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Determinants of public education spending in the Turkish provinces

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Abstract

The effective provision of public education service delivery is very important for all countries. It is especially important for Türkiye as the country faces a possibility of getting stuck in the middle-income trap. The country spends a large sum of budgetary resources on public education. However, the determination of the resource envelope at the provincial level does not take local socio-economic and demographic dynamics into account. We analyze the determinants of public education spending at the provincial level for the period of 2008-2021. Our findings suggest that the economic composition of provinces together with the student-teacher ratio and enrollment rate influence the resource needs for education services. However, there is a discrepancy between primary and secondary education in terms of student-teacher ratio and enrollment rate as they influence the outcome in different directions.

Keywords

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Provincial level public education expenditures
Student-teacher ratio
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Introduction

Countries prioritize human capital accumulation to be competitive in the world of knowledge economy. Human capital development is only possible by increasing the quality and quantity of education. As a high middle-income country, one of the challenges Türkiye faces is the middle-income trap. The middle-income trap is an economic development level in which a country gets stuck in after attaining certain level economic development (Gill et al., 2007). The term describes major economies like Brazil, Argentina and Türkiye which face serious challenges related to economic growth, wage competition and innovation. International Monetary Fund (IMF) notes that middle-income countries are "caught between the rapidly changing advanced technology of rich countries, and competition in mature products from poor countries with low wages" (Imam & Temple, 2024). In order to avoid the middle-income trap Türkiye invests a large sum of budgetary resources to improve public education system. According to the Turkish Statistics Institute, Türkiye spent 3.9 percent of the gross domestic product (GDP) on education in 2022 (Turkish Statistical Institute [TURKSTAT], 2024a). These budgetary resources are largely expensed at the provincial level. However, there is a significant variation across provinces of Türkiye in per capita education spending.[4] Providing an explanation for this variation is a major motivation of this paper.

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[4] The amount of per capita provincial education expenditures is calculated by dividing total provincial education expenditures (Ministry of Treasury and Finance, 2024) by the provincial population (TURKSTAT, 2024b).

Although, the question of what determines the allocation and distribution of public education expenditures is studied extensively in the literature, the question of variation in education expenditures across spending units is an understudied area of inquiry. It is especially an understudied research question for subnational levels of government in developing countries like Türkiye. The literature on the allocation and distribution of budgetary resources for education service delivery at the national level investigates the role of both economic and non-economic factors (Almadin et al., 2022; Busemeyer, 2007; Castles, 1989; Cristobal et al., 2022; Dragomirescu-Gaina, 2015; Jabbar & Selvaratnam, 2017; Imana, 2017; Sagarik, 2013; Sheikh, 2019; Strawczynski & Zeira, 2003; Yun & Yusoff, 2018). However, there is a limited number of studies investigating the same question at the subnational levels outside of the U.S. (Fernandez & Rogerson, 1997; Hirsch, 1960; McMahon, 1970; Nord, 1983; Porteba, 1997; Shapiro, 1962) Verbina and Chowdhury (2004) studied the Russian Federation; Chakrabarti and Joglekar (2006) researched Indian states; Grob and Wolter (2007) analyzed the Swiss cantons; and Bischoff and Prasetyia (2019) focused on Indonesian districts. There is no study looking into this question in Türkiye.

The objective of this study is to analyze the determinants of public education expenditures at the provincial level in Türkiye. The main reason for analyzing this question at the provincial level is the role of provincial administrations in executing the education budget.[5] The provincial administrations in Türkiye execute the budget allocated to the Ministry of National Education at the provincial level by deploying teachers, overseeing school construction projects, and distributing teaching materials and supplies to schools. As there is a huge diversity across Turkish provinces, the capacity of provincial administrations in executing the education budget varies as well. There are various reasons for budget variance across provincial administrations.[6] We hypothesize that there is a strong statistical relationship between per capita total education spending at the provincial level and the share of agriculture in total provincial economy, student-teacher ratio, enrollment rate and student population density.

This variation in education expenditures is due to the size and diversity of the country. Türkiye is large and heterogenous country. Out of 85 million people, about 16 million people live in Istanbul province (18.65 percent of total population). In contrast, Bayburt province has 85 thousand inhabitants (0.1 percent of total population). More importantly, there are extreme inequalities across provinces, with the GINI coefficient for regions ranging from 0.342 to 0.449. In terms of contribution to the gross domestic product, only five provinces are responsible for more than half of the national GDP (53.9 percent in 2022) and the share of the rest of 76 provinces is less than 50 percent (TURKSTAT, 2024a).

There is a substantial body of literature on the determinants of public education expenditures (Almadin et al., 2022; Bischoff & Prasetyia, 2019; Busemeyer, 2007; Castles, 1989; Chakrabarti & Joglekar, 2006; Cristobal et al., 2022; Dragomirescu-Gaina, 2015; Fernandez & Rogerson, 1997; Grob & Wolter, 2007; Hirsch, 1960; Imana, 2017; Jabbar & Selvaratnam, 2017; McMahon, 1970; Nord, 1983; Porteba, 1997; Sagarik, 2013; Shapiro, 1962; Sheikh, 2019; Strawczynski & Zeira, 2003; Verbina & Chowdhury, 2004; Yun & Yusoff, 2018). However, the existing literature on Türkiye focuses on the determinants of

[5] Türkiye is a unitary country with a dual structure local government system: the appointed deconcentrated local governments (provinces), headed by governors, and decentralized local governments (municipalities), elected by people (Yilmaz & Guner, 2013). The whole territory of the country is divided into 81 territorial administrations, namely provinces. The head of provincial administration is a governor, who is appointed by the central government. The education service delivery is not devolved to municipalities. It is the responsibility of the central government. The central government is responsible for all educational expenses of the public—nearly 10 percent of the total government budget is allocated for national education. The Ministry of National Education (MEB) runs educational administration of the country and is responsible for drawing up curricula and developing educational materials, as well as recruiting teachers and designing and building schools. In the provinces, educational affairs are organized by the Directorates of National Education appointed by the education minister, but working under the direction of the provincial governor. The director of national education in a province is responsible for the management of the teachers as well as executing the education budget apportioned to that province.

[6] A budget variance refers to the difference between budgeted amount and actual spending amount.

household education expenditures rather than public expenditures (Acar, Cilasun et al., 2016; Acar, Günalp et al., 2016; Bayar & Bengi, 2016). In that sense, there is a gap in the literature as there are no studies that analyze the determinants of public education expenditures. More importantly, there are no studies focusing on the role of provincial administrations in executing the provincial education budget to achieve educational outcomes. This study contributes to the literature by analyzing the determinants of public education expenditures at the provincial level in Türkiye for the period of 2008-2021. Specifically, we investigate the variation in per capita public expenditure patterns across provinces in primary and secondary education.

The next section provides a brief literature review on the determinants of public education expenditures. The following section discusses the method of analysis including model specification, definition of variables, and hypotheses. The fourth section presents the findings of our analysis, and the last section concludes the paper with discussions and suggestions for further research.

Literature Review

The multi-disciplinary literature on the determinants of public education spending is rich with theoretical formulations and empirical testing of relationships. However, both the theoretical formulations and empirical findings remain inconclusive on what explains the level of education spending at national or subnational levels. There are three groups of studies in the literature. The first group of studies presents evidence from cross-country analysis, whereas others use national or subnational levels as the unit of analysis.

The first group of studies using cross-country analysis investigate the role of both economic and non-economic factors in determining education expenditures. In a cross-country analysis, Castles (1989) analyzes the variation in total public education spending, including tertiary education, across the OECD countries. According to his analysis, the most important explanatory variables are religion, presence of rightwing parties in government and student enrolment in the tertiary education sector. Replicating Castles' model in a similar study, Busemeyer (2007) analyzes the same question with a different set of variables under the headings of socio-economic, political and institutional determinants in 21 OECD countries. He presents evidence showing the level of economic development, the share of young population, constitutional veto power, the level of social spending and revenue decentralization as the main determinants of public education spending.

In a similar study, Dragomirescu-Gaina (2015) analyzes the main determinants of public education spending across EU member states for a period of 2000-2012. He estimates a four-equation system to understand the drivers of public education spending—three equations focusing on primary, secondary and tertiary education and a fourth one on total education spending. Unfortunately, his findings are not conclusive—the empirical results are sensitive to basic robustness checks.

The second group of studies focuses on national factors in a single country context. They also use both economic and non-economic variables to explain the determinants of national public education expenditures in a single country context. They investigate the role of factors such as socio-economic composition, demographic structure, and economic development level as well as political and institutional systems in determining education service delivery spending levels. Strawczynski and Zeira (2003), for example, analyze education spending in Israel from 1962 to 1998 by using various demographic, economic, and political variables. They find that demographic variables, such as population size and share of minority student (Arab) and an economic variable (per capita GDP) explain a significant portion of education spending in Israel.

Sagarik (2013) investigates public education expenditures in Thailand by using a number of socio-economic, demographic, political and institutional variables for the period 1982-2010. His results indicate that prior year's expenditure are the main determinants of current year total education spending. However, he also finds that inflation, unemployment and the share of indirect tax to total tax also have an impact on total education spending. In terms of current versus capital expenditures, last year's expenditures and industrialization have positive impact on current spending but no impact on

capital expenditures. Inflation and the share of indirect tax have negative impact on current expenditures and no impact on capital, whereas unemployment has a negative impact on capital expenditures, but no impact on current spending.

There are two empirical analyses on the determinants of education expenditures in Malaysia. In the first study, Jabbar and Selvaratnam (2017) present evidence that budget deficits and revenue collections have significant positive impact on education spending, whereas demographic variables have no impact on education spending. In a second study, Yun and Yusoff (2018) analyze the determinants of public education spending in Malaysia during the period of 1982-2016. They identified real gross domestic product growth rate, unemployment rate, inflation rate and working age population as the main determinants of public education expenditures.

Imana (2017) examines the role of economic-demographic dynamics, money quantity, compensation, incremental, political and fiscal factors that affect the growth of public education expenditures for a period of 1980 to 2014 in Kenya. His analysis presents mixed results since variables in each of these factors had positive and negative signs; however, his model with economic-demographic variables presents the most robust results, showing that lagged expenditures, employment of more teachers, budget deficits and real per capita income have a positive impact on education spending.

Sheikh (2019) tries to answer the same question in the context of Bangladesh by using economic-demographic, decision-making and political factors, as well as governance indicators. His findings suggest that public education expenditures are mostly influenced by the previous year's spending and indirect taxes. In addition, he argues that total population and government effectiveness have a positive impact on levels of education expenditures.

Like Malaysia, there are two studies on the Philippines as well. In the first study, Almadin et al. (2022) examines the determinants of public education spending in the Philippines from 1989 to 2018 using time series data. Their findings show that gross domestic product per capita and lagged public education expenditures are the most important determinants of education spending in the Philippines. They could not find a statistically significant relationship between education spending and unemployment rate and urbanization growth. In a second study, Cristobal et al. (2022) looks into the same question for the period 1990 to 2019. Their results show that economic growth, tax, and population growth are the most important determinants of the public education spending in the Philippines.

The third group of studies focus on analyzing the determinants of education spending at the subnational levels. In a pioneering study, Hirsch (1960)—using data from two different periods of 1951 to 1952 and 1954 to 1955—analyzes the determinants of public education spending in U.S. states. According to his findings, population size, age structure of population, the size of school district, economic and governmental characteristics play an important role in determining the level of education spending.

Later, Shapiro (1962) examined the socioeconomic factors to explain differences in the level of per student expenditures in the southern versus non-southern states of the U.S. for the years 1920, 1930, 1940 and 1950. Although he used an exhaustive list of variables, ranging from per capita personal income to percentages of minority population, school age children, urban population, labor force, public enrollment, his findings were inconclusive. Similarly, McMahon (1970) examined the determinants of state level expenditure spending in the U.S using two different models. His structural model consists of factors of production cost, revenue sources and demand for education in a cross-sectional analysis that identifies school-age children as a per cent of the population, substitutes for public schools, and pupils per teacher as important determinants for the state level public education expenditures. However, in the time-series model, only the school-age children population from the cross-sectional model are a significant factor. Additional factors such as state aid to schools and unemployment were affecting state level education spending whereas state revenue from taxes didn't have any impact.

In a more micro-level analysis, Nord (1983) investigates the determinants of education expenditures in 100 countywide school districts in North Carolina for the 1970-71 school year. He uses family income, property values, percentage of students attending private schools, children between 5 and 18 as percentage of population, population density, median educational level of population, state aid, federal aid, average teacher salary and student-teacher ratio as explanatory variables. He shows that only median family income in these jurisdictions has a positive impact on public education expenditures.

Fernandez and Rogerson (1997) examine the determinants of education spending in the U.S. states by employing a panel data set over the period from 1950 to 1990. Their analysis presents evidence that per student expenditures grew at the same rate as personal income per student.

Porteba (1997) analyzes the relationship between demographic structure and per student education spending in the US states between 1960 and 1990. The main finding is that the increase in the share of elderly population reduces per capita education spending.

In terms of studies outside of the U.S., Verbina and Chowdhury (2004) perform a panel data analysis for 88 regions in the Russian Federation for the period of 1999-2000. Their results show that budget revenue and student-population ratio, measured as the number of students per thousand inhabitants, have positive impacts on education expenditures, whereas population density has a negative impact.

Chakrabarti and Joglekar (2006) focus government financing of education on 15 Indian states from 1980-81 to 1999-2000. Their analysis show that per capita income is positively correlated with total education expenditures. In addition, the presence of minority groups has a negative impact on education expenditures.

Grob and Wolter (2007) analyze the role of demographic factors on determining education spending levels in Swiss cantons for the period from 1990 to 2002. Their main finding is that the share of the elderly population has a significant negative impact on public education spending. Their second finding is related to inelastic response of education spending to changes in the school-age population. This means that total education spending adjusts slowly to the change in the number of students.

Bischoff and Prasetyia (2019) analyze the factors that drive primary and secondary education spending in Indonesian districts between 2005 and 2012. They use a set of socio-economic, political and geographic variables to explain total and per student educations expenditures. Their main finding is that landlocked municipalities and municipalities with low enrollment rates spend less on education and fiscal capacity of municipalities, and that the number of school age children positively contribute to determining the level of education spending. More importantly, their findings support the presence of economies of scale in the provision of education services in Indonesia: the share of educational expenditures is lower in districts with a large share population living in of urban areas.

Our study contributes the third group of literature which focuses on the determinants of education spending at the subnational levels. However, we have also benefited from model specifications in the second group of studies, and we include economic, social and demographic variables into our model.

By focusing on provincial level of public education expenditure, we aim to fill a gap in the literature, as there are no studies in the literature focusing on the determinants of provincial public education expenditures in Türkiye. Provincial administrations play an important role in administering public education system in Türkiye. In addition, they play an important role in efforts to increase primary and secondary school student enrollment rate, especially for girls.

Method

Data and description of variables

This paper analyzes the determinants of public education spending at the provincial level with a balanced data set of 81 Turkish provinces for the period of 2008-2021. The reason why our analysis covers this time period is the availability of data as there has been a change in the national system of compulsory education.[7] Table 1 presents the definition of variables in our analysis and their expected sign.

As the previous section on the literature review demonstrates there is a multitude of variables used by researchers in analyzing the determinants of public education expenditures. These determinants can be broadly classified as economic, social and demographic factors. In our analysis we will use variables that correspond to these factors. However, we would like to disaggregate these variables into primary and education levels. In Türkiye, there are three levels of formal public education: primary (grades 1 to 8), secondary education (grade 9 to12) and higher education (tertiary level of education).[8] Since financing of higher education is very different from the financing of primary and secondary education, we focus on the latter.

Our dependent variable is per capita total primary and secondary public education spending at the provincial level (TOTEDU). Following guidance from Mullahy and Norton (2022) about models with dependent variables that are non-negative and have large numbers (such as wages, spending, and income) we converted our dependent variable into its natural log form to reduce the numerical values of large magnitude. Therefore, we reduced the range of values for the dependent variable while preserving the differences (Mullahy & Norton, 2022).

The line graphs below in Figure 1 present visual representation of variation of the education expenditures (TOTEDU) over time for each Turkish province. They show that there is a wide variation in the levels of per capita total education spending within a province over the study period as well as across 81 provinces.

[7] With recent changes, the education service delivery in Türkiye is now governed by a national system of compulsory education which lasts 12 years. Compulsory education has two components. Primary education covers the education and teaching directed to children between the ages of 6–14. Secondary education includes all of the general, vocational and technical education which covers the education of children between 15 and 18 for four years after primary education.

[8] Our data classification and methodology are based on Turkish Statistical Institute, 2023 National Education Statistics. More information about the analytical framework, concepts, definition, classifications, scope of the data, accounting conventions, characteristics of basic data sources, compilation practices and revisions of National Education Statistics can be obtained from the Turkish Statistical Institute (TURKSTAT, 2024a).

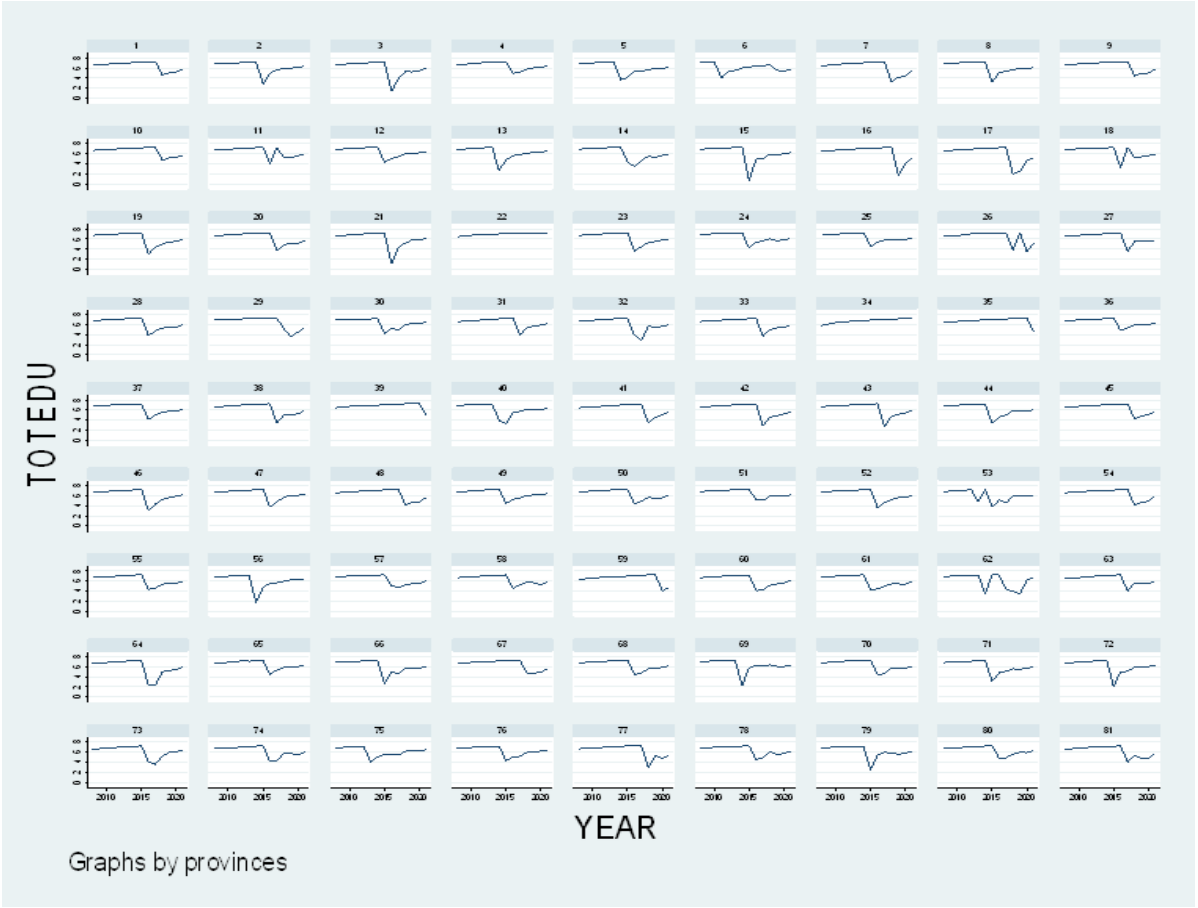

Figure 1. Line Graphs of Education Expenditures across 81 Provinces between 2008-2021

Our independent variables include:

- *Economic variable*: In order to capture the economic composition of provinces, we include an agriculture variable (AGR) that represents the share of the agriculture sector in total gross provincial product. Tholkes and Sederberg (1990) argue that the share of agriculture sector is an important determinant for analyzing economies of scale in the provision of public education. We expect that the AGR variable will have a positive sign as agriculture is expected to have a positive impact on education spending through two channels. First, the share of the agriculture sector is an indication of rural-urban dichotomy in a province. Provinces with higher share of agriculture sector in their gross provincial product tend to be more rural than urban localities. Rural localities invariably have more remote villages. Therefore, in more rural provinces, the need for providing education services in more remote locations is expected to increase per capita education spending. A corollary expectation is that there is a presence of economies of scale in the provision of education services in Turkey. A positive sign for AGR is an indication of economies of scale (Tholkes & Sederberg, 1990).
- *Social variables*: For social variables, we use student-teacher ratio and enrollment rate. Student teacher ratio is used by others, such as Nord (1983), and is expected to have a negative sign because as the average class size increases the average cost of education should decrease (Monk & Haller, 1986). In terms of enrollment rate, we expect a positive sign since the increase in enrollment would necessitate both capital and recurrent expenditures. In our model we have estimated student-teacher ratio separately for primary (STRP) and secondary (STRS) education. Similarly, we include separate enrollment rate for primary (ENRP) and secondary (ENRS) education. These variables are widely used in the literature (Fernandez & Rogerson, 1997; Grob & Wolter, 2007; Imana, 2017).

- *Demographic variables*: In order to understand the impact of demographics, we include student population density variable into our model. A demographic variable, such as population density, is widely used in the literature (McMahon, 1970; Nord, 1983; Shapiro, 1962); however, we followed the Fernandez and Rogerson (1997) model of estimating per student value. The variable is calculated by dividing the geographic area of a province by the number of primary school students (SPDP) and secondary school students (SPDS). This variable represents student population density per square kilometer and is expected to have a negative sign. That is, the increase in the student population density, which means an increase in the number of students, should help reduce per capita education spending.

Table 1. Definition of variables and expected sign

Variables	Definition	Measurement	Expected sign	Data source
Dependent Variable				
TOTEDU	Provincial primary and secondary public education expenditure per capita is calculated by dividing total provincial public education expenditure by mid-year population estimation of province	Turkish Lira (TRY)		Republic of Türkiye Ministry of Treasury and Finance Provincial Public Education Expenditures are available in at https://en.hmb.gov.tr/
Independent Variables				
AGR	Share of agriculture sector in gross provincial product	Percentage share	+	Turkish Statistical Institute www.tuik.gov.tr
STRP	Student-teacher ratio (primary)	Ratio	-	Turkish Statistical Institute and Ministry of National Education (Ministry of National Education [MoNE], 2024)
ENRP	Enrollment rate (primary)	Ratio	+	Turkish Statistical Institute and Ministry of National Education
STRS	Student-teacher ratio (secondary)	Ratio	-	Turkish Statistical Institute and Ministry of National Education
ENRS	Enrollment rate (secondary)	Ratio	+	Turkish Statistical Institute and Ministry of National Education
SPDP	Student population density (primary) (geographic area divided by primary student population)	Ratio	-	Turkish Statistical Institute and Ministry of National Education
SPDS	Student population density (secondary) (geographic area divided by secondary student population)	Ratio	-	Turkish Statistical Institute and Ministry of National Education

Econometric Model Specification and Hypothesis

In this study, we employ balanced panel data analysis—one of the most popular econometric methods. In economics, panel data analysis is widely used to study the behavior of various micro and macroeconomic variables (Arellano & Bond, 1991). Panel data contains more information, variability, and efficiency than pure time series or cross-sectional data. The advantages of panel data compared with cross-sectional data and time series data are summarized as follows (Hübler, 2005):

i. A large number of observations gives more informative data with less multicollinearity and more degrees of freedom as well as a higher efficiency of econometric estimates.

ii. Panel data allow researchers to control for unobserved heterogeneity, which is a major shortcoming of strictly time series and cross-sectional data.

iii. Panel data analysis improves the possibilities of evaluating the effects of policy interventions and determining under which conditions the effects can be interpreted as causal effects.

iv. Panel data can minimize estimation biases that may arise from aggregating groups into a single time series.

This method helps us to study cross sectional and time series data at the same time. In a balanced panel, the number of time periods T is the same for all individuals i. Our balanced panel model specification for per capita total education expenditure is illustrated as the functional form as follows:

$$\ln(TOTEDU_{it}) = \partial + \beta_1 * AGR_{it} + \beta_2 * STRP_{it} + \beta_3 * ENRP_{it} + \beta_4 * STRS_{it} + \beta_5 * ENRS_{it} + \beta_6 * SPDP_{it} + \beta_7 * SPDS_{it} + \varepsilon_{it}$$

where i refers to provinces (i= 1,…..81) and t indicates time (t=2008,…..2021), ∂ is fixed effects constant and ε is is the random error term varying across both cross section and time. Given our dependent variable of total education spending, we have the following independent variables (see Table 1):

We investigate the following three hypotheses using variables described in Table 1:[9]

Hypothesis 1: There is a significant relationship between AGR and TOTEDU.

H0: There is no significant relationship between AGR and TOTEDU.

Hypothesis 2: There is a significant relationship between student-teacher ratio (STRP & STRS) and enrollment rate (ENRP & ENRS) and TOTEDU.

H0: There is no significant relationship between STR and ENR and TOTEDU.

Hypothesis 3: There is a significant relationship between student population density (SPDP & SPDS) and TOTEDU.

H0: There is no significant relationship between SPD and TOTEDU.

Steps of the Methodology

The findings of the empirical studies in the literature on the determinants of the education spending are notoriously sensitive to basic robustness checks. In this study we use a balanced panel data set with a large cross-section dimension and a small number of time periods, therefore N (81) > T (14). Given N > T, we have employed a step-by-step approach to select the best estimator for our model:

i. Cross Sectional Dependency: First, cross sectional dependency is analyzed to decide whether to use first- or second-generation unit root test.

ii. Panel Unit Root Tests: Second, the stationarity of series is investigated with the panel unit root tests.

iii. Model Selection: Third, we estimate the model by using Pooled Ordinary Least Square (POLS), Fixed Effects (FE) panel, and Random Effects (RE) panel estimators to conduct cross tests to select the most reliable estimator among the three options.

iv. Diagnostic Tests: Last, based on the results of the third stage, we employ the most reliable estimator for the model and conduct diagnostic tests for the estimation results.

[9] In our analysis, we used STATA-16 software.

The methodological process of this study is presented in Figure 2. It summarizes each step of the methodology used in the study:

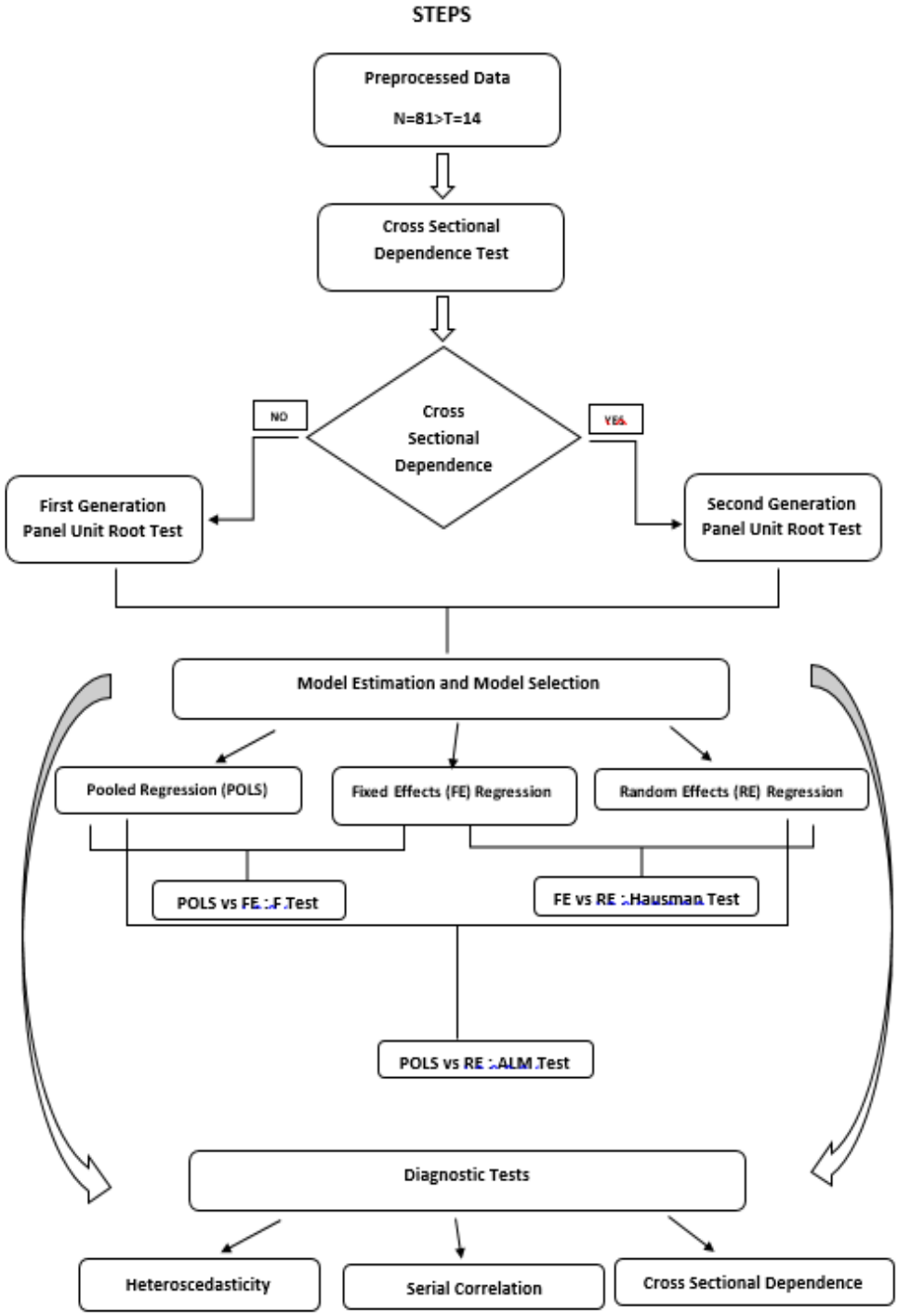

Figure 2. Flowchart of the Methodological Process of the Study

Cross Sectional Dependency

It is essential that all the study variables are checked for possible cross-sectional dependency before executing the panel unit root tests. Pesaran (2006) points out that ignoring cross-sectional dependence leads to inconsistent and upward-biased estimation. To verify the cross-sectional dependency among the provinces, this study applies Pesaran's (2004) Cross Sectionally Dependency (CD) test because in our dataset N is larger than T. The results of the CD test are presented in Table 2.

Table 2. Results of Cross Sectionally Dependency

Variable	CD Test Statistics	p-value	Decision
TOTEDU	73.56*	0.000	cross-sectional dependence
AGR	103.61*	0.000	cross-sectional dependence
STRP	188.81*	0.000	cross-sectional dependence
ENRP	125.80*	0.000	cross-sectional dependence
STRS	97.39*	0.000	cross-sectional dependence
ENRS	180.94*	0.000	cross-sectional dependence
SPDP	72.87*	0.000	cross-sectional dependence
SPDS	161.59*	0.000	cross-sectional dependence

Notes: (i) The null hypothesis of no cross-sectional dependence; (ii) $CD = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{k=i+1}^{N}\hat{\rho}_{ik}\right)$ where T is the time interval, N is the number of cross-section units, and $\hat{\rho}_{ik}$ is the pair-wise correlation between cross-sections.; (iii)* illustrates 1% statistical significance.

The CD test results presented in Table 2 indicate that the null hypothesis of "no cross-sectional dependence" is rejected at 1 percent statistical significance level for all variables. Therefore, the presence of cross-sectional dependence in all variables requires us to conduct a second-generation unit root test.

Panel Unit Root Tests

Conducting unit root tests is important to avoid spurious regression results. However, when cross-sectional dependence is present in a panel dataset, the first-generation panel unit root tests become invalid. In case of cross-section dependency, second generation unit root tests should be used to test whether the series are stationary. To test whether each of the variables in a study contains a panel unit root, the cross-sectional Pesaran and Shin (CIPS) unit root test developed by Pesaran (2007). The CIPS panel unit-root test accounts for the dependence that may exist across different units in the panel. More importantly, CIPS can be applied in cases where N > T, which is the case in this study.

The null hypothesis of CIPS is that all the time series are non-stationary and the alternative hypothesis of CIPS is that all the time series are stationary processes. Table 3 reports the results of the CIPS test. In the table, the unit root statistics are reported for both constant and constant & trend.

Table 3. The Results of the CIPS Test

Variables	Level		First Differences	
	Constant	Constant&Trend	Constant	Constant&Trend
TOTEDU	-3.968*	-3.978*	-4.445*	-4.400*
AGR	-2.546*	-2.986*	-4.160*	-4.147*
STRP	-2.736*	-4.198*	-5.316*	-5.345*
ENRP	-2.990*	-2.861*	-3.917*	-4.327*
STRS	-2.559*	-2.566*	-3.522*	-3.934*
ENRS	-2.963*	-3.519*	-4.712*	-4.682*
SPDP	-1.513	-1.992	-2.986*	-3.479*
SPDS	-1.632	-2.332	-3.145*	-3.156*

Notes: (i) The null hypothesis indicates that the series is homogeneous non-stationary.; (ii) * illustrates 1% statistical significance.; (iii) Test Statistics: $CIPS(N,T) = N^{-1}\sum_{i=1}^{N} t_i(N,T) = \frac{\sum_{i=1}^{N} CADF_i}{N}$ where $t_i(N,T)$ is the cross-sectionally augmented Dickey- Fuller test statistic for the ith cross section unit in the CADF regression

Table 3 shows that the null hypothesis of non-stationary is rejected for all the variables in both constant and constant & trend models except SPDP and SPDS. This implies that the series for all variables except SPDP and SPDS are stationary in their levels or integrated of order zero, I(0). Hence, the panel models will be estimated at the level of series in the analysis for these variables. However, variables SPDP and SPDS are found as I(1). Thus, we include non-stationary variables SPDP and SPDS with their first differences into the model to avoid spurious regression results.

Model Selection

The study estimates the POLS, FE and RE panel models, then applies cross tests and compares the models in order to find the most appropriate one. POLS method of estimation presents results under the principal statement that there is no difference among the data matrices of the cross-sectional dimension.

Table 4. Cross Tests of Model Specification

Model Specification			
Cross tests	**Test Statistics**		**Decision of null hypothesis**
POLS vs FE	F	1.81 (0.000)	Rejected
POLS vs RE	ALM	17.24 (0.000)	Rejected
FE vs RE	Hausman	242.30 (0.000)	Rejected

Note: p-values are shown in parentheses.

In order to select between the fixed-effects model and POLS model, we conducted an F test. The null hypothesis is that all the constants are the homogenous and therefore the POLS model is applicable. In Table 4, the results of the F-statistics (p-value = 0.000) recommends FE panel model over the POLS model.

The Adjusted Lagrange multiplier test (ALM) has been used to select the better model between the POLS and RE panel models. The null hypothesis is that the variance of the random effect is zero, and the POLS model is appropriate against the alternative hypothesis that the variance of the random effect is larger than zero and should instead use random effects models. According to the result of the ALM test (p-value = 0.000) the null hypothesis is rejected; that means the random effects model is more appropriate over POLS. ALM test provides the evidence of significant differences across countries; therefore, we decided to drop the POLS model among the options.

When it comes to RE versus FE estimators, the Hausman (1978) test allows choosing between the RE panel model and the FE panel model. The null hypothesis is that the difference in coefficients is not systematic. In Table 4, the result of Hausman's test (p-value=0.000) indicates that the fixed-effects model is superior to the random-effect model. The fixed-effects model allows for different constants for each group.

Findings

Our step-by-step diagnostic approach indicate that the fixed-effects model is more reliable than the other two options. The advantage of using the fixed effects estimator is that it is consistent even when the estimators are correlated with the individual effects. The fixed-effects model captures all effects which are specific to particular individual provinces and do not vary over time.

Before interpreting of the results in Table 5, we want to discuss the results of the diagnostic tests presented at the end of the table. We first start with heteroscedasticity, which can cause standard error estimates to be biased and lead to incorrect interpretation of regression results. A modified Wald test statistic for groupwise heteroscedasticity in fixed effects models is used to detect if we have heteroskedasticity in the data (Greene, 2000). For both models, the modified Wald test statistic values led us reject the null hypothesis (363.67 for Model I and 361.64 for Model II), indicating presence of heteroscedasticity (Greene, 2003).

Second, we tested for serial correlation. The correlation of the error term for each cross-sectional unit with the error term in the following period is called serial correlation (Bhargava et al., 1982). To detect the presence of serial correlation in the dataset, we used the Durbin-Watson test and Baltagi-Wu (1999) Locally Best Invariant (LBI) tests. The test statistics of the Durbin-Watson test, and the LBI test are 1.5621 and 1.6161 respectively for Model I and 1.5624 and 1.6157 respectively for Model II. Since the serial correlation is present if the test statistics are lower than 2, our results suggest the presence of serial correlation.

Last, we tested for cross-sectional dependence—an indication of correlation in disturbance terms across various panels. The Pesaran (2004) test is used to check whether there is a cross-sectional dependency problem in the models under the null hypothesis of no cross-sectional dependence. Since the Pesaran test statistic for both models were significant at the 1 percent level, we conclude that cross-sectional dependence is present in the data.

Overall, the diagnostic results show that our initial fixed effects model suffers from serial correlation, heteroscedasticity, and cross-sectional dependence. Thus, we re-estimated both models with robust standard errors. The last two columns in Table 5 presents standard and robust standard errors. The coefficient values presented in table are estimated with robust standard errors against serial correlation, heteroscedasticity, and cross-sectional dependence.

Table 5. Estimation of Fixed-Effects Panel Models and Diagnostics Tests

Variables	MODEL I			MODEL II		
	Coefficient	Standard error	Robust standard error	Coefficient	Standard error	Robust standard error
AGR	0.0012*	0.0002	0.0002	0.0012*	0.0002	0.0002
STRP	0.0164*	0.0064	0.0051	0.0165*	0.0064	0.0051
ENRP	0.0015*	0.0002	0.0003	0.0015*	0.0002	0.0003
STRS	-0.0053	0.0080	0.0122	-	-	-
ENRS	-0.0011*	0.0001	0.0004	-0.0011*	0.0001	0.0003
DSPDP	0.0042***	0.0024	0.0024	0.0045***	0.0023	0.0024
DSPDS	-0.0079*	0.0011	0.0009	-0.0078*	0.0011	0.0009
Constant	5.1143*	0.3251	0.5209	5.0694*	0.3180	0.4796
F test	46.28*		86.91*	53.94*		99.55*
R^2	0.2513			0.2510		
Diagnostic Tests						
Heteroscedasticity	Modified Wald Test	363.67 (0.000)		361.64 (0.000)		
Serial Correlation	Durbin-Watson	1.5621		1.5624		
	Baltagi-Wu LBI	1.6161		1.6157		
Cross Sectional Dependence	Pesaran	19.075 (0.000)		19.122 (0.000)		

Notes: (i)*,**,*** illustrates 1% ,5% and 10% statistical significance, respectively.; (ii) p-values are shown in parentheses.; (iii) D specifies the first difference of the variable.; (iv) Dependent variable is TOTEDU.

After estimation of fixed effects panel model, an added-variable plot used to control for the influence of individual effects as well as other covariates on the partial correlation of independent variables and education expenditures (TOTEDU). The plot creates a matrix of added-variable plots of all the independent variables and shows the partial correlation between one independent variable and the dependent variable from a multivariate panel regression (Gallup, 2020). The estimation results are presented in Table 5 and Figure 3 according to our model specification in the method section. In the first estimation we include all of the variables listed in Table 1. All variables are statistically significant at 1 percent level except the first difference of student population density for primary education (DSPDP) and student-teacher ratio for secondary education (STRS). Although DSPDP is significant at 10 percent level, which is an acceptable level, STRS is not statistically significant in any acceptable level. Therefore, we re-estimated the same model by dropping STRS. Figure 3 includes the added-variable plots for Model II. The added-variable plot provides a graphical representation of the relationship between independent variable and TOTEDU when other variables are also included in the model.

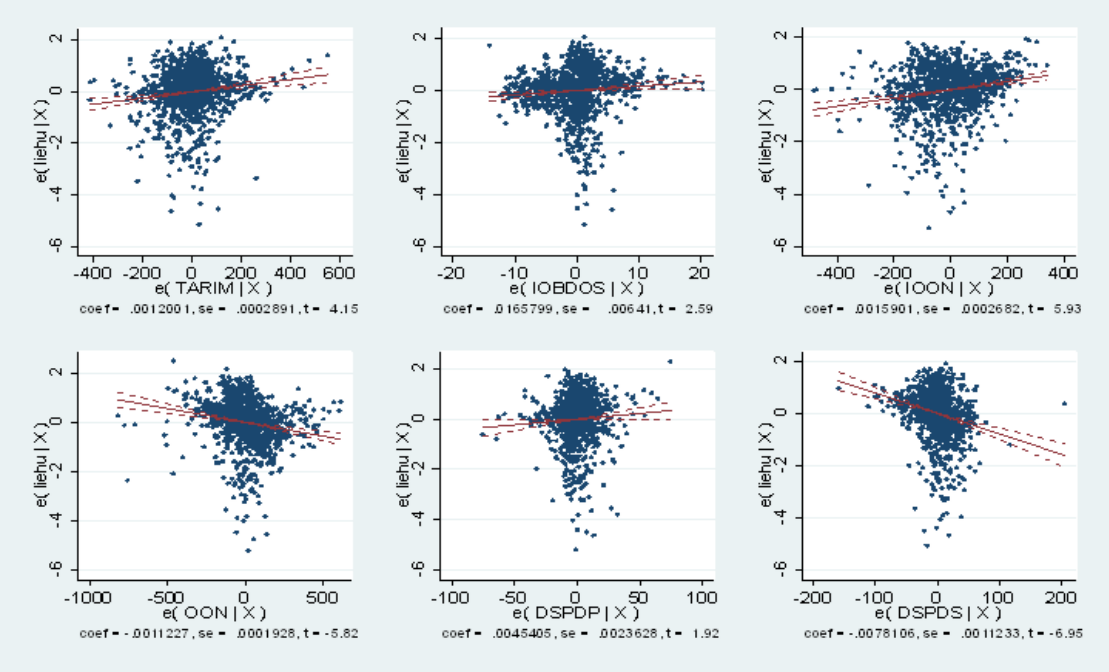

Figure 3. The Added-Variable Plot

The results of the second model in Table 5 and Figure 3 show us that all variables are statistically significant at the 1 percent level except DSPDP (at the 10%). Therefore:

We accept hypothesis 1: there is a statistically significant relationship between the share of agriculture sector in the gross provincial product and total per capita primary and secondary expenditures of provinces. The share of agriculture sector has statistically significant and positive effect on per capita total provincial primary and secondary education expenditures. Specifically, for each one-unit increase in the share of the agriculture sector, education expenditures go up by 0.12 percent. This is a sign of economies of scale in the provision of education services at the provincial level in Türkiye. Our finding is consistent with the findings of Tholkes and Sederberg (1990). As discussed above, the share of agriculture sector is an indication of rural nature of a province in which there are inherent inefficiencies. The provinces with substantial level of agricultural economic activity are spending more on primary and secondary education than other provinces.

In terms of hypothesis 2, our estimations present mix results. At the primary education level, we found a statistically significant relationship between student-teacher ratio (STRP) and enrollment rate (ENRP) and total per capita education expenditures in Türkiye, similar to the findings of Castles (1989) and Nord (1983). The increase in student-teacher ratio (STRP) and enrollment rate (ENRP) will lead to an increase in the per capita total education expenditures (TOTEDU). As for the secondary education, the increase in student-teacher ratio (STRS) and enrollment rate (ENRS) negatively influence the per capita total education expenditures (TOTEDU). However, student-teacher ratio for the secondary education (STRS) is not statistically significant at an acceptable level, whereas the variable for enrollment rate for the secondary education (ENRS) has statistically significant and negative effect on the dependent variable (TOTEDU) at 1 percent significance level. The coefficient of ENRS indicates that TOTEDU increases 0.01 percent overtime, when ENRS increases by one unit. Since the variable on STRS is not statistically significant, we dropped from the model and re-estimated the model. As presented in Modell II column of Table 5, the dropping of STRS from the model had no impact on the values and statistical significance levels of other variables.

As for the last hypothesis, we accept that there is a statistically significant relationship between student population density and total per capita primary and secondary expenditures of provinces.

However, the sign of variables for primary and secondary education is in opposite direction. Student population density for primary education (SPDP) has a positive impact on the dependent variable (TOTEDU) at the 10 percent significance level. Whereas population density for secondary education (SPDS) is negatively related with the dependent variable (TOTEDU) at the 1 percent significance level.

Discussion, Conclusion, Suggestions

In development economics, the middle-income trap refers to the state that a country finds it difficult to develop further and attain high-income status (Gill et al., 2007). Overcoming the middle-income trap has long been perceived as an important socio-economic issue as it is directly linked to the level of human capital of a country. Investing in education to power innovation and to improve human capital quality has been the most effective way to tackle the middle-income trap (Hara, 2021).

Türkiye was classified as an "upper-middle-income country" by the World Bank in 2007. After 2001, Türkiye maintained steady economic growth by embarking on economic reforms to attract foreign direct investments. Until 2020 Türkiye vigorously developed foreign trade sector while controlling inflation rate. However, Türkiye's economic development has stalled since 2020 signaling middle-income trap. According to the World Bank, Türkiye's gross domestic product (GDP) fell from $939 billion in 2014 to $720 billion in 2020. Lately, the persistent high inflation rate, high unemployment rate and high debt started to stoke the fears of middle-income trap.

For Türkiye, investing in education to improve human capital quality is the only way to escape the middle-income trap as the composition of the country's economy is inching towards producing high value-added products such as electric vehicles, drones, and appliances. Therefore, improving the efficiency of public education expenditures is not only about budget discipline and fiscal space issue, but also about achieving higher economic growth rate to escape the middle-income trap. In this context, analyzing public education expenditures helps policy makers to identify ways to increase efficiency and effectiveness in the use of budgetary resources.

Our analysis shows that the share of agriculture sector, student-teacher ratio, enrollment rate, and student population density are important determinants of public education expenditures at the provincial level in Türkiye. Given our findings, there are some implications that should be noted here as the suggestion to the policymakers on how to improve the determination of the total education expenditures in order to respond the needs of the people:

First, in determining per student formula for the allocation of budgetary resources, it is important to take economic composition of provinces into account. It seems it is more costly to provide education services in more rural provinces. Our finding is similar to the one Almadin et al. (2022) found for the Philippines. Their findings suggest that urbanization does not increase the cost of education services. Although our findings suggest that there are diseconomies of scale in the provision of education service in rural areas of Türkiye, it is important to conduct additional research to understand the dynamics of economies of scale. There is a need to understand the drivers of the increase in the cost of education service delivery in rural provinces: is it transportation cost, capital expenditure cost or student dispersion? How does cost affect the attainment of certain level of educational quality?

Second, student-teacher ratio and enrollment rate play an important role, but in different directions for the primary and secondary education. Student-teacher ratio and enrollment rate are important variables in explaining the determinants of public education expenditures in the literature (Nord, 1983). However, in Türkiye, they have differential impact on primary and secondary education expenditures. The fact that the expenditures continue to rise with the increase in the student-teacher ratio and enrollment rate for primary education is a sign that elementary schools are operating beyond the optimal size. It is important for policymakers to investigate whether elementary schools are overcrowded in Türkiye. We do not observe the same phenomenon in secondary education. The student-teacher ratio for secondary education has no statistically significant impact on education expenditures. However, enrollment rate has a highly significant negative impact. This suggests that

there has been an overinvestment in the secondary education service delivery and there is room to improve enrollment rates. The decrease in the marginal cost per an additional student suggests undercrowding of secondary schools.

There are several factors which might explain the observed differences in primary and secondary education. The primary and secondary level education are made compulsory in different times with different processes. Primary education has been compulsory since the early years of the republic with a school investment campaign especially in rural areas. Many of the primary school assets constructed in this period exhausted their economic life and there is a need for additional investments. In terms of timeline, primary education had been five years for a long time, and additional three years were added in 1997. Whereas secondary education has been made compulsory very recently—starting in 2012-2013 academic year—and enrollment rate for secondary education has always been lower than primary education. In this context, it is important to design policies to improve girls' participation in secondary education as anecdotal evidence suggests that families are reluctant to let girls to continue their education after the primary level, especially in rural areas. Lastly, the choice of private schools is more prevalent at the secondary education level compared to primary education which creates a situation of relative substitution of public education expenditures.

Third, the results for the student population density are consistent with the results of other studies (Bischoff & Prasetyia, 2019; Grob & Wolter, 2007). There is a statistically significant positive effect of student population density in primary education. This is consistent with the earlier observations on the potential suboptimal school size at the primary education level. More importantly, the statistically significant negative impact of student population density for secondary education is yet another sign that there is a room for improving enrollment rates in secondary education.

Our three findings—the role of economic composition of subnational levels, the importance of student teacher ratio and enrollment rate, and impact of student population density—present lessons for large and diverse developing countries stuck in the middle-income trap such as Brazil, Argentina, Colombia and others. They should consider the role of these factors in boosting the efficacy of education expenditures at the subnational level in tackling with the middle-income trap problem.

However, our analysis is not without shortcomings. An important missing variable in our analysis is information about internal and external migration patterns. The lack of available data on various immigration patterns prevents us analyzing the impact of population variability caused by internal and external migration. In terms of internal migration during the study period of 2008-2021, there has been an increased intra-provincial migration activity rather than inter-provincial migration. In many provinces, there has been an increased migration from rural to urban areas of provinces, mainly due to security reasons in the southeastern provinces. Furthermore, the enactment of the 2012 Metropolitan Municipalities Law complicated the picture in the highly urbanized provinces. As the law extended the urban definition to the whole geographical territory of 30 provinces, the Turkish statistical agency changed the urban/rural definitions. For external migration, there are no reliable numbers in terms of provincial level immigrants from Syria and other countries.

In concluding we would like to make suggestions to both academic and policy-making communities for Türkiye to avoid middle-income trap. The academic community can provide technical inputs to better policy making by investigating the components of the cost of education service provision and optimal size of classrooms in primary education. A better understanding of the drivers of the cost in rural areas and the determination of optimal classroom size will inform policy choices. As far as the policy makers are concerned, our findings suggest that the current formula of funding education spending needs to be revised. The findings of academic community should inform policy makers about the allocation of education spending across rural and urban provinces, deciding student-teacher ratios and promoting enrollment rate.

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