Where should we Spend Government's Money? The Effect of public Sector Investments on Socioeconomic Development in Turkey[1]

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Abstract:

In this paper, we analyze the effects of area-specific public investments through 1999-2002 in 76 provinces of Turkey on their socioeconomic development through the period 1996-2003. We consider public investments in areas of agriculture, health, education, transportation, telecommunication and others. Our objective is to find the area of public investments that has provided the largest socioeconomic improvement per lira invested in the relevant period. Given the scarce resources and a bitter history of budget deficits of the Turkish public sector, it is crucial for the policymaker to know which investment area yields the largest welfare improvement per lira invested. To find out, we use ordinary least squares and nonparametric estimation methods. The results from both methods reveal that on average, education investments have a positive significant effect on socioeconomic status of a province per lira invested. Investments in other areas appear to be insignificant in the period considered. The results emphasize the importance of policymaker's choice of which area to invest the next lira available.

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Introduction

Governments' role on development has been debated among economists and policymakers for centuries. There have been very diverse opinions about the issue ranging from proposing very active government intervention on all aspects of economy to confining governments' role as a very small regulatory player. As a general trend in recent decades, developed and developing countries tend to embrace the neoclassical view of government more. However this does not automatically mean that governments' role is really diminishing. On the contrary, when we take a long run perspective, we observe that ratios of government budgets' to GDPs of nations are increasing. However, modern governments intervene in the markets in different ways than the governments in the past.

Public investments constitute one of the most prominent means of government intervention in markets. They can contribute to the development of a country or a region in a variety of mechanisms. They can provide some public goods which would be underprovided by private markets. For example, infrastructure investments are generally considered as public goods, the social benefits of infrastructure are bigger than social costs, but since appropriating those investments is not technically feasible, private markets do not provide these investments at efficient amounts. Also, public investments can provide goods or services which create positive externalities. Primary education and post-graduate level education have been shown to have positive externalities. When markets fail to allocate resources efficiently for a variety of reasons, government investments are needed to improve the allocation of resources. Health services are one of the sectors in which private markets fail to work efficiently and need for government intervention is absolute[5]. Public investments can also provide income transfers to the relatively poor segments of the society. Especially in developing countries agricultural investments can be considered as income transfer to the poor[6]. Thus, public investments can have huge benefits and substantially influence development. However as we all know, financing these investments can be very costly. Governments must either increase current taxes or borrow money by issuing bonds, or obtain seignorage revenue by increasing the money supply. None of the options seem appealing especially for countries like Turkey. Already high tax rates, large government debt and a high rate of inflation make it very difficult for the government to undertake investment projects. Thus, governments have to analyze the issue very carefully and try to get involved in projects which will have the largest positive effect on the development.

[5] Asymmetric information, moral hazard, and adverse selection, are a few of the many problems in health services market. For a good review on the issue see Cutler (2002)

[6] In Turkey per capita income of individuals working in agriculture is approximately half of per capita of average Turkish population.

The literature on the effects of public investments can be classified into a few categories. An important number of studies concentrate on the relationship between public investments and *regional inequalities*. One of the objectives of a government is to help alleviate welfare inequalities across the regions of a country. Güneş (2004) studies the effect of public investments on the socioeconomic status of Diyarbakır, the eastern province of Turkey and shows that the government was unable to prevent this province from falling behind other provinces in welfare rankings. Zhang and Fan (2004) studies the effect of public investments on regional inequalities across regions of China. They find that public investments in the least-developed western part of China helped alleviate inequalities but investments in the more-developed east coast and middle regions increased inequality. They conclude that agricultural R&D and rural education investments in the west is crucial to reducing inequality. There are plenty of papers that study the existence of economic convergence across regions of Turkey such as Filiztekin (1997), Tansel and Güngör (1998), Berber et al. (2000), Gezici and Hewings (2004), but only a few papers that look at the effect of public investments on inequality such as Önder et al. (2007) and Yıldırım (2005). Önder et al. (2007) tests for conditional convergence across regions using a panel data model. They test the effects of public investments on per capita GDP of regions between 1980 and 2001. They show the existence of conditional convergence across regions of Turkey. They also find that in some of the models public capital has a positive and significant effect on output per capita. However, in models that use spatial effects, they do not find any effect of public capital on regional convergence.

Yıldırım (2004) studies the effects of public investments in ''Priority Regions for Development'' of Turkey[7] on economic development of those regions. Our paper is different from Önder et al. (2007) and Yıldırım (2005) because we compare the effects of public investments *across types* such as education, health, communication, etc. on welfare. Also, we take a broader perspective in measuring welfare by not restricting welfare into GDP per capita.

Another category of papers study the effects of public investments in a particular area such as health, education, transportation, agriculture etc. For example, Valdivia (2004) studies the effects of health infrastructure investments on nutrition of Peruvian children. Measuring children's nutrition by their height, he finds that investments have improved health status of poor children in urban areas but not in rural areas. Geographical difficulties and high costs of medical examination and treatment prevent rural children from getting good health services. He also finds that the most important factor that affects children's health is mother's education level. Yang (2005) studied the impact of West Sea Expressway project on regional and national development in Korea.

[7] This is an official term in Turkey that refers to regions or provinces that have priority in receiving public investments mostly because they are relatively behind in economic and social development.

To our knowledge, there is scarcely any study on Turkey that *compares* marginal welfare effects of public investments *across* types of investment using rigorous statistical analysis, which is what we aim to do in this paper. In a rare similar study by Bakış et al. (2008), authors look at type of public investments versus per capita income growth relationship. They classify types of public investments as education, health and military expenditures. They rigorously examine the causality between these types of expenditures and per capita income in a dynamic, time series setting. They find that health and education expenditures have lagged and significantly positive effects on per capita income. They also find lagged and significantly negative effects of military expenditures on per capita income. Their analysis implies that Turkey should increase its health and education expenditures and decrease military expenditures for development. The present paper is different from theirs in the sense that we take a broader measure of welfare than income per capita.

In this paper, we compare the effects of health, education, transportation and telecommunication, agriculture and other types of public investments in provinces of Turkey on the socioeconomic development of those provinces through 1996-2003. Previous literature mostly uses per capita income as the sole measure of economic development or welfare. However; welfare of individuals does not only depend on their private incomes but also on a variety of other factors. Public health services, public educational institutions, availability of clean water and sewage systems, reliability of electricity, air quality and many other variables can affect individual welfare but might not show up on per capita income statistics. Thus in this paper, we use an index of socioeconomic development prepared by State Planning Organization (SPO) that includes a wide array of both economic and social indicators of human development (Dinçer et al. 2003).

We consider public investments in five areas: agriculture, health, education, transportation and telecommunication and others. Our objective is to find out which areas of public investments have provided the highest socioeconomic improvement across provinces on average between years of 1996 and 2003.

Turkey has had persistent public sector budget deficits and consequent balance of payments crises since 1980s. Especially after the 2001 crisis however, government's fiscal discipline has been the foremost priority of economic policy. Therefore, it is indispensable for the policymaker to know which area of the economy yields the ''largest'' welfare improvement per lira invested.

It seems that empirical papers that have studied development especially in Turkey have mostly used ordinary least squares (OLS) regression as their technique of analysis. In addition to OLS in this paper, we use nonparametric regression (NP) model. Nonparametric regression is a method that is robust to misspecification of the functional form of regression as it does not impose an a priori functional form (Li et al.

2007). Not surprisingly, our estimation results show that nonparametric techniques perform better than OLS in terms of objective criteria such as mean squared error (MSE) and R-squared. We believe that the application of NP methods to this question is an important contribution to the development literature in Turkey.

The rest of the paper is organized as follows: section 2 describes the data and section 3 describes the methodology used in the analysis, section 4 presents the results and section 5 concludes.

Data

We do not attempt to measure levels of development or welfare in provinces of Turkey in this paper. Instead, we use indices of socioeconomic development across 76 provinces of Turkey for the years 1996 and 2003 constructed by the researchers at State Planning Organization (SPO) (Dinçer et al. 2003). SPO takes a broad view of the development concept by combining 58 economic and social variables that measure various aspects of development. These variables include, for instance, infant mortality rates, literacy rate, electricity consumption rate, and the number of motor vehicles among others. We use the improvement in the two development indices of each province between the years of 1996 and 2003 as the dependent variable in our analysis. We measure the improvement (or decline) in levels of development by the difference between the province's index in 2003 and 1996. Denoting improvement of province i by IMP_i,

$$IMP_i = INDEX_{i,2003} - INDEX_{i,1996} \quad i = 1,..,76 \tag{1}$$

where $INDEX_{i,t}$ is the socioeconomic development index of province i at year t.

As explanatory variables, we use per capita public sector investment amounts made in each of the 76 provinces in five different areas through the years 1999, 2000, 2001 and 2002. We consider public investments in five areas: health, education, agriculture, transportation and telecommunication and other investments. The investment data was also obtained from SPO. We add up the investments made in each area in each province through the 1999-2002 period. Then, we find the per capita investments by dividing the investment amounts by the population of each province.

Methodology

We use alternative regression methods to find the relationship between area-specific public investments and socioeconomic development. The purpose is to compare and verify results across alternative methods. First, we use OLS regression. The estimated linear model is

$$IMP_i = \beta_0 + \beta_1 AGR_i + \beta_2 HEA_i + \beta_3 EDU_i + \beta_4 TT_i + \beta_5 OTH_i \quad i = 1...76 \tag{2}$$

where IMP_i is the difference in the development index of province i between years 1996 and 2003; AGR_i, HEA_i , EDU_i , TT_i , OTH_i are the per capita investment amounts made to agriculture, health, education, transportation and telecommunication and other areas in province i respectively.

OLS regression as any other parametric method requires the practitioner to specify a functional form prior to estimation regarding the relationship between the dependent variable and independent variables. When the practitioner assumes a functional form (such as a linear function in the OLS case), there is a possibility that this chosen form does not represent the true population from which the data was gathered. Such a possibility can be evaluated using specification tests. If the parametric model is found to be misspecified, then the results obtained from the parametric estimation cannot be valid. Nonparametric (NP) kernel regression method is robust to misspecification of functional form (Li et al. 2007). For this reason, we also apply NP regression in this paper. The key issue in NP estimation is the selection of optimal bandwidths. Following Racine and Li (2004) and Li and Racine (2004), we employ least-squares cross validation (LSCV) method in bandwidth selection. The results of both the OLS and NP kernel regression estimation are provided in the next section.

In Turkey, during the period of 1996-2003, the status of five ''towns'' previously under the administration of their respective provinces have been elevated to the province status themselves. Those ''breakaway'' towns are Düzce (Bolu), Kilis (Gaziantep), Yalova (Bursa), Osmaniye (Adana), and Karabük (Zonguldak) with their former provinces written in parentheses. This administrative change has artificially influenced the socioeconomic development indices of those five provinces at varying degrees. The most significant effects were observed for Bolu and Gaziantep. As Düzce has become a province, Bolu jumped 15 provinces ahead in the socioeconomic development ranking during 1996-2003. In the same period, Gaziantep left 6 provinces behind in the ranking. The mean and the standard deviation of the change in the development indices of 76 provinces during 1996-2003 were -0.0016 and 0.13 respectively. The change in the index values of Bolu and Gaziantep were +0.46 and +0.26 respectively. Thus it is clear that regression results may unduly be influenced by the administrative change of the five provinces. To control for such an artificial influence, we include a dummy variable with the name DUM that takes the value of one for Bolu, Gaziantep, Adana, Bursa and Zonguldak and zero otherwise. So our OLS model becomes:

$$IMP_i = \beta_0 + \beta_1 AGR_i + \beta_2 HEA_i + \beta_3 EDU_i + \beta_4 TT_i + \beta_5 OTH_i + \beta_6 DUM_i \quad i = 1...76 \tag{3}$$

Results

The results of the OLS regression using equation (3) are presented on Table 1.

Table 1. Results of the OLS Regression of Public Expenditures on Socioeconomic Development.

Variable	Coefficient	t-statistic	Rejection Probability
AGR	-0.000267	-0.26	0.800
HEA	0.000116	0.05	0.960
EDU	0.00291	2.8	0.007***
TT	0.000520	0.33	0.743
OTH	0.0000737	0.89	0.376
DUM	0.219	4.66	0.000***
constant	-0.0847	-3.13	0.003
R-squared	0.324		
MSE	12.5×10^{-3}		
Sample size	76		
F (6, 69)	6.84		
Prob > F	0.0000		

Stars next to coefficients ***, ** and * indicate significance at the levels of 1%, 5% and 10% respectively.

The results clearly show that only education investments have a significant positive effect on socioeconomic development of provinces. The coefficient of the education variable is also large, considering the fact that the average improvement in the development index (*IMP*) is only -0.0016. This means that on average, a one Turkish Lira (of 1987) increase in the education investments in a province leads to 1.8 times[8] the magnitude of the average welfare improvement across provinces.

[8] 1.8 = 0.00291 / 0.0016

A second point to note is that the administrative division of the five provinces Bolu, Gaziantep, Adana, Bursa and Zonguldak into smaller provinces has very significantly affected their socioeconomic status. This was expected because the relative position of the five provinces in the rankings has been altered after the administrative change, as was discussed earlier.

The result is a strong one; however, we need to compare it with the results of an alternative method in order to see if the result is robust to the technique of analysis. Therefore, we use nonparametric regression with data-driven optimal bandwidth selection for categorical (discrete) and continuous variables (See Racine et al. 2004). In particular, our method uses local constant regression estimator with second order Gaussian kernel function for continuous variables and Aitchison and Aitken's 1976 kernel function for the dummy which is an unordered categorical variable.

We also use a nonparametric method of significance testing based on Racine, Hart, and Li (2006) and Racine (1997). This method uses the optimal bandwidths found in nonparametric regression in a bootstrap algorithm. This algorithm executes a user-specified number of bootstrap replications and returns the rejection probabilities analogous to a simple t-test in parametric regression. We used 399 bootstrap replications in results reported below. The results of the nonparametric regression and significance tests are presented on Table 2.

Table 2. Results of the Nonparametric Regression of Public Expenditures on Socioeconomic Development.

Variable	Selected Bandwidth	Rejection Probability
AGR	4.70	0.396
HEA	15.4	0.143
EDU	12.9	0.043 **
TT	3.7×10^{7}	0.642
OTH	109	0.434
DUM	8.7×10^{-17}	0***
R-squared	0.535	
MSE	7.9×10^{-3}	
Sample size	76	

Stars next to coefficients ***, ** and * indicate significance at the levels of 1%, 5% and 10% respectively.

We obtain a smaller MSE from nonparametric (NP) regression (7.9×10^{-3}) than OLS regression (12.5×10^{-3}). This shows that NP regression does a better job in fitting the actual distribution than OLS. Also, we get a larger R-squared value with nonparametric method. This implies that the latter method explains a larger percentage of the variation in the dependent variable using explanatory variables. In short, one could argue that NP regression could be a better way of studying the relationship between public investments and socioeconomic development.

As to the question of which area of investments yield the highest return in terms of socioeconomic development, the results of the two methods support each other. Investments in education appear to be the only significant type of public investments that positively contribute to socioeconomic development of a province. The OLS method seems to estimate a greater significance level (less than 1 percent) for education investments than the NP method (4 percent). Neither of the methods detects significant effects of investments on other areas than education on welfare for the relevant period. The implication for the policymaker is clear: on the margin, public investments on education should have priority over all other areas. Investments on other areas should be re-evaluated in terms of their welfare returns.

Also, NP regression confirms the OLS result that the administrative division of the five provinces has significantly affected their development level.

Conclusion

In this paper, we study the effect of education, health, transportation and other public investments made in 76 provinces of Turkey between 1999 and 2002 on the socioeconomic development levels of those provinces between 1996 and 2003. We apply two methods to the problem: OLS and NP regression. Both methods find that only education investments have a positive and significant effect on socioeconomic development of Turkish provinces. We do not detect any significant contribution of other public investments such as health, agriculture, transportation and telecommunications expenditures. These results support Bakış et al.'s (2008) result on education but not on health as they find positive effect of health investments. Of course, we consider a particular period different than theirs and a different dependent variable. Obviously, more research is needed to test our results. However, the message to the policymaker is clear: education investments have to be taken more seriously, even if this means that the government has to cut down other types of investments.

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