

Transfer payment structure and local government fiscal efficiency: The quantile regression by panel data

Wu Yongqiu, Zhao Jing*

After revenue-sharing system reform, the proportion of tax refund in fiscal transfer payments continued to decline, and the proportion of categorical grant and condition grant increased. The calculation results used SE-DEA method show that, the financial expenditure efficiency declined continuously from 1995. The paper studies how transfer payment structure effect fiscal efficiency from the perspective of local financial revenue structure. The theoretical and empirical studies indicate that, the tax refund is the most effective policy and the categorical grant is more efficient than condition grant. Because the categorical grant is the fairest policy, we suggest the central government should decrease the condition grant, and increase the tax refund or categorical grant in transfer payment.

Keywords: transfer payment, fiscal efficiency, quantile regression

1. Introduction and literature review

The vertical imbalance between central and local finance and lateral imbalance between regional finance contributes to the system of transfer payment. It is a policy tool universally used by central government to narrow the regional differences in economic development and to promote universal public service equal. Since China's reform of tax system in 1994, the system of tax refund and transfer payment has been introduced. At present, the transfer payment from central government to local government concludes tax refund, categorical grant¹ and condition grant (An, 2007). Among the constitution of local government revenue, central fiscal transfer payment is the most important revenue of local government. The local government fiscal revenue was 298.6 billion CNY in 1995 and the local financial subsidies from central to local government was 253.3 billion CNY, which accounts for 45.9% of local government revenue. By 2012, the tax refund and transfer payment from central to local government is 4538.3 billion CNY, which accounts for 42.6% of local government revenue. Although the scale of financial subsidies from central to local government

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¹ The categorical grant is called financial transfer payment before 2008.

has been expanding since 1995, with an average annual growth rate of 18.5%, the proportion of central transfer payment in local fiscal revenue has maintained the level of 40% to 50%. Table 1 shows the change of transfer payment structure from central financial to local government. The total scale of central government financial subsidies in 1995 was 253.3 billion CNY. Among them, the tax refund was 186.7 billion CNY, which accounts for 73.7%, the categorical grant was 29.1 billion CNY, which accounts for 11.5 and the condition grant was 37.5 billion CNY, which accounts for 14.8%. In 2012, the total size of central transfer payment was 4538.3 billion CNY. Among them, the tax refund was 512.1 billion CNY, which accounts for 11.3%, the categorical grant was 2147.1 billion CNY, which accounts for 47.3%, and the condition grant was 1879.2 billion CNY, which accounts for 41.4%. The changing trend of transfer payment structure is that proportion of tax refund is declining while that of categorical grant and condition grant is increasing.

Table 1

The change of transfer payment structure from 1995 to 2012 in China

Year	Scale of transfer payment (Billion CNY)	Tax refund		Categorical grant (Financial transfer payment)		Condition grant	
		Amount (Billion CNY)	Proportion (%)	Amount (Billion CNY)	Proportion (%)	Amount (Billion CNY)	Proportion (%)
1995	253.3	186.7	73.7	29.1	11.5	37.5	14.8
1996	267.2	194.9	72.9	23.5	8.8	48.9	18.3
1997	280.1	201.2	71.8	27.3	9.7	51.6	18.4
1998	328.5	208.3	63.4	31.3	9.5	88.9	27.1
1999	399.2	212.1	53.1	51.1	12.8	136.0	34.1
2000	474.8	220.7	46.5	89.3	18.8	164.8	34.7
2001	611.7	230.9	37.7	160.5	26.2	220.4	36.0
2002	735.3	300.7	40.9	194.4	26.4	240.2	32.7
2003	805.8	342.5	42.5	224.1	27.8	239.2	29.7
2004	1037.9	360.9	34.7	335.2	32.3	342.3	33.0
2005	1147.4	375.8	32.8	417.7	36.4	352.9	30.8
2006	1349.1	393.0	29.1	516.0	38.3	441.2	32.7
2007	1811.2	409.6	22.6	709.3	39.2	689.2	38.1
2008	2294.6	428.2	18.7	869.6	37.9	996.7	43.4
2009	2888.9	493.4	17.1	1137.5	39.4	1258.0	43.5
2010	3234.1	499.3	15.4	1323.6	40.9	1411.2	43.6
2011	3992.1	504.0	12.6	1831.1	45.9	1657.0	41.5
2012	4538.3	512.1	11.3	2147.1	47.3	1879.2	41.4

Notes: The data is from “China Financial Yearbook” and “Summary of Financial Statistics”; the categorical grant was called financial transfer payment before 2009.

On the relationship between transfer payment and fiscal efficiency, the early public fiscal theory held that the central transfer payments and local tax are treated as equal by local government, and the revenue structure of local government does not affect arrangement of local financial expenditure, as well as fiscal expenditure efficiency

(Wilde, 1968; Bradford and Oates, 1971;). The “flypaper effect” found at the end of 1970 shows that higher the proportion of transfer payment in revenue structure of local government, the larger the scale in financial expenditure (Hines and Thaler, 1995; Brennan and Pincus, 1996). Although the “flypaper effect” has no direct relationship with fiscal efficiency of local government, it has been proved that the financial revenue structure has effect on expenditure behavior of local government. Since 1990s, foreign studies focus on the issue of fairness and efficiency of transfer payment: whether the transfer payment can make the local government provide public service more fairly and efficiently (Gamkhar and Shah, 2007). In the literature of transfer payment and fiscal efficiency, the recent empirical studies generally think the transfer payment efficiency is lower than the local tax revenue. Oates (1994) suggests that local government pay more attention to the transfer payment from higher level of government than local tax revenue, and the transfer payment efficiency is lower than that of local revenue. Baker, Payne and Smart (1999) studied the Canadian’s subsidies system changing from unlimited amount to limited amount and found that this changing can improve capital efficiency and conserve spending of local government. Borck and Owings (2003) consider that it is the political reason not the efficiency that plays an important role that contributes the lower efficiency of transfer payment of central government. Albouy (2010) evaluated the efficiency and fairness of federal government fiscal equalization in USA, and suggested that the federal fiscal transfer policy is neither fair nor efficiency, and on the contrary, the problem of inefficiency and lacking of assistance to minority nationalities are aggravated. Bhatt and Scaramozzino (2013) empirically evaluated the relationship between transfer payment and financial deficit in India and suggested that the fiscal transfer payment system distorts the incentive status and has a significant positive correlation with government’s fiscal deficit. The domestic studies mainly concern about the equalization effect of transfer payments (Liu and Jiao, 2002; Ma and Yu, 2003; Guo *et al.*, 2009; Jia *et al.*, 2010). The literature of transfer payment efficiency is little. An (2007) suggested that it was due to unstandardized allocation of payment allocation, lacking of effective supervision and opaque operation that contributes to the low efficiency of financial transfer payment. Qiao *et al.* (2006) suggested both the categorical grant and condition grant have the moral risk, which reduces local government fiscal effort. Fan and Zhang (2010) study the relationship between transfer payment and economic growth and suggested the transfer payment policy is inefficient, which may reduce the potential of economic growth. However, Tang and Wang (2012) suggested that the higher local government depends on central financial transfer payment, the more capital invests to the strong rigidity area of science, education and agriculture, which improves the efficiency of local government finance. The view explains the efficiency of transfer payment is higher than that of revenue from another perspective.

The existing literature mainly focus on the effect of transfer payment on local

fiscal efficiency. This paper studies the different efficiencies of three kinds of transfer payment systems. In China's current fiscal transfer payment system, there are three kinds of transfer payments: tax refund, categorical transfer payment and condition payment. The proportion of tax refund since the tax reform in 1994 is continually declining while the other two kinds of payment is increasing. It is of great significance to study the effect of structural changes in transfer payment on financial efficiency in order to optimize the form of transfer payment and improve the financial funds efficiency. The following structure of this paper is as follows: based on the present literature research, the second part measures the financial efficiency with the SE-DEA model and analyzes the change trend of overall efficiency of fiscal funds. The third part constructs the theory model of transfer payment structure's effect on local government's expenditure behavior and analyzes how the change of transfer payment structure affects local government fiscal efficiency in the condition of unchanged amount of central transfer payment. The fourth part uses the quantile regression method to empirically test the relationship between transfer payment structure and local fiscal efficiency. The fifth part summarizes the conclusions and briefly describes the significance of this study.

2. The measurement of financial efficiency

We use the stochastic frontier function model and data envelopment analysis (DEA) to study the fiscal efficiency. Taking into the optimal input-output scheme of decision unit, the DEA method can better reflect the information and characteristics of evaluation object. Compared with stochastic frontier function and other parameter method, the method of DEA is more applicable to solve the efficiency evaluation of complex system of input and output. Therefore, this paper used DEA to evaluate the fiscal expenditure efficiency of local government. The existing literature used the traditional CCR-DEA to evaluate the financial efficiency, but this model cannot further evaluate the effective decision unit (Seiford and Zhu, 1998). The super DEA method (SE-DEA) proposed by Anderson and Petersen (1993) makes the comparison between effective decision units. The basic expression of the model is as follows:

$$\begin{aligned}
 & \text{Min } \theta \\
 & \sum_{i=1}^n \lambda_i X_i - \theta X_0 \leq 0 \\
 & \text{s. t. } \sum_{i=1}^n \lambda_i Y_i - X_0 \geq 0 \\
 & \lambda_i \geq 0 \quad i = 1, 2, \dots, n
 \end{aligned} \tag{1}$$

For the index of input and output, in reference to studies of Chen and Zhang (2008), Tang (2012), the nine representative financial output indexes such as education,

health, science, technology are selected: GDP, number of full-time teachers, number of patents, total energy consumption of residents, number of health institutions, capacity of telecom switches, supply capacity of city water (increment), railway mileage (increment); the financial expenditure is selected as input index. Since there is no effective data in the calculation of military expenditure, the military spending does not include military index. And the relative military index is not included in the output index. It is taken into account that government funding support public officials that office number is not regarded as the input indicators.

The SE-DEA method is used to calculate the national fiscal expenditure efficiency (central and local government finance are concluded). All the input and output data are from “Compilation of statistics of sixty years in China” and “Chinese Statistical Yearbook”. In order to eliminate the impact of price factors, the scale of fiscal expenditure, GDP are processed with CPI index. Figure 1 shows the historical trend of national fiscal SE-DEA efficiency calculated by software of EMS. It can be seen from the figure that the overall efficiency of China’s fiscal expenditure obviously decreased from 1978 to 2012. The efficiency value is 0.986 in 1978, and declined to 0.719 in 2012.

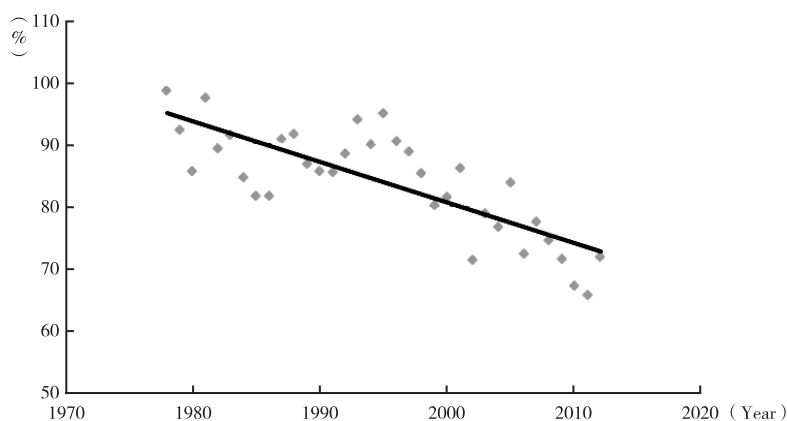


Figure 1. The changing trend of national financial expenditure efficiency (1978–2012)

3. The theoretical analysis of transfer payment structure affecting fiscal efficiency

Among these three types of transfer payments, since the tax refund is relevant with growth of local government revenue and central government has no restriction on the capital, the inaccurate budget cannot contribute to the “flypaper effect”. Therefore, it is generally considered that efficiency of tax refund has no different with revenue of local government. However, the large scale of transfer payment contributes to the financial does not match with the responsibility. The categorical transfer payment and condition

grant would reduce the effort of local government, which brings the loss of efficiency (Qiao *et al.*, 2006). Especially the condition transfer payment, since the fixed fund is for specified purpose, local government must execute with clear regulations made by the central government. It is due to the inaccuracy of capital demand, lag of disbursement of funds, as well as dispersion of supervision and management that the “flypaper effect” appears. From the perspective of practical experience, at the beginning of tax reform in 90s of last century, transfer payment from central financial to different local government was quite equal. Along with the strategy of western development (1999), revitalizing Northeast (2003), and rise of central China (2005), the proportion of tax refund is decreasing year by year, and the transfer payment to the backward regions is increasing in order to promote fairness. However, the policy effect is not satisfactory, the public expenditure in the backward regions has not been improved significantly, supply of public goods is still insufficient and regional gap of public service is still widening (An and Ren, 2008). Fan and Zhang (2010) found that each 1% increase in the proportion of transfer payment would decrease the long-term growth rate by 0.03%. In addition, in order to improve the efficiency of transfer payment, central government begins to clean up and integ rate the condition transfer payment. In 2014, the item of condition grant was compressed from 220 to 150, which is for the purpose of solve the arbitrary of condition transfer payment, abuse of power, corruption and other issues.

With the theory of consumer behavior, this paper analyzes the effect of transfer payment on fiscal expenditure efficiency. Public goods (services) that local government needs to buy are divided into two types: z_1 and z_2 . The revenue of local government is divided into three types: tax refund s_1 , categorical grant s_2 and condition grant s_3 . The condition grant can be only used for purchasing z_2 . Since this paper focuses on the internal structure of transfer payment, the local government’s tax revenue is not taken into consideration. The goal of local government is to provide public goods as much as possible in the constraint of limited fiscal revenue. The logarithmic utility function is used to set the local government objective function:

$$\text{Max}\{U\} = \beta_1 \ln z_1 + \beta_2 \ln z_2 \quad (2)$$

The logarithmic utility function reflects the marginal utility diminishing law of public goods provided by local governments. The exogenous parameters β_1 and β_2 reflects the relative importance of the two public goods. Since the condition grant revenue s_3 can be only used to buy the public goods z_2 , the budget constraint that local government faces is:

$$p_1 z_1 + \max(p_2 z_2 - s_3, 0) = s_1 + s_2 \quad (3)$$

p_1 and p_2 is the function is the price of public goods z_1 and z_2 respectively. The

Lagrange multiplier is introduced in the constraint of function 3, the function 2 can be expressed as follows:

$$U = \begin{cases} \beta_1 \ln \frac{\beta_1(s_1 + s_2 + s_3)}{p_1(\beta_1 + \beta_2)} + \beta_2 \ln \frac{\beta_2(s_1 + s_2 + s_3)}{p_2(\beta_1 + \beta_2)} & s_3 \leq \frac{\beta_2(s_1 + s_2)}{\beta_1} \\ \beta_1 \ln \frac{s_1 + s_2}{p_1} + \beta_2 \ln \frac{s_3}{p_2} & s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1} \end{cases} \quad (4)$$

The function 4 has the economic meaning: if $s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1}$, local government would use the condition grant s_3 in purchasing z_2 , and use the condition grant s_1 and s_2 in purchasing z_1 . If $s_3 < \frac{\beta_2(s_1 + s_2)}{\beta_1}$, local government would use the capital of $\frac{\beta_1(s_1 + s_2 + s_3)}{p_1(\beta_1 + \beta_2)}$ in purchasing z_1 , and use the $\frac{\beta_2(s_1 + s_2 + s_3)}{p_2(\beta_1 + \beta_2)}$ in purchasing z_2 . $s_3 = \frac{\beta_2(s_1 + s_2)}{\beta_1}$ means that in the condition that the optimal allocation of state

government utility is in the maximization, the marginal utility acquired when condition grant s_3 is used to purchase public goods z_2 is equal to that acquired when tax refund and categorical grant ($s_1 + s_2$) is used to purchase public good z_1 .

On the basis of the above analysis, this paper focuses on how the changes in the transfer payment structure affect the behavior of local governments. First is to analyze the efficiency difference between condition grant and the categorical grant. In the case of transfer payment from central to local government ($s_1 + s_2 + s_3$) and the tax refund being fixed, if central government reduces the condition grant, the categorical grant would be equally increased ($ds_2 = -ds_3$).

In the condition that total amount of central financial subsidy and the amount of tax refund are fixed, the unconditional financial subsidy would be transferred into the conditional transfer subsidy:

$$\left. \frac{dU}{ds_2} \right|_{ds_2 = -ds_3} = \begin{cases} \frac{\beta_1 + \beta_2}{s_1 + s_2 + s_3} (ds_2 + ds_3) & s_3 \leq \frac{\beta_2(s_1 + s_2)}{\beta_1} \\ \frac{\beta_1}{s_1 + s_2} ds_2 + \frac{\beta_2}{s_3} ds_3 & s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1} \end{cases} \quad (5)$$

When $ds_2 = -ds_3$, the function (5) would be:

$$\left. \frac{dU}{ds_2} \right|_{ds_2 = -ds_3} = \begin{cases} 0 & s_3 \leq \frac{\beta_2(s_1 + s_2)}{\beta_1} \\ \frac{\beta_1}{s_1 + s_2} - \frac{\beta_2}{s_3} > 0 & s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1} \end{cases} \quad (6)$$

The function 6 indicates that due to the use of condition grant is limited, when the size of condition grant $s_3 \leq \frac{\beta_2(s_1 + s_2)}{\beta_1}$ is limited, that reducing the condition grant while increasing the categorical grant equally would not affect the fiscal efficiency. If the size of condition grant is high ($s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1}$), since the condition grant is limited, that reducing the condition grant while increasing the categorical grant equally would improve the overall efficiency of financial funds. The above analysis can get the first proposition about the transfer payment structure and fiscal efficiency: in the condition that the size of transfer payment and tax refund is fixed, that increasing the categorical grant while decreasing the condition grant would make the efficiency of fiscal funds not lower than the original level.

The effect of tax refund structure on fiscal efficiency is analyzed below. Due to the information asymmetry, rent-seeking behavior and other factors that local government needs to spend extra cost when in fight for the categorical grant and condition grant. Therefore, in the condition that the size of transfer payment is fixed, if the tax refund is transferred into the categorical grant or condition grant, then the constraint would be required: $ds_1 = -d(s_2 + s_3)$. The function 4 is differentiated as follows:

$$\left. \frac{dU}{ds_1} \right|_{ds_1 = -d(s_2 + s_3) + c} = \begin{cases} \frac{\beta_1 + \beta_2}{s_1 + s_2 + s_3} d(s_1 + s_2 + s_3) & s_3 \leq \frac{\beta_2(s_1 + s_2)}{\beta_1} \\ \frac{\beta_1}{s_1 + s_2} d(s_1 + s_2) + \frac{\beta_2}{s_3} ds_3 & s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1} \end{cases} \quad (7)$$

With the constraint condition of $s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1}$, the function 7 can be changed to the follows:

$$\left. \frac{dU}{ds_1} \right|_{ds_1 = -d(s_2 + s_3) + c} = \begin{cases} \frac{\beta_1 + \beta_2}{s_1 + s_2 + s_3} d(s_1 + s_2 + s_3) & s_3 \leq \frac{\beta_2(s_1 + s_2)}{\beta_1} \\ > \frac{\beta_2}{s_3} d(s_1 + s_2) + \frac{\beta_2}{s_3} ds_3 & s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1} \end{cases} \quad (8)$$

With $ds_1 = -d(s_2 + s_3)$ replaced in the function 8, the function 9 can be acquired:

$$\left. \frac{dU}{ds_1} \right|_{ds_1 = -d(s_2 + s_3) + c} = \begin{cases} \frac{(\beta_1 + \beta_2) \times c}{s_1 + s_2 + s_3} & s_3 \leq \frac{\beta_2(s_1 + s_2)}{\beta_1} \\ > \frac{\beta_2}{s_3} \times c & s_3 > \frac{\beta_2(s_1 + s_2)}{\beta_1} \end{cases} \quad (9)$$

In the function 9, since the parameter and variables $\beta_1, \beta_2, s_1, s_2, s_3$ and c are greater

than 0, then $\left. \frac{dU}{ds_1} \right|_{ds_1 = -d(s_2 + s_3) + c} > 0$. The second proposition about the tax refund and

fiscal efficiency can be acquired: in the condition that the size of transfer payment is fixed, since local government needs extra cost and raise the tax refund when local government fighting for the central subsidy, the categorical grant and condition grant could be reduced, which can improve the fiscal efficiency of local governments.¹

4. Empirical test

4.1. Indicators and data

Under the background of tax system reform, China formulated the “methods of transfer payment in transitional period” in 1999. But this transfer payment system, as an incomplete transfer payment system, cannot really reflect the impact of subsidy structure from central to local on the local fiscal efficiency. Therefore, the empirical research sample is the provincial panel and mixed data from 2000 to 2011.

4.1.1. Dependent variable

Fiscal expenditure efficiency: using the SE-DEA to calculate the fiscal expenditure efficiency of local government. In the calculation of fiscal efficiency of local governments, the input index is the size of fiscal expenditure. The output index includes nine indicators: GDP in different regions, number of full-time teachers, number of patents, total energy consumption of residents, number of new health institutions, capacity of new telecom switch, capacity of new water supply, mileage of new city railway, mileage of new city highway. The data comes from “China Financial Yearbook”, “China Statistical Yearbook” and “China’s regional economic statistical yearbook”.

4.1.2. Independent variables

Proportion of tax refund: the index is reflected by the proportion of tax refund in the size of transfer payment, the function is as follows:

$$\text{Proportion of tax refund} = \frac{\text{tax refund}}{\text{central financial subsidy}} \quad (10)$$

In the formula (10), the central financial subsidy includes tax refund, categorical

¹ In addition to the transaction costs, central government tend to pursue more fairness when providing categorical grant and condition grant, which results in the loss of efficiency (Borck and Owings, 2003).

grant and condition grant. The data of tax refund in local governments is from “compilation of local financial statistics”, “China’s financial Yearbook” and “summary of financial statistics”.

Proportion of condition grant: the index is reflected by the proportion of condition grant in the sum of *categorical* grant and condition grant. The formula is as follows:

$$\text{Proportion of condition grant} = \frac{\text{condition grant}}{\text{condition grant} + \text{categorical grant}}$$

In the existing public statistics, only the “local fiscal statistics” from 2007 to 2009 provides the data of condition grant and categorical grant in local governments. Since the longitudinal time is short, the mixed data quantile regression method is adopted in the empirical study of the impact of condition grant structure on the fiscal efficiency.

4.1.3. Controlled variables

In addition to the indicators of central financial grant structure, other factors that influence the fiscal expenditure efficiency are as follows.

Proportion of financial transfer payment: the existing literature generally suggests the efficiency of transfer payment is lower than the local government’s own tax revenue (Oates, 1994); The proportion of financial transfer payment is calculated by the size of transfer payment from central to local divided by the total financial revenue of local government. The formula is as follows:

$$\text{Proportion of financial transfer payment} = \frac{\text{transfer payment from central to local government}}{\text{financial revenue of local government} + \text{transfer payment from central to local government}}$$

According to the majority of existing literature (Qiao *et al.*, 2006, Fan and Zhang 2010), the greater the proportion of financial transfer payment, the lower the financial efficiency of local government. In the formula, the data of local government revenue is from “China Statistical Yearbook” and “China Financial Yearbook”. The data of transfer payment from central to local government is from “compilation of statistical of local finance” and “summary of financial statistics”.

Population density: the essence of finance is to provide effective products and services that meet the public demand. Public demand is closely related to population density. The population density can affect the public service and size that local government supplies and further influence the financial efficiency of local government. Grossman, Mavros and Wassmer (1999) suggested that the cost of management and supervision is negatively correlated with population density. It is due to the scale effect that the expenditure efficiency is increased. However, Athanassopoulos and Triantis

(1998) and Loikkanen and Susiluoto (2006) suggested that the effect of population density on government efficiency is negative. The population density is calculated by dividing the population in each region by the total area. Relevant data is from the “China Statistical Yearbook” and “China population and employment statistic yearbook”.

Per capita GDP: Since the rich people have higher demand for government public services and exert local government greater pressure, it is generally considered arrears with higher economic development has higher fiscal expenditure efficiency. Afonso and Fernandes (2005) found that the high-income residents promote local government to provide the public goods and services with a more efficient way, which contributes to a higher fiscal expenditure efficiency. However, Loikkanen (2006) suggested that economic development lead to an extensive expansion of government personnel and expenditure, which results in the uncontrolled administrative costs and no-effective fiscal expenditure efficiency. The data is from “China Statistical Yearbook”, and the data is reduced by the CPI index.

Education level: Some studies (Hamilton, 1983; Hayes, Razzolini and Ross, 1998) suggested that the education level of residents would improve the political consciousness, as well as the ability to supervise the local government, which can affect the government fiscal expenditure efficiency. Borger and Kerstens (1996), Afonso and Aubyn (2005), Loikkanen (2006) confirmed the conclusion that residents’ education level is positively related to the fiscal expenditure efficiency. For the index of per education year, this paper calculates with the current schooling periods as the coefficient. Period of college education is set at 16 years, high school education is at 12 years, junior high school is at 9 years, primary school is at 6 years and illiterate is at 0 year. The data is from the “China’s population and employment statistics yearbook”.

Proportion of budget revenue: Compared with the out-budgetary revenue, budgetary revenue has the higher efficiency due to its stringent supervision (Davis and Hayes, 1993). Ping and Bai (2006) also suggested that the out-budgetary revenue has lower efficiency due to the decreasing scale returns. However, Chen and Zhang (2008) empirically studied and found that local government would improve the expenditure efficiency of the out-budgetary revenue’s discretionary power. The index data is from the “compilation of local fiscal statistics”, “China’s financial yearbook” and “summary of financial statistics”.

Degree of marketization: the degree of marketization can reflect whether a region has a complete legal environment and mature factor market. These factors would affect fiscal efficiency of government. At the same time, in the regions with higher marketization, the government scale is relatively high. Borger (1996) considered that the bigger the fiscal size of government, the more lacking of effective incentives of resources use, which leads to the low expenditure efficiency. It is generally believed that the marketization degree is positively related to the fiscal expenditure. This paper uses the proportion of private economy employment in the total employment to reflect

marketization degree. The data is from “China’s population and employment statistic yearbook”.

4.2. Unit root test

In order to avoid the spurious regression problem, the unit root test of panel data is needed. Panel unit root test can be divided into two types: homogeneous panel and heterogeneous panel unit root test. This paper tests with these different methods: LLC, IPS, ADF-Fisher, PP-Fisher and Breitung. The results in table 2 shows that LLC test rejects the hypothesis that all the variables have unit root. Although other methods have different results on the test, the variables are generally stable: the variables have no unit root.

Table 2

Test result of unit root tests

Variable	LLC	IPS	ADF -Fisher	PP-Fisher	Breitung
Fiscal expenditure efficiency	-6.17451*** (C, T, 1)	-0.15025 (C, T, 1)	84.1437** (C, T, 1)	154.155*** (C, T, 1)	4.06919 (C, T, 1)
Proportion of tax refund	-23.7420*** (C, T, 1)	-3.75580*** (C, T, 1)	152.458*** (C, T, 1)	109.134*** (C, T, 1)	0.04343 (C, T, 1)
Proportion of financial transfer payment	-7.17973*** (C, T, 1)	0.18014 (C, T, 1)	59.1414 (C, T, 1)	185.491*** (C, T, 1)	-2.91290*** (C, T, 1)
Population density	-9.32558*** (C, 0, 1)	1.44065 (C, T, 1)	49.5195 (C, T, 1)	296.060*** (C, T, 1)	1.01631 (C, T, 1)
Per capita GDP	-7.76914*** (C, T, 1)	0.02933 (C, T, 1)	129.052*** (0, 0, 1)	222.806*** (0, 0, 1)	-0.15045 (C, T, 1)
Education level	-9.83629*** (C, T, 1)	-0.59993 (C, T, 1)	77.9654* (C, T, 1)	161.307*** (C, T, 1)	-2.49907*** (C, T, 1)
Proportion of budget revenue	-15.4158*** (0, 0, 1)	0.08470 (0, 0, 1)	251.691*** (C, T, 1)	380.493*** (C, T, 1)	-0.13604 (C, T, 1)
Degree of marketization	-14.5442*** (C, T, 1)	0.28879 (C, T, 1)	68.8743 (C, T, 1)	81.1704* (C, T, 1)	3.39272 (C, T, 1)

Notes: The brackets in Table 2 are test form setting. C is constant, T is trend item and the last item is lagging order. *, ** and *** represents 10%, 5% and 1% significant level respectively. Since the variable of proportion of condition grant has only part of annual data, there is no unit root test.

4.3. Estimation results of parameters

This paper estimates the parameter with the method of quantile regression suggested by Koenker and Bassett (1978). Compared with the method of traditional least squares, the advantage of the quantile regression is low sensitivity to outliers. When the error is non normal distribution, the quantile regression is more effective than OLS, and more statistical information can be acquired by the quantile regression method (li and Ye,

2012). The parameter estimated by the quantile regression uses the method of linear programming. The R software provides the procedure of quantile regression for the panel data suggested by Koenker (2004). Since the data is not uniform, the proportion of condition grant has only three years data, the study in the paper could be empirically analyzed by two regression equation methods. First use the data from 2000 to 2011 to examine the effect of tax refund on expenditure efficiency. There are fixed and random effects in setting the model of econometric equation. The value of Hausman is 41.89, which refused the assumption of random effects model. The paper then use the panel data quantile regression proposed by Koenker (2004) to estimate the panel data. According to the criterion of minimum sum of squares of residuals, the penalty coefficient λ is 0.9. In the table 3, the model 1 gives the results of FEQR of five main sites.

Since the data of proportion of condition grant are only acquired from 2007 to 2009, the effect of proportion of condition grant on financial efficiency is added on regression equation. Since the time sequence of proportion of condition grant is short, so the pooled data is used to quantile regressed. In the regression analysis, the residuals are assumed to be independent and non-identical distribution. Therefore the Huber method proposed by R software is approximately estimated for the covariance matrix. The results of five sub loci are listed in model 2 in table 3. R^2 is the fitting degree of quantile regression. LR reflects the overall significant level of quantile regression.

According to the results of quantile regression in table 3, the conclusions about grant structure and financial efficiency are as follows. The first is that increasing the proportion of tax refund is conducive to improving the fiscal efficiency of local government. The regression analysis of panel data and mixed data shows that there is a significant positive correlation between tax refund and fiscal efficiency. The quantile estimation of different parameters shows that either panel data regression model or mixed regression model, the coefficient of proportion of tax refund is significant with high value at the low point of 0.1 and 0.25 while the coefficient of proportion of tax refund is significant with low value at the high point of 0.75 and 0.9. This also indicates that along with the improvement of fiscal efficiency, the effect of tax refund structure on local government efficiency would decline. Second is that there is no obvious difference between condition grant and categorical grant. In the regression model of mixed data, there is correlation at the significant level of 10% between proportion of condition grant and fiscal efficiency at the fractile of 0.9, and there is no significant level at the other fractile. The conclusion is different from previous expectation and there are two possible reasons: one is that there is the widespread situation that local government misappropriates the condition grant (China National Audit Office, 2006). A lot of financial funds nominally are condition grant, but actually are used as department funding or systematic funding. The other one is that in the central government's allocation of categorical grant, fairness rather

Table 3
Quantile regression results of factors affecting fiscal efficiency

Variable	Model 1: quantile regression of panel data					Model 2: quantile regression of mix data				
	0.1	0.25	0.5	0.75	0.9	0.1	0.25	0.5	0.75	0.9
Constant	-19.01119 (-1.58913)	-26.3694*** (-3.78311)	-12.36654* (-1.80535)	29.08985*** (4.09741)	25.00064 (1.50226)	14.48595 (1.09793)	-12.44011 (-0.46223)	11.03235 (0.30328)	5.14809 (0.20617)	11.27833 (0.48578)
Proportion of tax refund	0.57745*** (7.16811)	0.62308*** (7.40576)	0.57892*** (8.89608)	0.37847*** (4.29930)	0.29948*** (3.65326)	0.77165*** (11.04981)	0.84927*** (5.96192)	0.66690*** (3.46371)	0.47226*** (3.57324)	0.55524*** (4.51839)
Proportion of condition grant						-0.04243 (-0.84644)	-0.05498 (-0.53771)	-0.03732 (-0.27000)	-0.03284 (-0.34614)	-0.15146* (-1.71711)
Proportion of financial transfer payment	-0.03355** (-2.33520)	-0.00329 (-0.76149)	-0.00615 (-1.42557)	-0.01595*** (-4.57422)	-0.01659*** (-2.63667)	-0.04624*** (-8.51703)	-0.02966*** (-2.67888)	-0.00898 (-0.60005)	-0.00517 (-0.50325)	-0.00566 (-0.59198)
Population density	-0.40781** (-2.05557)	-0.44742* (-1.91752)	0.03264 (0.10537)	1.22461*** (3.85641)	1.66547*** (4.09892)	-0.19289 (-0.90525)	-0.45290 (-1.04199)	0.62253 (1.05963)	1.94916*** (4.83338)	2.38806*** (6.36897)
Per capita GDP	-10.62017 (-2.69518)	-9.38714** (-2.41739)	-6.48708 (-1.34878)	3.02845 (0.61234)	8.40883* (1.96650)	-15.4897*** (-4.53204)	-11.89780* (-1.70657)	5.83165 (0.61885)	4.95819 (0.76652)	-2.43753 (-0.40529)
Education level	7.38000*** (7.12654)	7.62204*** (9.66954)	7.17285*** (8.94870)	4.32834*** (5.80688)	4.19406** (2.48495)	5.34559*** (3.83007)	8.94833*** (3.14309)	6.73494* (1.75020)	7.25184*** (2.74541)	8.36351*** (3.40539)
Proportion of budget revenue	0.19619*** (3.41957)	0.22834*** (4.09420)	0.17623*** (4.32710)	0.09363 (1.37880)	0.23452*** (4.27094)	0.21537*** (2.69728)	0.06624 (0.40670)	-0.09188 (-0.41734)	0.06410 (0.42415)	-0.02393 (-0.17032)
Degree of marketization	0.05296 (0.38798)	0.11786 (0.96446)	-0.18009 (-1.52762)	-0.64916*** (-4.83944)	-0.65869 (-4.43159)	0.04206 (0.28911)	-0.39348 (-1.32601)	-1.00761** (-2.51221)	-0.83117*** (-3.01896)	-0.90470 (-3.53417)
R ²	0.76170	0.69668	0.64870	0.61091	0.58495	0.65890	0.54643	0.55378	0.57853	0.58977
LR	372.8789	365.5931	360.6661	288.6559	180.1155	85.57791	64.21197	78.51349	71.72961	55.68724

Notes: *t* statistic is in the bracket. *, **, and *** refer to the significant level of 0.1, 0.05 and 0.01 respectively.

than the efficiency is taken more consideration, which leads to the low efficiency. The third is that proportion of financial transfer payment has negative impact on financial efficiency at the fractile of 0.1 and 0.25, which verifies the general view that financial efficiency of transfer payment is lower than local government's own tax revenue (Oates, 1994; Borck, 2003). The population density, education level and budget revenue has positive relationship with financial efficiency, which is consistent with the conclusion of Fan and Zhang (2010), Tang and Wang (2012). In addition, the results of quantile regression also indicate the effect of per capita GDP and degree of marketization is not obvious on financial efficiency and only has correlation relationship at some loci.

5. Conclusions and policy implications

This paper focuses on the effect of transfer payment structure on the fiscal efficiency of local government. Analyzing the data of financial transfer payment structure, this paper found that the way and structure of transfer payment from central to local government changes obviously ever since the tax-sharing reform in 1994. The proportion of tax refund is decreased from 73.7% in 1995 to 11.3% in 2012. The proportion of categorical grant and condition grant is increased. Tax refund is no longer the major way of transfer payment from central to local government. After calculating the efficiency of national financial fund by the model of SE-EDA, this paper found that the overall efficiency of China's financial capital showed a downward trend. Based on the theory of consumer behavior analyzing the financial expenditure, the reason of declining fiscal funds is analyzed and two hypotheses about the transfer payment structure on financial efficiency is put forward: one is that in the situation of size of transfer payment and tax refund unchanged, increasing the categorical grant while decreasing the condition grant with similar size could make the efficiency of financial funds be lower than the original level. The other is that due to a certain cost needed in local government competing for the central subsidy, the tax refund is transformed into the categorical grant and condition grant, which leads to low financial efficiency of local government. Based on the theoretical analysis, this paper uses the regression method with the panel data and mixed data to examine the relationship between transfer payment structure and fiscal efficiency. The empirical results show that tax refund has a significant positive correlation with fiscal efficiency of local government, which indicates the declining proportion of tax refund the one of reasons that fiscal efficiency is declining. Moreover, the empirical results have not supported the hypothesis that condition grant has significant difference with categorical grant. The possible reason is that in the appropriation of condition grant, central government pays more attention to fairness rather than efficiency.

Since the central transfer payment has the double goals of "fairness" and "efficiency" (Zhu, 1997), not only the "efficiency", but also the "fairness" should be taken into

consideration. The domestic literature on transfer payment having fairness effect (Yin *et al.*, 2007; Jia, 2009) indicated that tax refund and condition grant are most unequal ways of transfer payment. Policy implications based on the research results of this paper include: the categorical grant is conducive to fairness, and tax refund is more conducive to efficiency. But the condition grant has neither fairness nor efficiency. The direction of optimizing the transfer payment structure is to reduce the proportion of condition grant while increasing that of categorical grant or tax refund.

References

- Afonso, A., & Aubyn, M. S. (2005). Cross-country efficiency of secondary education provision: A semi-parametric analysis with non-discretionary inputs. European Central Bank Working Paper, No.494.
- Afonso, A., & Fernandes, S. (2005). Assessing and explaining the relative efficiency of local government. *The Journal of Socio-Economics*, 37(5), 1946-1979.
- Albouy, D. (2010). Evaluating the efficiency and equity of federal fiscal equalization. *Journal of Public Economics*, 96(9), 824-839.
- An T. F., & Ren, Q. (2008). Construction of equalization index of public service level—A quantitative analysis based on regional difference. *Finance & Trade Economics (Caimao jingji)*, 6, 79-82.
- An, T. F. (2007). China's transfer payment: Status, problems and reform suggestions. *Public Finance Research (Caizheng Yanjiu)*, 1, 2-5.
- Andersen, P., & Peteren, N. C. (1993). A procedure for ranking efficient units in data envelopment analysis. *Management Science*, 39(10), 1261-1264.
- Athanassopoulos, A. D., & Triantis, K. P. (1998). Assessing aggregate cost efficiency and the related policy implications for Greek local municipalities. *INFOR*, 36(3), 66-83.
- Baker, M. A., Payne, A., & Smart, M. (1999). An empirical study of matching grants: The 'gap on CPA'. *Journal of Public Economics*, 72(2), 269-288.
- Bhatt, A., & Scaramozzino, P. (2013). Federal transfers and fiscal discipline in India: An empirical evaluation. Asian Development Bank Economics Research Paper Series, Working Paper, 343.
- Borck, R., & Owings, S., The Political Economy of Intergovernmental Grants, *Regional Science and Urban Economics*, Vol.33, No.2, 2003, pp.139-156.
- Borger, B. D., & Kerstens, K. (1996). Cost efficiency of belgian local governments: A comparative analysis of FDH, DEA, and econometric approaches. *Regional Science and Urban Economics*, 26(2), 145-170.

- Bradford, D. F., & Oates, W. E. (1971). Towards a predictive theory of intergovernmental grants. *American Economics Reviews*, 62(2), 440-448.
- Brennan, G., & Pincus, J. (1996). A minimalist model of federal grants and flypaper effects. *Journal of Public Economics*, 61(2), 229-246.
- Chen S. Y. & Zhang J. (2008). Study on the financial efficiency of local government: 1978-2005. *Social Sciences in China (Zhongguo Shehui Kexue)*, 4, 65-78.
- Davis, M. L., & Hayes, K. (1993). The demand for good government. *The Review of Economics and Statistics*, 75(1), 148-152.
- Fan, Z. Y., & Zhang, J. (2010). How China sacrificed the efficiency in the balance: From the perspective of transfer payment. *World Economy (Shijie Jingji)*, 11, 117-138.
- Gamkhar, S., & Shah, A. (2007). The impact of intergovernmental fiscal transfers: A synthesis of the conceptual and empirical literature, in Boadway, R., & Shah, A. (eds.), *Intergovernmental Fiscal Transfers: Principles and Practice*. World Bank Publications, 225-258.
- Grossman, P., Mavros, P., & Wassmer, R. W. (1999). Public sector technical inefficiency in large U.S. cities. *Journal of Urban Economics* 46(2), 278-299.
- Guo, Q. W., Jia, J. X., & Gao, L. (2009). Transfer payment of central finance and regional economic growth. *World Economy (Shijie Jingji)*, 12, 15-26.
- Hamilton, B. W. (1983). The flypaper effect and other anomalies, *Journal of Public Economics*, 22(3), 347-361.
- Hayes, K. J., Razzolini, L., & Ross, L. B. (1998). Bureaucratic choice and nonoptimal provision of public goods: Theory and evidence. *Public Choice*, 94(1-2), 1-20.
- Hines, J. R., & Thaler, R. H. (1995). Anomalies: The flypaper effect. *Journal of Economic Perspectives*, 9(4), 217-226.
- Jia, J. X., Guo, Q. W., & Gao, L. (2010). Central government transfer payment, competition between incentive effect and regional financial expenditure. *Finance & Trade Economics (Caimao Jingji)*, 11, 52-57.
- Jia, X. J. (2009). Intergovernmental horizontal equilibrium effect of transfer payment. *Economic Perspectives (Jingjixue Dongtai)*, 3, 72-76.
- Koenker, R., & Bassett, G. J. (1978). Regression quantiles, *Econometrica*, 46(1), 33-50.
- Koenker, R. (2004). Quantile regression for longitudinal data. *Journal of Multivariate Analysis*, 91(1), 74-89.
- Li, Z. N., & Ye, A. Z. (2012). *Advanced applied econometrics*, Press of Tsinghua University (in Chinese).
- Liu, R. C., & Jiao, G. H. (2002). Difference in regional finance and innovation in transfer payment system. *Finance & Trade Economics (Caimao Jingji)*, 6, 5-12.
- Loikkanen, H. A., & Susiluoto, I. (2006). Cost efficiency of Finnish municipalities in basic service provision 1994-2002. Discussion Paper, No.96.

- Ma, S. Y., & Yu, H. X. (2003). Transfer payment and regional economic convergence. *Economic Research Journal (Jingji Yanjiu)*, 3, 26-33.
- Oates, W. E. (1994). Federalism & government finance. in Quigley, J. M., & Smolensky, E. (eds.), *Modern Public Finance*, Massachusetts: Harvard University Press, 126-164.
- Ping, X. Q. & Bai, J. (2006). The fiscal decentralization of China and supply of local public goods, *Finance & Trade Economics (Caimao Jingji)*, 2, 49-56.
- Qiao, B. Y., & Fan, J. Y., Peng J. M. (2006). Intergovernmental transfer payment and efforts of local finance. *Management World (Guanli Shijie)*, 3, 50-56.
- Seiford, L. M., & Zhu, J. (1998). Sensitivity analysis of DEA models for simultaneous changes in all the data. *Journal of the Operational Research Society*, 49(10), 1060-1071.
- Tang, Q. M., & Wang, B. (2012). An empirical study on the efficiency of fiscal expenditure and the influencing factors in China. *Journal of Financial Research (Jingrong Yanjiu)*, 12, 48-61.
- Wilde, J. A. (1968). The expenditure effects of grant-in-aid programs. *National Tax Journal*, 21(3), 340-348.
- Yin, H., Kang, L. L., & Wang, L. J. (2007). The effect of fiscal equalization of intergovernmental transfer payment. *Management World (Guanli Shijie)*, 1, 48-55.
- Zhu, L. (1997). Efficiency and fairness of transfer payment. *Management World (Guanli Shijie)*, 3, 30-35.