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The Impact of Public Capital on the Efficiency of Private Manufacturing Industry at the Regional Level

Metin KARADAĞ[1]

ABSTRACT

The public capital installed in a region has an important role in the development of that region, because the studies in this area show us that public capital has an important role on the private sector performance. It is expected that public capital enhances private sector efficiency, and thus the output of that sector. As it is well known regional disparities still exist in Turkey. The research in this area shows that public capital can be used to reduce regional disparities. In this respect the main aim of this study is to investigate the impact of public capital formation on the efficiency of private manufacturing industries in Turkey at NUTS II level. While most of the studies in this area use public capital as a direct input for production, we assume that public capital has an effect on private output by enhancing technical efficiency. For the aim of the study, we employ data envelopment analysis to calculate efficiency scores by using a panel data of 25 regions at the first stage; afterwards we estimate the effects of public capital on private sector efficiency econometrically by using these scores. The results reveal that public capital has positive impact on private sector efficiency both at the regional level and regional level.

Key Words: Public capital, technical efficiency, data envelopment analysis, Turkish manufacturing industry, regional development.

1. INTRODUCTION

Since the seminal works of Aschauer (1989a and 1989b), many economists have investigated the relationship between public capital and output and productivity in the private sector in the development literature. (see, for example, Munell, 1992; Holtz-Eakin, 1994; Seitz and Licht 1995; Pereira and Roca-Sagalés, 2001; Zugasti *et al.*, 2001; Rovolis and Spence 2001; Puig-Junoy, 2001; Kim and Lee, 2002; Fernandez and Montuenga-Gomez, 2003, Stephan, A., 2003, Sena and Destefanıs 2005, Karadağ et.al 2004, Deliktas et.al. 2009). In general, the results of these studies indicate that public capital has a positive impact on regional economic performance for many countries (see, for example Pereira and Flores, 1999, Zugasti *et al.*, 2001; Karadağ *et al*., 2004, Deliktas *et.al* 2009). On the other hand, some of other studies found no clear evidence of positive impact of public capital on private sector performance at the regional level for some countries (See, for example, Holtz-Eakin, 1994; Garcia-Mila *et al.*, 1996).

One should mention that most of the studies in this area have used either the production approach in which public capital is included as an additional productive factor (see, for example, Aschauer 1989; Munell 1992) or a dual approach in which public capital stock is included as an unpaid fixed input (see, for example, Seitz and Licht 1995, Rovolis and Spence 2001). On the other hand, some other studies have used two step method which estimates technical efficiency or inefficiency from the production function in the first step, and then estimate the relationship between public capital and technical efficiency in the second step (see for example, Kim and Lee, 2002; Fernandez and Montuenga-Gomez, 2003)[1].

One can say that efficient and appropriate provision of public capital has a very significant role in improving access to markets and in reducing the cost of production, because better infrastructure especially in the form of transportation might tend to reduce the cost of private sector production. Also, one can say that public capital can be complementary for private capital, and thus it attracts private investment (see also Deliktas et.al 2009). Regarding this, we can say that public capital stock can have a positive effect on private sector performance and thus foster regional economic growth.

In order to reduce the regional disparities, the Turkish government has followed some specific economic policies, such as investing more in relatively less developed regions and giving more investment incentives to those regions since 1960s. Although the manufacturing sector is not the whole economy, it has continued to expand its output and made a positive contribution to total economic growth. In this respect, investigating the relationship between public capital installed the regions and the efficiency level of those regions gains importance as far as Turkish private manufacturing industry is concerned[2].

[1] **Assoc. Prof., Department of Economics, Ege University, metin.karadag@ege.edu.tr**

In recent years, there have been a number of studies on regional convergence regarding Turkey (see, for example, Filiztekin, 1998, Yildirim, 2005, Gezici and Hewings, 2004). Although there are several studies analysing regional convergence in Turkey, there appears limited number of studies that investigates the impact of the public capital on the private sector performance and regional convergence (see Önder et.al. 2010, Deliktas et al. 2009 and Karadağ et al. 2004). Also, to the author's best knowledge, there seems to be only two studies that investigate the impact of public capital on private sector efficiency (see Önder et.al. 2003 and Karadağ 2004).

Therefore, the main aim of this paper is to investigate the effects of public capital formation on the efficiency of the private manufacturing industries for the 25 regions at NUTS II level in Turkey[3]. For the aim of the study, the panel data set for the 25 regions are used for the time period for 1980-2001[4].

Rather than calculating the effects of public capital on the basis of a general production function, we use two steps following Kim and Lee (2002), and Fernandez and Montuenga-Gomez (2003). In this context, efficiency scores for each region is obtained by using data envelopment analysis (DEA) in the first stage by employing panel data and then these scores are regressed on public capital to find out the impact of public capital on private sector efficiency. This study differs from the earlier studies by Önder et.al 2003 and Karadağ 2004, because this study analyses the effects of public capital at NUTS II level[5]. In this respect, this study analyses the impact of public capital in more detailed regional level. Thus, the results of this study might well be more useful for the regional policies in Turkey regarding the distribution of public investment between the regions.

The remainder of this paper is organised as follows. The next section gives brief background information about regional economics of Turkey at NUTS II level. Section three provides information about the data set used in the study for the aim of the study. Section four is about the methodology used in the study. Evaluation of the results are summarised and discussed in section five. The paper concludes with a summary analysis of the findings in section six.

2. BRIEF INFORMATION ABOUT REGIONAL ECONOMICS OF TURKEY AT NUTS II LEVEL

Although the Turkish economy performed relatively well between 1980-2001[6], there are still big disparities between the regions in Turkey. Since there is an excessive agglomeration industry in the western part, especially there are large economic disparities between eastern part and western part of Turkey.

In this respect the Eastern part of Turkey is much less developed than the western part. Hence, relatively more developed regions in the western part of the country lead to inequalities between the regions (see also Karadağ *et al*., 2004). Hence, the existence of the big regional disparities between west and east has become very important issue with regard to the regional economic policies. In spite of the fact that Turkey has followed economic policies to reduce regional inequalities since 1970s, there has not been much success regarding this issue.

The following table gives some basic economic data regarding the regions at NUTS 2 level.

Table 1: Basic Data for Turkish Regions at NUTS 2 Level

NUTS 2 Regions	*Population in Year 2000 (000)*	*Share of the total population in 2000 (%)*	*GDP per capita in 2000 (YTL, in) (1987 prices)*	*Share of total Gross Domestic Product in 2000*	*Share of Public Capital on average (1980-2000)*	*Share of Manufacturing Industry in Total Value-added in 2000*
TR10 İstanbul	10018,735	14,78	2623	22,12	9,98	28,47
TR21 Tekirdağ	1354,658	2,00	2401	2,74	1,98	6,86
TR22 Balıkesir	1541,322	2,27	1821	2,36	2,04	2,14
TR31 İzmir	3370,866	4,97	2675	7,59	7,99	8,18
TR32 Aydın	2516,114	3,71	2195	4,65	4,98	2,87
TR33 Manisa	3051,801	4,50	1758	4,52	6,44	3,19
TR41 Bursa	3025,475	4,46	2318	5,90	4,24	11,71
TR42 Kocaeli	2715,766	4,01	3091	7,07	3,69	14,66
TR51 Ankara	4007,86	5,91	2382	8,04	9,35	4,98
TR52 Konya	2435,376	3,59	1247	2,56	2,40	1,14
TR61 Antalya	2490,235	3,67	1576	3,30	2,37	0,73
TR62 Adana	3500,878	5,16	1898	5,59	4,12	6,65
TR63 Hatay	2714,892	4,00	1238	2,83	8,94	0,95
TR71 Kırıkkale	1690,826	2,49	1313	1,87	1,71	0,33
TR72 Kayseri	2498,442	3,68	1048	2,20	4,11	2,24
TR81 Zonguldak	1024,879	1,51	1846	1,59	2,92	0,71
TR82 Kastamonu	871,405	1,29	1131	0,83	1,15	0,32
TR83 Samsun	2999,46	4,42	1276	3,22	3,67	0,56
TR90 Trabzon	3131,546	4,62	979	2,58	2,70	0,82
TRA1 Erzurum	1351,588	1,99	636	0,72	1,35	0,13
TRA2 Ağrı	1156,15	1,71	451	0,44	1,05	0,04
TRB1 Malatya	1770,597	2,61	987	1,47	3,22	0,13
TRB2 Van	1956,437	2,89	418	0,69	1,48	0,03
TRC1 Gaziantep	2023,784	2,98	1203	2,05	1,05	1,85
TRC2 Şanlıurfa	2806,13	4,14	872	2,06	5,17	0,14
TRC3 Mardin	1778,705	2,62	668	1,00	1,90	0,21
Turkey	67803,927	100	1752	100	100	100

Source: Adjusted from Önder et.al. 2010.

As can be seen from the table, there is a clear existence of regional disparities in population, income distribution, and GDP per capita. The table also shows that the public investment is mainly distributed in the western regions and as a result public capital stock is mainly concentrated in the western regions. In other words, public investment expenditures are not used in the right direction to reduce regional inequalities in Turkey.

As Table 1 shows, GDP per capita in Kocaeli (the highest) region is 3091 TL, while it is only 418 TL in Van region. In other words, GDP per capita is more than seven times higher in Kocaeli than it is in Van. Also as can be seen from the table, real GDP per capita in the western regions (such as Istanbul, Kocaeli, and Izmir) is much higher than Turkey's average. However, GDP per capita in the eastern regions (especially Van, Agri, Erzurum, and Mardin) is much below the Turkey's average (24%, 26%, 36% and 38% of Turkey's average respectively). Also, this uneven distribution of income between the regions can clearly be seen when we compare the regions by taking the share of population and share of gross domestic product of the regions into account. For instance, while Kocaeli İstanbul and İzmir have 4.01%, 14.78%, and 4.97% of total population, their shares in total GDP are 7.07 %, 22.12%, and 7.59% respectively. Nevertheless, the shares of Van and Ağrı regions in total population are 2.89% and 1.71 %, their shares in total GDP are 0.69% and 0.44 % respectively.

Table 1 also shows that public investment is not used in the right direction in order to reduce regional disparities in Turkey. As mentioned earlier, in order to reduce regional disparities, the government should invest more in less developed regions. However, as can be clearly seen from the table, the relatively more developed regions such as İzmir and Ankara get relatively high amount of public capital stock on average, while the less developed regions get relatively small amount of it. For example, despite the share of Ankara region in total population is 5.91 %, its share in public capital stock on average is 9.35 %. Nevertheless, Agri region, one of the least developed regions in Turkey, has 1.71 % of total population and gets 1.05 % of public capital stock on average.

Moreover, as it can be seen from Table 1, the manufacturing sector is mainly concentrated in the regions in the western part of Turkey such as İstanbul, Tekirdağ, İzmir, Kocaeli and Bursa. For example the shares of value added created in manufacturing industry in 2000 in İstanbul, Kocaeli, and Bursa are 28.47%, 14.66% and 11.71% respectively. In other word around 55% of value-added created in manufacturing industry is in these three regions.

As it is well known, the European Union (EU) suggests that disparities between the regions in the member countries should be eliminated. As Turkey wants to become a member of the EU, reducing regional disparities between the regions is important in that context as well. In this context, the performance of the manufacturing industry will have a positive contribution to reduce regional disparities, since the share of manufacturing industry in the Turkish economy is considerably high, and has increased in recent years.

3. DATA

In this study, we used the data set consisted of regional level manufacturing outputs and inputs for the 25 regions at NUTS II level for the aim of the study for the time period of 1980 to 2001[7].

The data set related to private manufacturing industry of each region was obtained from several issues of Annual Manufacturing Industry Statistics published by Turkish Statististical Institute (TURKSTAT). Also, manufacturing industry wholesale price index was obtained from several issues of Monthly Bulletin of Wholesale Price Index, published by TURKSTAT. Investment deflators for public investments were taken from Main Economic Indicators published by State Planning Organisation (SPO). The public investment series were mainly obtained from Kutbay (1982) and SPO (see http://www.dpt.gov.tr/kamuyat) for the entire period.

Gross output in manufacturing industry for each region was measured in value terms at constant 1987 prices. In this study, labour, capital, and raw material were the main inputs. Labour was taken as the total number of working hours in production, while total horsepower of installed equipment is used as a proxy for private capital input[8]. Also, raw material included expenditures on output, supplementary materials, packaging materials, and the other raw materials required for production. Raw materials were also measured in value terms at 1987 prices.

Public capital stock for NUTS 2 level for time period 1980-2001 were calculated through Perpetual Inventory Method (PIM). In order to calculate capital stocks, public investment series for 1963-2001 were used. The public investment series for the time periods 1963-1981 and 1982-2002 were obtained from Kutbay's study (1982) and from State Planning Organization respectively. This PIM method is one of the methods of calculating capital accumulation. The method uses past investment expenditures to calculate initial capital stock by considering depreciation rates. Hence, the PIM is as follows:

$$K(t) = (1-\delta)K(t-1) + I(t) \qquad (1)$$

Where K (t) denotes real capital stock at time, I (t) denotes the real investment series at time t, and δ is the depreciation rate. In order to calculate the public capital stock for the 25 regions, the benchmark public capital stock is required. As public capital stock was not available for NUTS 2 level in

Turkey, the initial capital stock was estimated by using the following equation:

$$K(t) = \sum_{j=1}^{L} (1-\delta)^{j} I(t-j) \qquad (2)$$

Where L denotes the lifetime of the investment. One can say that the lifetime of investments in calculating capital stock can change for different countries and for different sectors of economies. The lifetime of investments were determined as 17 years to calculate regional public capital stock for time period 1980-2001 in this study, because public investment series are available from 1963. Hence, the depreciation rate was calculated as a 5.88 % in this study.

4. METHODOLOGY

In this study by following Kim and Lee (2002), and Fernandez and Montuenga-Gomez (2003), we employ two-step method to analyse the impact of public capital stock on private sector efficiency at the regional level. Kim and Lee applied a stochastic frontier production model, while Fernandez and Montuenga-Gomez employed growth accounting approach to obtain the technical efficiency scores in the first stage in their studies. In this study, the DEA method is used to calculate technical efficiency scores of the Turkish private manufacturing industries for the 25 regions in Turkey at the first stage. As it is well known, the DEA method was developed by Charnes et al., 1978. Since then, there has been a large literature about the application of DEA methodology specifically in the area of calculations of technical efficiency scores.

The output-oriented DEA model for a single output used in this study is closely related to Coelli *et al.*, 1998, p 158 and the model can be formalised as follows. Consider the situation for the *N* industries, each producing a single output by using *K* inputs. For the *i*-th industry x_{it} is a column vector of inputs, while yit is a scalar representing the output. *X* denotes the $K \times NT$ matrix of inputs and Y denotes $1 \times NT$ matrix of output. In this respect, the CRS output-oriented DEA model is given by;

$$\max_{\phi,\lambda} \phi \qquad (3)$$

subject to

$$-\phi\, y_{it} + Y\lambda \geq 0,$$

$$x_{it} - X\lambda \geq 0,$$

$$\lambda \geq 0,$$

where $1 \leq \varphi < \infty$, λ is a $NT \times 1$ vector of weights. $1/\varphi$ defines technical efficiency score, which varies between zero and one, with a value of one indicating any point on the frontier. The linear programming problem must be solved NT times in order to provide a value of φ for each industry in the sample.

After getting he efficiency scores by using the DEA method, then these score are regressed against the public capital stock in order to investigate the possible effects of public capital on private sector efficiency. So we estimate the effects of public capital by using the following model,

$$TE_{it} = \beta_0 + \beta_1 \ln G_{it} + e_{it} \qquad (4)$$

where TE_{it} is technical efficiency for region *i* in the *t*th year, G_{it} is public sector capital for state i in the tth year. Equation (4) is estimated by OLS.

5. EMPIRICAL RESULTS

The main focus of this study is on the mechanism through which public capital increases the performance of the private sector by increasing technical efficiency. As mentioned above, firstly we get the efficiency scores for the private manufacturing industry at the NUTS 2 level. In this respect, the following table gives the efficiency scores for different years for the regions by using DEA method.

Table 2 gives the efficiency scores for the 25 regions for different years.

Table 2: Efficiency Scores for the Regions for different Years

Regions	1980	1981	1986	1991	1996	2001
TR10 İstanbul	0.909	0.783	1.000	1.000	1.000	1.000
TR21 Tekirdağ	0.906	0.699	0.954	0.978	1.000	0.952
TR22 Balıkesir	0.884	0.769	0.965	1.000	1.000	0.986
TR31 İzmir	0.899	0.645	0.924	0.952	0.979	1.000
TR32 Aydın	0.836	0.652	0.877	0.844	0.892	0.836
TR33 Manisa	0.815	0.667	0.907	0.949	0.908	0.945
TR41 Bursa	0.861	0.694	0.952	1.000	0.974	0.860
TR42 Kocaeli	1.000	1.000	1.000	1.000	1.000	1.000
TR51 Ankara	0.801	0.732	0.913	0.976	0.988	1.000
TR52Konya	0.740	0.611	0.851	0.856	0.877	0.768
TR61 Antalya	0.823	0.721	0.870	0.864	0.887	0.816
TR62 Adana	1.000	1.000	0.992	1.000	0.923	1.000
TR63 Hatay	0.828	0.925	0.810	0.861	0.745	0.828
TR71 Kırıkkale	0.780	0.579	0.870	0.986	0.939	0.775
TR72 Kayseri	1.000	0.738	0.796	0.953	1.000	0.920
TR81 Zonguldak	0.792	0.534	0.962	0.736	0.861	0.604
TR82 Kastamonu	0.969	0.628	1.000	0.996	0.826	0.746
TR83 Samsun	0.709	0.599	0.786	0.836	0.794	0.695
TR90 Trabzon	1.000	0.946	0.900	0.832	0.804	0.976
TRA1 Erzurum	0.902	0.956	0.914	0.889	0.896	0.807
TRA2 Ağrı	0.761	0.859	0.712	0.758	0.900	1.000
TRB1 Malatya	0.755	0.650	0.868	0.871	0.784	0.840
TRB2 Van	0.754	1.000	0.719	0.708	0.838	0.603
TRC1 Gaziantep	0.708	0.571	0.837	0.809	0.811	0.983
TRC2 Şanlıurfa	0.995	0.808	0.815	0.738	0.828	0.717

As can be seen from the Table there are significant differences in efficiency scores between the regions. Also, as the Table shows efficiency in most of regions deteriorated in 1981 and there was improvement in almost all regions (apart from Ağrı) in 1986. In general, Konya, Antalya, Malatya, Hatay, Zonguldak, Samsun, Malatya, and Van have lower efficiency scores compared to the other regions, while İstanbul, İzmir, Kocaeli, Ankara, and Adana have higher efficiency scores. As can be seen from the Table efficiency scores in the western regions are higher compared to eastern regions. For example, İstanbul, Kocaeli, and İzmir have relatively higher efficiency scores in the manufacturing industry. This is not surprising as almost 50% of value-added created in belongs to these regions as mentioned before (see Table 1). On the other hand, Kocaeli is found to be on the frontier for all of the years.

Regarding the impact of public capital on the technical efficiency of private sector, firstly we give the regression estimations at the aggregate level for Turkey. This is an important step as it gives us the benchmark for the overall effects of public capital formation aggregated across the seven regions.

Table 3 shows the estimated results using equation (2), in which one-sided technical efficiencies from the estimated technical frontier are regressed against public capital by utilising ordinary least squares (OLS).

Table 3: Technical Efficiency and Public Capital at aggregate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.096441	0.120198	0.802346	0.4227
LOG(PUBCAP?)	0.043083	0.006787	6.348177	0.0000
R-squared	0.068501			
Adjusted R-squared	0.066802			
S.E. of regression	0.109508			
Sum squared resid	6.571632			
Log likelihood	437.0517			
F-statistic	40.29934			
Prob(F-statistic)	0.000000			

(*) PUBCAP denotes public capital.

As can be seen from the table, the regression results show us that there is a positive significant relationship at the 5 % level between the public capital and technical efficiency on aggregate as expected. These results may indicate that public capital as a whole significantly increases technical efficiency in the Turkish private manufacturing industry. The results of this study are in line with Kim and Lee (2002), as they also found a positive relationship between public capital and efficiency.

Table 4: Technical Efficiency and Public Capital at NUTS II Level

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.134832	0.269556	-0.500201	0.6171
TR10--LOG(PUBCAPTR10)	0.059294	0.014380	4.123399	0.0000
TR21--LOG(PUBCAPTR21)	0.062434	0.015621	3.996658	0.0001
TR22--LOG(PUBCAPTR22)	0.061985	0.015647	3.961600	0.0001
TR31--LOG(PUBCAPTR31)	0.055960	0.014553	3.845188	0.0001
TR32--LOG(PUBCAPTR32)	0.053939	0.014866	3.628347	0.0003
TR33--LOG(PUBCAPTR33)	0.055599	0.014693	3.783943	0.0002
TR41--LOG(PUBCAPTR41)	0.057679	0.014983	3.849704	0.0001
TR42--LOG(PUBCAPTR42)	0.063251	0.015119	4.183612	0.0000
TR51--LOG(PUBCAPTR51)	0.056557	0.014410	3.924915	0.0001
TR52--LOG(PUBCAPTR52)	0.053123	0.015446	3.439316	0.0006
TR61--LOG(PUBCAPTR61)	0.053960	0.015500	3.481416	0.0005
TR62--LOG(PUBCAPTR62)	0.060331	0.015055	4.007419	0.0001
TR63--LOG(PUBCAPTR63)	0.049236	0.014463	3.404246	0.0007
TR71--LOG(PUBCAPTR71)	0.055683	0.015745	3.536587	0.0004
TR72--LOG(PUBCAPTR72)	0.057714	0.015074	3.828768	0.0001
TR81--LOG(PUBCAPTR81)	0.052028	0.015321	3.395798	0.0007
TR82--LOG(PUBCAPTR82)	0.059126	0.016137	3.664037	0.0003
TR83--LOG(PUBCAPTR83)	0.049363	0.015173	3.253393	0.0012
TR90--LOG(PUBCAPTR90)	0.059406	0.015364	3.866627	0.0001
TRA1--LOG(PUBCAPTRA1)	0.058093	0.015991	3.632931	0.0003
TRA2--LOG(PUBCAPTRA2)	0.054687	0.016258	3.363704	0.0008
TRB1--LOG(PUBCAPTRB1)	0.051568	0.015276	3.375851	0.0008
TRB2--LOG(PUBCAPTRB2)	0.055914	0.015905	3.515550	0.0005
TRC1--LOG(PUBCAPTRC1)	0.054980	0.016245	3.384491	0.0008
TRC2--LOG(PUBCAPTRC2)	0.052348	0.014932	3.505732	0.0005
R-squared	0.406965			
Adjusted R-squared	0.378672			
S.E. of regression	0.089355			
Sum squared resid	4.183802			
Log likelihood	561.2257			
F-statistic	14.38364			
Prob(F-statistic)	0.000000			

Table 4 shows the estimated results using equation (2) regarding regions of Turkey at NUTS II level using the same method as in Table 3.

As can be seen from the table, the results show that the public capital formation affects technical efficiency positively at the regional level regarding the private manufacturing sector. All of the estimated coefficients regarding the regions have the expected positive sign and all are significant at the 5 % level for all regions. This is in line with studies showing that public capital decreases inefficiency (see, for example, Puig-Junoy 2001, and Kim and Lee 2002, Önder et.al. 2003). This implies that public capital in the regions significantly increases technical efficiency in the private manufacturing production.

Hence, the results as a whole indicate that public capital enhances technical efficiency, which influences actual output. In other words, public capital reduces the gap between actual output and maximum potential output. Therefore, one can say that public capital can be an important tool to reduce the gap between the regions in the country.

6. CONCLUSION

In this study, the effects of public capital formation on technical efficiency of private sector were analysed at both national and regional level regarding the Turkish private manufacturing industry. For the aim of the study, we obtained the efficiency scores of the 25 regions regarding private manufacturing industry for the time period 1980-2001 at the first stage by using DEA method. Afterwards we estimated the effects of public capital stock on private sector efficiency at aggregate and at NUTS II level for 25 regions. This study is based on panel data of 25 sub-regions for the time period 1980-2001. The present study covers longer available time period and covers more regions than those considered in previous studies.

The results of the study indicate that public capital has a positive significant effect on private sector efficiency on aggregate. Moreover, the results reveal that the impact of public capital on technical efficiency in all regions is positive and significant. There was broad agreement between the findings of this study and earlier studies in this area (see, for example, Kim and Lee 2002, and Önder et.al. 2003).

Hence, the results of the present study imply that pubic capital increases the efficiency in the Turkish private manufacturing industry both on aggregate level and on regional level. In this respect, a policy implication of these results is that public capital can be used as a tool in order to reduce the regional disparities between the regions of the country. Regarding this, more public investment expenditures should be made by the government in the relatively less developed regions particularly in Ağrı, Mardin, Şanlıurfa, Van, Erzurum and Malatya to increase the private sector efficiency.

END NOTES

1. Using the production function approach has been questioned in the literature, because elasticity estimated in most commonly used Cobb-Douglas production function is sometimes too big to be credible. These studies also have been critisied for contatining some econometric problems (see Kim and Lee 2002 and Fernandez and Montuenga-Gomez, 2003 for more details). Therefore, we also emloy two step method in this study.
2. Since data are not available for the other sectors at the regional level, we are restricted to the manufacturing industry in this study.
3. Although there are 26 regions at NUTS II level in Turkey, we had to drop the TRC3 (Mardin) region due to data unavailability in manufacturing industry belonging to this region. Therefore, we estimate the effects of public capital on private sector performance for the 25 regions.
4. As the data related to manufacturing industry is only available until 2001, we take 2001 as the latest year.
5. Önder et.al. carried out the study for some selected regions, while Karadağ carried out the study for the seven geographical regions for the time period between 1980-2000.
6. It grew at about 4.5 % on average during this period (see www.dpt.gov.tr for details)
7. As mentioned before, we dropped Mardin Region (TR3) because the data is not available for all years for this region. Also, as the data related to manufacturing industry at the regional level is only available until 2001, the time period covers 1980 to 2001.
8. Total horsepower of installed equipment can also be used as a proxy for capital. (See, Taymaz and Saatçi, 1997).

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