specific effects and ε_{it} is the random disturbance term. Z is an explanatory variable vector that includes aforementioned policy variables such as $K_{g,it}$ (Pubinv) and S_{it} (Subsidy) as well as such factors as population density (PopDens) and firm size (Fsize) thought of as potential determinants of technical inefficiencies. PopDens is added to the model to control for potential spillover effect of urbanization while Fsize accounts for the impact of scale economies. Negative signs on δ parameters mean that the policy variables under study have a favorable impact on technical efficiency and thus contribute to the convergence process across provinces. In this model, technical inefficiency scores can be calculated using,

$$TE_{it} = \exp\{-u_{it}\} \quad (6)$$

A small value of u_{it} in magnitude would imply the closeness of the production of *ith* province to the production frontier. For instance, subsidy or public investment could narrow the gap between actual production of a province and the frontier production through reducing the expected value of u_{it}. The parameters of the translog stochastic frontier and technical inefficiency functions, $\beta, \delta, \sigma_u, \sigma_v$, can be estimated using a single estimation method of maximum likelihood. (Kumbhakar, 1991; Coelli and Battese, 1995). The statistical properties of the model and the estimation method are discussed in detail by Kumbhakar and Lowell (2000) and Hadri *et al*., (2003).

Another objective of this study is to investigate whether the regional public policies are subject to an efficiency-equality trade off. To this end, this paper groups the provinces with respect to their socioeconomic development levels with an application of a K-means clustering algorithm. As an unsupervised method, the K-means clustering technique is novel in that it requires no *a priori* restriction on the choice of thresholds for the provincial performances. This algorithm aims to partition the data set into K disjoint subset R_i by minimizing the sums of squares of within group deviations from the centers (Hartigan and Wang, 1979) such that $\min \quad J = \sum_{j=1}^{K} \sum_{n \in R_i} \left| x_n - v_j \right|^2$ where x_n is a vector representing the n[th] data point and v_j is the cluster center of the data points in R_i. In this case, the input vector is one dimensional (socioeconomic performances of provinces) and the aim is to group provinces with similar performances. Dichotomous variables will be defined from this application (grouping) and incorporated into equation (5) in order to see if these policies have different impacts on the provinces depending on their level of socioeconomic performances.

3. DATA AND EMPIRICAL RESULTS

3.1. Data Sources

The data on the private manufacturing sector of each province were obtained from Annual Manufacturing Industry Statistics by Statistics Institute of Turkey. The data set includes the private firms that employ ten or more individuals. It covers 58 provinces in Turkey over the periods of 1986-2000. There are 81 provinces in Turkey at this time. However, while there is no complete private manufacturing data for 9 of them, the other 14 were proclaimed provinces during the sample period that were formerly a part of another province. In order to make the results comparable, the data on these 14 provinces were merged into the data on the provinces where they were initially a part of. As a result, we are constrained to a sample of 58 provinces. In addition, we are unable to extent the time dimension of the panel to recent years because TSI has augmented the way in which manufacturing statistics were collected since 2001 and has published no comparable data since then.

The data on such variables as output, labor, capital stock, firm size of the private sector were collected from TSI. The value added definition is used for output because the production function includes only labor and capital stock as inputs. Labor is measured by total number of hours of work in production. Because the data on capital stock are not available, capital stock variable is proxied by the horsepower of installed equipment. Firm size is computed as the number of employees over the number of firms. The data on population is also taken from TSI and population density is the relative population size of a province in the total population of Turkey. The data on public investment at provincial level are obtained from the State Planning Organization (SPO).

Socioeconomic Development Index is taken from the report by SPO (2003). In the construction of this index, they used the indicators of demography, employment, education, health, industry, agriculture, construction, income and infrastructure. From these components, a summary measure of socioeconomic development was constructed using principal component analysis. Finally, investment subsidy series are taken from the Secretariat of Treasury. All nominal variables were converted into real ones in 1981 constant prices using producer price index taken from TSI.

3.2. The Results

The translog stochastic production frontier and technical inefficiency models are applied to the panel data of 58 provinces over 1986-2000 periods by employing the single step estimation method of maximum likelihood. We use Frontier 4.1 program by Coelli (1996) to obtain the estimates. The results are presented in Table 1. Before interpreting these results, we need to discuss several diagnostic tests performed to identify the optimal functional form along with the test on the existence of technical inefficiencies. The results on the tests are reported in Table 2. The first test is related to the question of whether the standard Cobb-Douglas production is more suitable functional form than the translog production function. As seen from the first row of the table, we reject the null at 5% significance level that the Cobb-Douglas function provides a better fit to the sample data. Second test concerns whether there exists technological change in the production of private manufacturing sector over the sample period. We also reject the null of no technological change at 5% level. Third test enables us to check whether the technical inefficiencies are present. Namely, the null hypothesis states that the production of each province lies on the production frontier, which is rejected at %5 level. Thus, it is significant to model technical inefficiencies. Finally, the null of time-invariant inefficiencies is tested against the alternative of time-variant inefficiencies. The test reveals that the time effects are significant, indicating that the technical inefficiencies differ over time.

Accordingly, the preferred specification is the one we reported in Table 1. We now turn to interpreting these results. The coefficients of the translog production function are individually significant. Also, the LR test at the bottom of the table shows that the model is significant as a whole, providing a good fit to the sample data. As is well known, the estimated coefficients of the translog function cannot be interpreted directly as elasticities. The translog function is too flexible to calculate robust estimates for these elasticities (Punig-Junoy, 2001). A look at the estimated coefficients of inefficiency model indicates that the two policy instruments are statistically significant and negatively affect technical inefficiencies. That is, both investment subsidy and public investment help reduce inefficiencies in private manufacturing sectors in the sample of 58 provinces. Because these two policy variables are measured on the same scale, their coefficients are directly comparable to see their relative contributions. From this point of view, investment subsidies contribute about three times more than public investment to the convergence process of provinces to the production frontier. In addition, the coefficient on the firm size is negative and statistically significant, suggesting that larger firms are more technically efficient. This result provides support for the Schumpeterian analysis, arguing that the large scale firms have many advantages that may lead them to be more innovative and so more efficient than small scale firms.

Table 1. Estimates of Production Frontier and Technical Inefficiency Model

		Coefficients	Std. Dev.	t-stat
Constant	β_0	-1.239	0.543	-2.28*
log(L)	β_1	0.070	0.006	11.81*
log(K_p)	β_2	0.525	0.093	5.64*
Trend	β_3	0.081	0.038	2.11*
$[\log(L)]^2$	β_{11}	0.068	0.012	5.46*
$[\log(K_p)]^2$	β_{22}	0.105	0.024	4.28*
$Trend^2$	β_{33}	-0.002	0.001	-2.18*
log(L)*log(K_p)	β_{12}	-0.146	0.036	-4.04*
Trend*log(L)	β_{13}	0.008	0.005	1.472
Trend*log(K_p)	β_{23}	-0.013	0.006	-2.13*
Inefficiency Model				
Constant	δ_0	3.725	0.369	10.09*
log(Subsidy)	δ_1	-0.360	0.040	-9.02*
log(Pubinv)	δ_2	-0.104	0.029	-3.58*
log(Fsize)	δ_3	-0.308	0.045	-6.85*
Popden	δ_4	2.498	0.852	2.93*
Variances				
σ^2		0.521	0.051	10.21*
γ		0.751	0.026	28.67*
Loglikelihood		-444.12		
LR-stat		49.94		

Note: * and ** indicate 1% and 5% levels of significance. Time specific effects are not reported to save the space.

According to Schumpeter, the advantages may stem from i) large firms can allocate more resources for R&D activities, which in turn enables them to enjoy scale economies and ii) large firms can better exploit new advances and innovations in cost-reducing techniques that are of indivisible nature. Lastly, the coefficient of population density is significant and carries a positive sign, indicating that technical inefficiencies get larger as do the populations of the provinces. One reason for this may be that a rise in the population of a province may result in an increase in cheap labor, affecting the capital-labor ratios and thus the resource allocation, which may in turn create technical inefficiencies (X-inefficiency).

Table 2. Diagnostic Tests

	Loglikelihood Ratios	LR-stat	Critical Values (95%)
Null Hypotheses			
Cobb-Douglas Production Function	-508.22	128.2*	7.81
No technological change	-511.46	134.68*	9.49
No technical inefficiencies	-543.04	197.84*	9.35
Time invariant inefficiencies	-462.07	35.9*	23.68

Note: * indicates 5% level of significance. The critical value for the test on no technical inefficiencies is taken from Kodde and Palm (1986: Table 1)

Another important question raised in this paper is whether these regional policies are subject to equality-efficiency tradeoff. More specifically, the aim is to check whether these policies can follow regional cohesion criteria without incurring efficiency losses. Thus the success of these policy instruments can be better assessed on the basis of whether a greater effect of these policies is felt by the provinces with low and medium performances. With an application of K-means clustering algorithm with respect to socioeconomic performances of the provinces in the sample, we identify three homogenous groups: low, medium and high performance provinces. The results are reported in Table 3. There are five provinces with high, 25 provinces with medium and 28 provinces with low socioeconomic performances. Because there are three clusters, two dichotomous variables are defined to allow for differing impacts of subsidy and public investment on technical efficiency of the provinces with respect to their performances. Taking high performance cluster as a base group, *DumMid* and *DumLow* are created to be the two dichotomous variables that take a value of one respectively for the medium and low performance provinces and of zero otherwise. The efficiency equation is then modified to incorporate the interactions of subsidy variable and the dummy variables, and the interactions of public investment and dummy variables. The results from this effort are presented respectively in Tables 4 and 5.

Table 3. Clusters of Provinces with Respect to Socioeconomic Performances

Provinces	Socioeconomic Development Index (2003)[a]	Clus-ters[b]	Provinces	Socioeconomic Development Index (2003)[a]	Cluster s[b]
İstanbul	4.80772	1	Samsun	0.08791	2
Ankara	3.31483	1	Nevşehir	-0.07483	3
İzmir	2.5241	1	Elazığ	-0.10131	3
Kocaeli	1.94329	1	Rize	-0.1784	3
Bursa	1.6789	1	Trabzon	-0.18582	3
Eskişehir	1.10368	2	Amasya	-0.18591	3
Tekirdağ	1.05893	2	Kütahya	-0.20684	3
Adana	0.94901	2	Malatya	-0.22627	3
Antalya	0.9148	2	Kırşehir	-0.2287	3
Kırklareli	0.86287	2	Afyon	-0.27246	3
Denizli	0.71624	2	Çorum	-0.32761	3
Muğla	0.71238	2	K. Maraş	-0.34968	3
Bolu	0.6086	2	Niğde	-0.35582	3
Balıkesir	0.5654	2	Giresun	-0.36696	3
Edirne	0.56234	2	Kastamonu	-0.37558	3
İçel	0.51934	2	Sivas	-0.40597	3
Bilecik	0.50429	2	Sinop	-0.48518	3
Kayseri	0.47748	2	Erzincan	-0.49288	3
Gaziantep	0.46175	2	Çankırı	-0.51917	3
Zonguldak	0.44906	2	Erzurum	-0.53286	3
Aydın	0.42025	2	Tokat	-0.5901	3
Sakarya	0.40404	2	Ordu	-0.64489	3
Çanakkale	0.36924	2	Diyarbakır	-0.66993	3
Manisa	0.34165	2	Yozgat	-0.71652	3
Konya	0.25254	2	Adıyaman	-0.77647	3
Isparta	0.21187	2	Kars	-0.81944	3
Hatay	0.19613	2	Şanlıurfa	-0.83158	3
Uşak	0.16867	2	Mardin	-0.98944	3
Burdur	0.14395	2	Van	-1.09297	3

Notes: a. Source SPO (2003); b. Obtained by using K-means clustering method. Cluster 1 indicates the provinces with high performance and Cluster 2 medium and Cluster 3 low performance provinces

Table 4. Testing for the Differing Impacts of Subsidy Policy

		Coefficients	Std. Dev.	t-stat
Constant	β_0	0.133	0.566	0.234
log(L)	β_1	0.065	0.005	13.58*
log(K_p)	β_2	0.357	0.094	3.79*
Trend	β_3	0.073	0.043	1.68**
$[\log(L)]^2$	β_{11}	0.053	0.013	4.21*
$[\log(K_p)]^2$	β_{22}	0.083	0.025	3.37*
$Trend^2$	β_{33}	-0.003	0.001	-3.01*
log(L)*log(K_p)	β_{12}	-0.106	0.036	-2.91*
Trend*log(L)	β_{13}	0.007	0.006	1.306
Trend*log(K_p)	β_{23}	-0.011	0.006	-1.77**
Inefficiency Model				
Constant	δ_0	1.742	0.306	5.69*
log(Subsidy)	δ_1	-0.093	0.025	-3.69*
log(Pubinv)	δ_2	-0.055	0.015	-3.73*
DumLow*[log(Subsidy)]	δ_3	0.059	0.015	3.95*
DumMid*[log(Subsidy)]	δ_4	-0.024	0.019	-1.252
log(Fsize)	δ_5	-0.253	0.050	-5.04*
Popden Table 4 (continued)	δ_6	0.414	0.953	0.434
Variances				
σ^2		0.301	0.033	9.16*
γ		0.628	0.054	11.69*
Time Effects		Yes		
Loglikelihood	-424.1	LR-stat	89.98	

Note: * and ** indicate 1% and 5% levels of significance.

Table 5. Testing for the Differing Impacts of Public Investment

		Coefficients	Std. Dev.	t-stat
Constant	β_0	0.270	0.466	0.579
log(L)	β_1	0.066	0.005	13.38*
$\log(K_p)$	β_2	0.333	0.075	4.42*
Trend	β_3	0.075	0.041	1.84**
$[\log(L)]^2$	β_{11}	0.049	0.012	4.08*
$[\log(K_p)]^2$	β_{22}	0.074	0.024	3.09*
$Trend^2$	β_{33}	-0.004	0.001	-3.33*
$\log(L)*\log(K_p)$	β_{12}	-0.092	0.034	-2.68*
Trend*log(L)	β_{13}	0.007	0.006	1.317
$Trend*\log(K_p)$	β_{23}	-0.010	0.006	-1.68**
Inefficiency Model				
Constant	δ_0	1.516	0.303	5.00*
log(Subsidy)	δ_1	-0.045	0.024	-1.87**
log(Pubinv)	δ_2	-0.063	0.025	-2.56*
DumLow*[log(Pubinv)]	δ_3	0.053	0.015	3.63*
DumMid*[log(Pubinv)]	δ_4	-0.021	0.009	-2.34*
log(Fsize)	δ_5	-0.183	0.038	-4.81*
Popden	δ_6	-0.893	1.504	-0.594
Variances				
σ^2		0.265	0.023	11.64*
γ		0.578	0.069	8.39*
Time Effects		Yes		
Loglikelihood	-430.3	LR-stat	77.52	

Note: * and ** indicate 1% and 5% levels of significance

As seen from Table 4, the coefficients of subsidy variable and its interaction with the dummies are significantly negative. They are 0.093 for high, 0.148 for medium and 0.034 for low performance provinces. More specifically, these findings show that the effect of investment subsidies on technical efficiency is the largest in the provinces with medium performance while it is the smallest for the low performance groups. In other words, the regional subsidy policy seems to contribute significantly to the provinces with medium performance while its contribution to the low performance provinces is rather small. Interestingly, as seen in Table 5, the impacts of public investment are quite parallel to those of subsidy. Public investment has its largest effect on technical efficiency in medium performance cluster. These results suggest that although the regional policies do create positive externalities by giving rise to technical efficiencies, they appear to be only partly successful in speeding up the convergence process across the regions. Overall, if more public investment and investment subsidies are devoted to the medium performance provinces, the highest efficiency gains can be generated with no efficiency-equity tradeoff. However, the allocation of these public supports to the low performance provinces for cohesion purposes seems to have a positive but small impact on technical efficiency as compared to its impacts for medium and high performance provinces. This implies that the provision of public support to low performance group is subject to equity-efficiency tradeoff. Regardless of such a tradeoff however, if the governments in Turkey aim for regional cohesion, these policies are of little help in this regard. Therefore, it is obvious that there is a need for well–designed and systematic regional development policies geared especially toward low performance provinces in Turkey.

CONCLUSION

One of the ongoing issues in the literature of regional development is whether public policies have any roles in enhancing regional economic activities, and if so, have any differing impacts on the economy at the national and regional levels. In the present paper, we investigated that question by focusing on the effects of regional policy instruments such as investment subsidies and public investment as on technical efficiency of private manufacturing sector in Turkish provinces. To this end, a stochastic production frontier model was applied to the panel data from 58 provinces of Turkey over the periods of 1986-2000. Incorporating investment subsidy and public investment variables into the (in)efficiency equation enables us to capture if these variables generate any externalities through affecting efficiency and thus productivity. This analysis, therefore, aims to critically assess the success of these regional policies both at the national and regional levels.

The empirical results reveal that both investment subsidies and public investment are positively related to technical efficiency. This suggests that these regional policies are useful and so necessary to promote the competitive power of an economy, in order to survive in the conditions of increasing competition in a global world. Furthermore, a comparison of the estimated coefficients on subsidy and public investment reveals that subsidies play a more substantial role than public investment in reducing technical inefficiencies at provincial level. This suggests that along with the provision of public infrastructure, direct investment subsidies might do a better job in increasing private sector productivity.

Another objective of the study was to examine whether the impacts of these regional policies differ with respect to the degree of socioeconomic performances of the provinces. The purpose is to check the presence of an equity-efficiency tradeoff. That is, although the findings indicate that these policies may help in the convergence process of the provinces through reducing technical inefficiencies, the question is whether the catching up effect generated by subsidy and public investment policies is higher in the provinces with low performances. If this is the case, the provision of these public supports can follow the redistribution criteria without efficiency losses. To this end, we used an empirical approach combining the K-means clustering algorithm and stochastic frontier analysis. This approach consists of two steps. First, the provinces were divided into three groups with respect to the extent of their socioeconomic performances as low, medium and high performance provinces. Second, the technical inefficiency equation was modified to embody the information from these clusters. The findings from this effort show that the provinces with medium performance get benefited the most from these policies in terms of the increased technical efficiency. The medium performance group covers the provinces viewed as new industrial districts such as Gaziantep, Denizli, Çanakkale, Kayseri and İçel. This implies that the success of these provinces so-called “Anatolian tigers” may in part be attributable to the subsidy and public investment policies and depends crucially on the provision of government grants and investments for the convergence process. However, these policies do not seem to provide a sufficient stimulus to the provinces with low performance, implying the existence of an equality-efficiency tradeoff. On the other hand, given the low share of these provinces in total subsidy and public investment spending, another explanation for this result may be that the amounts of subsidies and public investment are not large enough to bring about a significant productivity boost in these regions. While the provinces in this group constitute half of the whole sample, they receive approximately 27% of the total public investment expenditure and 17% of the total subsidies. Thus, the extent to which these policies give rise to the catching-up effect appears to be related to the shares of these provinces in total government grants and investments.

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