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Government size, fiscal transparency, and the composition of public expenditure: Evidence from Chinese prefecture-level cities

Cong Liu[1]
Judhiana Abd Ghani[2+]
Wency Bui Kher Thinng[3]

[1,2,3]*School of Business and Economics, Universiti Putra Malaysia, Kuala Lumpur, Malaysia.*
[1]*Email: gs64597@student.upm.edu.my*
[2]*Email: judhiana@upm.edu.my*
[3]*Email: wency@upm.edu.my*

(+ Corresponding author)

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ABSTRACT

This study investigates how fiscal transparency moderates the relationship between local government size and the composition of public expenditure in Chinese prefecture-level cities. Using panel data from 283 cities between 2013 and 2022, the study employs a two-way fixed effects dynamic panel model estimated with the system GMM approach to address endogeneity and dynamic behavior. The results show that an increase in local government size is initially associated with a rise in productive expenditures, such as science and technology, and a decline in unproductive expenditures, including education, social security, and health care. However, fiscal transparency significantly moderates these effects. As transparency increases, the positive impact of government size on productive spending weakens, while the negative impact on unproductive spending also diminishes. These findings suggest that fiscal transparency plays a critical role in shaping how local governments allocate resources under fiscal pressure, by reducing information asymmetry and enhancing accountability. The study concludes that while larger governments may prioritize economic functions over social services, transparency can constrain such tendencies. Policymakers should therefore closely monitor government expansion and improve transparency mechanisms to ensure a balanced approach that supports both fiscal sustainability and public welfare.

Contribution/ Originality: This study reveals how fiscal transparency moderates the impact of local government size on expenditure composition, highlighting its role in constraining shifts toward productive spending. It offers new empirical evidence on the interaction between government size, transparency, and spending behavior at the prefecture level.

1. INTRODUCTION

The composition of public expenditure is pivotal not only in fostering national and local economic development but also in enhancing social welfare (Keefer, Scartascini, & Vlaicu, 2020). According to Barro's (1990) growth theory, productive government expenditure stimulates private investment by increasing the returns on capital, thereby promoting economic growth. Typical examples of productive expenditure include investments in scientific and technological development (Aschauer, 1989). However, government expenditure is not exclusively directed toward fostering economic growth; it also encompasses spending on social welfare, such as social security, employment, and health care. Although these expenditures may not directly contribute to economic growth, they

play a critical role in improving residents' quality of life, which is essential for effective national governance and sustainable social development (Keefer & Khemani, 2005).

Empirical studies on the relationship between government size and the composition of public expenditure have shown varying impacts across countries, income levels, and expenditure categories. Dreher, Sturm, and Ursprung (2008) analyzed data from 108 countries spanning 1970 to 2001 and found that an increase in government size generally reduced the share of goods and services expenditure while boosting capital expenditure in the global sample. However, in OECD countries, the expansion of government size was primarily associated with a rise in interest payments. Similarly, Moore and Zanardi (2010) highlighted regional differences, noting that in low-income countries, government size expansion often resulted in reduced public service expenditure. In contrast, in middle-income countries and Latin American regions, there was a decrease in the share of economic affairs expenditure and an increase in social security spending. Brender and Drazen (2013) constructed an indicator to assess public expenditure composition and observed that while government size significantly influenced expenditure composition in the long term, the relationship was less pronounced in developed countries.

Some studies have delved into the impacts of government size on productive and unproductive expenditures, yielding mixed findings. Hailemariam and Dzhumashev (2019) found that in Canadian provinces, larger governments significantly reduced productive expenditures, such as infrastructure investment, while increasing unproductive expenditures, based on fixed effects models and instrumental variable estimation approaches. In contrast, Chen, Lv, and Liu (2019) observed in a cross-country sample that government size expansion in developing countries substantially promoted productive expenditures, driven by public investment policies aimed at economic development. These contrasting results highlight the critical role of institutional frameworks and policy priorities in shaping expenditure composition. Overall, the relationship between government size and the composition of public expenditure appears to be highly context-dependent, influenced by economic conditions, governance structures, and policy objectives. This ambiguity underscores the need for further exploration of the heterogeneity in the institutional environment, such as fiscal transparency.

Fiscal transparency is a relatively recent but essential element of modern governance. It is defined by Kopits and Craig (1998) as the degree to which data on public sector accounts, fiscal policy goals, government structures, and forecasts are made available to the public. The financial crises in the late 20th century were largely caused by a lack of fiscal transparency, according to the International Monetary Fund (2007), which prompted attempts to institutionalize openness in fiscal governance. It is now acknowledged that one of the most important elements of good fiscal management is fiscal transparency. With its foundation in principal-agent theory, it serves as a vital instrument for mitigating information asymmetry and preventing any conflicts of interest between citizens and governments (Alt, 2019). Fiscal openness improves monitoring, which helps prevent local governments from acting opportunistically and may lead them to adjust their spending plans.

By defining revenue divisions and giving subnational authorities more public responsibilities through matching expenditure mandates, the 1994 tax-sharing reform (State Council of the People's Republic of China, 1993) drastically changed the fiscal relationship between China's central and subnational governments (Zhang, 2016). According to Zhang, Zhu, and Hou (2016), this trend of decentralization continued at the local level, which helped to increase the size of local government. Simultaneously, China has improved budgetary openness significantly, especially since the Government Information Disclosure Regulations were introduced in 2008 (State Council of the People's Republic of China, 2007). According to data from the Chinese Prefecture-Level Fiscal Openness Reports, fiscal openness has significantly improved in prefecture-level cities; on a scale of 100 points, the average score increased from 18 points in 2012 to 56 points in 2022 (Tsinghua University, 2023).

Although we don't find studies that investigate the impacts of fiscal transparency on the composition of public expenditure, some scholars have examined the influence of democracy, another institutional factor. Avelino, Brown, and Hunter (2005) analyzed the relationship between democracy and public expenditure in Latin American

countries and found that democracy significantly increases education expenditure. Similarly, Profeta, Puglisi, and Scabrosetti (2013) explored the effects of democracy on tax revenue and public expenditure in developing countries. Their fixed-effects models showed no significant relationship between democracy and public expenditure, except for a reduction in defense spending. In a broader context, Kotera and Okada (2017) investigated 125 countries from 1972 to 2010 using a difference-in-differences approach and found that democratization often leads to increased health and education expenditures while reducing defense spending. Although the impacts of democracy on public expenditure vary across countries and regions, the findings suggest that higher institutional levels generally shift expenditure toward social welfare priorities.

China began implementing a few budgetary changes in the 1980s with the goal of more decentralization. These changes expanded the administrative and financial duties of local governments and greatly improved their fiscal independence. The size of local administrations has significantly increased in this setting, particularly at the prefecture level. Local government spending as a proportion of GDP grew from 13% to 14.8% between 2011 and 2022 (National Bureau of Statistics of the People's Republic of China, 2023). Two important considerations are raised in conjunction with the rapid improvement of fiscal transparency in Chinese prefecture-level cities. First, as the size of local governments expands, will they adjust the composition of public expenditure by increasing productive spending to alleviate the resulting fiscal pressure? Second, does increased fiscal transparency affect the adjustment under the pressure of legitimacy?

Accordingly, this study sets out two main objectives. The first is to analyze the impact of local government size on the composition of public expenditure. The second is to assess the moderating effect of fiscal transparency on this relationship. To achieve these objectives, the study draws on panel data from 283 prefecture-level cities in China over the period 2013-2022 and employs the GMM estimation method. Public expenditure is classified into two categories: unproductive spending, which focuses on social welfare, and productive spending, which directly supports economic growth. By exploring these dimensions, the study contributes new empirical insights into how fiscal transparency influences expenditure decisions at the local level. It also enriches the theoretical understanding of fiscal transparency as a governance mechanism and offers practical policy recommendations for improving expenditure structure and fiscal efficiency in local governments.

2. THEORETICAL FOUNDATION AND HYPOTHESIS DEVELOPMENT

2.1. Government Size and the Composition of Public Expenditure

The relationship between government size and the composition of public expenditure has received limited attention in the literature, though several scholars have explored relevant theoretical perspectives. Peacock and Wiseman (1961) proposed that government size tends to expand following crises or wars, often resulting in increased allocations toward social security, public services, and education. Similarly, Tanzi and Schuknecht (2000) highlighted that in developed countries with well-established welfare systems, larger governments are closely associated with higher spending on social security programs, including pensions, healthcare, and unemployment benefits. Moreover, Faguet (2014) emphasized that the expansion of local governments can reshape the composition of public expenditure due to shifts in their roles and responsibilities within public service systems.

While existing theories rarely systematically explore the direct relationship between government size and the composition of public expenditure, relevant insights can be drawn from the framework of Keen and Marchand (1997). Their model, grounded in the context of fiscal decentralization, suggests that when local governments are granted greater fiscal autonomy and responsibilities, they face stronger incentives to adjust their expenditure composition under competitive and budgetary pressures. They tend to increase productive expenditure, such as infrastructure and economic services, to stimulate growth and expand their revenue base. To extend this reasoning, we argue that the essence of government size lies in the scope of governmental intervention in the economy. When fiscal decentralization leads to an expansion in local government size, reflected in rising expenditure responsibilities

and administrative structures, it also intensifies fiscal pressure, especially in the face of limited revenue sources. As a response, local governments may adjust their spending composition by increasing the share of productive expenditure that supports long-term economic returns, while curbing unproductive items aimed mainly at short-term welfare. Thus, based on this extended logic, we propose the following hypothesis.

H_1: An increase in local government size leads to a higher share of productive expenditure and a lower share of unproductive expenditure.

2.2. Fiscal Transparency's Moderating Role

Several public economics theories provide the theoretical foundation for understanding the role of fiscal transparency. According to the principal-agent theory, because of their own limited knowledge and informational capabilities, citizens, acting as principals, assign the administration of public resources to elected governments, acting as their agents (Jensen & Meckling, 2019). However, according to public choice theory, governments could behave more in their self-interest than in the public interest, such as increasing bureaucratic control and maximizing income, which would result in agency costs (Niskanen, 2017). Since governments frequently have access to better and more information than citizens, notable information asymmetries make these agency issues worse (Alt & Lassen, 2006). By lowering monitoring costs, eliminating information asymmetries, and empowering individuals to monitor and hold governments responsible, fiscal transparency helps alleviate these problems (Bellver & Kaufmann, 2005). According to legitimacy theory, governments should increase disclosure and transparency to win or keep the public's trust and legitimacy (Suchman, 1995).

Building on these theoretical insights, this study introduces fiscal transparency as a moderating factor in the relationship between local government size and the composition of public expenditure. When fiscal transparency is low, the asymmetry of information shields local governments from public scrutiny, allowing them to adjust expenditure composition, such as by increasing productive spending, without facing immediate resistance or accountability. In such contexts, citizens may remain unaware of deviations from their welfare expectations. However, as fiscal transparency improves, the flow of information reduces asymmetries (Alt, 2019), making citizens more capable of monitoring government behavior. When citizens perceive a shift toward productive expenditure at the expense of social welfare-oriented spending, they may hold local governments accountable for such deviations. Following legitimacy theory (Suchman, 1995) local governments, seeking to maintain public support and legitimacy, may reduce or even reverse such adjustments. Based on this reasoning, we propose the second hypothesis.

H_2: Fiscal transparency constrains the adjustment by local governments to increase productive and reduce unproductive expenditure in response to government size expansion.

3. RESEARCH METHODOLOGY

3.1. Model Specification

In order to examine the effects of fiscal transparency and local government size on the composition of public expenditure, with an emphasis on the moderating role of transparency, this study builds a dynamic panel model with two-way fixed effects, as indicated in Equation 1, in reference to the research conducted by Chen et al. (2019) and Bamba, Combes, and Minea (2020).

$$EC_{it} = \beta_1 EC_{it-1} + \beta_2 GS_{it} + \beta_3 FT_{it} + \beta_4 (GS_{it} \times FT_{it}) + \beta_0 + \theta X + \mu_i + \omega_t + \varepsilon_{it} \quad (1)$$

Here, EC represents the composition of public expenditure, GS stands for the size of local governments, FT refers to fiscal transparency, and X includes control variables, including population size and economic development. The term μ_i represents individual fixed effects, ω_t accounts for time-period fixed effects, and ε_{it} is the error term.

Endogeneity problems and the impact of missing variables are addressed by the dynamic panel model (Arellano & Bond, 1991). Both person and time-specific heterogeneities are controlled for using the two-way fixed effects

model. To evaluate the moderating impact of fiscal openness on the link between the size of the government and the makeup of public spending, the interaction term is added. The total effect of government size on the makeup of public spending is not directly represented by the coefficient for the government size variable. Equation 2, therefore, computes the partial derivatives of government size to the composition of public expenditures. This formula emphasizes how budgetary transparency affects the impact of government size. Additionally, the standard errors of the marginal effect are calculated using Equation 3 (Brambor, Clark, & Golder, 2006).

$$\frac{\partial EC_{it}}{\partial GS_{it}} = \beta_2 + \beta_4 FT_{it} \quad (2)$$

$$\hat{\sigma}_{\frac{\partial EC_{it}}{\partial GS_{it}}} = \sqrt{Var(\beta_2) + (FT_{it})^2 Var(\beta_4) + 2(FT_{it})Cov(\beta_2, \beta_4)} \quad (3)$$

3.2. Variable and Data Source

A set of variables reflecting expenditures on healthcare, education, social security and employment, and research and technology is used to capture the composition of public spending. At the prefecture level, each variable is expressed as a percentage of total government expenditure (Kotera & Okada, 2017; Pan & Liu, 2012). These expenditures are categorized into two groups: unproductive expenditures, which include healthcare, social security, and education; and productive expenditures, which consist of spending on research and technology. Although education expenditure contributes to human capital development, it is more commonly associated with social welfare, like healthcare and social security. Based on the classification by Hailemariam and Dzhumashev (2019) education spending is therefore considered unproductive.

In terms of explanatory variables, the general public budget expenditures as a proportion of GDP in cities at the prefecture level serve as a gauge of government size. Empirical studies frequently employ this well-known metric to accurately depict the range of government operations in the economy (Choudhury & Sahu, 2023; Qiao, Ding, & Liu, 2019; Thanh & Canh, 2019). Fiscal transparency is quantified using Tsinghua University's fiscal transparency index for prefecture-level cities, which is logarithmically transformed to address potential heteroscedasticity. Adapted for the Chinese context, the index is based on the Manual on Fiscal Transparency (International Monetary Fund, 2007) and has been widely employed in public economics research since its development (Li & Yang, 2024; Sun & Andrews, 2020). To ensure comparability across years despite changes in scoring methods, the index values are rescaled to a 0-100 scale, where 0 indicates the lowest level of transparency and 100 the highest.

A logarithmic transformation is applied to population size, defined as the total number of inhabitants in prefecture-level cities, to serve as a control variable (Keefer et al., 2020). According to Endrikat (2017) economies of scale associated with larger populations may influence the composition of public expenditure. However, Kotera and Okada (2017) argued that the effects on spending patterns remain uncertain, as preferences for public goods and services can vary significantly among consumers. In addition, real GDP per capita, also logarithmically transformed, is used as an indicator of economic development (Cordis, 2014; Endrikat, 2017; Kotera & Okada, 2017). Real GDP is calculated using the GDP growth index, with 2011 as the base year. Following Wagner (1893) rising income levels tend to increase the demand for public goods relative to private goods, thereby affecting the structure of public spending.

Panel data spanning 283 Chinese cities at the prefecture level from 2013 to 2022 is used in this study. The Chinese Prefecture-level Fiscal Transparency Reports (2014-2023), which are released by the Tsinghua University Research Center for Public Economics, Finance, and Governance, are the source of the fiscal transparency statistics. These reports, which are usually made public before September of each year, are accessible on the Center's official website and include information on the fiscal transparency circumstances of the previous year. The China City Statistical Yearbooks include information on education, research, and technology expenditures, as well as revenue

and expenditures from the general public budget. Additional data are taken from the statistics yearbooks of each city at the prefecture level, such as population, GDP growth index, healthcare spending, and social security and employment spending. All referenced yearbooks and reports cover the period from 2014 to 2023. The combined dataset was compiled using the China Economic Information Network (CEInet) Statistics Database (https://ceidata.cei.cn/). Tables 1 and 2 provide an overview of the variables, their corresponding data sources, and descriptive statistics.

Table 1. Variables and data sources.

Variables	Definition	Source
Composition-science and technology	The proportion of local government expenditure for science and technology to general public budget expenditure in prefecture-level cities (%).	China city statistical yearbooks
Composition-education	The proportion of local government expenditure for education to general public budget expenditure in prefecture-level cities (%).	China city statistical yearbooks
Composition-social security and employment	The proportion of local government expenditure for social security and employment to general public budget expenditure in prefecture-level cities (%).	Statistical yearbooks of respective prefecture-level cities
Composition-health care	The proportion of local government expenditure for health care to general public budget expenditure in prefecture-level cities (%).	Statistical yearbooks of respective prefecture-level cities
Government size	General public budget expenditures as a share of GDP in prefecture-level cities (%).	China city statistical yearbooks
Fiscal transparency	The fiscal transparency index of Chinese prefecture-level cities, measured on a scale from 0 to 100, where higher values indicate better fiscal transparency (Log-transformed).	School of public administration, Tsinghua university
Population size	The number of residents in prefecture-level cities, in millions (Log-transformed).	Statistical yearbooks of respective prefecture-level cities
Economic development	Real GDP per capita in prefecture-level cities (2011 fixed prices), in thousands (Log-transformed).	Statistical yearbooks of respective prefecture-level cities

Note: All the yearbook data is collected from the CEInet Statistics Database (https://ceidata.cei.cn/).

3.3. Estimation and Model Selection

This study uses both difference GMM and system GMM estimators to account for possible endogeneity (Arellano & Bover, 1995; Blundell & Bond, 1998). By using lagged values of endogenous variables as internal instruments, these dynamic panel approaches eliminate the need for external instruments. When it comes to lowering the danger of poor instruments, System GMM is very useful. First differencing is replaced with the orthogonal deviation transformation to protect data and reduce information loss. Corrected standard errors are used in a two-step estimation process to account for any bias in the standard error estimations (Windmeijer, 2005). The Arellano-Bond test looks for first- and second-order serial correlation in the residuals (Arellano & Bond, 1991), whereas the Hansen (1982) test is used to evaluate the validity of the instrument.

According to Kiviet (2020) selecting the right model improves forecasting accuracy and aids in addressing serial correlation, especially when higher-order delays and pertinent control variables are included. Andrews and Lu (2001) provide the Model and Moment Selection Criteria (MMSC) for GMM estimation, which are consistent with common information criteria including the AIC, BIC, and HQIC. As a result, this study uses MMSC to assess the effect of adding variables and lag structures to reduce serial correlation. Joint significance tests, namely chi-squared tests, are also performed to determine if all time dummy coefficients are jointly equal to zero to validate the use of the two-way fixed effects model.

Table 2. Descriptive statistics.

Variables	Obs.	Mean	Std. dev.	Min.	Max.
Composition-science and technology	2,830	0.018	0.018	0.001	0.207
Composition-education	2,830	0.173	0.038	0.036	0.304
Composition-social security and employment	2,360	0.141	0.046	0.023	0.443
Composition-health care	2,120	0.099	0.024	0.034	0.209
Government size	2,830	0.216	0.106	0.057	0.872
Fiscal transparency	2,830	49.352	17.627	2.770	92.150
Population size	2,830	4.304	2.920	0.256	21.268
Economic development	2,830	57.392	32.489	8.502	250.633

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Unproductive Expenditure Results

The estimation findings from dynamic models assessing the impact of fiscal transparency and local government size on the makeup of unproductive expenditures, such as health care, social security and employment, and education, are shown in Table 3. At the 1% significance level, the Arellano-Bond test findings for each model reject the null hypothesis that there is no first-order serial correlation, but at the 10% significance level, the null hypothesis that there is no second-order serial correlation is not rejected. Furthermore, the null hypothesis, which maintains the validity of all instruments, cannot be rejected at the 10% significance level, according to the Hansen J tests. The veracity of the GMM calculations is confirmed by these diagnostic tests taken together.

For education expenditure, both the first- and second-order lagged terms are positive and statistically significant at the 5% level or lower across Models (1) to (3), indicating some inertia in education spending. In Model (1), which includes both government size and fiscal transparency, the coefficient for current government size is negative but statistically insignificant, while the first-order lagged term is significantly positive at the 10% level. The fiscal transparency variable also shows a negative coefficient, significant at the 10% level. Model (2) introduces an interaction term, which is positive and statistically significant at the 10% level. The significance of the terms in Model (2) improves relative to Model (1), especially the current government size term, which becomes significant at the 10% level. Moreover, the coefficients for both government size and fiscal transparency in the current period decrease noticeably. In Model (2), both control variables show significantly positive coefficients at the 10% level, suggesting that population growth and economic development contribute to a larger share of education expenditure. Additionally, Chi-squared tests reject the null hypothesis that all time dummy variables are jointly equal to zero, supporting the use of two-way fixed effects models over individual fixed effects models. The values of the three selection criteria in Model (2) are lower than those in Model (1), indicating that the inclusion of the interaction term improves the model's explanatory power. Thus, Model (2), which uses the difference GMM approach, provides the best fit to the data. Model (3), which applies the system GMM approach, yields results consistent with those in Model (2).

For education expenditure, both the first- and second-order lagged terms are positive and statistically significant at the 5% level or lower in Models (1) to (3), indicating a degree of inertia in education spending. In Model (1), which includes both government size and fiscal transparency, the coefficient for current government size is negative but statistically insignificant, while the first-order lagged term is significantly positive at the 10% level. The fiscal transparency variable has a negative coefficient, which is also significant at the 10% level. Model (2) introduces an interaction term, with its coefficient positive and significant at the 10% level. The significance of the terms in Model (2) improves compared to Model (1), particularly the current term for government size, which becomes significant at the 10% level. Additionally, the coefficients for both government size and fiscal transparency in the current period decrease noticeably. In Model (2), the coefficients for both control variables are significantly positive at the 10% level, indicating that population growth and economic development contribute to a higher share of education expenditure. Furthermore, the Chi-squared tests reject the null hypothesis that all time dummy

variables are simultaneously equal to zero, supporting the use of two-way fixed effects models over individual fixed effects models. The values of the three selection criteria in Model (2) are lower than those in Model (1), suggesting that the inclusion of the interaction term improves the model's explanatory power. Therefore, Model (2), which uses the difference GMM approach, provides the best fit to the data. Model (3), which applies the system GMM approach, yields consistent results with those in Model (2).

For healthcare expenditure, the Chi-squared tests indicate that Models (10) to (12) all reject the hypothesis that the time dummy variables are simultaneously equal to zero. Model (11), which includes the interaction term, shows smaller selection criterion values compared to Model (10), suggesting that the inclusion of the interaction term is necessary. Moreover, Model (12), which employs the system GMM approach, demonstrates better overall significance levels compared to Model (11), making it the most suitable model for capturing the examined relationship. Additionally, the lagged terms of the dependent variable exhibit significantly positive coefficients in Models (10) to (12), indicating a similar inertia effect as observed in social security and employment expenditures, where past values positively influence current outcomes. In all three models, the current terms of government size are significantly negative, while the first- and second-order lagged terms are both significantly positive in the latter two models, although with smaller absolute values. Regarding fiscal transparency, although the current terms in Models (11) and (12) are negative, only the latter is statistically significant at the 10% level. Furthermore, in Model (12), the second-order term is also significant and exhibits a positive coefficient. The interaction terms in both models are positive and statistically significant at the 5% level. Additionally, in both models, the current terms of population size and economic development are significantly negative, while their second-order terms are significantly positive. This suggests that an increase in population size and economic development decreases the share of healthcare expenditure in the same period, but their effects lead to an increase in the subsequent period.

Table 3. Estimation results: unproductive expenditures.

Variables	Education			Social security and employment						Health care		
	DIF-GMM		SYS-GMM	DIF-GMM				SYS-GMM		DIF-GMM		SYS-GMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable, it-1	0.577***	0.517***	0.510***	0.318*	0.495***	0.463***	0.627***	0.434***	0.875***	0.652***	0.635***	0.640***
	(6.64)	(5.76)	(6.05)	(1.79)	(3.87)	(3.85)	(5.46)	(4.03)	(10.72)	(3.71)	(4.04)	(4.29)
Dependent variable, it-2	0.099**	0.096**	0.088**									
	(2.16)	(2.11)	(2.18)									
Government size	-0.096	-0.489*	-0.471**	0.006	-0.057	-0.353***	-0.811**	-0.344***	-0.664***	-0.142***	-0.285***	-0.279***
	(-0.88)	(-1.91)	(-2.00)	(0.06)	(-1.36)	(-2.90)	(-2.22)	(-2.79)	(-2.87)	(-3.07)	(-3.44)	(-3.48)
Government size, it-1	0.199*	0.153***	0.148***							0.115*	0.075*	0.074**
	(1.88)	(5.62)	(5.99)							(1.82)	(1.86)	(1.99)
Government size, it-2										0.084	0.105*	0.104**
										(1.45)	(1.91)	(2.14)
Fiscal transparency	-0.015*	-0.043**	-0.040**	-0.037**	-0.010**	-0.041***	-0.063**	-0.043***	-0.053***	0.002	-0.011	-0.011*
	(-1.65)	(-2.15)	(-2.20)	(-2.13)	(-2.25)	(-2.78)	(-2.45)	(-2.62)	(-3.36)	(1.35)	(-1.62)	(-1.68)
Fiscal transparency, it-2										0.014***	0.009	0.010**
										(2.64)	(1.61)	(2.21)
Government size * Fiscal transparency		0.135*	0.121*			0.086**	0.183**	0.086**	0.160***		0.062**	0.060**
		(1.79)	(1.70)			(2.10)	(1.97)	(2.02)	(2.74)		(2.07)	(2.24)
Population size	0.248	0.467*	0.265	0.201**	0.144**	0.238***	0.138***	0.240***	0.023	-0.282	-0.353***	-0.352***
	(1.06)	(1.76)	(1.40)	(2.11)	(2.44)	(4.50)	(2.99)	(4.78)	(0.65)	(-1.51)	(-2.58)	(-2.63)
Population size, it-2										0.099	0.096*	0.095*
										(1.57)	(1.67)	(1.78)
Economic development	0.138	0.368*	0.202							-0.121	-0.197**	-0.190**
	(0.72)	(1.78)	(1.38)							(-0.79)	(-2.06)	(-2.13)
Economic development, it-1				0.139	0.033***	0.215***	0.026***	0.199***	0.002			
				(1.61)	(2.76)	(3.67)	(2.72)	(3.19)	(0.31)			
Economic development, it-2										0.112**	0.076	0.075*
										(2.17)	(1.57)	(1.77)
Number of observations	1981	1981	1981	1652	1652	1652	1652	1652	1652	1272	1272	1272
Time effects	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
AR (1) test	-4.878	-3.955	-4.652	-3.849	-3.534	-4.267	-3.973	-3.739	-4.966	-3.358	-2.401	-2.890
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.016	0.004
AR (2) test	-0.332	-0.964	-1.019	-0.348	-1.107	-1.277	-0.129	-0.173	-0.628	-0.201	-0.661	-0.618
	0.740	0.335	0.308	0.728	0.269	0.202	0.897	0.863	0.530	0.841	0.509	0.536

Variables	Education			Social security and employment						Health care		
	DIF-GMM		SYS-GMM	DIF-GMM				SYS-GMM		DIF-GMM		SYS-GMM
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Hansen test	8.789	4.691	7.442	7.836	16.862	18.086	19.111	17.810	22.303	7.565	7.631	8.080
	0.457	0.968	0.878	0.347	0.206	0.701	0.385	0.717	0.324	0.752	0.813	0.885
Chi-squared test	29.350	44.850	46.690	5.220		12.320		8.800		26.230	24.510	29.120
	0.000	0.000	0.000	0.516		0.055		0.185		0.000	0.000	0.000
MMSC-AIC	-9.211	-19.309	-18.558	-6.164	-9.138	-25.914	-16.889	-26.190	-17.697	-14.435	-16.369	-19.921
MMSC-BIC	-42.020	-63.055	-65.949	-30.411	-54.168	-102.118	-79.238	-102.395	-86.974	-51.357	-56.648	-66.913
MMSC-HQIC	-22.678	-37.265	-38.010	-16.176	-27.732	-57.380	-42.634	-57.656	-46.303	-29.727	-33.052	-39.384

Note: t-statistics are reported in parentheses. Significance levels are indicated as follows: $p < 0.1$, $p < 0.05$, *$p < 0.01$. Coefficients are excluded if they fail to achieve significance at the 10% level or below in both the difference and system GMM estimations. For diagnostic tests, the first row presents the test statistics, while the second row provides the corresponding p-values. MMSC-AIC, BIC, and HQIC denote three types of model selection criteria. The null hypothesis for the Chi-squared tests is that all time dummy variable coefficients are jointly equal to zero.

Overall, the estimation results across the three categories of public expenditure show consistent patterns in the relationships involving government size, fiscal transparency, and their interaction. Specifically, the coefficients for government size and fiscal transparency are significantly negative, while the interaction terms are significantly positive. This implies that when fiscal transparency is zero, an increase in local government size tends to reduce the share of these expenditures in total expenditure.

However, the positive interaction terms suggest that fiscal transparency moderates this relationship, potentially mitigating the negative effects of government size. Further analysis is needed to determine whether these moderating effects are statistically significant. Additionally, for both education and healthcare expenditure, the lagged terms of government size and fiscal transparency exhibit significantly positive coefficients, indicating intertemporal effects that result in an increase in these expenditure shares over time.

4.2. Productive Expenditure Results

Table 4 presents the estimation results for productive expenditure, specifically science and technology expenditure, across four models. Model (1) includes government size and fiscal transparency, while Model (2) introduces their interaction term, with both models estimated using the difference GMM approach. Model (3) uses the system GMM approach, incorporating both individual and time effects, while Model (4) corresponds to Model (3) but includes only individual effects.

Diagnostic tests, including the Arellano-Bond tests and Hansen J tests, confirm the absence of second-order correlation and validate the use of instruments, ensuring the robustness of all four models. For model selection, Chi-squared tests reveal that Models (1) and (2) reject the null hypothesis that all time dummy variables are zero, while Model (3) does not, justifying the inclusion of Model (4). Additionally, Model (2) exhibits lower selection criterion values compared to Model (1), suggesting the inclusion of the interaction term is beneficial. However, Model (3) does not show a substantial improvement in significance levels compared to Model (2). Therefore, Models (2) through (4) all appear to be suitable for capturing the relationship.

For prudence, this analysis focuses on the common characteristics observed across the models. Specifically, the first-order lagged terms of the dependent variable are significantly positive in all four models, indicating that science and technology expenditure, like other expenditure categories, exhibits inertia, where changes persist into subsequent periods but gradually diminish over time.

The current terms of government size and fiscal transparency are significantly positive across all models, while their interaction terms are significantly negative. These results suggest that increases in government size and fiscal transparency independently contribute to a higher share of science and technology expenditure, assuming the other variable is held at zero.

However, the negative interaction terms indicate that fiscal transparency moderates the effect of government size on science and technology expenditure, potentially weakening its impact. Furthermore, while the coefficients for population size and economic development are statistically significant in Model (4), they are not significant in Model (2), indicating that these effects are not robust across different model specifications. As such, the hypothesis that their effects equal zero cannot be consistently rejected. Overall, the findings related to government size, fiscal transparency, and their interaction differ from those for unproductive expenditures, underscoring the distinct dynamics involved in the allocation of productive expenditure.

Table 4. Estimation results: Productive expenditures.

Variables	Science and technology			
	DIF-GMM		SYS-GMM	
	(1)	(2)	(3)	(4)
Dependent variable, it-1	0.450**	0.409**	0.444**	0.280*
	(2.28)	(2.03)	(2.29)	(1.84)
Dependent variable, it-2	0.066*	0.069*	0.078**	0.086
	(1.71)	(1.89)	(2.04)	(1.34)
Dependent variable, it-3	0.066**	0.073**	0.078***	-0.027
	(2.29)	(2.55)	(2.65)	(-0.23)
Government size	0.028**	0.086**	0.086**	0.087*
	(2.19)	(2.34)	(2.29)	(1.92)
Fiscal transparency	0.004*	0.010**	0.011**	0.008**
	(1.90)	(2.41)	(2.56)	(2.33)
Fiscal transparency, it-1	0.001*	0.001	0.001	0.001**
	(1.83)	(1.52)	(1.43)	(2.29)
Government size * Fiscal transparency		-0.018*	-0.021**	-0.024**
		(-1.83)	(-2.20)	(-2.07)
Population size	0.023	0.016	0.005	0.016***
	(1.22)	(0.92)	(0.70)	(2.98)
Economic development	0.028	0.023	0.012**	0.006***
	(1.59)	(1.45)	(1.99)	(2.63)
Number of observations	1981	1981	1981	1981
Time effects	Yes	Yes	Yes	No
AR (1) test	-3.529	-3.510	-4.205	-2.851
	0.000	0.000	0.000	0.004
AR (2) test	-0.976	-0.984	-0.956	-1.142
	0.329	0.325	0.339	0.254
Hansen test	23.169	21.147	22.850	27.717
	0.510	0.819	0.855	0.533
Chi-squared test	12.550	11.510	9.380	
	0.051	0.074	0.154	
MMSC-AIC	24.831	34.853	39.150	30.283
MMSC-BIC	112.322	136.926	152.159	136.001
MMSC-HQIC	60.743	76.750	85.536	73.676

Note: t-statistics are reported in parentheses. Significance levels are indicated as follows: p < 0.1, p < 0.05, *p < 0.01.

4.3. Marginal Effect Analysis

When fiscal transparency deviates from its average level, the estimation results do not clearly indicate whether government size significantly affects the composition of public spending. Therefore, conducting a marginal effects analysis becomes essential. Figure 1 presents the marginal effects of government size on the composition of public spending across four subgraphs, each corresponding to a specific expenditure category. The left y-axis displays the marginal effects of government size, while the x-axis represents fiscal transparency (log-transformed). A histogram of fiscal transparency is overlaid, with the right y-axis indicating the proportion of observations. In the figure, the solid slashed line illustrates how the marginal effects of government size vary with fiscal transparency, while the two dotted lines represent the 95% confidence intervals. A solid horizontal line, parallel to the x-axis, marks the zero point for the marginal effects of government size.

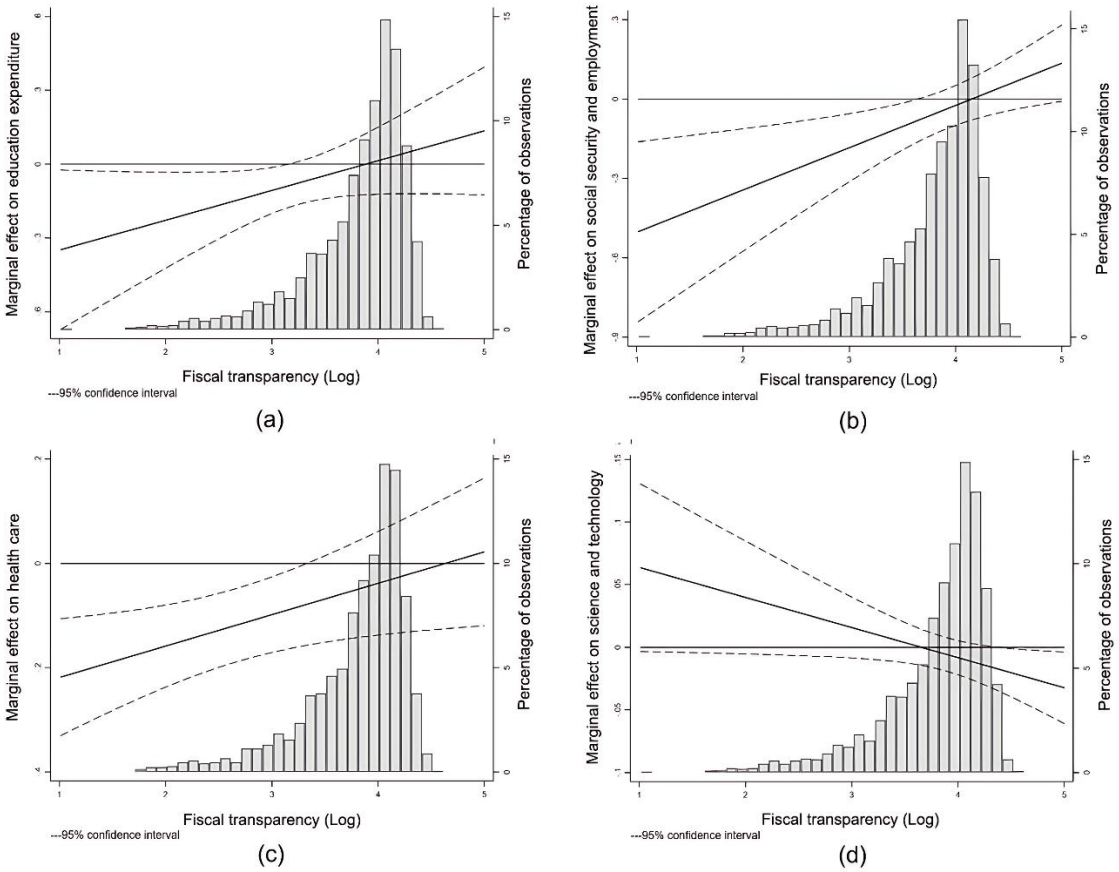

Figure 1. Marginal effect of government size on public expenditure composition.

Subgraph (d) displays a distinct pattern compared to the other three subgraphs: its solid line slopes downward to the right, whereas the lines in subgraphs (a), (b), and (c) slope upward. This indicates that as fiscal transparency increases, the marginal effects of government size on education, social security and employment, and health care expenditures tend to increase, while those on science and technology expenditure tend to decrease. However, it is important to recognize that these marginal effects are not always statistically significant. In the case of education, represented by subgraph (a), the horizontal solid line does not intersect the lower dotted line but intersects the upper dotted line at approximately 3.1 on the x-axis—a value within the observed range of fiscal transparency. This suggests that when fiscal transparency falls between 0 and approximately 22.198, the marginal effects of government size on education expenditure are statistically significant and generally rise with greater transparency. Beyond this threshold, however, the hypothesis that the marginal effects equal zero cannot be rejected at the 95% confidence level.

For social security and employment expenditure (subgraph b) and health care expenditure (subgraph c), both exhibit similar characteristics. In these subgraphs, the horizontal solid lines do not intersect the lower dashed lines but intersect the upper dashed lines at approximately 3.6 and 3.3 on the x-axis, respectively—values that fall within the observed range of fiscal transparency. This indicates that when fiscal transparency lies between 0 and approximately 36.598, the marginal effects of government size on social security and employment expenditure are statistically significant and increase as fiscal transparency rises. Beyond this threshold, the marginal effects may no longer be statistically significant. Similarly, for health care expenditure, statistically significant marginal effects are observed when fiscal transparency ranges from 0 to approximately 27.112, with a positive moderating effect within this interval. In contrast, subgraph (d), which represents science and technology expenditure, shows a distinct trend. The dashed lines representing the 95% confidence interval slope downward from the upper left to the lower right. The horizontal solid line does not intersect the lower dashed line but intersects the upper dashed line at

approximately 4.3 on the x-axis—a value within the distribution of fiscal transparency. This suggests that when fiscal transparency exceeds the threshold of approximately 73.743, the marginal effects of government size on science and technology expenditure become statistically significant, negative, and continue to decline as fiscal transparency increases. Conversely, when fiscal transparency is below this threshold, the marginal effects remain statistically insignificant.

4.4. Discussion and Interpretation

These results indicate that all four categories of public expenditure are positively influenced by their expenditures in the previous period, consistent with the findings of Bamba et al. (2020) and Moore and Zanardi (2010). This suggests that any adjustment in the composition of public spending tends to have a persistent, positive effect on itself over time, although the magnitude of the impact gradually diminishes and eventually converges to zero. Moreover, the results reveal that as local government size expands, the share of science and technology expenditure increases, while the shares of education, social security and employment, and health care expenditures decline. This pattern contrasts with the arguments of Peacock and Wiseman (1961) and Tanzi and Schuknecht (2000) who suggest that government expansion typically leads to a greater share of social welfare spending. However, the findings are in line with the predictions of public choice theory (Niskanen, 2017). According to this perspective, local governments, motivated by the objective of revenue maximization, tend to prioritize productive over unproductive expenditures. Science and technology expenditure, as a typical productive category, directly contributes to economic growth, which in turn expands the local tax base and increases fiscal revenues. In contrast, although education spending also fosters economic development, its benefits are realized over a longer time horizon. Expenditures on education, social security, employment, and health care are therefore often categorized as unproductive in the short term. Consequently, in the absence of external constraints, local governments are inclined to allocate a greater share of their budgets to productive spending as their size increases.

The findings regarding fiscal transparency's moderating role offer a potential explanation for the observed phenomenon, where the share of social welfare expenditure increases as government size expands. In countries or regions with high transparency, local governments are more likely to align their actions with citizens' preferences due to the constraints imposed by accountability mechanisms. From the citizens' perspective, they tend to prioritize social welfare expenditures, such as education, social security, employment, and health care, since the immediate benefits of economic growth may not be directly perceptible. Fiscal transparency enhances citizens' understanding of public expenditure and, in turn, strengthens accountability, which constrains the adjustment toward increasing the share of productive expenditures. Furthermore, while this study does not observe a significant shift in the effects of government size on unproductive expenditure towards the positive, it does find that the negative effects diminish as fiscal transparency increases. Additionally, the significant negative effects of government size on science and technology expenditure, which become more pronounced with higher fiscal transparency, suggest that at higher levels of fiscal transparency, the share of other expenditures, possibly including unproductive expenditures, may improve.

5. CONCLUSION

In the context of fiscal decentralization, local governments are tasked with greater responsibility for delivering public services. As a result, the expansion of local government size places increasing pressure on fiscal revenues. According to public choice theory, local governments are driven by the objective of revenue maximization, which may lead them to prioritize productive expenditures as their size grows. Fiscal transparency, a relatively recent institutional innovation in China, has received significant policy attention and has yielded notable progress. By mitigating information asymmetry, fiscal transparency strengthens accountability mechanisms. However, it remains unclear whether greater fiscal transparency enhances citizens' awareness of local governments' expenditure

adjustments, particularly when such adjustments deviate from the public's expectations for social welfare maximization, and whether transparency ultimately constrains such behavior through increased accountability. Thus, this study examines the moderating role of fiscal transparency in the relationship between local government size and the composition of public expenditure.

Using panel data from 283 Chinese prefecture-level cities between 2013 and 2022, this study yields several key findings. First, at low levels of fiscal transparency, the expansion of local government size leads to a reallocation of public expenditure, with a reduction in unproductive expenditures such as education, social security and employment, and health care. Second, this adjustment is moderated by fiscal transparency. As transparency increases, the negative effects of government size on unproductive expenditures gradually diminish, while the positive effect on productive expenditure, represented by science and technology, also weakens. At moderate to high levels of fiscal transparency, the results suggest that the expansion of government size no longer significantly alters the composition of public expenditure. Third, when fiscal transparency exceeds a certain threshold, an increase in government size is associated with a significant reduction in the share of science and technology expenditure. This negative effect intensifies as transparency continues to rise, indicating that at higher levels of transparency, local governments may shift their focus from productive expenditures toward social welfare considerations. Overall, these findings are robust across various model specifications, supported by dynamic panel models and the GMM approach, which address concerns related to endogeneity, omitted variable bias, and model selection criteria.

The findings of this study have important implications for policymakers. First, the expansion of local government size, often a consequence of fiscal decentralization, requires closer attention. While fiscal decentralization can enhance the efficiency of public resource allocation by leveraging local governments' superior knowledge of citizen preferences or can constrain the expansion of the overall government size, it also tends to increase the size of local governments, thereby exerting pressure on fiscal revenues. This pressure can influence the composition of public spending, potentially shifting resources away from long-term social welfare priorities. Given the critical role of expenditure composition in achieving sustainable development, managing government size becomes a key concern. Second, fiscal transparency emerges as an important moderating mechanism in this context. It can curb local governments' tendency to prioritize productive expenditures for revenue-maximization purposes, thereby promoting a more balanced allocation of public resources. However, more transparency is not always unambiguously better. As the results suggest, excessively high levels of transparency may suppress productive investment, such as science and technology expenditure, which is essential for economic growth. Policymakers must therefore consider the trade-offs involved in setting the optimal level of transparency, balancing social welfare objectives with the need to maintain fiscal capacity.

Finally, the study raises a broader question: as fiscal transparency improves, constraining government behavior to better reflect citizen preferences, how can local governments continue to fulfill their role in promoting economic development? Future research should explore this trade-off in greater depth and examine whether the moderating role of fiscal transparency holds across different national contexts or whether other institutional factors have such a moderating effect.

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