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The Effect of Vertical Fiscal Imbalances on Local Tax Effort in Türkiye

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September 2025

Abstract

This paper examines the role of vertical fiscal imbalances (VFI) on tax effort in Türkiye's 81 provinces over the period 2007–22, using linear and non-linear panel data models. We measure local tax effort, applying a panel stochastic frontier model to better address the endogeneity problem relative to previous studies. The same approach is employed to calculate VFI, focusing on the overall difference between expenditure needs and fiscal capacity of subnational jurisdictions. Our results indicate that the presence of VFI leads to decreases in tax effort at the provincial level. Subnational governments would appear to perceive transfer payments as a costless source of revenues as opposed to those coming from their own sources, leading to decreasing tax effort, both in the baseline and extension models. Moreover, we find that alternative measurements of transfer dependency are consistent with our findings. To further clarify the effect of transfer payments on subnational tax effort in a unitary country, we also apply dynamic panel threshold analysis. These results indicate that the overall effects depend on the degree of VFI. For VFI below a threshold value, transfer payments do not exert a constraining effect on subnational tax effort, but this is reduced when the VFI is above the threshold value.

Keywords: vertical fiscal imbalance, transfer dependency, local tax effort, fiscal capacity, expenditure needs, stochastic frontier model, dynamic panel

JEL Code: H20, H71, H77

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1. Introduction

In the last two decades, the concept of vertical fiscal imbalance (VFI) has emerged as a prominent issue in the literature on fiscal decentralization. VFI has been generally defined as a mismatch between subnational government (SNG) revenues and expenditures (Hunter, 1977; Bird and Tarasov, 2004). A certain level of mismatch or imbalances between subnational revenues and expenditures is unavoidable or, even more so, it may be desirable at the optimal level (Boadway, 2002; Sharma, 2010; Eyraud and Lusinyan, 2013). This optimal imbalance may contribute to a more efficient redistribution of resources, easier fiscal adjustment, and offer an opportunity for risk-sharing to regional shocks in a well-designed transfer mechanism (Boadway, 2002; Eyraud and Lusinyan, 2013). On the other hand, VFI often becomes much larger than the optimal level, a much more serious issue, such as in situations under partial fiscal decentralization where there is a large discrepancy between the expenditure responsibilities of SNGs and their allocated (insufficient) revenue or tax autonomy. In such cases, VFI are likely to pose substantial risks, as SNGs become more dependent on central transfers, leading to lower levels of accountability and to operating under soft budget constraints (Sharma, 2010). Therefore, large VFI are an important decentralization design issue undermining economic efficiency and fiscal discipline at the subnational level—the fundamental outcomes which fiscal decentralization promises theoretically. Not unrelatedly, many developed and developing countries have implemented reform policies to ensure greater efficiency and fiscal discipline at the subnational level. For example, we have witnessed increasing regional reforms focusing on the amalgamation and merger of municipalities in recent times (Fox and Gurley, 2006; Blom-Hansen et al., 2016).

In this paper, we analyze the impact of VFI on subnational tax effort in Türkiye, a country with a unitary governance system and a fast-developing fiscal decentralization design, which coincidentally, has recently implemented municipality mergers to increase economies of scale in public service provision at the subnational level. Türkiye is an interesting case to study the impact of VFI because its revenue structure remains quite centralized, with, for example, most tax revenues generally collected by the central government—and therefore with pronounced VFI leading SNGs to be heavily dependent on transfer payments to meet their expenditure needs. Moreover, the recent Law No. 6360, which provides the legal basis for municipal mergers with provisions to expand the expenditure responsibilities of metropolitan municipalities, it does not address the issues regarding the tax power of local governments. In addition, the implementation of this law has led to notable changes in the distribution ratio of intergovernmental revenues. On the other hand, there would seem to be in Türkiye a generalized perception that SNGs are keen to increase their actual tax revenues, with both increased local tax effort and greater fiscal discipline, in response to the expansion of their public service responsibilities following recent municipality mergers. More specifically, in this paper we investigate how VFI and transfer dependence have affected the tax effort of Türkiye's 81 provinces over the period 2007–22.

The paper contributes to the literature in various dimensions. It is the first to focus on the effect of VFI on tax effort at the subnational level in Türkiye.[1] As mentioned, Türkiye is as a prominent case of VFI, especially because legal reforms have included provisions to expand subnational expenditure responsibilities, while local governments still do not have any substantial degree of tax autonomy. Moreover, while the existing literature on Türkiye has predominantly focused on the impact of transfer payments on expenditure behaviors, much less attention has been devoted to the impact of

[1] Several previous papers have calculated subnational tax effort in Türkiye (Sagbas, 2001; Calcali, 2018; Kiziltan and Yereli, 2023).

VFI on local tax revenue effort.[2] For these reasons, we analyze the impact of the impact of VFI on local tax effort at the provincial level in Türkiye. Another critical point is that local governments in Türkiye have legal power to borrow. However, the approval of the Ministry of Environment, Urbanization, and Climate Change is required for domestic borrowing,[3] while the opinion of the Undersecretariat of Treasury is required in projects requiring external resources. These approval mechanisms leave transfers as the key component of the local financing system in Türkiye.

Secondly, unlike previous literature, this paper estimates VFI employing stochastic frontier analysis (SFA) based on measures of *expenditure needs* and *fiscal capacity* rather than actual expenditures and revenues. For robustness checks, we follow Eyraud and Lusinyan's (2013) methodology to alternatively measure VFI by considering the potential effects of subnational debt and deficits. In addition, we incorporate a measure of *transfer dependency* (TR), following Goerl and Seiferling (2014), as a potential tool to address the presence of VFI but do not treat TR as an adequate proxy for VFI. Moreover, owing to the difficulties associated with accessing sub-items of local government revenues and expenditures, we also calculate alternative transfer payment measurements, developed by Neyapti and Oluk (2021). Lastly, in the paper we employ system GMM and dynamic panel threshold methods to test linear and non-linear effects, following Li and Du (2021). To check the robustness of the estimation results, we adopt alternative specifications to measure tax effort. Furthermore, we adopt a dynamic panel threshold model to test the non-linear relationship among VFI, TR, and local tax effort. Specifically, we aim to answer whether VFI mediates how transfers shape local governments' tax behavior. Summing up, this paper provides public policy insights for analyzing and improving Türkiye's fiscal imbalances and the regulation of its local government behavior.

Using a panel dataset for 81 provinces from 2007–22 and applying both linear and non-linear effects, we find that VFI has a negative impact on tax effort, while SNGs seem to perceive transfer payments as a costless source. These findings support the conclusion that higher VFI levels influence fiscal indiscipline by decreasing their tax effort.

The remainder of the paper is organized as follows. Section 2 reviews the relevant past literature. Section 3 presents institutional background on Türkiye's decentralization system. Section 4 presents the dataset, empirical methodology and model, and the measurement of our key variables (VFI, transfer dependency, and local tax effort). Section 5 presents our model design. Section 6 presents the empirical findings, and Section 6 concludes.

2. Review of Literature

In this section, we first highlight the critical fact that there is no consensus in the empirical literature concerning the definition and measurement of VFI. Then we report on the larger variety of findings regarding the potential impact of VFI on subnational tax effort and other key budget variables. We conclude with a review of previous papers that have focused on the case of Türkiye.

Most notably, there is no consensus on the measurement of VFI. Several previous studies have argued that the correct measurement of VFI needs to account for the difference between *expenditure needs* deriving from the expenditure assignments to SNGs and their *fiscal capacity* implied by their revenue assignments (Boex and Martinez-Vazquez, 2007; Martinez-Vazquez and Sepulveda, 2011, 2018; Jia et al., 2021). Given the inherent difficulties associated with the measurement of expenditure needs

[2] There are a limited number of previous studies addressing the presence and effects of vertical fiscal imbalances in Türkiye. Two notable exceptions are Neyapti and Oluk (2021) and Cukur (2023).
[3] Until February 2025, the Ministry of Interior was in charge of authorizing the approval of domestic borrowing.

and fiscal capacity, the vast majority of previous studies have found it convenient to utilize accounting budgetary measures as proxies for VFI; however, while this approach facilitates the use of more practical measures, it may compromise the reliability of the measured VFI and any associated results.

There is a large literature using a variety of budgetary measures as proxies for VFI. The most common approach has been to measure VFI as the ratio of received local government transfer payments to total local expenditure (or total local revenues) (e.g., Rodden, 2002; Guo, 2008; Asatryan et al., 2015; Meloni, 2016). As an extension of that approach, some researchers (e.g., Chu and Fei, 2021; Li and Du, 2021; Liu and Zhang, 2022) select to follow the Eyraud and Lusinyan (2013) methodology approach that does not only include transfer payments in the VFI but also accounts for local borrowing and local budget deficits. Although Eyraud and Lusinyan's (2013) methodology still measures VFI as budgetary measures, which may present certain limitations, it differs from other budgetary measurement techniques because they allow for transfer dependency, borrowing (potential soft-budget constraint issues), the mismatch between local revenue and local expenditure, and the consideration of fiscal deficits.[4] More recently, several studies (Chu and Chi, 2018; Li and Du, 2021; Chu and Fei, 2021; Wang and Liew, 2024) instead of just including central government transfers (TR) as a proxy for VFI, they have opted for integrating both variables into their empirical models, generally arguing that, at least in China, high levels of VFI affect the transfers system and its effects on tax effort and other aspects of subnational budgets.

There is a relatively large literature focused on the empirical relation between different measures of VFI and several dimensions of subnational fiscal discipline. Some studies examine this relationship by using expenditures (Rodden, 2002; Borge and Rattso, 2002; Jia et al., 2014; Liu and Zhang, 2022), and others have focused on debt behavior (Aldasoro and Seiferling, 2014) or public deficits (Rodden, 2002; Eyraud and Lusinyan, 2013). Fewer papers have focused on local own tax revenues (Guo, 2008; Koley and Mandal, 2019; Jia et al. 2021; Wang and Liew, 2024). In particular for this group of papers, Guo (2008) adapts the measurement of VFI in Rodden (2002) (the ratio of grants to revenues) by using the ratio of subsides to revenues for Chinese counties and finds no crowding effects of subsidies on local tax effort. On the other hand, Koley and Mandal (2019), measuring VFI as the proportion of SNGs' expenditures not covered by their own revenues for 24 major Indian states, find crowding out effects on the states' revenue effort. Jia et al. (2021) define VFI using actual expenditure and revenue data to analyze the effect of VFI on local fiscal discipline in China. They find that SNGs are not keen to increase local tax revenue in the presence of high level of VFI, but alternatively they find no significant effects on extra-budgetary and shared revenues, which are not subject to central government clawback provisions. Wang and Liew (2024) test the effect of VFI on local tax revenue, applying panel threshold and simultaneous equation models as well as the VFI measure in Eyraud and Lusinyan (2013) to 30 provinces in China. They find a direct negative effect of VFI on own tax revenue collections.

It is important to highlight that the literature also has drawn attention to country cases that have successfully addressed the potential challenge of VFI on budget stability—for example, Norway (Borge and Rattso, 2002; Karpowicz, 2012), Belgium (Karpowicz, 2012; Mitra and Chymis, 2022), and Italy (Bordignon et al., 2013). These studies generally highlight the importance of operating with a hard-budget constraint and a transparent political system for understanding the success of fiscal decentralization policies and the effectiveness of fiscal adjustment programs.

[4] In this methodology, VFI is calculated by subtracting the product of the ratio of revenue decentralization to spending decentralization, multiplied by 1 minus the government deficit. Please refer to Equation 3.

Let us now turn our attention to the case of Türkiye, where only two previous studies have addressed the impact of VFI in its decentralization system.[5] In a pioneer paper, Neyapti (2005) measures VFI in three different ways—the ratio of expenditures to total revenues, the ratio of expenditures to own revenues, and the ratio of expenditures to shared taxes at the provincial level—to develop a mechanism for fiscal equalization considering both horizontal and VFI. In a second, more recent paper, Cukur (2023) calculates VFI following the Eyraud and Lusinyan (2013) approach[6] and finds evidence that VFI negatively affect local fiscal discipline in Türkiye.

On the other hand, there has been considerably more research on the issue of transfer dependence (TR) and its impact on SNG behavior. Some papers have focused on the expenditure side, or the 'flypaper effect' (Sagbas and Saruc, 2004; Saruc and Sagbas, 2008; Tekeli and Kaplan, 2008; Kizilkaya et al., 2018; Acar, 2019; Neyapti and Oluk, 2021), with fewer papers on the revenue side, or tax effort (Sagbas, 2001; Calcali, 2018; Kiziltan and Yereli, 2023). In particular, Sagbas (2001) finds that revenue sharing does not have an impact on the level of tax effort.[7] Calcali (2018) reports a negative relationship between fiscal transfers and municipalities' tax effort.[8] A significant contribution by Kiziltan and Yereli (2023) measures both fiscal capacity and fiscal effort at the province level by applying spatial panel data analysis between 2007–19 for regional disparities in Türkiye, but does not focus on TR and VFI; they find that fiscal decentralization has a positive impact effect on fiscal effort with the central government's reluctance to share revenue capacity to local governments.[9] On the other hand, they emphasize that local policies adopted since 2014 have had a negative impact on fiscal effort—contributing to an increase in the share by local governments from the general budget while simultaneously reducing fiscal effort.

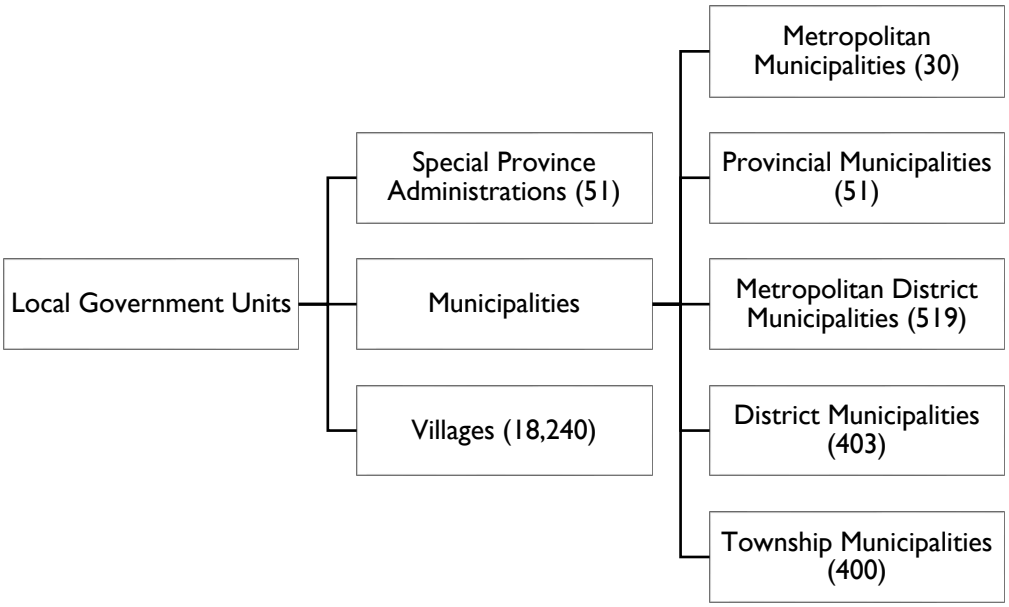
3. Institutional Background and Research Hypotheses

The Republic of Türkiye has a unitary governance model, with power concentrated in the president and two tiers of administration, the central and local levels. There are three types of local government units: municipalities, special provincial administrations, and villages (see Figure 1).[10] There are 81 provinces, of which 30 are governed by the metropolitan municipality model, while 51 are governed by the provincial municipality model.[11] There are special provincial administrations in 51 provinces

[5] For completeness, Güzel and Yilmaz (2018) note that there are insufficient data available to measure VFI while measuring fiscal decentralization for selected provincial samples.
[6] Of note, Cukur (2023) employs the general government budget deficit to measure VFI at the local level, following Eyraud and Lusinyan(2013)'s approach.
[7] This is measured using tax base estimations through simulated multiple regression analysis, or as the ratio of per capita collected tax to per capita local GDP.
[8] In this case, tax effort is measured as a ratio of the total collection of municipalities to the total accrued revenue, or the ratio of property tax collections to the accrued total revenue for municipalities in Türkiye's Eastern Black Sea Region.
[9] According to Kiziltan and Yereli (2023), local fiscal capacity is measured as the ratio of local government budget revenues in the provinces to the gross value added of the respective province, while the fiscal decentralization index is defined as the sum of the ratio of total local governments' tax revenue collection at the provincial level to the sectoral GDP of the province and the ratio of the total central government tax revenue collection at the provincial level to the sectoral GDP of the province.
[10] While the head of the special provincial administration (governor) is appointed by the president, the members of the provincial general council are elected by the people.
[11] Before the introduction of Law No. 6360, there were 16 metropolitan municipalities, and 65 provincial municipalities.

that are not metropolitan municipalities.[12] And there are currently 18,240 villages (Yilmaz and Guner, 2013; Tan, 2020; Neyapti and Oluk, 2021).

Figure 1. Local Government Structure in Türkiye



Since the 2000s, there have been several initiatives to improve subnational governance. Called 'first-generation' reforms, these policies spanned 2004–12 and have been critical in their scope and impact. The reforms were significantly influenced by the European Union accession process and were instrumental in the adoption of the principles of subsidiarity and accountability. The reforms were also essential for the establishment of regional development agencies and investment monitoring and coordination department units (Tosun and Yilmaz, 2010; Yilmaz and Guner, 2013, 2017; Tan, 2020; Neyapti and Oluk, 2021). During the same period, Türkiye's Letter of Intent (2004) to the IMF stated its aim to introduce local fiscal rules on spending responsibilities and debt to promote local fiscal discipline. However, it is important to note that these reforms were only partially successful, and some policy changes were left incomplete (Yilmaz and Guner, 2017). Another shortfall from this period is the inadequate progress made towards the development of local tax or own revenue autonomy.

'Second-generation' reforms started by conducting municipality mergers, which were accepted in 2012 and entered into Law No. 6360 in 2014.[13] Türkiye is one of many OECD countries to follow forced municipality mergers over the last decade. As a result, the number of metropolitan municipalities increased from 16 to 30, and special provincial administrations were abolished in metropolitan municipalities. Furthermore, the legal entities of metropolitan municipalities with village status were dissolved and restructured as neighborhoods. Another consequence of these reforms was an expansion of municipalities' spending responsibilities. The core objective of Law No. 6360 was the realization of economies of scale in the delivery of local services. However, observers of

[12] Before Law No. 6360, SPAs were present in both metropolitan municipalities and provincial municipalities, one in each province. In the aftermath of the legislative amendment, however, SPAs were abolished within metropolitan municipalities, whereas they remain within provincial municipalities.
[13] Law No. 6360 on the Establishment of Metropolitan Municipalities in Fourteen Provinces and Twenty-Seven Districts and Amending Certain Laws and Decree Laws

these reforms found that the amalgamation policies created more subnational transfer dependency (Akilli and Akilli, 2014; Yilmaz and Guner, 2017). In this regard, Türkiye's local governments continue to have limited tax autonomy powers, and own revenues are largely contained to property taxes. Municipalities have discretion only over the property tax base, among the seven taxes assigned to them.[14] The other six taxes include environment cleaning, advertising, communication, electricity and liquid petroleum gas consumption, fire insurance, and entertainment taxes (Tan, 2020).[15] With no changes regarding revenue autonomy after the forced municipality mergers, transfer payments to SNGs were rearranged to meet their increasing expenditure responsibilities.[16]

Overall, considering those past policy reforms, SNGs have been given more spending responsibilities, but more limited powers, to raise their own tax revenues to cover expenditure needs. However, although SNGs do not have significant discretionary powers to alter their tax revenues, they do have full powers regarding their collection effort and so affect their potential tax revenues from their assigned taxes.[17] In this context, the main aim of this paper is to focus on the effect of transfers—designed to close the existing VFI—on the collection or tax effort of SNGs; this addresses an existing important gap in the literature between 2007–22, covering first and second-generation policies for 81 provinces.

The role of transfer payment mechanisms takes special importance because of the significant revenue capacity and socio-economic differences between provinces in Türkiye. In this regard, there has been no absolute or conditional economic convergence between the provinces in the recent past, although an array of development plans and sub-scale strategies are still in force. In Türkiye, indicators such as economic development, income per capita, and urbanization show significant differences from province to province (Aksoy et al., 2019). That is to say, transfer payments are not only an

[14] The Property Tax in Türkiye is established under Law No. 1319. The tax rates are set by Articles 8 and 18 of this law and are only subject to the discretion of the central government. On the other hand, the participation of municipalities as a member of the appraisal commission for the determination of tax base is based on this law and the Tax Procedure Law.

[15] The tax rate of the building tax for residential property is 1 per 1,000, whereas the tax rate for other buildings is 2 per 1,000. The rate of land tax is 1 per 1,000, whereas the rate for a building plot is 3 per 1,000. These rates are increased by 100 percent within the metropolitan municipality borders and adjacent areas of Law No. 5216. The president is authorized to decrease the tax rates by one half or increase them by three times.

[16] Following the enactment of Law No 6360, 4.50 percent of the total general budget tax revenue collection is allocated to district municipalities in metropolitan areas, 1.50 percent to municipalities outside of metropolitan areas, and 0.5 percent to special provincial administrations. Before these rates were introduced, they were 2.50 percent, 2.85 percent and 1.15 percent, respectively. The formulas use indicators such as provincial population, rural area population, a development index, the geographic area, and the number of villages (in the case of provincial special administrations). For municipalities outside of metropolitan areas, the indicators include population and a development index. These criteria have not been revised with the new law. On the other hand, for municipalities in metropolitan areas, the new law added the geographic area criterion to population, the only criterion applied before the new law. Furthermore, the share allocated from total general budget tax revenues to metropolitan municipalities increased from 5 percent to 6 percent. Previously, the allocation criteria were as follows: 70 percent was allocated directly, and 30 percent was distributed based on population. Currently, 60 percent is also allocated directly, while the remaining 40 percent is allocated as 70 percent (according to population) and 30 percent (according to geographic area) (Arikboga, 2015; Yilmaz and Guner, 2017).

[17] Municipalities have collection tax effort, and it can be related to the information level of appraisal commissions, the level of expertise and educational attainment among the local personnel, the knowledge system to determine the true value of real estate, effective audits and control mechanisms, and taxpayers' willingness to pay (Haciköylü and Heper, 2019).

important tool for closing the existing VFI, but also a potential tool for helping to reduce socioeconomic differences among the provinces.[18]

As already highlighted above, with no sufficient resources to meet their expenditure needs because of limited revenue autonomy, the transfer design becomes crucial to the decentralization system, but SNGs have borrowing authority, a tool that affects the VFI in Türkiye.

However, there is a lack of SNG borrowing data, the different types of transfers, and other payments from central government in Türkiye. To complicate matters further, the unity or singularity principle is not respected by local governments. The fact is that municipalities' legal entities, the budgets of affiliated administrations, and municipal companies are at present held in separate and independent reports (Karaer, 2022). This creates significant difficulties in accessing all units' expenditures and revenues to calculate VFI at each unit.

Then there is a question of incentives. With high levels of VFI, SNGs prefer to use TR under the soft-budget constraint and abuse the lack of transparency and fiscal rules at the local level. Consequently, TR can be employed as an alternative and costless alternative to own tax revenues and as a political tool to avoid negative reactions of local citizens and to achieve re-election. Therefore, we would expect the impact of VFI on local tax revenue effort to be negative, although transfer dependency may not have a simple linear effect. This paper tests this hypothesis by applying system GMM—and, to help clarify the possible nonlinear effect of TR, we employ panel threshold analysis. In this context, the hypotheses under consideration are as follows.

H1. VFI negatively affect local tax effort.

VFI represents the difference between local government expenditure needs and their potential revenues or fiscal capacity. For our sample, these gaps are likely to be related not only to transfer payments to local government but also to borrowing policies and public procurement. There are two distinct perspectives to consider. After implementing the forced amalgamation of municipalities in Türkiye, fiscal decentralization policies have often prioritized local public services and transfer payments to local governments, without adequate emphasis on local tax effort and fiscal capacity. In these conditions, it is highly possible to encounter a widening of *de facto* VFI, with increasing reliance on transfer payments given the disincentive effects on local tax effort. However, as already remarked above, the optimal VFI is not zero. Thus, for example, the necessity of transfer payments may be defended to address regional differences and horizontal fiscal imbalances. Therefore, we expect the possible impact of transfer payments to be mixed, with negative but also positive effects.

H2. The effects of VFI on tax effort are expected to be nonlinear. If VFI are above the threshold value, SNGs will prefer that transfer payments replace their local tax effort, thus effectively reducing their local tax effort.

4. Empirical Approach, Data and Key Variables, and Econometric Methodology

In this paper, we aim to measure tax effort at the provincial level in Türkiye for the first time, applying SFA, by using, among others, determinants of a political nature such as *election term* and *ideological gap*. Additionally, we employ SFA for measuring VFI by calculating the difference between *expenditure needs* and *fiscal capacity* instead of accounting budgetary measures. Furthermore, we aim to arrive at a more accurate measure of VFI by adopting the Eyraud and Lusinyan (2013) methodology.[19] In

[18] For more on the general and article justifications of Law No. 5779: www.tbmm.gov.tr/kutuphane-tutanaklara-erisim.
[19] As we see below our measurements of VFI differs from those in Cukur (2023), who uses the same methodology but

contrast to previous studies in the literature, this methodology asserts that transfer dependency is not solely the central variable in Türkiye's context, but that there are other determinants, like borrowing authority and public procurement processes at the local level, that are also relevant. In this context, we measure TR by following the methodology in Goerl and Seiferling (2014) and calculate four alternative transfer measurements as developed by Neyapti and Oluk (2021). Finally, we aim to contribute to the literature on how TR and VFI affect tax effort by applying linear effects and determining a threshold value of VFI for potential non-linear effects in Türkiye.

4.1. Data

Our empirical work will be based on provincial level data because there are no adequate data at the municipality level.[20] Specifically, we make use of local administration budget statistics at the provincial level. This includes special provincial administrations, municipalities, affiliated corporations, and SNG associations.[21] This approach follows that in several notable recent studies on fiscal decentralization in Türkiye such as Neyapti and Oluk (2021) and Kiziltan and Yereli (2023) using the Local Government Budget Statistics database, by province, from the Republic of Türkiye's Ministry of Treasury and Finance. This means that rather than testing for the effect of transfer dependency and VFI on tax revenue effort separately at the metropolitan municipality, provincial municipalities, and special provincial administration levels, we test those effects at the aggregate subnational provincial level.

The analysis uses annual data spanning from 2007 to 2022. Table 1 shows the definition of all variables in our paper and the source of the data.[22]

Table 1. Data Sources and Basic Summary Statistics

Variable	Definition	Source
Act Tax	Actual tax revenue (log level)	The Republic of Türkiye, Ministry of Treasury and Finance
LR	Actual local revenue (log level)	The Republic of Türkiye, Ministry of Treasury and Finance
LE	Actual local expenditure (log level)	the Republic of Türkiye, Ministry of Treasury and Finance
Local Tax Effort	Local tax effort	Calculated using SFA by following Karakaplan and Kutlu (2017)
VFI	Vertical fiscal imbalance	*Expenditure needs* and *fiscal capacity* are calculated using SFA, again by following Karakaplan and Kutlu (2017) After these calculations, VFI is defined as $= \frac{(Expenditure\ needs - Fiscal\ capacity)}{Expenditure\ needs}$

data from cross-country samples rather than provincial data.

[20] Throughout the paper, the concept of subnational government applies to the provincial level, as data are not available at the municipal level in Türkiye. The paper utilizes the terminology subnational, provincial, and local interchangeably.

[21] There is no municipal level database in Republic of Türkiye's Ministry of Treasury and Finance, and while there are municipality level reports in the Turkish Court of Accounts, these present a significant number of missing years and provinces with municipal level data.

[22] Please refer to Appendix 1 for descriptive statistics. In particular, local tax effort, VFI, and TR are measured for each province. Additionally, we add several control variables including ideological gap, social development index, and legal structure index for each province. The measurement of these three control variables is contained in Appendix 2–3 and Appendix 4. The other control variables used in our models are listed in Table 1.

		For robustness checks, VFI is also measured using the methodology of Eyraud and Lusinyan (2013).
TR	Transfer dependency	Measured by using Goerl and Seiferling's (2014) methodology, alternatively using Neyapti and Oluk's (2021) transfer measures.
GDP Per Capita	GDP per capita (log level)	Turkish Statistical Institute
Industry	Industry / Gross Value Added	Turkish Statistical Institute
Services	Services / Gross Value Added	Turkish Statistical Institute
Openness	(Import + Export) / GDP	Turkish Statistical Institute
Population	Population (log level)	Turkish Statistical Institute
Tiers	Number of municipalities + districts + villages (log level)	Turkish Statistical Institute
Land	Land (log level)	Republic of Türkiye, Ministry of National Defense, General Directorate of Mapping
Labor	Labor force (+15) (log level)	Turkish Statistical Institute [23]
Election term	Election term = 1 Others = 0	Supreme Election Council
Ideological Gap[24]	Shows the level of furthest distance between the ruling party and SNG party ideology Can take values between 0 (maximum gap) and 2 (minimum gap)	The authors develop a composite index to measure how a SNG's ideology is different from the central government's ideology.
Legal Structure Index[25]	Legal Development Indicator Index	Calculated using principal component analysis of five indicators: *culture, energy, environmental and electronic communications, and building statistic*, Data from the Turkish Statistical Institute and Information Technologies and Communication Authority
Social Development Index[26]	Social Development Indicator Index	Calculated using principal component analysis of five indicators, including *health, education, and age of marriage data* Data from Turkish Statistical Institute and Ministry of National Education Türkiye.

4.2. Measurement of Key Variables

4.2.1. Measurement of Tax Effort

Local tax revenues are generally measured as a percentage of GDP or as a percentage of total local revenues, but these measures ignore the potential tax revenue of each SNG—or the effort that each

[23] There are no available data on labor force at the provincial level in Türkiye; the regional level is available from the Nomenclature of Territorial Units for Statistics (NUTS-2).
[24] See Appendix 2 for details about the measurement of ideological gap.
[25] See Appendix 3 for details about the measurement of legal structure index.
[26] See Appendix 4 for details about the measurement of social development index.

jurisdiction puts into collecting its taxes—and therefore it would generate misleading results. For these reasons, we use SFA to estimate the tax effort at the provincial level.

Specifically, we utilize the stochastic endogenous frontier model developed by Karakaplan and Kutlu (2017, 2019) and Karakaplan (2017, 2022), which allows us also to address potential endogeneity issues in the estimation of the model. This is important because several past studies have emphasized the importance of political and institutional variables in calculating tax effort (Bird et al., 2008; Cyan et al., 2014). But adding these variables to the model creates a possible endogeneity problem.27 Our stochastic frontier panel data model is presented in Equation 1.

$$Tax\ Effort_{it} = x'_{yit}\beta + v_{it} - su_{it} \quad [1]$$

$$i = 1, \ldots..81\ t = 2007, \ldots, 2022$$

$$x_{it} = Z_{it}\,\delta + \mathcal{E}_{it}$$

$$s = \begin{cases} 1 \text{ for production function} \\ -1 \text{ for cost function} \end{cases}$$

where $Tax\ Effort_{\mathbf{it}}$ represents the logarithm of the output of the i-th province at the time year t, with $\mathbf{I = 1, \ldots..81\ t = 2007, \ldots, 2022}$; $\mathbf{x_{it}}$ is a vector of all endogenous variables (EN- GDP Per Capita) to help explain tax effort of provinces; $\mathbf{Z_{it}}$ is a vector of all exogenous variables; $\mathbf{v_{it}}$ and $\boldsymbol{\mathcal{E}_{it}}$ are two-sided error terms; and $\mathbf{u_{it}}$ is a one-sided error term capturing inefficiency (Karakaplan and Kutlu, 2017).

$$\mathcal{E}_{it} = w_{it} - u_{it}\,.\,[1]$$

$$w_{it} = \sqrt{1 - p'\,p\,\tilde{w}_{it}} = \sigma_w\,\tilde{w}_{it}\,,$$

$$\eta = \frac{\sigma_w\,\Omega^{\frac{1}{2}}}{1 - p'\,p}$$

where $\mathbf{v_{it}}$ (two-sided error term) and $\mathbf{u_{it}}$ (one-sided error term) are likely correlated with $\mathbf{x_{it}}$ (vector of endogenous variables), but $\mathbf{v_{it}}$ and $\mathbf{u_{it}}$ are conditionally independent given $\mathbf{x_{it}}$ (vector of endogenous variables) and $\mathbf{Z_{it}}$ (vector of exogenous variables). Hence, a prominent feature is that $\boldsymbol{\mathcal{E}_{it}}$ is conditionally independent from the regressors given $\mathbf{x_{it}}$ and $\mathbf{Z_{it}}$. This model in Equation 2 gives an opportunity to test for endogeneity using the term $\boldsymbol{\eta}$, rooted in a similar concept to the Durbin-Wu-Hausman test (Karakaplan and Kutlu, 2017).

We use a panel dataset for 81 provinces covering the period 2007–22 and fit a production frontier model to estimate the tax effort of provinces. Efficiency is modeled with *labor force,* following Diabaté and Koffi (2023) and *legal structure index* which we develop by identifying the factors that may influence the outcomes to each province, taking into account Law No. 5779, Municipality Law. The frontier function represents the local tax efficiency frontier—or the potential tax effort considering various economic, geographic, social, and politic factors. To select the explanatory variables, we follow Lotz and Morss (1970) and Bahl (1972) in using *GDP per capita, service, industry* and *openness* as preliminary indicators, and Cyan et al. (2014) and Xing and Zhang (2018) for using *population* as a demographic control variable. We add *transfer dependency* as an endogenous. Additionally, as instrumental variables, we use *land*, *election term*, *ideological gap, tiers,* and our created *social*

[27] Another advantage of this approach is that unlike the two-stage traditional SFA models, the parameter is estimated in a single stage. This method is statistically more efficient compared to the two-stage method and has the advantage of not requiring a bootstrapping procedure to correct SEs (Karakaplan and Kutlu, 2017).

development index. We have also followed Zárate Marco and Vallés-Giménez (2019) and Diabaté and Koffi (2023) for using the variable *GDP per capita*, which presents endogeneity problems.

Table 2. Estimation Results of Local Tax Effort

	EN
Constant	-5.455*** (0.246)
GDP Per Capita	0.929***
	(0.017)
Openness	-0.043
	(0.034)
Industry	0.125
	(0.117)
Service	0.423***
	(0.125)
Population	1.060***
	(0.042)
Transfer Dependency	-0.219*** (0.033)
Constant	-3.359*** (0.406)
Labor Force	0.014*
	(0.007)
Legal Structure Index	-0.100*** (0.025)
Constant	-4.548***
	(0.041)
Eta 1	-0.175*** (0.033)
Transfer Dependency	
Endogeneity Test	X_1=28.67
	p=0.000
Observations	1296
Log Likelihood	1524.28
Mean Tech Efficiency	0.8012
Median Tech Efficiency	0.8124

Note. Symbols indicate significance at the 0.1% (***), 1% (**), 5% (*), and 10% (†) levels. Standard errors are in parentheses. Endogenous variables: *GDP per capita*
Instrumental variables: *land, tiers, social development index, ideological gap, election term*

Table 2 shows the estimation results of local tax effort without addressing and allowing for endogeneity, identified as Model EN. The eta endogeneity test (η=28.67) is significant at the 0.1 percent level, which strongly suggests the need to address the presence of endogeneity in our estimations. Our findings confirm Zárate Marco and Vallés-Giménez (2019) and Diabaté and Koffi (2023)—the need to test GDP per capita for endogeneity. Notably, loglikelihood in Model EN (1866.58) is higher than that in Model EX, which again indicates the need to address the endogeneity problem; Model EN is more reliable (Karakaplan, 2017, 2022). Therefore, only the result for Model 1-EN is included in Table 2.

The sectoral composition of production has different effects on local tax effort. *Service* shows a positive and significant relationship on tax effort, perhaps related to the service sector, which is the largest share of the economy. Warehousing and real estate activities, which are subgroups of the service sector, are directly related to the *property tax,* whereas cultural, artistic, entertainment, recreation, and sports activities are related to the *entertainment tax*. Furthermore, the service sector is one sector that has extensive advertising activities, and it is clearly linked to another local tax, the *advertisement tax.* Additionally, warehousing, property, and the accommodation subsectors are where fire security measures need to be implemented. In this context, fire insurance for movable and immovable properties within municipal boundaries and adjacent areas is another determinant

and explains its positive impact of service sector on local tax effort. All these details are related to Municipal Revenues Law No. 5339 and explain the positive impact of service sector on local tax efforts.

Other findings are the positive effect of *GDP per capita* and *population* on local tax effort. It might be related to increasing demand of the real estate and entertainment sectors, which increase local government taxes, due to increases in citizens' income in a province. The effect of *population* might be explained by making tax collection easier, and it is related to economies of scale in local tax effort (Cyan et al., 2013; Zárate-Marco and Vallés-Giménez, 2019).

On the other hand, we found no statistically significant relationship between openness and industry sector on local tax effort, primarily because local government taxes such as the *property tax, environmental tax,* and *advertisement tax* are not directly affected by international trade. One possible explanation is that the lack of a significant relationship between industry and tax effort might result from the tax exemptions and exceptions within the sector.

Lastly, we observe that *transfer dependency* has a negative association with local tax effort, which is expected, as transfer payments from the central government replace their own revenue as a costless tool for SNG. It confirms a crowding out effect of transfer payments on local tax effort.

These findings for local tax effort were used in the empirical analysis that follows.

4.2.2. Measurement of VFI

Instead of using accounting budgetary measures as proxies of VFI, we will follow a 'standard' measure of VFI based on expenditure needs and fiscal capacity covering the 81 provinces over the period 2007–22. Again, we employ SFA to estimate expenditure needs and fiscal capacity and use these estimates to compute the ratio of the difference between these two concepts to expenditure needs as our measure of VFI.

Following the structure specified in Equation 1 above, we identify expenditure needs as a local expenditure in logarithm level and fiscal capacity as a local expenditure in logarithm level as a dependent variable for each of two models; we estimate them using the same variable in Equation 1. In both models, our variables are represented by the same preliminary variables in Model 1 (GDP per capita, service, industry, transfer dependency, population, and openness). We also refer to GDP per capita to check the presence of endogeneity. Unlike Model 1, we only include land, tiers, and the social development index as instrumental variables in Models 2 and 3 because the revenue potential (expenditure needs) is derived from assigned and given revenue assignments (expenditure assignments). For this reason, we prefer not to use political determinants in these models.

As for the measurement of tax capacity, we tested for the presence of endogeneity. To assess the reliability of the model, it should be noted that based on the tests, the values of both loglikelihood are highest for Model 2-EN and Model 3-EN compared to Model 2-EX and Model 3-EX, as illustrated in Table 3. Therefore, only the results for Model 2-EN and Model 3-EN are included in Table 3.

Table 3. Estimation Results of Expenditure Needs and Fiscal Capacity at the Local Level

	Fiscal Capacity	Expenditure Needs
Constant	-3.373***	-2.729***
	(0.156)	(0.183)
GDP Per Capita	0.940***	0.964***
	(0.012)	(0.014)
Openness	-0.023	-0.037
	(0.020)	(0.024)
Industry	0.133†	0.114
	(0.074)	(0.092)
Service	0.259***	0.297***
	(0.073)	(0.080)
Population	0.855***	0.782***
	(0.024)	(0.029)
Transfer Dependency	0.185***	-0.195***
	(0.021)	(0.024)
Constant	-1.970***	-1.275***
	(0.413)	(0.363)
Labor force	-0.023**	-0.027***
	(0.007)	(0.006)
Legal Structure Index	-0.289***	-0.268***
	(0.039)	(0.036)
Constant	-5.391***	-5.199***
	(0.041)	(0.041)
Eta 1	-0.047*	0.041†
GDP Per Capita	(0.022)	(0.025)
Endogeneity Test	X_2=4.55	X_3=2.73
	p=0.033	p=0.099
Observations	1296	1296
Log Likelihood	1973.11	1836.42
Mean Tech Efficiency	0.8400	0.7980
Median Tech Efficiency	0.8445	0.7920

Note. Symbols indicate significance at the 0.1% (***), 1% (**), 5% (*), and 10% (†) levels.
Standard errors are in parentheses.
Endogenous variables: *GDP per capita*
Instrumental variables: *land*, *tiers, social development index*

As shown in Table 3, we observe that *GDP per capita* presents endogeneity problems (X_2=4.55 and X_3=2.73 at the 5 percent and 10 percent significance levels, respectively) in two models. In our SFA-based estimation, *GDP per capita* exhibits a significant and positive relationship in both models for expenditure needs and fiscal capacity. Consist with previous studies, we confirm that income remains a prominent variable determining expenditure needs and fiscal capacity and promote fiscal capacity and expenditure efficiency. Another finding is that *population* has significant and positive effects within both models, perhaps because a significant majority of Türkiye's population lives in metropolitan provinces, and as the population grows, it increases expenditure needs.

On the other hand, the impact of population on fiscal capacity might be related to two other reasons. First, transfer payments are one of the largest revenue sources for local governments in Türkiye, and these are designed using an objective formula.[28] Population is one factor determining the distribution of transfer payments for both the metropolitan municipality and municipalities outside the metropolitan municipality.

[28] See footnote 17.

Second, increasing population might be related to increasing tax revenue (see Table 2). Population, due to the increase in the number of taxpayers, has an expanding effect on fiscal capacity. In the light of these findings, an increase in *population* is likely to be associated with an increasing demand for public expenditures among citizens. Furthermore, a rising effect in *population* can also be linked to a higher demand for housing and, consequently, a rise in property taxation, which is a significant source of local tax revenue in Türkiye. Additionally, the increase in fiscal capacity with rising *population* is likely to be related to social and economic dynamics.

Another important finding is that *transfer dependency* has a positive effect on explaining fiscal capacity but a negative effect on fiscal needs. These findings indicate that SNGs prefer to increase their revenue sources by depending on transfer payments from the central government rather than increasing their tax effort. Furthermore, countries such as Türkiye where revenue or taxation autonomy is low need transfer payments to meet their needs, address regional imbalance, and cover a significant portion of local services. Therefore, there is a decreasing effect of transfer dependency on expenditure needs.

Whereas *service* exhibits a significant positive effect in all models, *industry* shows a significant positive effect only in fiscal capacity. The reason we do not find the effect of the industrial sector may be related to Türkiye's late industrialization and the exemptions in this sector (Bugra and Savaskan, 2015). Lastly, *openness* shows no significant relationship in either model.

After all these measurements, the final aim is to calculate VFI. Following in Equation 2, we measure VFI, defined as the ratio of the difference between expenditure needs and fiscal capacity to expenditure needs (Martinez-Vazquez and Sepulveda, 2011, 2018).

$$\text{VFI} = \frac{(Expenditure\ needs - Fiscal\ capacity)}{Expenditure\ needs} \qquad [2]$$

Up to this point, we have detailed the methodology for measuring VFI to be used in the baseline model. We also follow Eyraud and Lusinyan's (2013) methodology to measure it as a robustness check. The main reason to choose this methodology is that SNG borrowings and the asymmetry between expenditure and revenue are considered in that model. Eyraud and Lusinyan (2013: 574) define VFI as in Equation 3.

$$\text{VFI} = 1 - \frac{\text{Revenue Decentralization}}{\text{Expenditure Decentralization}} \times (1 - \text{Deficit}) = 1 - \frac{\frac{\text{SNG (own)R}}{\text{SNG R}}}{\frac{\text{SBG (own)E}}{\text{SNG E}}} \times \left(1 - \frac{\text{SNG E} - \text{SNG R}}{\text{SNG E}}\right) \qquad [3]$$

where *revenue decentralization* is defined as SNG own revenue (SNG (own)R) to total revenue (SNG R), *expenditure decentralization* is computed as SNG own expenditure (SNG (own) E) to total revenue (SNG E), *deficit* is calculated as a ratio between SNG total expenditure (SNG E) and SNG revenue (SNG R) to expenditure (SNG E).

We define SNG own revenue for Türkiye as follows. Total SNG revenue minus "interests, shares and fines," "grants, aids and special revenues," and local net borrowing. On the other hand, own expenditure is specified as total local expenditures minus transfers paid by SNG. Lastly, local public deficit is described as a local expenditure minus local revenue as a ratio of local expenditure.

4.2.2 Measurement of Transfer Dependency

We aim to measure TR by following the approach in Goerl and Seiferling (2014). They define TR as the ratio of transfer payments from the central government and other SNGs to the total

expenditure level of SNG as shown in Equation 4.

$$TR = \frac{Grant\ Revenue_{LG} + Grant\ Revenue_{SG}}{Expenditure_{LG} + Expenditure_{SG}} \quad [4]$$

We only consider SNG revenue and expenditure in the formula due to unitary governance in Türkiye. However, we have met some difficulties in calculating it. We can access the sub-items of "interests, shares and fines" and "grants, aids and special revenues" in the SNG budget at the aggregate level. Therefore, we simply calculate the TR index as a ratio of "interests, shares and fines" and "grants, aids and special revenues" to local expenditures at city level. To improve the reliability of our study, we also consider four alternative transfer dependence measures developed by Neyapti and Oluk (2021).29 These authors use the economic classification of SNG consolidated budget revenues and the SNG budget at the provincial level, benefiting from the sub-items of these two data and estimating transfer expenditures. Following this approach as seen in Appendix 5, we calculate the alternative transfer payment for each province.

5. Model Design

We follow the canonical specification in previous studies (Jia et al., 2021; Li and Du, 2021) to analyze how VFI affect fiscal discipline by using the two-stage system GMM (Arellano and Bover, 1995; Blundell and Bond, 1998) as shown in Model (1).

Model 1:

$$Tax_{it} = \beta_0 + \beta_1 Tax_{it-1} + \beta_2 VFI_{it} + \beta_3 TR_{it} + \beta_4 X_{it} + \epsilon_{it}$$

where tax, the dependent variable, represents local tax effort. In our baseline specification, VFI and TR are vertical fiscal imbalance and transfer dependency, respectively, and X is a vector of additional control variables, and i indicates the province, at time t, and ϵ is the error term. We run two-step system GMM with robust standard errors.

Although TR is used as a proxy of VFI in many papers, we think that it is not valid, in general, and especially for the case of Türkiye because there are many other determinants of VFI besides transfers, such as local revenue and expenditure policies, authority for external and domestic borrowing, and the role of public procurements on fiscal imbalances. Besides, the role of transfer payments to SNG is not only to close the gap, but also because they have multiple regulatory and policy roles.

The additional control variables we add in the baseline model are suggested by the theoretical literature. We add land to test geographic effect and tiers to control the effect of municipality merger policy on tax effort, and we include a few socio-economic and political variables such as social development index, legal structure index, ideological gap, and election term.

To better clarify the potential effect of TR, it may be appropriate to apply at a second-stage estimation a threshold value for VFI to better interpret SNGs' behaviors. With this aim, we employ a dynamic panel threshold model (Seo et al., 2019) to investigate whether there is a threshold value for VFI. With this aim, consider the following dynamic panel threshold regression model.

Model 2:

[29] Please refer to the Appendix 5 for details about measurement of alternative transfer payments and all indicators definition; more details on measurement can be found in Neyapti and Oluk (2021).

$$Tax_{it} = \mu_1 + \chi\, Tax_{it-1} + \beta_1 TR_{it}\ \ I\,(VFI \leq \gamma) + \beta_2 TR_{it}\ \ I\,(VFI > \gamma) + X_{it} + \epsilon_{it}$$

where *i* and *t* still show province and year, respectively. Tax_{it} is a scalar stochastic dependent variable, and it symbolizes *local tax effort*; *I* (.) is a determinator function showing the regime defined by the threshold variable, VFI. As seen in Model 2, the threshold variable and regime dependent variable are not the same in our model.

At VFI levels that are above threshold value, TR may have different effects on tax effort compared to those below the threshold; X_{it} is a vector of control variables already introduced in GMM baseline model.

6. Empirical Results

6.1 Baseline Model

Table 4 presents the baseline and extended regression results and diagnostic tests using two-step system GMM with robust standard errors. Columns (a), (b), and (c) shows the baseline regression with sector variables and other control variables. Columns (d), (e), (f), (g), and (h) add various geographic, socioeconomic variables, and political determinants in the extended regressions. All regression results in Table 4 correspond to the full sample, where VFI is calculated as the ratio of differences between expenditure needs and fiscal capacity using SFA, TR is measured using the basic index, and local tax efforts are measured using SFA.

We should point out that there are no overidentification problems or autocorrelation problems in our models.[30] While the Arellano-Bond test for second-order serial correlation is not rejected, the test of first-order serial correlation is rejected. Additionally, we apply the Hansen test for the validity of the instruments, and the results do not reject the exogeneity of the instruments.

Our findings show that VFI has a negative and significant effect on local tax effort in the baseline model and all extension estimation models. Our results support the argument that VFI has a negative effect on tax effort. And the finding is consistent with those in previous studies, such Koley and Mandal (2019), Jia et al. (2021), Wang and Liew (2024). SNGs tend to make use of their soft-budget constraints, including borrowing and bail-out arrangements, as opposed to taking the harder decision of taxing their residents. The low level of tax autonomy and lack of power to determine local tax rates may contribute to this behavior. In addition, current local fiscal rules in Türkiye do not provide enough incentives for local politicians to promote fiscal discipline. There are borrowing rules and personnel expense rules at the local level, but it is not clear which ministry or institution has responsibility to audit whether SNGs obey the rules or which may impose sanctions (Karaer, 2022).

At a more general level, the negative impact of VFI on tax effort is associated with inadequate data and fiscal transparency: there is a data access problem of sub-items of SNG budgets in Türkiye. If there are low levels of fiscal transparency and accountability regarding SNG activities and inadequate data for measuring those activities in a transparent way, SNGs are incentivized to adopt other policy decisions rather than tax their residents in order to cope with VFI. They would prefer not to eliminate VFI by increasing local tax effort due to reelection concerns.

[30] Additional to diagnostic tests, we also present Variance Inflation Factor (VIF) values for all regressions in the paper. The VIF is a metric used to assess multicollinearity in regression analysis. Please refer to Table A-6-1 in Appendix 6. Our findings indicate that the VIF values suggest moderate correlation (all values below 5), which is generally not considered a concern.

Importantly, we also find that there is a negative and significant relationship between TR and local tax effort for all models Our finding is consistent with those in previous papers, such as Canavire-Bacarreza and Espinoza (2010), Calcalı (2018), and in an indirect way, Kiziltan and Yereli (2023) for Türkiye. The results support the argument that transfer payments seem like an alternative and costless financing alternative for SNGs, which creates a crowding out effect on local tax effort. We also observe that TR has a more destructive effect than VFI across all specifications in Table 4, regarding to the coefficients of VFI and TR.

We should note that all lagged dependent variables (baseline and extended models) show statistically significant and positive effects, justifying the requirement of the dynamic model approach in our paper. This positive effect supports the conjecture that high levels of tax collections promote increasing economic growth (Castro and Camarillo, 2014). *Population* also shows a negative impact on all the models a significant degree of congestion might cause more problems of tax exemptions (Wang et al., 2009). Moreover, *GDP per capita* has a consistent positive impact on local tax effort, confirming that if the province experiences economic growth, its tax effort increases.

To test the effect of sectoral variables, initially, *service* is included in the model, and we found its statistical significance and positive effect on local tax effort at the 5 percent level. Subsequently, the model is re-estimated with only *industry* included, following the same procedures. Finally, both *service* and *industry* are added into the model to test the effect of sectors on local tax. *Industry* is negatively associated with the local tax effort at the 1 percent level in all Table 4, except for column (g). The negative impact of *industry* on local tax effort is related to tax exemptions and reductions as well as the frequency of tax amnesties. The case in point is that building and property taxes are the responsibility of municipalities; however, buildings located in organized industrial zones, technology development zones, and industrial sites are the responsibility of the central government and are exempted from property taxes by various legal regulations.[31] Although a building is on the border of a metropolitan or provincial municipality, it can negatively affect tax effort because it is actually located in an area under the responsibility of the central government. On the other hand, we cannot confirm the effect of *service* on local tax in column (c).

The *openness* and *land* indicators show no significant relationship with tax effort in all models.

[31] Please refer to Article 4 of Law No. 1319

Table 4. Baseline and Extension Regression: Effect of VFI and TR on Local Tax Effort

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Lag Dep. Var.	0.97***	0.989***	0.984***	0.933***	0.976***	0.98***	0.849***	1.07***
	(0.05)	(0.049)	(0.05)	(0.04)	(0.053)	(0.049)	(0.066)	(0.086)
VFI	-0.122***	-0.0845***	-0.0876***	-0.0964***	-0.0903***	-0.0865***	-0.0833***	-0.0449**
	(0.042)	(0.029)	(0.028)	(0.028)	(0.03)	(0.029)	(0.028)	(0.022)
TR	-0.173***	-0.127***	-0.131***	-0.141***	-0.134***	-0.131***	-0.0949***	-0.0753***
	(0.052)	(0.035)	(0.035)	(0.035)	(0.036)	(0.036)	(0.031)	(0.026)
GDP Per Capita	0.0137***	0.0113***	0.011***	0.0158***	0.0117***	0.0115***	0.00548**	0.00918**
	(0.004)	(0.003)	(0.003)	(0.0045)	(0.003)	(0.003)	(0.002)	(0.004)
Openness	-0.00981	-0.00529	-0.00408	-0.00768	-0.00408	-0.00406	0.00208	0.00128
	(0.009)	(0.007)	(0.006)	(0.004)	(0.006)	(0.006)	(0.007)	(0.005)
Population	-0.0283***	-0.0171***	-0.0186***	-0.018***	-0.0186***	-0.0172***	-0.0195***	-0.0177**
	(0.011)	(0.006)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.008)
Industry		-0.0472***	-0.0469**	-0.0286***	-0.0454***	-0.0434***	-0.00799	-0.0562*
		(0.016)	(0.019)	(0.011)	(0.016)	(0.016)	(0.018)	(0.034)
Service	0.0491**		-0.00302					
	(0.022)		(0.016)					
Land	0.00346	-0.00196						
	(0.008)	(0.005)						
Social Development				-0.003***				
				(0.0017)				
Ideologic Gap					-0.0013			
					(0.0016)			
Tiers						0.00256*		
						(0.0014)		
Legal Structure							0.009***	
							(0.0028)	
Election Term								-0.00165**
								(0.0007)
Constant	0.222***	0.177***	0.189***	0.207***	0.193***	0.173***	0.286***	0.0752
	(0.079)	(0.061)	(0.062)	(0.07)	(0.065)	(0.064)	(0.084)	(0.059)
Diagnostic Tests								
Number of observations	1215	1215	1215	1215	1215	1215	1215	1215
N-T	81-16	81-16	81-16	81-16	81-16	81-16	81-16	81-16
Number of groups	81	81	81	81	81	81	81	81
Number of Instruments	28	28	28	24	28	28	25	21
AR(1)	-3.42	-3.31	-3.33	-3.28	-3.35	-3.312	-3.62	-2.99
p-value	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
AR (2)	-0.1	-0.811	-0.823	-0.91	-0.821	-0.847	-1.28	-0.577
p-value	(0.317)	(0.417)	(0.411)	(0.362)	(0.411)	(0.397)	(0.199)	(0.564)
Hansen J Test	0.243	0.214	0.212	0.140	0.240	0.205	0.211	0.363

Note: Robust standard errors in parentheses and coefficients are estimated by using two-system GMM.
It is noted that *t* statistics are represented by ***, **, * and state the significance at the level of 1, 5 and 10 percent, respectively.
Source: Authors' research result

6.2 Model Extensions and Robustness Checks

We proceed with several extensions to our baseline model. Checking the effects of the service and industry sectors on the model in Table 4, columns (a), (b), and (c), only the *industry* sector is added to the extension models as a sectoral variable due to the high significance level to explain model—also to avoid the over-identification problem.

First, we add several socio-economic and political control variables, *social development index, legal structure, tiers, ideological gap* and *election term*. The estimation results are shown in Table 4, columns (d)–(g). The findings confirm that VFI and TR have negative and significant effects on tax effort in these extensions of the model, and the results are similar to those obtained for our baseline model. In the extended model, we find a positive and statistically significant relationship between *tiers* and local tax effort. *Tiers*, a control variable added to control for how municipality mergers have affected tax effort, indicate that the municipality merger policy pursued has had a deterrent effect on local tax effort. Furthermore, we can observe insignificant effects of *ideological gap* on local tax effort. When the ideologies of the central government party and local governments' party are aligned closely or not, it does not tend to affect local tax effort. Nevertheless, we detect a negative relationship between *election term* and local tax effort. This finding supports the electoral business cycle hypothesis at the local level in Türkiye.

Finally, the positive impact of the *legal structure index* on local tax effort is related to regulation for taxation and the expansion of the scope of taxation. The estimated regressions also show that the *social development index* has negative and significant effects on local tax effort. This finding is associated with exemptions aimed at ensuring social justice for property taxation. According to Article 8 of Law No. 1319, individuals who are retired and whose income consists solely of monthly pensions from social security are exempt from the property tax, provided that they own only one residential property. Another reason is that if social development and tax awareness are high, voluntary tax compliance might decrease when some citizens believe the system is unfair or they might not find a relationship between tax payments and the provision of a desirable local public service (Cummings et al., 2004; Kirchler, 2007).

Next, we run a series of robustness test using alternative measurements of key variables. First, we present the estimation results when using an alternative measurement of VFI following Eyraud and Lusinyan's (2013) approach, which is based on budget accounting measures, in Table 5. The results still show negative and significance coefficients of the key variables VFI and TR on local tax effort with those both in our baseline and extended regressions. The findings for the role of socioeconomic and political determinants are also similar to those obtained with our extended regressions in Table 4. However, unlike Table 4, we cannot confirm the effect of *social development index* and *tiers* on the local tax effort in Table 5, column (d) and (f).

Table 5. Robustness Check: Alternative Measurements of VFI (Eyraud and Lusinyan's (2013) Approach)

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Lag Dep. Var.	0.971***	1***	0.996***	0.897***	0.993***	0.991***	0.832***	1.08***
	(0.05)	(0.045)	(0.046)	(0.048)	(0.049)	(0.044)	(0.067)	(0.086)
VFI	-0.0551***	-0.0356***	-0.0357***	-0.0326***	-0.0363***	-0.0354***	-0.0401***	-0.0223**
	(0.017)	(0.011)	(0.01)	(0.012)	(0.011)	(0.011)	(0.011)	(0.0096)
TR	-0.115***	-0.0791***	-0.0798***	-0.0478***	-0.0804***	-0.0798***	-0.053***	-0.0579***
	(0.03)	(0.019)	(0.019)	(0.016)	(0.02)	(0.019)	(0.016)	(0.016)
GDP Per Capita	0.0139***	0.0114***	0.0109***	0.00563	0.0115***	0.0113***	0.00495***	0.0104**
	(0.0038)	(0.0026)	(0.0024)	(0.0037)	(0.0026)	(0.0027)	(0.0019)	(0.0044)
Openness	-0.00753	-0.00368	-0.00281	-0.00503	-0.00305	-0.00285	0.00172	0.0006
	(0.0097)	(0.0066)	(0.0057)	(0.007)	(0.0059)	(0.0058)	(0.0076)	(0.0053)
Population	-0.0272***	-0.0154***	-0.0155***	-0.00419	-0.0155***	-0.0144***	-0.0162***	-0.0182**
	(0.01)	(0.0059)	(0.0046)	(0.004)	(0.0046)	(0.0045)	(0.0042)	(0.0077)
Industry		-0.0555***	-0.0559***	-0.0045	-0.0538***	-0.0509***	-0.00312	-0.0665*
		(0.016)	(0.02)	(0.013)	(0.016)	(0.016)	(0.019)	(0.037)
Service	0.0548**		-0.0046					
	(0.023)		(0.017)					
Land	0.00565	-0.00042						
	(0.009)	(0.006)						
Social Development				0.00023				
				(0.002)				
Ideologic Gap					-0.00087			
					(0.002)			
Tiers						0.0022		
						(0.001)		
Legal Structure							0.009***	
							(0.003)	
Term								-0.0017**
								(0.0007)
Constant	0.191**	0.138***	0.148***	0.143***	0.147***	0.134**	0.276***	0.0689
	(0.075)	(0.053)	(0.052)	(0.05)	(0.056)	(0.053)	(0.079)	(0.057)
Diagnostic Tests								
N. of observations	1215	1215	1215	1215	1215	1215	1215	1215
N-T	81-16	81-16	81-16	81-16	81-16	81-16	81-16	81-16
N. of groups	81	81	81	81	81	81	81	81
N. of Instruments	28	28	28	25	28	28	29	21
AR(1)	-3.57	-3.36	-3.36	-3.15	-3.38	-3.34	-3.6	-2.99
p-value	(0.000)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.000)	(0.003)
AR (2)	-0.98	-0.78	-0.78	-0.73	-0.77	-0.80	-1.32	-0.64
p-value	(0.325)	(0.433)	(0.436)	(0.463)	(0.441)	(0.424)	(0.187)	(0.521)
Hansen J Test	0.427	0.322	0.325	0.177	0.336	0.296	0.114	0.386

Note: Robust standard errors in parentheses and coefficients are estimated by using two-system GMM; *t* statistics are represented by ***, **, * and state the significance at the level of 1, 5 and 10 percent, respectively; source: authors' research results.

We also perform one last robustness test by using the alternative *transfer dependency indices* (TR-1, TR-2, TR-3, and TR-4), developed by Neyapti and Oluk (2021). These results are presented in Table 6. Like our baseline model, these all new results validate the negative and significant effect of transfer dependence on *local tax effort*. Furthermore, the findings indicate that the VFI have the same effect on tax effort. One exception is the negative and significant effect of *TR-1* on local tax effort at the 5 percent level. Among these alternative measures, *TR-4* measures the broadest form of the transfer from central governments to local governments, while *TR-1* measures the narrowest form, which only considers the "the current flow of grants, aids, and special revenues from the central government budget agencies" from central government (See Table A-5-1 and Table A-5-2). Therefore, our finding in Table 6, column (a) has a lower level of significance.

Table 6. Robustness Test: Alternative Measurements of TR (Using Neyapti and Oluk's (2021) Approach)

	(a)	(b)	(c)	(d)
Lag Dependent Variable	0.975***	0.974***	0.934***	0.937***
	(0.026)	(0.040)	(0.031)	(0.031)
VFI	-0.011**	-0.0138***	-0.034***	-0.0397***
	(0.005)	(0.005)	(0.007)	(0.010)
TR	-0.037***	-0.0275***	-0.0508***	-0.0648***
	(0.008)	(0.006)	(0.009)	(0.014)
GDP Per Capita	0.0076***	0.00576***	0.0043***	0.0052***
	(0.002)	(0.002)	(0.001)	(0.001)
Openness	-0.0023	-0.00233	-0.0044	-0.004
	(0.003)	(0.003)	(0.004)	(0.004)
Population	0.0036	0.004	0.004	-0.00016
	(0.003)	(0.005)	(0.004)	(0.004)
Industry	-0.0058	0.00049	0.0063	-0.00056
	(0.010)	(0.014)	(0.010)	(0.010)
Land	-0.0037	-0.00286	-0.00587	-0.005
	(0.003)	(0.004)	(0.004)	(0.003)
Constant	0.0016	-0.0028	0.064***	0.091**
	(0.017)	(0.021)	(0.018)	(0.023)
Diagnostic Tests				
Number of observations	1215	1215	1215	1215
N-T	81-16	81-16	81-16	81-16
Diagnostic Tests	81	81	81	81
Number of observations	17	17	17	17
AR(1)	-3.09	-3.08	-3.15	-3.21
p-value	(0.002)	(0.002)	(0.002)	(0.001)
AR (2)	-0.377	-0.365	-0.516	-0.606
p-value	(0.707)	(0.715)	(0.606)	(0.545)
Hansen p-value	0.259	0.256	0.309	0.329

Note. Please refer to the note in Table 4.
In here (a), (b), (c), and (d) indicate transfer dependency indexes (TR-1, TR-2, TR-3 and TR-4)

One final issue we explore is the presence and importance of SNG behavioral changes after VFI have reached certain threshold values. For that we employ the dynamic panel threshold model to test for the presence of nonlinear effects, as previously studies by Seo et al. (2019). The important question to be examined here is how the effect of transfer payments on SNG's behavior is mediated by the level of VFI.

The findings from the nonlinearity threshold model are presented in Table 7. These findings show a robust rejection of the linearity hypothesis at the 1 percent level, confirming that the level of VFI can modify how transfers affect local tax effort.

Table 7. Dynamic Threshold Panel Regression Estimation

	Below VFI < 0.131	Above VFI > 0.131
L. Dep. Variable	0.498***	-0.0512***
	(0.007)	(0.003)
TR	0.0175***	-0.0158***
	(0.001)	(0.001)
Constant	0.0535	
	(0.003)	
Threshold *VFI*	0.1319	
CI	0.115 0.148	
No. Year	16	
No. Countries	81	
Linearity test (prob.)	0.000	

Note: Instrumental variables include *GDP per capita, openness, land, industry, population*

We predict the threshold value as the point at which local governments have less power of fiscal independence and increasingly depend on the transfer payments from the central government for our case. We estimate the threshold value for VFI (0.131), and the estimation is significant at 1 percent level. These findings show that since we are discussing the issue of a centralist structure and different provinces of varying socio-economic backgrounds in Türkiye, it is not surprising that fiscal needs are higher than fiscal capacity at the threshold value. The finding confirms that when VFI is below the threshold level, TR has a positive impact on local tax effort. Conversely, when VFI is above the threshold level, an increase in TR leads to decreases in local tax effort. It seems to support an asymmetric effect of transfers on SNGs behavior for the case of Türkiye.

Under lower VFI, transfer payments can be used to close the vertical fiscal gap at the subnational level, meeting the demands of citizens and contributing to economic growth and development, at the same time these transfers create a channel to support local tax effort. In this scenario, local governments have more fiscal independence and less dependence on transfer payments compared to the high level of VFI. Their fiscal independence may allow them to better manage their resources and increase their own revenues and tax revenues, or it may cause a less distorted effect on it. In this point, transfer payments from the central government are likely to have a positive impact on tax effort and create a positive effect on the economic growth and fiscal discipline of provinces, which could subsequently lead to an increase in local tax effort.

When VFI is above the threshold level, there is distortion effect. SNGs are inclined to see transfer payments as a costless tool under high VFI and reduce their tax effort, abusing soft-budget constraints, bailout packages from the central government, and avoiding their residents' reactions against higher taxes. We know that considering the local government policies that have been enacted in Türkiye, it is significant to observe that while expenditure responsibilities are becoming increasingly dependent on transfer payments from the central government, the regulations pertaining to fiscal autonomy are limited. In this scenario, because local governments have deeper VFI and less fiscal autonomy, transfer payments are likely to create a common pool problem. Additionally, the still incomplete process in practice for appropriate transparency policy arrangements at the local level in Türkiye, which is a significant cost of VFI, can pave the way for this situation to deepen. In such a situation, local governments prefer to use more transfer payments instead of increasing tax collection effort. The

predominance of unconditional transfers in Türkiye constitutes an additional rationale reason that may further intensify this effect.

Overall, the optimal level of VFI is very likely different from zero because of different cost advantages of raising tax revenues at the central and subnational levels, in favor of the former. Therefore, at some low levels of VFI, the positive impact of TR on local tax effort can be interpreted as a recognition by SNGs that despite the central transfers they receive, they need and are still expected to raise their own revenues to provide public service and optimize citizens' well-being. But when the level of tax autonomy is too low and there is not the possibility to meet a SNG's expenditures needs, as is often the case in Türkiye, the SNG become dependent and turns to the political advantages of providing services without having to tax their own residents—and therefore the negative consequences of TR on lower tax effort.

In summary, we confirm that VFI is a determinant of local government behavior for Türkiye case.

7. Conclusions

Focusing on SNGs in the Republic of Türkiye, this paper investigates how vertical fiscal imbalance (VFI) and transfer dependency (TR) shape SNGs' behavior regarding local tax effort, covering first- and second-generation policy reform in the country. With this aim, we calculate local tax effort applying SFA to address the endogeneity problem in our models. Then, we employ linear and nonlinear models to test our hypotheses.

These are the highlights of our results. First, in our linear model, the results show a consistent negative effect of VFI and TR on local tax effort across SNGs in Türkiye. These same results are supported in all our extended models. These basic results hold when we conduct robustness checks by using the alternative method for computing VFI, following Eyraud and Lusinyan (2013). Our findings support the negative effect of TR and VFI on local tax effort in all additional robustness checks for alternative measures of TR, following Neyapti and Oluk (2021). In addition, we attempt to identify a threshold value for VFI using the dynamic threshold model developed by Seo et al. (2019) to test the non-linear effects of transfer dependence on tax effort. Our results indicate that if VFI is low, TR has a positive impact on local tax effort, while there is a negative impact above the threshold level of VFI.

As for policy implications and recommendations, the most important is the need for enhancing fiscal autonomy at the subnational level in Türkiye, which still can be respectful of the current unitary structure of the country. SNGs should have a more extensive assignment of tax instruments and the autonomy to determine tax rates. There should also be a reassessment of current incentives in the system for SNGs' tax effort. Other needed policy changes could contribute to reducing effective VFI and to increasing subnational tax effort, including improving consistent transparency by publishing budget data and full information on public procurement processes for all SNGs.[32]

[32] See "Making Public Procurement Transparent at Local and Regional Levels," prepared by the Council of Europe (2017) and presented at the Congress of Local and Regional Authorities (Resolution 421), which is very applicable to Türkiye.

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Appendix 1

Table A-1-1. Descriptive Statistics

Variable	Obs.	Mean	Std. Dev	Min	Max
Tax Effort	1296	0.801	0.103	0.440	0.993
VFI	1296	0.0766	0.110	-0.672	0.603
*VFI**	1296	0.758	0.168	-0.445	1.360
TR	1296	0.716	0.158	0.211	1.555
TR-1 - Neyapti and Oluk(2021)	1296	0.464	0.109	0.169	1.360
TR-2 - Neyapti and Oluk(2021)	1296	0.432	0.116	0.169	1.359
TR-3 - Neyapti and Oluk(2021)	1296	0.541	0.109	0.172	1.362
TR-4 - Neyapti and Oluk(2021)	1296	0.587	0.126	0.174	1.362
GDP Per Capita	1296	4.351	0.342	3.563	5.481
Industry	1296	0.276	0.118	0.054	0.664
Services	1296	0.558	0.092	0.293	0.826
Openness	1296	0.159	0.204	0	1.824
Population	1296	5.744	0.411	4.872	7.202
Land	1296	3.899	0.281	2.9	4.61
Tiers	1296	2.320	0.497	1.255	3.111
Election term	1296	0.187	0.390	0	1
Ideological Gap	1296	1.251	0.621	0	2
Social Development Index	1296	4.77e-10	1.000	-2.161	3.432
Legal Structure Index	1296	-4.56e	1.000	-3.993	2.007
Local Expenditure	1296	5.776	0.535	4.052	8.112
Local Revenue	1296	5.761	0.529	4.051	8.064
Local Tax	1296	4.549	0.666	2.464	7.114
Labor force	1296	49.963	5.557	28.8	61.1

Appendix 2

Measurement of Ideological Gap

We create an index to measure the ideological gap, quantifying the ideology distance between the central government and SNG parties for 2007–22 at the provincial level. With this aim, we use two criteria: the first is whether local governments (metropolitan municipality or provincial municipality) are governed by opposition parties. If it is an opposition party, the index takes a value of 0; if it is the same ideology as the central ruling party, it takes a value of 1. The second criterion captures how many districts municipality are governed by the opposition or by the central ruling party.

$$Ideological\ Gap\ = p + \frac{\sum_{i=1}^{m} d}{m} \quad [5]$$

where p is the metropolitan municipality's ideology for each of subnational government, i=1; m represents the number of district municipalities; $\sum_{i=1}^{m} d$ is the sum of ideological distances between district municipalities and central government. The index can take values between 0 (maximum ideological gap) and 2 (minimum ideological gap). There are two important situations for the case of Türkiye in measuring the ideological gap. First, there are two electoral alliances in Türkiye, called the Nation Alliance and People's Alliance. People's Alliance was established in February 2018 between the ruling Justice and Development Party and the Nationalist Movement Party. One year later, the Great Unity Party also joined the alliance. On the other hand, there is another alliance in Türkiye, called the Nation Alliance. It was established in May 2018 between the Republican People's Party, the IYI Party, the Felicity Party, and the Democrat Party. Later, the Democracy and Progress Party

and the Future Party also joined this alliance.[33] After these alliances took place, the first local election term was held on March 31, 2019. Second, there is a legal guardianship or trustee system in Türkiye. The Ministry of Internal Affairs has the authority to appoint a person as governor, deputy governor, and district governor instead of mayors being elected for several listed reasons. If there are provincial and district municipalities where trustees are appointed, we proceed with the calculation by accepting that these regions have the same ideology as the central government, given that these municipalities are appointed by the central government.

Appendix 3

Measuring the Legal Structure Index Using Principal Components Analysis

Due to the large number of variables and high correlation among some of the indicators on the legal structure, our models could suffer from over identification problems. To address this issue, we develop a *legal structure index* using PCA to the aggregate five existing indicators in Türkiye. Table A-3-1 presents the name of the variables, their definition, and source.

Table A-3-1. Data, Definitions and Sources

Variable	Definition	Source
Culture statistics (log level)	It comprises a number of spectators for cinema and theatergoers at each level[34].	Turkish Statistical Institute
Energy statistics (log level)	Total consumptions (MWh)	Turkish Statistical Institute[35]
Environmental statistics (log level)	Drinking water networks and water treatment plants-Total amount of water abstracted (1000 cubic meters/year)[36]	Turkish Statistical Institute
Electronic Communications (log level)	It consists of the total number of fixed telephone access lines, the number of mobile phone subscribers, and the number of broadband internet subscribers.	Information Technologies and Communication Authority
Building statistics (log level)	Construction permit-number of buildings	Turkish Statistical Institute

Table A-3-2 shows that the KMO test is 79 percent. This is an indication that there is a high correlation between the data and that our dataset is suitable for factor analysis.

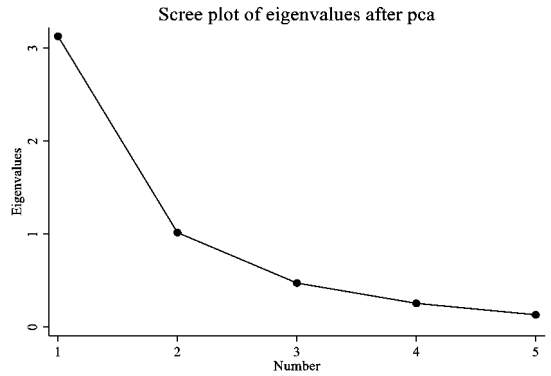
Table A-3-2. Screeplot Represents the Variances of All Principal Components

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.7940

The factor analysis line chart is presented in Figure A-3-1. In this chart, we determine the number of factors as 1, considering the stage when the slope begins to disappear. Finally, we obtain a rotated component matrix, which gives the result of our analysis.

[33] The unity of alliances is detailed to cover the analysis period in our paper.
[34] There is inadequate data on the number of visitors to private and public museums. Because of this reason, we use spectators and theatergoers for culture statistics.
[35] There was a missing observation for 2022. We requested from TUIK to share the data of total consumptions for each of province for the project and used balanced data.
[36] The data set is published every two years. Because of this reason, we use the same data for two years it covers.

Figure A-3-1. Line Chart of Factor Analysis



Appendix 4

Measurement of the Social Development Index by Using Principal Components Analysis

We develop a *social development index* to reduce the number of dimensions—and not to ignore the possible information content and impact of socio-economic variables. To construct this index, we include four indicators: *age at first marriage, school enrollment rate, infant mortality rate,* and *number of doctors per capita* by again using PCA. Table A-4-1 presents the name of the variable, its definition, and source.

Table A-4-1. Data, Definitions, and Sources

Variable	Definition	Source
Physicians Total	Physicians Total per capita	Turkish Statistical Institute
Infant mortality rate	Infant mortality rate	Turkish Statistical Institute
School enrollment rate	Net school enrollment rate[37]	Turkish Statistical Institute
Marriage age	Mean age at first marriage for female	Turkish Statistical Institute

Table A-4-2 shows KMO test of 79 percent, indicating that there is high correlation between the data and therefore suitable for factor analysis.

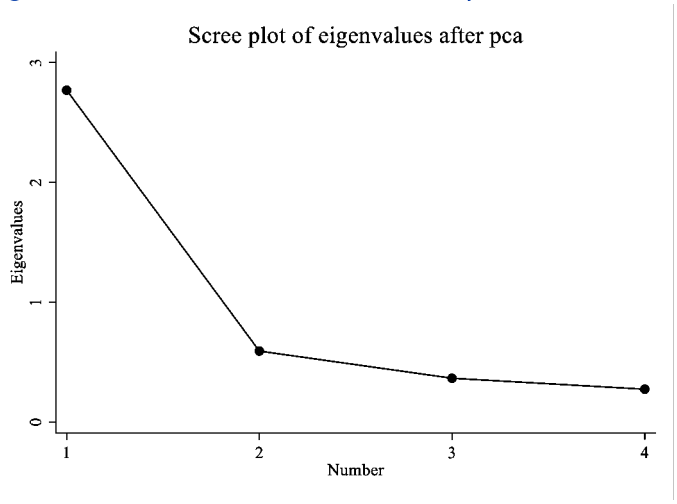
Table A-4-2. Screeplot Represents the Variances of All Principal Components

Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.7978

A factor analysis line chart is presented in Figure A-4-1. In this chart, we determine the number of factors as 1, considering the stage when the slope begins to disappear.

[37] Since the data prior to 2012 are not provided by TUIK, the Education Ministry dataset is used between 2008–12. In 2012, the Primary Education Law No: 6287 implemented an educational system requiring a compulsory four years of primary school, four years of middle school, and four years of secondary school. Before this system, there were five years of compulsory primary education and four years of high school. While creating this dataset, the relevant changes are followed to ensure comparability.

Figure A-4-1. Line Chart of Factor Analysis



Appendix 5

Alternative Transfer Dependency Measures, Following Neyapti and Oluk (2021)

As Neyapti and Oluk (2021: 27) note the sub-items "grants, aids and special revenues" and "interest, shares, and fines for city" are not available for subnational government budgets at the provincial level in Türkiye. As a solution, they propose to use local administration's consolidated budget revenues. In particular, they follow a decomposition approach, using data on current aid, capital aid, project aid (current and capital), and "interest, shares, and fines for city from central management revenue" for each of province. In the last step, they measure transfers by using the separation values obtained from the subnational government budget and consolidated government budget. The components are detailed in Table A-5-1 and the formula of alternative measurements are presented in Table A-5-2.

Table A-5-1. Code Classification for Measurement of Alternative Transfer Payments

Code of Classification	Name		Definition
4.0	y(i)		Grants, aids and special revenues
4.2.1.	j		Current
4.2.1.0.1		w	Treasury aid, current
4.2.2.0.2	k		Capital
		v	Treasury aid, capital
4.5.1.0.1	u		Project aid, current from general
4.5.2.0.1	t		Project aid, capital from general budget agencies
5.0	x(i)		Interest, shares and fines for province
5.2.2.5.1	z		From central management revenues

Source: Neyapti and Oluk (2021)

See more details about the local budget database from The Republic of Turkey, Ministry of Treasury and Finance, General Directorate of Public Accounts: İller İtibariyle Mahalli Yönetim Bütçe İstatistikleri (2006-2018) - T.C. Hazine ve Maliye Bakanlığı Muhasebat Genel Müdürlüğü (hmb.gov.tr); muhasebat.hmb.gov.tr/mahalli-idareler-butce-istatistikleri. Follow these steps to access data: General Government Financial Statistics- Budget Statistics- Budget Statistics by Provinces- Local Administrations Budget Statistics by Provinces (2006-2023). Local Government Budget Statistics - Local Government Consolidated Budget Revenues (Ekod4).

Table A-5-2. Formula of Alternative Transfer Measurement by Neyapti and Oluk (2021)

Alternatives	Formula of Measurement
TR-1	"International shares and fines + current grants, aids and special revenue" for province i. (z/x) xi + (k/y) yi
TR-2	"International shares and fines + current and capital treasury aid" for province i. (z/x) xi + ((w + v) / y) yi
TR-3	"International shares and fines + current and capital grants, aids and special revenue" for province i. (z/x) xi + ((j + k) / y) yi
TR-4	"International shares and fines + current and capital project aid" for province i. (z/x) xi + ((j + k + u + t) / y) yi

Source: Neyapti and Oluk (2021)

For robustness checks, we calculate four alternative transfer measures for each province following Neyapti and Oluk (2021) and calculate alternative transfer dependency measures as a ratio of the obtained alternative transfer payments to total subnational expenditure.

Appendix 6

In our estimations and analysis, we investigate that there is no correlation between the main predictors and all other variables, as indicated by the variance inflation factor (VIF) values for all models presented in Table A-6-1 (next page).

Table A-6-1. Variance Inflation Factor (VIF) Values for All Models

	Table 2	Table 3a-3b	Table 4a	Table 4b	Model 4c	Table 4d	Table 4e	Table 4f	Table 4g	Table 4h	Table 5a	Table 5b	Model 5c	Table 5d	Table 5e	Table 5f	Table 5g	Table 5h	Table 6a	Table 6b	Table 6c	Table 6d	Table 7
VFI			3.28	3.28	3.29	3.32	3.31	3.28	3.28	339									1.88	1.56	2.69	2.97	3.28
*VFI**											1.15	1.14	1.15	1.17	1.17	1.14	1.15	1.18					
TR	1.73	1.66	4.29	4.40	4.40	4.69	4.42	4.40	4.47	4.41	1.34	1.39	1.39	1.52	1.39	1.40	1.44	1.42					4.40
TR-1																			2.26				
TR-2																				2.08			
TR-3																					2.94		
TR-4																						3.52	
GDP Per Capita	4.70	4.13	1.23	1.34	1.33	3.52	1.34	1.45	1.37	1.38	1.20	1.31	1.30	3.48	1.31	1.41	1.34	1.33	1.88	1.88	1.59	1.50	1.34
Industry	4.20	4.17		1.72	3.33	1.65	1.65	1.65	1.71	1.65		1.72	3.32	1.64	1.64	1.64	1.71	1.65	1.58	1.57	1.63	1.50	1.72
Services	3.30	3.25	1.25		2.51						1.24		2.51										
Openness	1.94	1.92	1.85	1.88	1.63	1.62	1.63	1.62	1.65	1.61	1.85	1.88	1.63	1.61	1.63	1.62	1.65	1.61	1.90	1.90	1.89	1.88	1.88
Population	4.41	4.28	3.23	2.96	2.20	2.00	1.97	2.04	2.65	1.97	2.81	2.61	1.84	1.66	1.64	1.70	2.33	1.64	2.34	2.44	2.34	2.58	2.96
Land	1.95	1.94	1.68	1.76							1.68	1.76							1.75	1.76	1.75	1.76	1.76
Legal Structure	2.26	2.24							2.08								2.09						
Tiers	1.39	1.38						1.31								1.31							
Election term	1.07									1.09								1.08					
Ideological Gap	1.19						1.04								1.05								
Soc. Dev.	4.83	4.24				3.28								3.32									
Labor	1.47	1.47																					
Mean VIF	**2.65**	**2.79**	**2.40**	**2.48**	**2.67**	**2.87**	**2.19**	**2.25**	**2.46**	**2.21**	**1.61**	**1.69**	**1.88**	**2.06**	**1.40**	**1.46**	**1.67**	**1.42**	**1.94**	**1.88**	**2.12**	**2.27**	**2.48**

Note. VFI* indicates the alternative data of VFI by following Eyraud and Lusinyan (2013), while *TR-1*, *TR-2*, *TR-3* and *TR-4* indicate the alternative data of *TR* by following Neyapti and Oluk (2021).