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CAMA Working Paper 44/2022
Aug 2022

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JEL Classification

C23, H51, H75, I10

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ISSN 2206-0332

The Determinants of Provincial Public Health Expenditures in Turkey: Evidence from a Spatial Data Analysis

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Abstract

This study investigates the determinants of provincial public health expenditures for Turkey, employing spatial econometrics models. To this end, the panel data at NUTS3 level for the period 2009-2019 have been employed. The exploratory spatial data analysis suggests that real GDP per capita, real health expenditure per capita, and all other socio-demographic variables used in the analysis are significantly spatially dependent. Also, the traditional East-West divide shows persistence in income and health indicators. Empirical results show that there is a spatial dependence in the provincial real public health expenditure per capita. This result corroborates the externality effect of government expenditure. The results also show the presence of strong path dependency, implying long-term policy stability. According to our findings, it seems that age structure, education level, and urbanization are important determinants of public health expenditure with significant spatial effects. Overall, our empirical results do not support the supply-induced demand theory, but rather indicate that demand side factors are more important determinants of central public health expenditures.

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Introduction

Provision of basic healthcare services and improving their access have been among the primary goals for the Turkish health policymakers. For example, there have been significant improvements in the healthcare system with the implementation of the government's Health Transformation Programme in 2003.[1] As part of this programme, institutional and organizational reforms have been conducted in an attempt to eliminate fragmentation and duplication in the health financing and delivery systems and to assure universal access to health insurance and health services. Social Insurance and Universal Healthcare Insurance Law consolidated five health insurance schemes in 2008 to ensure unity, equity, and efficiency in the delivery of the services (Gursoy, 2015). Within the framework of the compulsory general health insurance model, all citizens are required to contribute to the public health insurance fund (Ark Yildirim et al., 2019). The universal health coverage framework covered 98 percent of the population and improved access to healthcare services at both private and state hospitals, as well as reducing out-of-pocket expenditures. All public hospitals formerly owned by social security funds were handed over to the Ministry of Health, which has then contributed to improvements in delivering the service (Yilmaz, 2013). To eliminate the regional inequalities, 30 health regions were determined in 2010, and a region-based health service planning scheme was adopted.[2]

Turkey has a combined healthcare system where the welfare-oriented (also referred as the Bismarck Model) general health insurance is accompanied by a public assistance model, proposed by the Beveridge Model (Yilmaz et al., 2019). Although Turkey has adopted mixed healthcare and financing system, health services are mainly provided by the public sector. According to the welfare-oriented health system, health services are accepted as a social welfare

[1] For a brief account of Turkish health policies please see (Kilci, 2021).
[2] https://shgmshpdb.saglik.gov.tr/TR-5708/saglik-hizmet-bolgeleri.html, accessed on March 2nd, 2022.

project and these services are provided for the public benefit. However, as in most countries, a mixed health system is dominant in Turkey, where the private sector is the service provider as well as the public one. The transformation in the healthcare system brought a nearly 64 percent increase in per capita total health expenditures from 749 US dollars in 2003 to 1,225.5 US dollars in 2019 in constant PPP-adjusted 2015 prices. Yet total expenditure on health as a share of GDP has always been the lowest among OECD countries, with 4.35 percent of GDP in 2019, much lower than the OECD average of 8.82 percent. After the health transformation programme was implemented, the ratio of total health expenditure to gross domestic product increased from 5.3 percent in 2003 to 5.8 percent over the period 2007-2009, but it decreased to 4.7 percent in 2019. According to the statistics by the Turkish Statistical Institute[3], the share of general government health expenditure in total health expenditure increased from 71.9 percent in 2003 to 78 percent in 2019, while there was a decrease in the share of private sector health expenditure in total health expenditure from 28.1 percent in 2003 to 22 percent in 2019.

There are five sources to finance the general health management and insurance expenses: central government expenditures, local administration expenditures, contributions from employed citizens through contributions by the Social Security Institution, and out-of-pocket payments. Concerning the type of financing of healthcare expenditures, the 2019 statistics by the Turkish Statistical Institute show that the Social Security Institution has the highest share (51.7 percent) while central government and local administration expenditures constitute 25.6 percent and 0.7 percent of total financing, respectively. Whereas out-of-pocket expenses have a ratio of 16.7 percent, insurance companies accounted for 2.9 percent of total health financing. In addition, non-profit institutions have a share of 2.4 percent.

[3] https://data.tuik.gov.tr/Bulten/Index?p=Saglik-Harcamalari-Istatistikleri-2019-33659, accessed on March 2nd, 2022.

Recognizing the persistent disparities in aggregate growth and large differences in the wealth of the Eastern and Western regions particular attention has been given to regional economic policy and public expenditures in Turkey in order to achieve regional equality and economic convergence (Gezici and Hewings, 2007; Karaalp-Orhan, 2020; Yildirim, 2004; Yildirim et al., 2009). The regional inequality in public health expenditures, as well as the distribution of medical devices, has been addressed by several studies (Alataş and Sarı, 2021; Allahverdi et al., 2021; Nak and Sagbas, 2020). Alataş and Sarı (2021), for example, studied the convergence of public expenditures, including the public health expenditures for Turkey, employing provincial data. According to their study, there is a clear geographical distinction between the eastern and western regions with three health expenditure clubs in Turkey.

Understanding the determinants of public health expenditure and spatial interaction among provinces may help policymakers to allocate resources more efficiently to improve regional disparities. Yet there are limited studies for Turkey that address the determinants of public health expenditure. This paper contributes to the existing literature by investigating the factors affecting provincial (central) health expenditures taking spatial interactions into account. The rest of the paper is organized as follows: Section 2 offers a brief review of literature on spatial aspects in health expenditures. Data are presented in Section 3, along with descriptive statistics. The theoretical framework and modelling strategy are given in Section 4. The estimation results are presented in Section 5 where spatial interaction effects are explored. Section 6 concludes.

Literature Review

There is a vast body of studies that investigate the determinants of health expenditures in the literature. In addition to single-country analyses, other studies address the drivers of health spending for a group of countries (Baltagi et al., 2017; Baltagi and Moscone, 2010; Jeetoo, 2020) using macro data. While another strand of the literature utilizes state or provincial-level data to analyse the regional differences in factors affecting health expenditures (Atella et al., 2014; Bai et al., 2021; Bilgel and Tran, 2013; Bose, 2015).

Following the study of Case et al. (1993), there is a growing body of the literature on public economics that emphasizes the regional spillover effects of public spending. The fiscal decisions on taxing and public good provision are affected by those fiscal decisions in the neighbouring regions. Several factors may lead to spatial interactions in fiscal expenditures. For example, the yardstick competition model states that voters assess the performance of their government by comparing the policies implemented with those of neighbouring jurisdictions (Ferraresi et al., 2020, 2018; Revelli, 2006; Terra and Mattos, 2017). However, tax competition models are based on the idea that public goods are financed through taxation of the residents in a region who are mobile among regions. Therefore, regional governments may wish to interest more people by providing better public services (Brueckner et al., 2001; Ferraresi et al., 2018; Rizzo, 2010). Regional public spending may have spillover effects, which may lead to interregional spatial dependence. The traditional spillover model argues that public spending in one region may affect the welfare of neighbouring regions. Moreover, cooperation among regions can also be a source of spatial interaction. Interregional cooperation and coordination may enhance the public sector's efficiency by improving the management of public services, as well as by realizing a more equitable distribution of resources (Breuillé et al., 2018; Charlot et al., 2015). In addition to tax competition, yardstick competition, or expenditure spillover effects contributing to spatial interaction, Manski (1993) proposes a "common intellectual trend" in an attempt to explain the evolution of fiscal expenditures in the same direction. In line with Manski (1993), Moscone et al. (2007) assert the "directive effect", where local authorities react to common policy environments in determining the levels of fiscal expenditures. This form of spatial interaction is more likely to occur in the framework of this paper as it examines the determinants of central public health expenditures.

In addition to studies that investigate the spatial spillovers of total public expenditures (Ferraresi et al., 2018; López and Martínez-ortiz, 2017; Rios et al., 2017; Siano and Uva, 2017; Solé-ollé, 2006), other studies focus on the health expenditures (Atella et al., 2014; Bose, 2015; Costa-font and Pons-novell, 2007; Haini, 2020; Lippi Bruni and Mammi, 2017; Magazzino and Mele, 2012; Yu et al., 2013). The existing literature recognizes expenditure externalities as one of the main sources of spatial interaction in public health expenditures. Residents of neighbouring regions may benefit from any infrastructure investment in one region that increases the magnitude and capacity of healthcare facilities and improve the quality of healthcare services. Additionally, spillover effects may arise when the regions have the same socio-demographic conditions. Institutional framework generating interdependencies in planning a service provision may also result in spatial interdependencies (Costa-font and Pons-novell, 2007; Lippi Bruni and Mammi, 2017). While a strand of literature considers positive spatial spillover effects (Atella et al., 2014; Bai et al., 2021; Costa-Font, J., Moscone, 2008; Costa-font and Pons-novell, 2007), the empirical findings of Yu et al. (2013)'s study support the externality hypothesis.

The literature on health economics identifies several factors that may affect health expenditures. In addition to demographic and environmental characteristics, supply side factors, such as provision and administration of health services play an important role in determining the level of health expenditures[4]. Income, population size, population growth, and the age structure of the population are considered to be the most important factor in determining health expenditure. Determination of income elasticity of health expenditures, whether healthcare is a luxury or a necessity, is important for designing health policies and has been the focus of many empirical papers (Di Matteo, 2003). If healthcare is a necessity, government involvement in the healthcare system may be necessary to efficiently distribute resources and finance healthcare (Baltagi et

[4] Please see Amiri et al. (2021) for a review of factors determining health care expenditures.

al., 2017; Costa-Font, et al., 2011). Depending on the sample under consideration, the time period covered, the models, and the estimation techniques used, different empirical results have been found regarding the size of the income elasticity of health expenditures. While there are studies suggesting that healthcare is a luxury (Clemente et al., 2019; Kiymaz et al., 2006; Wang and Rettenmaier, 2007), others report lower income elasticities suggesting that healthcare is a necessity (Baltagi and Moscone, 2010; Bilgel and Tran, 2013; Costa-font and Pons-novell, 2007; Moscone and Tosetti, 2010; Murthy and Okunade, 2016; Rahman, 2008; Wang, 2009). Moreover, the income elasticity of health expenditures may change depending on the development level of a country. Developed countries with more resources compared to developing countries may provide better healthcare services through more comprehensive public and private health insurance plans (Baltagi et al., 2017; Bustamante and Shimoga, 2018). Thus, the income elasticity of health expenditures may rise as the income level of the country increases.

Data and Descriptive Statistics

This study relies on the annual panel data for 81 Turkish provinces that span the years 2009-2019. As can be seen from Table 1, data come from a variety of sources. The income indicator is GDP. While supply-side variables are the number of health staff, and the number of hospital beds, the demand-side variables are urbanization rate (urban), literacy rate (literacy), the percentage of the population aged less than 15 (under15), and the percentage of the population aged 65 and over (over65).

The spatial distribution of averages of real health expenditures, real GDP, the number of beds, and the number of health staff are shown for the period 2009-2019 in Figures 1-4, respectively. Although the share of central public health expenditures in GDP decreased from 6.88 percent in 2009 to 5.57 percent in 2019, there has been still more than a twofold increase in real health expenditures over the period 2009-2019; however, this increase has not been equally distributed among the provinces. In general, western provinces that are more developed seem to have received the highest share of central health expenditures. Yet the highest increases took place in the total number of beds and healthcare workers in eastern provinces (Siirt, Sirnak, Kilis, Mardin) that are relatively underdeveloped. Spatial exploratory analysis indicates that the typical East-West disparities are present because the spatial distribution of variables, such as real health expenditure, the number of beds, and the number of healthcare workers is similar to the spatial distribution of real GDP.

Choosing a weighting matrix that reflects the significance of each observation across locations is important in assessing the spatial dependence (Anselin et al., 2008). A row-normalized inverse distance weight matrix is used in this study, where W_{ij} is equal to $1/d_{ij}$ and d_{ij} denotes the distance between two provinces, i and j ($i \neq j$).[5] This specification implies that as the distance between provinces i and j increases, the weight decreases (Balta-Ozkan et al., 2021; Yildirim et al., 2021). Moran's I Index is used to investigate if spatial autocorrelation exists. The characteristics of spatial dependence's are summed up by the Moran's I Statistic, which is a useful tool in identifying clusters (in the case of a positive Moran's I) and dispersions (in the case of a negative Moran's I). Table 2 displays the Moran's I values for each year. For all variables, it appears that there is a statistically significant positive spatial association.

[5] For both exploratory spatial and spatial econometric models, a different contiguity matrix has also been used as a weight matrix to see if the results are robust. The results are robust; however, they are not discussed here to save space.

Table 1. Data Description and Sources

<table>
<tr><th>Variable</th><th>Definition</th><th>Source</th></tr>
<tr><td>Health expenditure</td><td>Central government expenditure at the provincial level</td><td>Ministry of Treasury and Finance - Directorate General of Public Institutions https://en.hmb.gov.tr/general-government</td></tr>
<tr><td>CPI</td><td>Consumer Price Index</td><td rowspan="8">TURKSTAT
biruni.tuik.gov.tr</td></tr>
<tr><td>GDP</td><td>Gross Domestic Product at 2009 prices</td></tr>
<tr><td>Urbanization</td><td></td></tr>
<tr><td>Number of healthcare workers</td><td></td></tr>
<tr><td>Number of hospital beds</td><td></td></tr>
<tr><td>Population aged less than 15</td><td></td></tr>
<tr><td>Population aged 65 and over</td><td></td></tr>
<tr><td>Literacy rate</td><td>Percentage of literate people in total population</td></tr>
</table>

Figure 1. Real Health Expenditure, 2009-2019 Averages

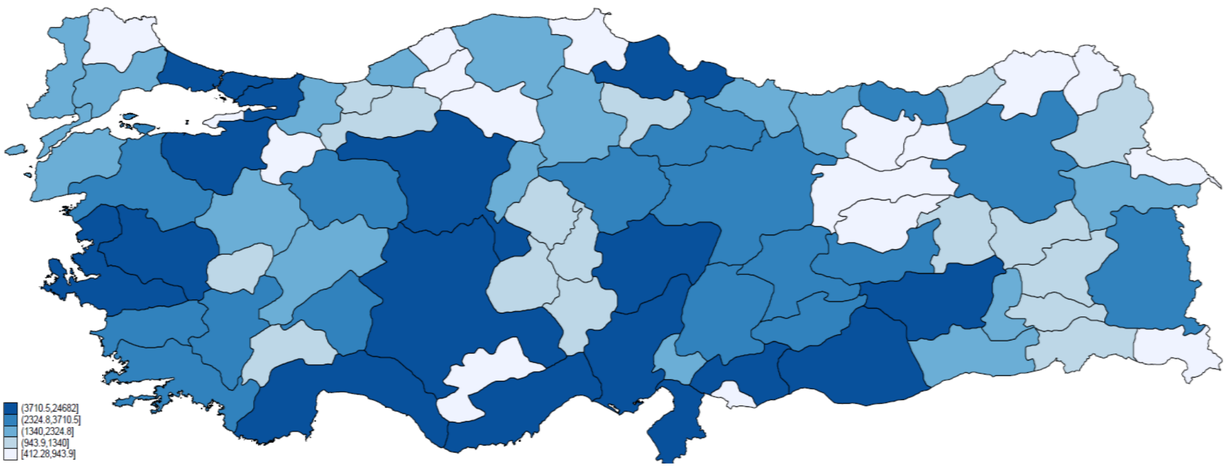

Figure 2. Real GDP, 2009-2019 Averages

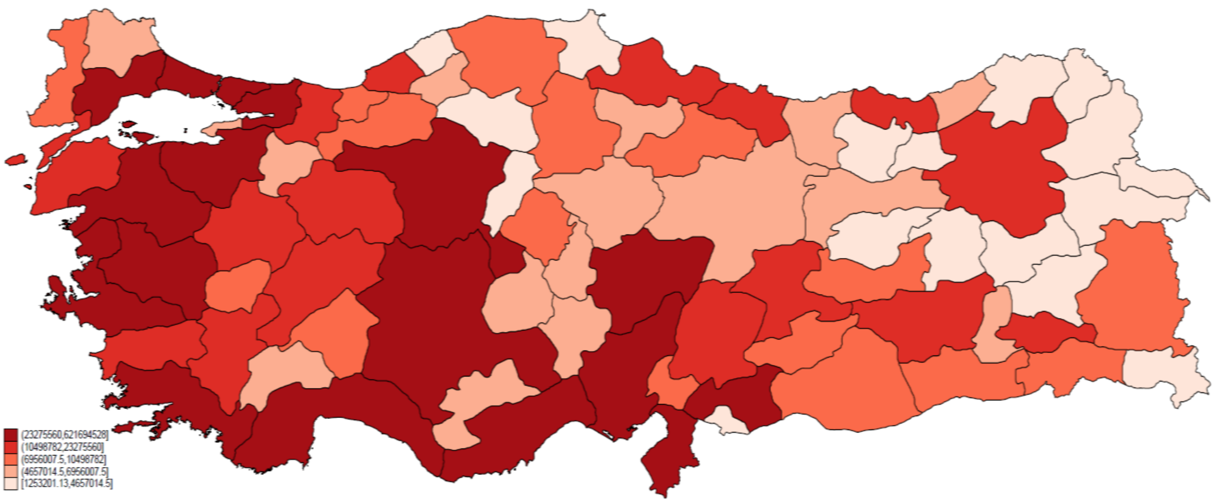

Figure 3. Total Number of Beds, 2009-2019 Averages

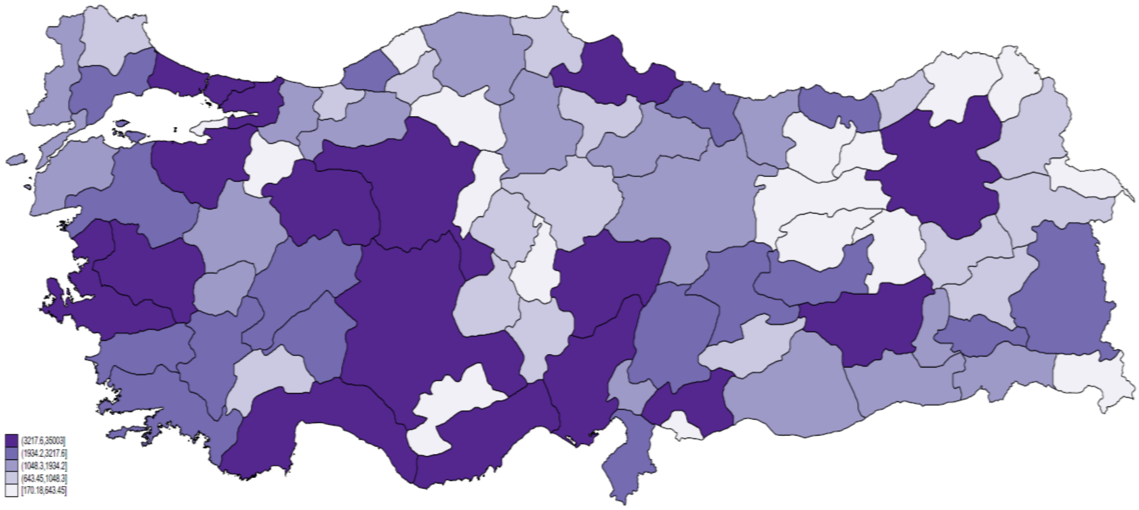

Figure 4. Total Number of Healthcare Workers, 2009-2019 Averages

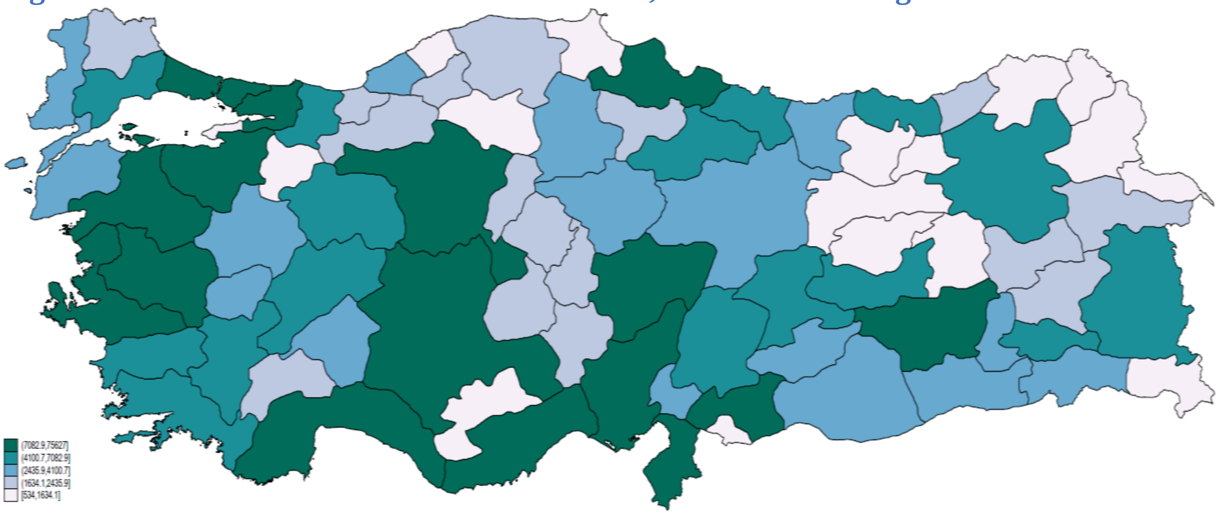

Table 2. Moran's I Statistics

Year	Real GDP	Real Health Expenditure	Urbanization	Total Number of Healthcare Workers	Total Number of Beds	prctpopless15	prcpopover65	Literate %
2009	0.287***	0.270***	0.076***	0.038***	0.011**	0.289***	0.175***	0.274***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.027]	[0.000]	[0.000]	[0.000]
2010	0.283**	0.265***	0.085***	0.032**	0.011**	0.289***	0.169***	0.266***
	[0.003]	[0.000]	[0.000]	[0.002]	[0.034]	[0.000]	[0.000]	[0.000]
2011	0.294***	0.275***	0.079***	0.037**	0.010**	0.278***	0.178***	0.243***
	[0.000]	[0.320]	[0.000]	[0.001]	[0.041]	[0.000]	[0.000]	[0.000]
2012	0.284*0*	-0.104	0.080***	0.041***	0.008*	0.275***	0.180***	0.234***
	[0.000]	[0.321]	[0.000]	[0.000]	[0.051]	[0.000]	[0.000]	[0.000]
2013	0.271***	0.100***	0.048***	0.037**	0.008*	0.274***	0.180***	0.234***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.052]	[0.000]	[0.000]	[0.000]
2014	0.265***	0.073***	0.050***	0.035**	0.006*	0.244***	0.165***	0.052***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.064]	[0.000]	[0.000]	[0.000]
2015	0.266***	0.079***	0.052***	0.037**	0.007*	0.240***	0.168***	0.050***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.055]	[0.000]	[0.000]	[0.000]
2016	0.271***	0.080***	0.050***	0.041***	0.005*	0.238***	0.168***	0.051***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.086]	[0.000]	[0.000]	[0.000]
2017	0.260***	0.071***	0.051***	0.033**	0.004*	0.234***	0.172***	0.051***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.086]	[0.000]	[0.000]	[0.000]
2018	0.256***	0.066***	0.056***	0.037**	0.004*	0.224***	0.170***	0.049***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.081]	[0.000]	[0.000]	[0.000]
2019	0.236***	0.047***	0.053***	0.037**	0.004*	0.226***	0.171***	0.038***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.082]	[0.000]	[0.000]	[0.000]

Values in brackets are p-values. Significance levels: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Theoretical Framework and Model

The sources of spatial interaction in fiscal policies have been well-documented in the literature. Although spatial variation can be observed in real health expenditures, real GDP, and other socio-demographic variables of interest may change little over time or do not change at all, which may lead to the homogeneity of parameters in each spatial unit. Therefore, following several studies in the literature (e.g. Kang et al., 2016; Yildirim et al., 2021; Yu et al., 2013; Zheng et al., 2015), a spatial fixed effects panel model is employed in this study.

Following Elhorst (2014), Spatial Durbin Panel Model (SDM) is utilized. It can be represented as follows:

$$Y_{it} = \rho \sum_{j=1}^{N} W_{ij}\, Y_{it} + X_{it}\beta + \mu_i + \sum_{j=1}^{N} W_{ij}\, X_{it}\theta + u_{it} \qquad (i \neq j) \qquad (1)$$

where Y_{it} denotes the dependent variable for province i at time t ($i=1,\dots,N;\ t=1,\dots,T$). $\sum_{j=1}^{N} W_{ij}\, Y_{it}$ denotes the endogenous interaction effects between the dependent variables in neighbouring provinces. X_{it} denotes a matrix of observations on the explanatory variables. β is a vector of fixed but unknown parameters. The spatial autoregressive parameter (ρ) reflects the degree of interdependency across regions demonstrating the impact of spatial lag in the dependent variable, and the spatial lag in the independent variable is represented by $\theta . u_{it}$ is an independently and identically distributed error term with zero mean and variance σ^2. Finally, W_{ij} denotes the weight matrix.

Restricting the parameters in Equation (1) will produce a family of related spatial econometric models. The Lagrange Multiplier (LM) tests "can be utilised to examine whether the SDM model can be simplified into a spatial lag model, spatial error model, or an OLS model. The spatial error model (SEM) arises when the restriction $\theta = -\rho\beta$ is in effect, resulting in spatial dependence in the error term alone" (Balta-Ozkan et al., 2015, p. 421). "The spatial autoregressive (SAR) model is obtained setting $\theta = 0$ eliminating $W_{ij}X_{it}\theta$ from Equation (1), which exhibits spatial dependence only in the dependent variable" (Yildirim et al., 2021, p. 2632). The spatial lag model (SAR) examines the extent to which regional health expenditure levels depend on the expenditure levels of adjacent regions.

To investigate the determinants of central public health expenditures for 81 provinces in Turkey, considering previous studies and data availability, the following SDM model has been employed:

$$(lnhealthpc)_{it} = \alpha_i + \delta(lnhealthpc)_{i,t-1} + \rho \sum_{j=1}^{N} W_{ij}\, (lnhealthpc)_{it} + \beta_1 lngdppc_{it} + \beta_2 literacyrate_{it} + \beta_3 urbaniation_{it} + \beta_4 \mathrm{lnstaff}_{it} + \beta_5 \mathrm{lnbeds}_{it} + \beta_6 \mathrm{prctpopless15}_{\,it} + \beta_7 \mathrm{prctpopover65}_{it} + \gamma_1 \sum_1^N W_{ij}\, lngdppc_{it} + \gamma_2 \sum_1^N W_{ij}\, literacyrate_{it} + \gamma_3 \sum_1^N W_{ij}\, urbaniation_{it} + \gamma_4 \sum_1^N W_{ij}\, \mathrm{lnstaff}_{it} + \gamma_5 \sum_1^N W_{ij}\, \mathrm{lnbeds}_{it} + \gamma_6 \sum_1^N W_{ij}\, \mathrm{under15}_{it} + \gamma_7 \sum_1^N W_{ij}\, \mathrm{over65}_{it} + u_{it} \qquad (2)$$

Where lnhealthpc and lngdppc are the logarithms of real health expenditure per capita and real GDP per capita, respectively. The literacy rate is the percentage of literate people, urbanization is the share of the urban population, lnstaff is the logarithm of the total number of health staff per 1000 people, lnbeds is the logarithm of the total number of beds per 1000 people, under15 is the share of the population aged under 15 years and over65 is the share of the population aged 65 years and above. Since the existing literature suggests that fiscal policy generally exhibits path dependence characteristics (Torfing, 2009; Yildirim et al., 2021), the lagged value of the dependent variable $(\mathrm{lnhealthpc})_{\mathrm{i,t-1}}$ is also included in the model.

Estimation Results

According to the exploratory spatial data analysis previously discussed, real GDP per capita, real health expenditure per capita, and all other socio-demographic variables used in the analysis are significantly spatially dependent. Non-spatial panel models may cause estimation bias in the parameter estimates, as the variables under consideration are spatially dependent; this bias can, however, be omitted by using spatial panel data estimation techniques. In this study, the xsmle estimator in Stata developed by Belotti et al. (2017) is used to obtain the maximum likelihood (ML) estimate that yields SAR, dynamic SAR, SDM, dynamic SDM, and SEM models. Table 3 reports both the estimation findings of non-spatial panel data models and those findings from Equation (2).

According to our findings, the estimated coefficients of the spatial panel data models and the non-spatial panel data models are consistent. The first column in Table 3 gives the fixed effect of non-spatial panel estimation results. The Hausman specification tests indicate that fixed effects model is preferable in modelling the individual-level effects. It is clear that there is a spatial dependence in the provincial real public health expenditure per capita because for each model, the spatial lag and error parameters are statistically significant and positive. This expenditure is affected by socio-economic variables of both local and neighbouring provinces due to the spatial spillovers. The results also suggest that real public health expenditure per capita in one province has been enhanced by an increase in its neighbours' real public health expenditure per capita levels, supporting the expenditure externality, spatial spillovers, and arguments on "directive effect", and the empirical findings in several studies (e.g. Atella et al., 2014; Bai et al., 2021; Costa-Font, J., Moscone, 2008; Costa-font and Pons-novell, 2007; Moscone et al., 2007). To identify the most appropriate model specification, Elhorst's (2014) model selection approach has been used. The dynamic SDM model offers the best specification, according to the results of the LR tests in Table 4.

GDP per capita and its spatially lagged values are both statistically significant, according to the empirical findings of dynamic SDM estimations in Table 3. The income elasticity of health expenditures is less than one, indicating that health is a necessity good, supporting the findings of previous studies (e.g. Baltagi and Moscone, 2010; Bilgel and Tran, 2013; Costa-font and Pons-novell, 2007; Moscone and Tosetti, 2010; Murthy and Okunade, 2016; Rahman, 2008; Wang, 2009). This finding is also consistent with that of Yavuz et al. (2013)'s study for Turkey. Moreover, our empirical results also show that the real provincial public health expenditure is affected by its past levels; indicating path dependency in time. In the dynamic SAR and dynamic SDM models, the lagged value of real provincial public health expenditure is statistically significant and positive, supporting the findings of other studies (e.g. Brady et al., 2016; Torfing, 2009; Yildirim et al., 2021).

Regarding the demographic characteristics, the existing literature suggests that health expenditures vary depending on the age structure of the economy as there are differences in health expenditures for certain categories of the population. Empirical evidence shows that health expenditures are relatively high at young ages, then there is a sharp decline, but they tend to increase as the population ages (Matteo and Matteo, 1998; Pan and Liu, 2012). It is believed that the aging population imposes a burden on healthcare expenditure as they tend to have greater long-term care needs compared to younger people (Lee and Rao, 2018; Mason and Miller, 2018). Besides, they may be out of the labour force because of health problems, thereby creating an escalating health burden on society (Bloom et al., 2016). The existing literature shows that health expenditures tend to increase as the share of the population over 65 and above increases (e.g. Bai et al., 2021; Costa-Font, J., Moscone, 2008; Dai, 2019; Lee and Rao, 2018; Matteo and Matteo, 1998; Meijer et al., 2013; Rios et al., 2017; Wang, 2009). However, the findings on the effect of the share of the young population on health expenditure are mixed. Indeed, studies report that the share of young people imposes a burden on health expenditures (e.g. Atella et al., 2014; Baltagi and Moscone, 2010; Pan and Liu, 2012), while other studies suggest that as the share of young people increases, health expenditures tend to fall because young people are generally healthier and less likely to benefit from the health system (e.g. Bellido et al., 2019; Bose, 2015; Lippi Bruni and Mammi, 2017; Yu et al., 2013). Our results show that an increase in the share of the young and elderly population positively affects real health expenditure per capita. However, when the spatial effects are considered, it seems that spatial interaction effect for the "under15" variable is negative, while it is positive for the "over65" variable. There has been a significant increase in the share of the elderly population in the total population from 4.3% in 1990 to 9.5% in 2020. Since the public provision of elderly care is limited in Turkey, in general, elderly people live with their children or relatives when they need healthcare. Moreover, family members, generally daughters or daughters-in-law provide long-term elderly care for their parents (Aysan and Aysan, 2016).

Another demand-side factor that may affect health expenditures is urbanization; however, the direction of this effect is mixed (Galea et al., 2005). More precisely, a strand of the literature argues that urbanization, especially in developing countries, is generally associated with environmental problems, such as air and water pollution, intense traffic emissions, and inadequate waste disposal, which may lead to an increase in health expenditures (e.g. Magazzino and Mele, 2012; Moore et al., 2003; Yu et al., 2013). According to the "urban health penalty" approach, the spread of infectious diseases is easier in urban areas with high population density. Moreover, the crime and accident likelihoods are higher in urban areas that require higher health expenditures. Proponents of "urban advantage" argue that urbanization may provide better access to healthcare services, which may positively affect health status, and therefore lead to a decrease in health expenditures (Bai et al., 2021; Pan and Liu, 2012; Wang, 2009; Yu et al., 2013). The mixed effect of urbanization on health expenditures can be attributed to differences in the development levels of countries. Besides, urbanization may have a differential impact on health expenditures depending on the age structure and gender (Hu et al., 2019; Zhu et al. 2021). Estimation results show that both the level and the spatial lagged value of urbanization have a statistically negative effect on real provincial health expenditures, supporting the urban advantage hypothesis.

One of the important determinants of health status is the education level of individuals. Several studies report a positive association between health status and literacy rate (Dewalt et al., 2003). Paasche-Orlow and Wolf (2007) argue that a higher level of education improves healthcare access and utilization, patient-provider relationship, and self-care, thereby improving the health status of individuals. Furthermore, highly educated people are more health conscious. For example, they are more aware of doing regular physical activities, healthy eating, getting vaccinated, and having a cancer screening test etc. (Li, J., and Powdthavee, 2015). However, several studies report that people with lower education tend to have disproportionally higher healthcare expenditure and healthcare utilization (Lemstra et al., 2009; Loef et al., 2021). Likewise, lower education and income level are reported to be associated with more hospital visits and prescribed medication (Agerholm et al., 2013; Fitzpatrick et al., 2015). Estimation results of our dynamic SDM model show that an increase in literacy rate has a negative impact on real provincial public health expenditures, while its spatial lagged value has a positive impact. This may be due to the fact that the relatively developed provinces offer better healthcare services, which attract people from the less developed provinces, where the education level is lower.

Health expenditures also include healthcare inputs, such as the number of beds and healthcare workers, which may be considered as supply-side factors. Empirical studies show that these supply-induced institutional factors may positively affect health expenditures (e.g. Bai et al., 2021; Bose, 2015; Costa-font and Pons-novell, 2007; Magazzino and Mele, 2012; Pan and Liu, 2012), although other studies report that the number of beds has a negative impact on health expenditure (Atella et al., 2014; Lippi Bruni and Mammi, 2017). The estimation results indicate that the number of beds and healthcare workers are not statistically significant. This result is, however, contradictory to the supply-induced demand theory (Wang, 2009). However, spatially lagged values of the number of beds and healthcare workers are statistically significant.

Table 3. Estimation Results

	Fixed-effects	SAR	Dynamic SAR	SDM	Dynamic SDM	SEM
lngdppc	0.946***	0.593***	0.280***	0.857***	0.460***	0.995***
	(0.114)	(0.098)	(0.064)	(0.095)	(0.077)	(0.085)
literacyrate	-0.023**	-0.01	-0.001	-0.006	-0.010**	-0.002
	(0.011)	(0.006)	(0.004)	(0.004)	(0.003)	(0.003)
urbanization	-0.002*	-0.003*	0.000	-0.001	-0.006***	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.0009)
lnstaff	0.431***	0.240**	0.019	0.151*	-0.027	0.123
	(0.133)	(0.092)	(0.064)	(0.089)	(0.067)	(0.091)
lnbeds	-0.259**	-0.094	0.064	-0.033	0.066	-0.068
	(0.113)	(0.088)	(0.058)	(0.085)	(0.064)	(0.087)
under15	0.055***	0.043***	0.007	0.023*	0.058***	0.024
	(0.015)	(0.012)	(0.006)	(0.011)	(0.009)	(0.012)
over65	0.246***	0.121***	0.024*	0.152***	0.051**	0.165***
	(0.024)	(0.023)	(0.014)	(0.028)	(0.020)	(0.028)
$Lnhealthpc_{(t-1)}$			0.615***		0.638***	
			(0.041)		(0.045)	
rho		0.983***	0.626***	0.908***	0.954***	
		(0.076)	(0.071)	(0.058)	(0.061)	
lambda						0.530***
						(0.051)
Wlngdppc				-1.708***	0.946***	
				(0.207)	(0.206)	
Wliteracyrate				-0.045***	0.057***	
				(0.012)	(0.009)	
Wurbanization				0.001	-0.015***	
				(0.003)	(0.002)	
Wlnstaff				0.633**	-0.678***	
				(0.218)	(0.195)	
Wlnbeds				-0.183	6.248***	
				(0.283)	(0.223)	
Wunder15				-0.001	0.369***	
				(0.031)	(0.022)	
Wover65				-0.061	-0.586***	
				(0.062)	(0.046)	
Log-lik	216.21	468.63	586.82	557.58	644.77	516.29
Obs	891	891	810	891	810	891
$\boldsymbol{R^2}$ _within	0.72	0.72	0.84	0.82	0.4	0.7
$\boldsymbol{R^2}$ between	0.01	0.05	0.04	0.08	0.07	0
$\boldsymbol{R^2}$	0.05	0.06	0.3	0.01	0.03	0.08
Hausman χ^2		59.62		76.9		9.04
		[0.000]		[0.000]		[0.340]

Values in parentheses are robust standard errors. Values in brackets are p-values. Significance levels: *p < 0.05, **p < 0.01, ***p < 0.001.

Table 4. Model Selection

Test Statistics	SAR vs Dynamic SAR	SDM vs Dynamic SDM	Dynamic SAR vs Dynamic SDM	SEM vs Dynamic SDM
χ^2	236.39	174.38	115.91	256.97
p-value	[0.000]	[0.000]	[0.070]	[0.000]

Robustness Analysis

Although a considerable amount of literature has been published on health expenditure-income association, empirical results are somewhat mixed. Any increase in GDP leads to an improvement in government resources which can then be used for investment purposes, including health expenditure, supporting the direct causality hypothesis (Khan et al., 2016; Rana et al., 2020). Health and education are considered as key components of human capital, which promotes economic growth. The reverse causation hypothesis is therefore supported by the possibility that any increase in health spending will have a positive effect on economic performance through its impact on human capital (Christopoulos and Eleftheriou, 2020; Odhiambo, 2021; Rivera Iv et al., 1999). Such that, several published studies suggest a bidirectional causality between health expenditure and economic growth (e.g. Chen et al., 2014; Erdil and Yetkiner, 2009), which may, however, lead to an endogeneity issue (Magazzino and Mele, 2012; Yu et al., 2013).

A generalized spatial two-stage least squares (GS-2SLS) method was used to determine if our estimations are subject to any endogeneity bias (Kelejian and Prucha, 2010, 1998). In reviewing the literature, there are several studies (e.g. Kelejian and Prucha, 1998, 2010; Arraiz et al., 2010) that suggest a three-step procedure to estimate models with spatially lagged dependent variables and spatially autoregressive disturbances. Under the assumption that the explanatory variables are in fact related to the dependent variable exogenously, this method produces consistent and asymptotically efficient estimates. Table 5 shows the instrumental variable estimates. Based on the use of the spatially lagged explanatory variables as instruments, the GS-2SLS estimates are robust to non-normality and consistent; however, they are not necessarily efficient.

The estimates are very similar to those of the spatial Durbin and GS-2SLS. The results suggest a significant positive though a smaller parameter estimate of SAR coefficient (ρ), implying the spillover effect of public health expenditure in one province to neighbouring provinces. The results also suggest that the income elasticity is less than one, indicating that health is a necessity, though its parameter estimate is smaller compared to the SDM model. However, estimation results for age structure, literacy rate, and urbanization variables are similar to SDM estimates.

The Hausman specification tests show that the instruments used for the GS-2SLS model meet the instrument relevance criterion and that the spatially lagged dependent variable is endogenous. Sargan's over-identification test, however, is statistically significant, indicating that the instruments do not either pass the over-identification tests or meet the exogeneity criteria. According to Yu et al. (2013), the inability of the instruments to pass the over-identification test indicates that the WX terms need to be explicitly included in the right-hand side of the regression model, indicating that SDM is the correct model specification.

Table 5. GS-2SLS Estimates

Variable	
lngdppc	0.770***
	(0.070)
literacyrate	-0.011***
	(0.002)
urbanization	-0.003***
	(0.000)
lnstaff	0.248***
	(0.0448)
lnbed	-0.114**
	(0.050)
under15	0.0437***
	(0.006)
over65	0.127***
	(0.013)
constant	-6.707***
	(0.469)
rho	0.848***
	(0.061)
Hausman test	-351.951
	(0.000)
Identification Restrictions	
Sargan Overidentification Test χ^2	37.712
	[0.000]
Hausman Endogeneity LM Test	38.054
	[0.000]
Cross sections	81
Observations	891

Values in parentheses are robust standard errors. Values in brackets are p-values. Significance levels: *$p<0.05$, **$p<0.01$, ***$p<0.001$.

Conclusion

This study investigated the determinants of provincial public health expenditures for Turkey, employing spatial econometrics models. To this end, the panel data at NUTS3 level for the period 2009-2019 were employed. The exploratory spatial data analysis suggests that real GDP per capita, real health expenditure per capita, and all other socio-demographic variables used in the analysis are significantly spatially dependent. Also, the traditional East-West divide shows persistence in income and health indicators. Empirical results show that there is a spatial dependence in the provincial real public health expenditure per capita. This result corroborates the externality effect of government expenditure. The results also show the presence of strong path dependency, implying long-term policy stability. According to our findings, it seems that age structure, education level, and urbanization are important determinants of public health expenditure with significant spatial effects. Overall, our empirical results do not support the supply-induced demand theory, but rather indicate that demand side factors are more important determinants of central public health expenditures.

Our analysis can be extended in a number of ways: Turkey, like the rest of the world, has been deeply impacted by COVID-19. The first case of COVID-19 in Turkey was recorded in early March 2020. The country's swift and coordinated policy response to this one-in-a-hundred-year crisis has helped reduce the pandemic's severe impacts on people's livelihoods and their health. In this regard, discretionary fiscal pandemic support has been implemented. The total size of this support is 13 percent of GDP, of which 0.1 percent is allocated to healthcare (International Monetary Fund, 2021). However, our sample period covers the period 2009-2019; therefore, the COVID-19 pandemic period can also be considered for further research this is because the pandemic may have led to even more disparities in the East-West divide. Besides, although in most emerging and developing countries, there has been more demand for health expenditures due to the additional resources to be used in response to the COVID-19 pandemic, limited fiscal space is still considered to be a challenge for higher health expenditures in these countries. Therefore, countries have no choice but to use their resources efficiently. Indeed, according to the study of Dabla-Norris (2012) for a sample of 71 developing countries, 60 percent of public investment, including health expenditures is wasted. As a result, the factors behind health expenditure inefficiency may also be addressed for further research. Last not but least, the distribution of public health expenditure across provinces may not be even and this may be due to the fact that the allocation of public resources may depend on the provincial-level political decision-making processes, and therefore needs to be addressed.

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