

SPATIAL DECOMPOSITION OF FUNDING INEQUALITY IN CHINA'S BASIC EDUCATION: A FOUR-LEVEL THEIL INDEX ANALYSIS

Wen Wang
Assistant Professor
School of Public and Environmental Affairs
Indiana University-Purdue University Indianapolis
801 West Michigan Street, BS 4062
Indianapolis, IN 46202
Tel: 317-274-1078 Email: wenwang@gmail.com

Zhirong Zhao
Associate Professor
Hubert H. Humphrey School of Public Affairs
University of Minnesota
#246 Humphrey Center, 301, 19th Avenue South
Minneapolis, MN 55455
Tel: 612-625-7318 Email: zrzha@umn.edu

ABSTRACT

Various education finance and taxation reforms in the past several decades have substantially changed China's system for funding basic education, but the present system is still characterized by insufficient funding and large inequalities across localities. Using data of more than 2000 county-level units all over the country during 1998-2005, this study uses Theil index to spatially decompose the pattern of funding inequality in China's basic education across four geographic and administrative levels. The analysis shows that the level of inequality remained high after the rural taxation and education finance reforms since 2000, despite the efforts to increase education-purpose fiscal transfers to local governments, and that the gaps are especially severe across provinces in the same region and across prefectures in the same province.

1. INTRODUCTION

In recent years, the development of the funding system for China's basic education program has attracted a lot of public and scholarly attention.¹ Various reforms in the past several decades have substantially changed this system, but the present system is still characterized by insufficient funding and large inequalities across regions and localities. Existing studies on inequalities in

1. Basic education in China refers to pre-school, nine-year compulsory education from elementary to junior high school, standard senior high school education, special education for disabled children, and education for illiterate people. For more details, see <http://www.china.org.cn/english/features/Brief/192134.htm>.

basic education have mostly employed data at the national or provincial level (Tsang, 1994; Xue and Shi, 2001; Li, 2008). Only a few examined funding inequality of China's basic education using county-level data (Pan, 2000; Tsang and Ding, 2005; Wang, 2001). Analyses based on provincial-level data cannot fully reveal the real pattern of inequalities across local jurisdictions, because major responsibilities for funding basic education rest with cities and urban districts in urban areas, and with counties in rural areas (Wang and Zhao, 2012). Therefore, policy decisions based on such analyses without careful evaluation would not be effective in mitigating educational inequalities and improving educational performance. Taking advantage of a database on more than 2000 counties/districts in the country covering 1998-2005, this study assesses changes in the pattern of inequalities in funding for basic education, and spatially decomposes the inequalities at four levels, including counties, cities or prefectures, provinces, and the eastern, central and western regions in China.²

This study mainly addresses the following three research questions: (a) What was the state of inequality in funding for basic education at the four levels in China in recent years? (b) Was there a change in inequality after education finance and taxation reforms in recent years? (c) At what geographic or administrative level is the fiscal inequality of China's basic education especially severe? The last question is especially important for the Chinese government to design proper intergovernmental grants to mitigate the funding inequalities for China's basic education. This study has two major contributions. First, we did not find any empirical analysis on the funding inequality of China's basic education based on a national county-level dataset after 2000, a period in which the education finance and rural taxation systems went through substantial changes. Since 2001, the central government shifted the administrative responsibilities of rural basic education to the county level, and implemented a series of policies to make up for the loss of revenues to education (Wang and Zhao, 2012). Second, this study is the only and very first effort to spatially decompose China's education fiscal inequalities at four levels. Not only does the study provide a more accurate depiction of the real pattern of the inequalities than previous provincial-level studies, but also it has direct policy implications in particular to the design and implementation of intergovernmental grants to mitigate China's educational inequalities and improve educa-

2. The government system in China is divided into five levels: the central, provincial, prefectural, county and township level (Wong, 1997). There is a strict vertical hierarchical relationship among these levels of government (Shah and Shen, 2008). Governments at the lower levels are wholly subordinate to those of higher levels (Wong, 1997). The eastern, central and western regions in China were first determined in 1986 by China's "Seventh Five-Year National Socio-Economic Development Plan". The eastern region include Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Shandong, Guangdong, and Hainan; the central region includes Shanxi, Neimenggu, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, and Guagnxi; the western region includes Sichuan, Guizhou, Yunnan, Tibet, Shannxi, Gansu, Qinghai, Ningxia, and Xinjiang.

tional performance. During 1994-2000, the Chinese central government mainly allocated its grants for basic education to provincial-level governments, which were categorized as three “Plans” (groups) according to their progress and capacity in achieving the universalization of nine-year compulsory education by 2000 (Tsang and Ding, 2005). The distribution of funding within provinces was then left to the provincial governments, which did not necessarily take fully into consideration the actual funding needs of various local governments within their jurisdiction. Without knowing at which level the fiscal inequality is especially severe, it would be difficult to target intergovernmental grants for effective equalization.

The remainder of the paper is organized as follows. The next section introduces China’s education finance system and some recent reforms since 1985. The third section reviews previous literature on funding inequality in China’s basic education, and the fourth section discusses data and methodology of our empirical analysis. The fifth section presents our empirical results. The final section concludes with a discussion of the policy implications of our study.

2. CHINA’S RECENT EDUCATION FINANCE REFORMS

The education finance reform in 1985 set up an overly decentralized funding system for China’s basic education (Tsang, 2000). Under this system, local governments below the provincial level were charged with the responsibility for the financing of primary and secondary education, and different levels of education were administered by different levels of government. In urban areas, cities and urban districts were responsible for financing secondary and primary education, respectively. In rural areas, higher-secondary education was financed by county governments, whereas lower-secondary education and primary education were respectively financed by township and village governments (Tsang, 2002). Because of the over-decentralization of education financing and absence of effective fiscal transfers from higher levels of the government, regional economic inequalities led to inequalities in resources for basic education directly (Lin, 2009; Tsang, 2000).

The “Tax-For-Fee” reform implemented since 2000 created some substantial impact on the financing of basic education in China. The reform was first introduced in Anhui in 2000, and then introduced to 20 other provinces in 2002 (Kennedy, 2007). Later, it was implemented all over the country. The reform replaced all fees collected previously by townships and villages with agriculture taxes and related surcharges (Lu et al., 2004). It helped to lower farmers’ burden and reduce rural tension in China (Yep, 2004), but it might also have created some undue effects on the fiscal capacity of local governments to provide public services such as basic education (Wong and Bird, 2005). The reform abolished fees and extra-budgetary fundraising for educa-

tion (Kennedy, 2007), but the fiscal transfers from above did not fully compensate for the loss of funding for village and township governments (Yep, 2004). Thus, with the implementation of the reform, the inadequacy in funding for education, especially in rural areas, has become a more significant problem (Kennedy, 2007).

In the wake of the rural taxation reform, the Chinese central government has begun to take on more responsibility for financing basic education since 2001 (Brock et al., 2008). The State Council (2001) issued *The Decision on the Reform and Development of Basic Education*, committing to work with provincial governments to increase investment for basic education in poorer areas and ethnic minority areas through fiscal transfers to lower levels of government. The Chinese central government shifted the administrative responsibilities of compulsory education from the village and township level to the county level (Lu et al., 2004). In 2002, The General Office of the State Council (2002) issued *The Notice of Completing the Management System of Compulsory Education in Rural Areas*, which again stressed the importance for provincial governments to provide financial help to local governments, particularly county-level governments (Lin, 2009). After 2001, the Chinese central government introduced the so-called “two exemptions and one subsidy” policy (TEOS) for the purpose of easing local governments’ financial difficulties and reducing the financial burdens of rural families for paying for their children’s education. Under this system, major efforts have been made by the central and provincial governments to provide free textbooks to poor rural students (the first exemption), to provide exemption from “miscellaneous fees” (*zafei*) to the same students (the second exemption), along with a subsidy to cover living costs for boarding students with financial difficulties (the one subsidy). Since 2006, the central government has significantly increased its own share of funding to the TEOS program, reducing the burden on provincial and local governments. The expansion of the program later on has led to the formulation of a new finance mechanism for basic education in rural areas (Brock et al., 2008), which is beyond the scope of this study. In general, the shift of administrative responsibilities for education upward to a higher level of government and the increase of fiscal transfers for education from the central and provincial governments have to a certain extent made the education finance system more centralized than before, though inadequacy in funding for education still remain a concern.

3. PREVIOUS LITERTURE ON CHINA’S EDUCAITON FINANCE INEQUALITIES

With national data from 1997 and 1999, several county-level studies used the Theil index to measure and compare funding inequality of China’s basic education within or across provinces (Pan, 2000; Tsang and Ding, 2005; Wang, 2001). Using either per-capita or per-pupil basic education expendi-

tures, the results in general showed that intra-provincial inequality was more pronounced than the inter-provincial one, though the relative shares of the two inequalities varied in different studies.

With incomplete county-level data from 19 provinces,³ Pan (2000) used multiple inequality indices, including the Theil index, Gini coefficient, and coefficient of variation, to study the inequality of basic education expenditure in 1997, and explored factors that may explain regional differences. He found that the inequality of per-pupil basic education expenditure was far more pronounced than that of per-capita basic education expenditure, especially when the indices were measured across counties in the same province. For per-capita basic education expenditure, intra-provincial inequality accounted for about 55% of the total inequality, only slightly higher than the inter-provincial one. For per-pupil expenditure, however, the intra-provincial inequality played a more predominant role, about 2 to 3 times higher than the inter-provincial one. With a regression analysis, Pan showed that the county-level fiscal capacity was the most influential factor for the education finance disparity.

With data in 2,178 counties, cities and districts all over the country in 1999, Wang (2001) used three generalized entropy indices, including the Theil index, to examine the inequality of per-pupil basic education expenditures that were either budgetary or extra-budgetary. She found much higher levels of inequality in the extra-budgetary spending than in the budgetary one, likely because counties in more affluent areas were in a better position to generate extra-budgetary resources than other counties. Looking at all students from both urban and rural areas, the share of intra-provincial inequality accounted for 65% to 70% of total inequality based on various categories of per-pupil budgetary and extra-budgetary education spending⁴ for primary and lower-secondary schools. Looking separately at spending for rural schools in the 1,773 ordinary counties and counties under Municipalities directly affiliated to the central government, the intra-provincial inequality accounted for an even higher share, ranging from 67% to 74%. Accordingly, Wang (2001) argued that intergovernmental grants within provinces should play a more active role in equalizing per-pupil basic education spending between urban and rural areas and across different counties.

3. Pan (2000)'s analysis excludes those districts under prefectural-level cities and Municipalities directly affiliated to the central government from the analysis.

4. Extra-budgetary spending was funded by education revenue outside of government's budget, which included education surcharges and levies, education fees (tuition and miscellaneous school fees), income from school-owned enterprises, work-study and service, and social contributions and donations (Tsang and Ding, 2005).

Based on a dataset of 2,950 county-level units in 1997 and 1999,⁵ Tsang and Ding (2005) examined resource utilization and inequalities in basic education in China. They found that while the pattern of resource utilization was similar across different areas in the country, there were substantial inequalities in the level of per-pupil spending across these areas. The spending gap was particularly substantial between urban and rural areas, and between coastal region and other regions. Although non-minority areas spent more than minority areas, the gap was relatively modest. Decomposition of the Theil indexes indicated that between two-thirds and three-quarters of financial inequality resided within provinces, and between one-quarter to one-third of the financial inequality existed between provinces. Comparison of 1997 and 1999 results showed that nationwide, there was no significant change in the overall level of inequality in per-pupil total spending. In fact, in the same period, the spending gap increased between counties at the top-end and bottom-end of the spending distribution, as per-pupil total spending increased much faster at the top end than at the bottom end.

Our study contributes to the literature in three ways. First, previous studies typically used some single year data of selected counties due to data availability, and thus failed to show how the trends of education inequality evolved over time. Second, no studies have been done with data after 2000 when China launched a series of recent education finance reforms. We do not know whether the education inequality has been substantially changed since the Chinese government raised the provision of rural education from towns or villages to the county level along with the allocation of additional education grants. Third, and most importantly, previous studies that decomposed inequality into inter- and intra-provincial components provided insufficient information to guide equalization efforts. As Tsang and Ding (2005) alluded, the inter-provincial inequality may exist in part across different regions, as the Municipalities and coastal provinces are more developed socioeconomically and more resourceful fiscally than other provinces, while western provinces, on the other hand, may receive more central government support due to recent western-development central policy or national-unity considerations (Zhao, 2009). Moreover, the intra-provincial inequality could be further divided as the inequality across prefectures as well as between counties in the same prefecture. This demarcation is important because the prefecture level sits between the provincial level and the county one, and provinces rarely allocate their grants directly to counties bypassing the prefecture level. In this study, we aim to bridge these gaps by conducting a four-level Theil index analysis – including the region level, provincial level, prefectural level, and the county level – with the most comprehensive database currently available during the period of 1998-2005.

5. All mainland provincial-level regions except for Tibet are included in the dataset (Tsang and Ding, 2005).

4. DATA AND METHODOLOGY

Thanks to the Barometer on China's Development (BOCD) project, the Universities Service Center (USC) at the Chinese University of Hong Kong built a database with various fiscal and socio-economic variables for all of the prefectures and county-level governments in China for recent years.⁶ The sources of the database are from official annual series of statistics yearbooks. The education spending data used for this analysis are from the *Countrywide Prefecture, City and County Financial Statistics* published by the Ministry of Finance. The data for population are from the *Countrywide County/City Population Statistics* published by the Ministry of Public Security. The data for student numbers are from *China County (City) Socio-economic Statistical Yearbook* published by the National Bureau of Statistics of China. We use the data covering the period of 1998-2005, the most recent years' data available, for this analysis.

Berne and Stiefel (1984) discussed various concepts of inequality in the financing of public education and alternative ways to measure them quantitatively. Many subsequent studies used their framework to analyze educational equality. Some variation of a per-pupil expenditure measure is mostly adopted as a means to gauge the distribution of educational resources. Alternative measures of education input include per-capita education expenditure or education expenditure as a share of Gross Domestic Product (GDP) (Wang and Zhao, 2012; Wang, Zheng and Zhao, 2012). In this study we use both per-capita education expenditure and per-pupil education expenditure to control for the differences in the size across jurisdictions. Each measure has its strength and weakness. The per-pupil measure more accurately reflects the level of education investment on its target group than the per-capita measure. However, the latter is more convenient for policy comparison than the former because data on population is more widely available than data on student numbers. Using both measures in one study, we also intend to compare the results and assess the comparability between the per-capita measure and per-pupil measure. Expenditure measures should ideally be adjusted for the costs in providing a unit of education in different regions. However, due to the limitation of data availability, we do not have the data to adjust for regional cost differences in the country. None of the previous studies using national data have attempted to do so (Pan, 2000; Tsang and Ding, 2005; Wang, 2001); this may be a fruitful area for future research.

There are many potential measures of inequality, such as restricted range, coefficient of variation, and Gini index etc., that can be used, all with distinct advantages and shortcomings (Berne and Stiefel, 1984). For this analysis, we

6. It is the most comprehensive database we are aware of for local governments in China that has recently become accessible to researchers.

choose the Theil index, which can be conveniently decomposed by different levels of geographical aggregation. The use of the Theil index for our analysis also enables us to make comparisons with the results of previous studies concerning the distribution of inter- and intra-provincial inequalities of education spending in China. Following Murray et al. (1998), the Theil index for province k equals

$$T_k = \frac{\sum_{j=1}^{J_k} P_{jk} X_{jk} \ln(X_{jk} / \bar{X}_k)}{\sum_{j=1}^{J_k} P_{jk} X_{jk}} \quad (1)$$

where X_{jk} is per-capita expenditure in county j , J_k is the number of counties in province k , P_{jk} is the population in county j in province k , and \bar{X}_k is the population-weighted mean expenditure per capita for the province. A value of zero on the Theil index indicates equality in per-capita spending among counties. The index reaches the natural log of the county population when one county has all expenditures in the province and the rest have nothing.

Theil index can be decomposed to show the inequality in per-capita spending between and within provinces. Across all provinces and counties in our sample, the decomposition can be written as

$$T = \sum_{k=1}^K (P_k \bar{X}_k / \bar{X}) \ln(\bar{X}_k / \bar{X}) + \sum_{k=1}^K (P_k \bar{X}_k / \bar{X}) T_k, \quad (2)$$

where \bar{X} is a population-weighted mean expenditure per capita for the country. The first term on the right-hand side of the equation measures between-province inequality. The second term measures the degree of within-province inequality and can be interpreted as a weighted average of the within-province Theil index values. Such an approach of two-level decomposition has been adopted by previous research on China's education inequality (Pan, 2000; Tsang and Ding, 2005; Wang, 2001) to determine the extent to which the inequality occurred due to variations across different provinces or within each province. In this article, we will further extend this method to conduct a four-level Theil decomposition. For the first time, the BOCD project enables China's education expenditure data to be aggregated at four different aggregate levels: county, prefecture, provincial, and regional level. The overall Theil index of education expenditure is measured at the county level. Then we will decompose the index into four components: (a) between different geographic regions, (b) between provinces in each region, (c) between prefectures in each province, and (d) between counties in each prefecture.

$$T_{\text{county-in-prefecture}} = T_{\text{between-county}} - T_{\text{between-prefecture}} \quad (3)$$

$$T_{\text{prefecture-in-province}} = T_{\text{between-prefecture}} - T_{\text{between-province}} \quad (4)$$

$$T_{\text{province-in-region}} = T_{\text{between-province}} - T_{\text{between-region}} \quad (5)$$

Results of the four-level decomposition will have significant policy implications. If intergovernmental grants are used to enhance equalization of basic education provision, the equalization effect may be most efficiently achieved if the grants are allocated at the level that has the highest between-units inequality.

5. EMPIRICAL RESULTS

We conducted Theil index analyses to assess China's basic education inequality in three ways: (a) with per-capita education expenditure, (b) with per-pupil education expenditure, and (c) with per-pupil education expenditure on 27 regular provinces after excluding the four Municipalities (special cities with provincial status).⁷ As it turns out, the three analyses provided very different results regarding the pattern of inequality and its changes, suggesting that caution should be exercised in selecting measures to assess China's education inequality.

Table 1 shows the first set of Theil indices, which were calculated based on per-capita education expenditures of more than 2000 county-level jurisdictions during 1998-2005.⁸ In the eight-year period, the average per-capita education expenditure has increased from about 80 Yuan to about 200 Yuan (in real 2000 Yuan), indicating a rapid increase of public education investment. However, the average level remains very low compared with international standards (Li, 2008). As late as in 2008, China's public expenditure on education represented only 3.3% of the country's GDP, compared with 5.9% of that, on average, across OECD countries, and 7.2% in the United States (OECD, 2011).

7. These Municipalities are Beijing, Shanghai, Tianjin, and Chongqing, four megacities in China that are given provincial status.

8. The sample size is 2075 in year 1999, 2099 in 2000, 1878 in 2002, 1898 in 2002, 1876 in 2003, 1862 in 2004, and 1865 in 2005. The decrease of sample size is mainly due to administration changes such as consolidating counties or converting counties into city-level districts. While they are still considered county-level jurisdictions, several hundred city-level districts are not included in our sample as we were not able to match their student enrollment data (provided at the city level only) with education expenditure data (provided at the district-level of these cities). In assessing per-capita inequality and per-pupil inequality, we used the same set of samples to enable a direct comparison of the results.

Table 1. Theil Index of Per-capita Education Expenditure

	1998	1999	2000	2001	2002	2003	2004	2005
Per Capita Education Expenditure*	83.0	90.2	92.1	113.3	132.7	143.8	168.9	193.3
Between-county Theil Index	0.168	0.166	0.160	0.150	0.141	0.157	0.157	0.158
Two-level decomposition:								
County-in-province	0.047	0.054	0.058	0.060	0.056	0.064	0.062	0.065
% contribution	28.3%	32.6%	35.9%	40.0%	39.6%	40.6%	39.8%	41.5%
Between-province	0.120	0.112	0.103	0.090	0.085	0.094	0.094	0.092
% contribution	71.7%	67.4%	64.1%	60.0%	60.4%	59.4%	60.2%	58.5%
Total % contribution	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Four-level decomposition:								
County-in-prefecture	0.020	0.024	0.025	0.026	0.024	0.027	0.026	0.025
% contribution	11.8%	14.7%	15.9%	17.6%	17.1%	16.9%	16.3%	16.2%
Prefecture-in-province	0.028	0.030	0.032	0.034	0.032	0.037	0.037	0.040
% contribution	16.5%	17.9%	20.1%	22.3%	22.5%	23.8%	23.5%	25.3%
Province-in-region	0.083	0.075	0.078	0.063	0.059	0.064	0.064	0.063
% contribution	49.5%	45.4%	48.7%	42.0%	42.2%	40.6%	40.8%	39.9%
Between-region	0.037	0.036	0.025	0.027	0.026	0.030	0.030	0.029
% contribution	22.2%	22.0%	15.4%	18.0%	18.2%	18.8%	19.4%	18.6%
Total % contribution	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Observations	2501	2778	2814	2839	2830	2829	2838	2841

*: In 2000 real RMB.

The overall Theil index is measured at the county-level, and thus it is a lower-bound estimation of the true level of inequity should it be measured at the school or student level. The Theil index slightly decreased from about 0.168 in 1998 to about 0.141 in 2002, and then rose again and fluctuated around 0.157 during 2003-2005. The results suggest that the inequality was reduced in the beginning years of “Tax-For-Fee” reform, probably due to a higher level of central government grants that may have had partial equalization effects. After 2002, however, the level of inequality increased again in accompany with a significant growth of education expenditure in several Municipalities and some coastal provinces.⁹ Overall, it may be safe to say that, after the Tax-For-Fee reform, the level of education finance inequality has not been substantively reduced despite the fact that education administration has been more centralized than before. Decomposing the Theil index sheds additional light on the spatial distribution of inequality. In 1998, the between-region Theil index is 0.037, equal to about 22.2% of the overall Theil index with a value of 0.168. This means the variations among the three regions (Eastern, Central, and Western) account for about 22.2% of the overall inequality, while the within-region variations account for the remaining 77.8%. The within-region variations occur among governments at the lower levels, which can be further decomposed to the contribution of province, prefecture, and county levels. Thus we can distinguish and separate the extent to which each level of government contributes to the overall inequality. Table 1 shows how the indices (or its percentage contributions) are decomposed either by

9. We observed a similar pattern with the coefficients of variation (CV) measured either at province or at county level: the CV decreased annually during 1999-2002 but then increased again after 2003. The federal ratio, however, shows a more complicated picture: at the province level, the ratio follows the similar pattern with the Theil index and CV; at the county level, the ratio increased during 1999-2000 and fluctuated after 2002.

two levels (above or below province), or by four levels (region, province, prefecture, and county) during 1998-2005. For two-level decomposition, variations at or above the provincial level in general account for a higher percentage of inequality than variations within provinces, especially in late 1990s. This result runs against the previous finding by Pan (2000) with 1997 data, suggesting a possible change of pattern in more recent years.¹⁰ More details can be seen at the four-level decomposition. Above the provincial level, the between-region variations are smaller than between-province-in-region variations; below the provincial level, the between-prefecture variations are larger than between-county-in-prefecture variations. In 2005, for example, the between-region contribution of inequality is 18.6%, the between-province-in-region contribution is 39.9%, the between-prefecture-in-province contribution is 25.3%, and the between-county-in-prefecture contribution is 16.2 %.

Table 2 presents the second set of Theil indices, which were calculated based on per-pupil education expenditure of all available jurisdiction units during 1999-2005.¹¹ Our results in 1999 show that the intra-provincial inequality accounts for 51.6% of total inequality in per-pupil education expenditure, which is lower than the share of 65% or above as indicated by the analysis of Wang (2001) and Tsang and Ding (2005). In Table 2, we observe a significantly different historical pattern of Theil indices, which have a spike during 2001-2002 with a much higher level of inequalities. The spike was caused mainly by the Municipalities (especially Shanghai), of which the per-pupil education expenditure was barely affected by the Tax-For-Fee reform because these Municipalities had a much smaller percentage of rural population than typical provinces, which suffered from the loss of education fees in their rural areas during the two-year period. The spike was quickly reduced after 2003, indicating some equalization effects of recent education reforms, in which the central government worked with provincial ones to increase investment for basic education in poorer areas and ethnic minority areas through fiscal transfers to lower levels of government. However, the level of inequality during 2003-2005 was still higher than that of the pre-2000 period.

10. The difference may also be caused by the use of different samples. Our study has about 2800 county-level units in recent years, while Pan (2000)'s analysis was based on about 1900 county-level units.

11. The pupil numbers are calculated as total enrollments of elementary schools and secondary schools. The data in 1998 are not available.

Table 2. Theil Index of Per-pupil Education Expenditure

	1999	2000	2001	2002	2003	2004	2005
Per Pupil Education Expenditure*	468.1	500.1	675.3	785.7	814.4	982.5	1161.3
Between-county Theil Index	0.108	0.124	0.198	0.180	0.124	0.128	0.128
Two-level decomposition:							
County-in-province	0.056	0.069	0.069	0.056	0.063	0.062	0.064
% contribution	51.6%	55.8%	34.7%	31.4%	50.5%	48.8%	49.9%
Between-province	0.052	0.055	0.129	0.123	0.061	0.065	0.064
% contribution	48.4%	44.2%	65.3%	68.6%	49.5%	51.2%	50.1%
Total % contribution	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Four-level decomposition:							
County-in-prefecture	0.022	0.033	0.034	0.028	0.026	0.024	0.026
% contribution	20.2%	26.4%	17.4%	15.6%	20.6%	19.0%	19.9%
Prefecture-in-province	0.034	0.037	0.034	0.028	0.037	0.038	0.039
% contribution	31.5%	29.4%	17.3%	15.7%	29.9%	29.8%	30.0%
Province-in-region	0.037	0.038	0.104	0.102	0.046	0.051	0.052
% contribution	34.2%	30.5%	52.5%	56.9%	37.4%	40.0%	40.2%
Between-region	0.015	0.017	0.025	0.021	0.015	0.014	0.013
% contribution	14.2%	13.7%	12.8%	11.8%	12.1%	11.1%	9.9%
Total % contribution	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

*: In 2000 real RMB.

Table 3. Theil Index of Per-pupil Education Expenditure (Without Municipalities)

	1999	2000	2001	2002	2003	2004	2005
Per Pupil Education Expenditure*	425.5	498.8	635.5	742.6	814.5	983.1	1160.1
Between-county Theil Index	0.104	0.119	0.116	0.102	0.119	0.122	0.124
Two-level decomposition:							
County-in-province	0.057	0.071	0.068	0.055	0.064	0.063	0.065
% contribution	54.8%	59.7%	59.1%	53.8%	53.2%	51.6%	52.7%
Between-province	0.047	0.048	0.047	0.047	0.056	0.059	0.059
% contribution	45.2%	40.3%	40.9%	46.2%	46.8%	48.4%	47.3%
Total % contribution	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Four-level decomposition:							
County-in-prefecture	0.022	0.033	0.031	0.024	0.026	0.024	0.026
% contribution	21.2%	28.1%	26.6%	23.7%	21.5%	19.9%	20.9%
Prefecture-in-province	0.035	0.038	0.038	0.031	0.038	0.039	0.039
% contribution	33.6%	31.6%	32.5%	30.1%	31.7%	31.7%	31.8%
Province-in-region	0.033	0.032	0.034	0.037	0.042	0.046	0.047
% contribution	31.3%	26.8%	29.6%	36.1%	34.9%	37.6%	37.8%
Between-region	0.015	0.016	0.013	0.010	0.014	0.013	0.012
% contribution	13.9%	13.5%	11.3%	10.0%	11.9%	10.8%	9.5%
Total % contribution	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

*: In 2000 real RMB.

Given the fact that China's education investment is very unbalanced between urban and rural areas, and that Municipalities have significantly different demographic structures than other provinces, we create the third set of Theil indices, as shown in Table 3, based on per-pupil education expenditure only in county-level jurisdictions of 27 regular provinces. Comparing Table 3 and Table 2, we see that the level of education inequality becomes much lower after we exclude the Municipalities, but the gaps of basic education finance continued to be substantial during the 1999-2005 period as far as this sample of counties are concerned.

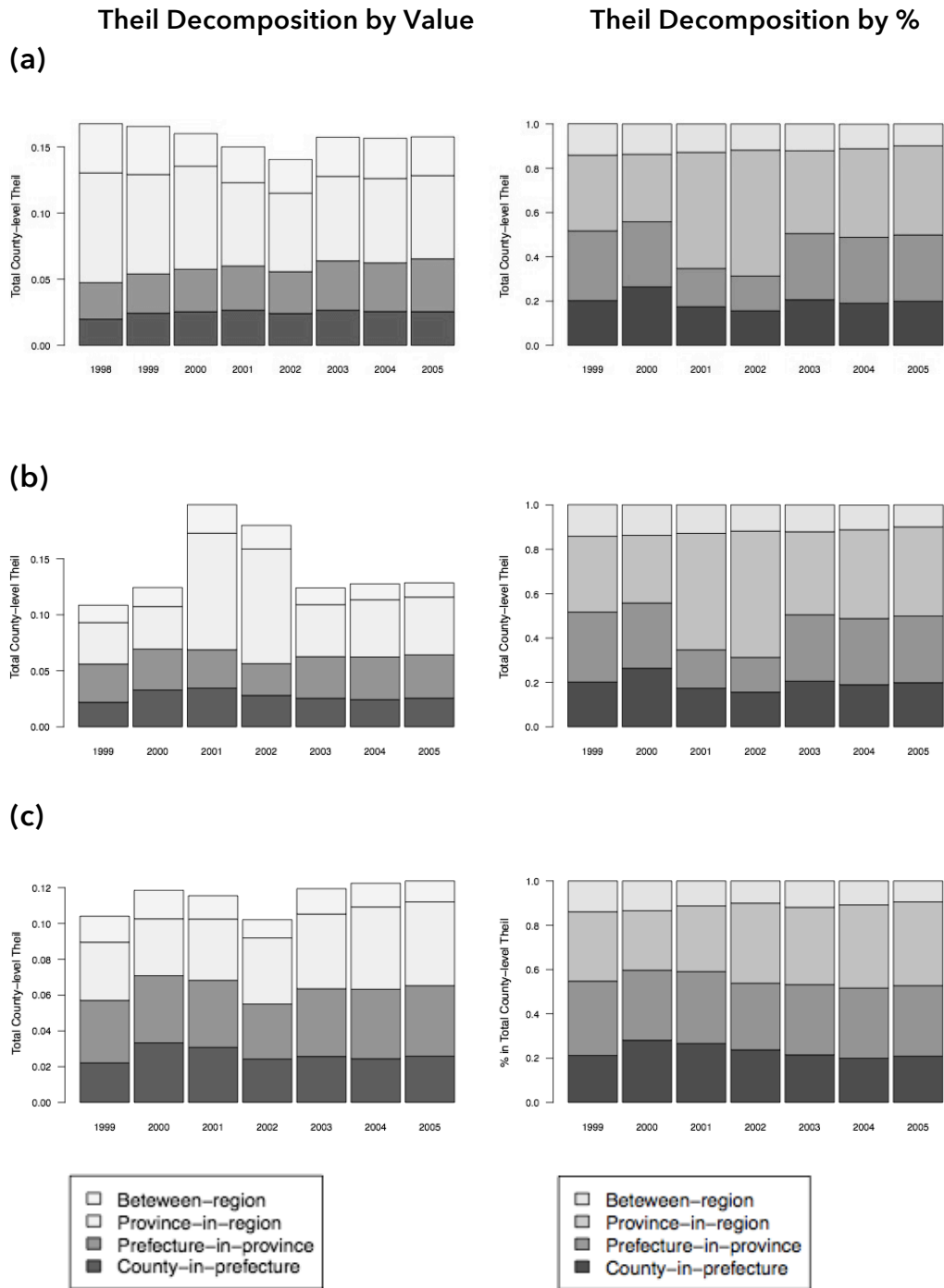


Figure 1. Four-level Theil Decomposition for Education Expenditure (1999-2005)

In Figure 1, we visually compare the three sets of Theil indices and their corresponding four-level decompositions. Panel (a) shows the results with per capita education expenditure, Panel (b) with per pupil education expenditure,

and Panel (c) with per pupil education expenditure after removing the four Municipalities from the sample. The results are significantly different from each other. This suggests that assessing spatial inequality of China's education expenditure is sensitive to (a) different measures of education level, (b) different data coverage, and (c) different levels of spatial aggregation. Regarding per-capita education expenditure, the Theil index shows a U-shape pattern during 1998-2005, with relatively lower levels of inequality in 2001 and 2002. Regarding per-pupil education expenditure with all available data, however, the Theil index shows a revised U-shaped pattern during 1999-2005, showing unusually high values in 2001 and 2002. When we see per-pupil education expenditure only in rural areas, the Theil index fluctuated during 1999-2005 with an upward pattern especially in recent years.

Compared to the widely cited research by Wang (2001), our results based on per-pupil education expenditure echo the previous finding in 1999, but the stories were different with a different measure or in other years. For per-capita education expenditure, for all years during 1999-2005, however, the variation was higher between-province (the upper two levels together) than within-province (the lower two levels together). This discrepancy is likely driven by the combination of two factors. The first is the diverse demographic profile and age composition across provinces, as more urbanized provinces (especially the Municipalities) tend to have a much lower percentage of population among education ages due to the differential treatment of one-child policy in urban and rural areas (Leggy and Zhao, 2004). The second one is that China's population statistics are based on *Hukou* registration record rather than the actual residing location. In recent decades, a significant percentage of population has temporarily migrated from rural areas to urban areas in coastal provinces. These people are still counted in their original provinces, while some of their children may be counted in school enrollment of the provinces where they work. Thus the per-capita measure may underestimate the level of education expenditure in some emigrant provinces by over-estimating the actual living population. For policy purposes, we suggest that future studies on China's education inequality use the per-pupil measure instead of the per-capita one, because the former one more accurately reflects the link between education expenditure and education needs. To assess the level of inequality and hence to design proper equalization policies, it shall be further advised to separate the Municipalities from other regular provinces as the Municipalities are far outliers that significantly skews the overall distribution.

Even if we use the per-pupil measure, for the second sets of Theil results based on all available data, the between-province variation was higher than within-province variation after 2000, especially in 2001 and 2002 when the between-province variation is significantly raised due to the outlier effect associated with Shanghai. For the third sets of Theil results based on a restricted

sample without Municipalities, between-province variation became very close to within-province variation after 2000.

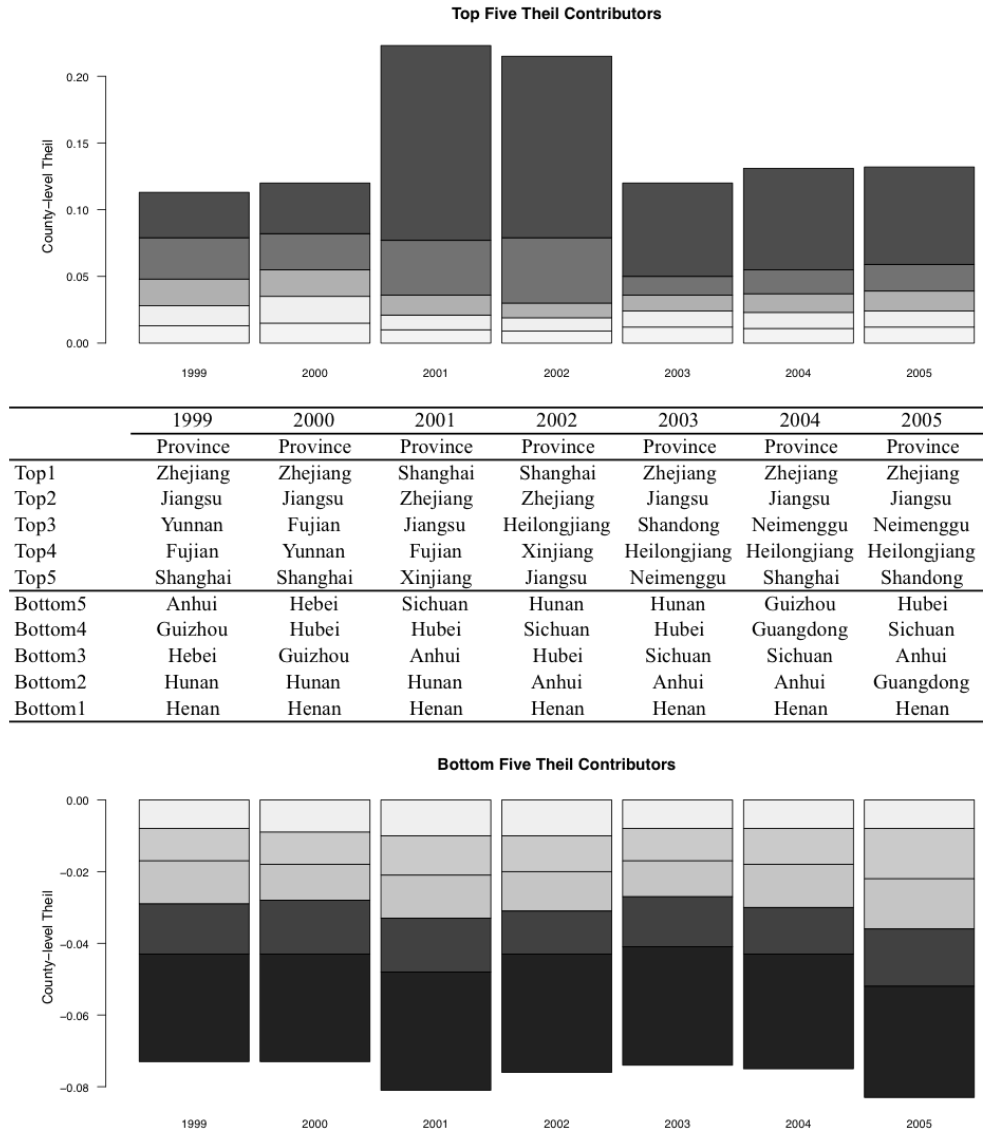


Figure 2. Major Contributors to the Theil Index (1999-2005)

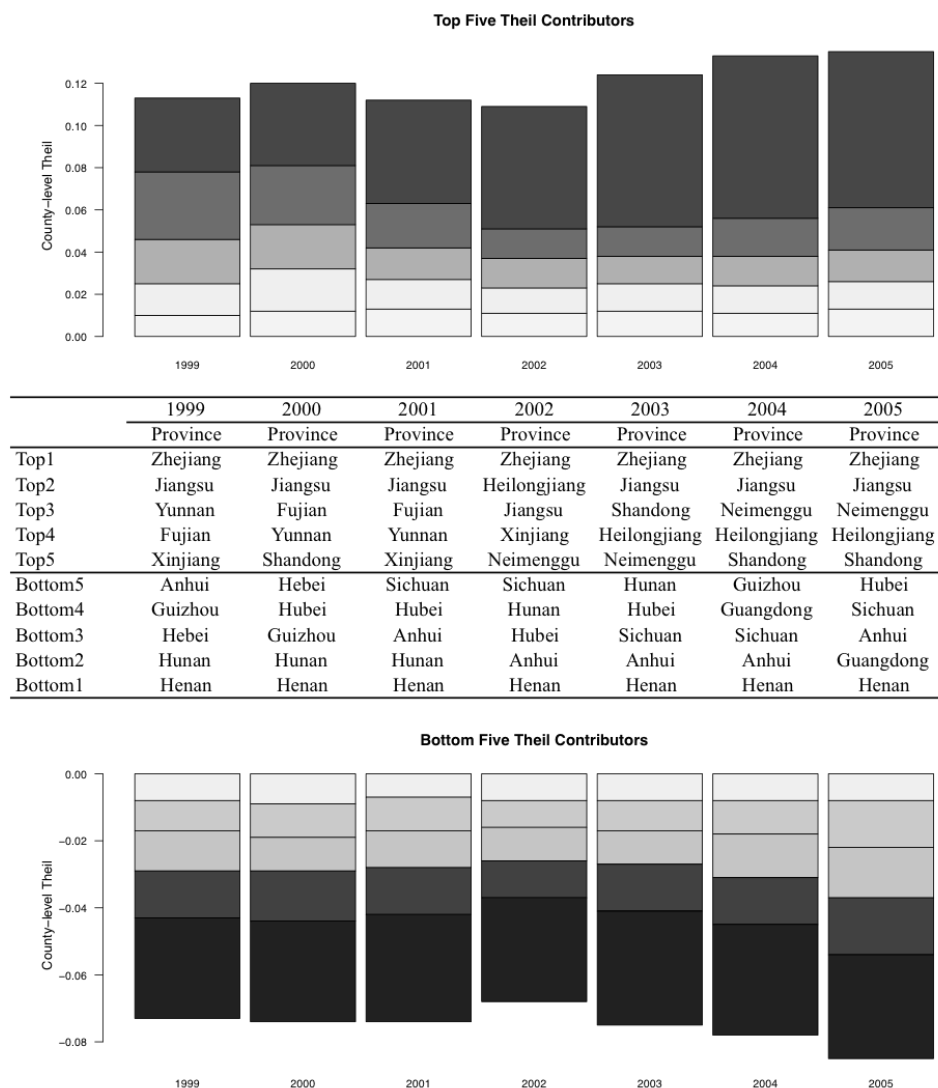


Figure 3. Major Contributors to the Theil Index Without Municipalities (1999-2005)

In addition, we are interested in the provinces that are major contributors of the overall Theil index. The lists of these provinces, in both samples with or without Municipalities, are shown in Figure 2 and Figure 3. The top-five contributors are the provinces that have the highest Theil elements, which are caused by a combination of much higher education expenditure level and bigger population shares in these provinces. The bottom-five contributors are the provinces that have the lowest and negative Theil elements, due to the fact that they have lower education expenditure level and also bigger population shares. Figure 2 clearly shows how Shanghai has driven up the Theil index in 2001

and 2002. In the rest of this discussion, we focus on Figure 3, which includes only regular provinces but not Municipalities. The top-five list has been quite stable, with Zhejiang Province always at the top and Jiangsu province almost always in the second position. In recent years, the Theil elements of these two provinces grow significantly. For example, Zhejiang Province's per-pupil education expenditure was 50% higher than national average in 1999, and grew to be 100% higher than national average in 2005. The bottom-five list is quite stable as well, with Henan province always at the bottom and Anhui and Hunan provinces always near the bottom. Henan Province's per-pupil education expenditure stayed at about 50% of national average throughout the study period, while the difference between Zhejiang and Henan grew from about 3 times in 1999 to about 4 times in 2005. If we would include the four Municipalities, the gaps are even more appalling. The per-pupil education funding in Shanghai was about 8 times larger than that of Henan province in 1999, and the difference has grown to more than 10 times in 2005. Such results clearly indicate an increasing level of inequality of per-pupil education expenditure in recent years.¹²

6. DISCUSSIONS AND CONCLUSION

To summarize, the results of our analysis suggest that assessing spatial inequality of China's education expenditure is sensitive to (a) different measures of education level, (b) different data coverage, and (c) different levels of spatial aggregation. Studies based on data from different sources could generate discrepant results, thus we should pay special attention to the data issue in our future studies on China's education equity. It is advisable to use per-pupil fiscal measures instead of per-capita ones, because China's population statistics are based on *Hukou* registration record rather than the actual residing location. In addition, care should be taken in comparing the Municipalities with other provinces. With much higher levels of socioeconomic development and urbanization, the Municipalities are often outliers that would significantly skew the overall distribution across jurisdictions.

With data between 1999 and 2005, our analysis shows that the inequality of per-pupil basic education expenditure increased sharply right after the Tax-For-Fee reform, even though the Chinese central government shifted the administrative responsibilities of basic education in rural areas from village and township governments to county governments and attempted to increase investment for basic education in poorer areas and ethnic minority areas. Despite the efforts of the central and provincial governments to increase fiscal

12. In a rough comparison, in the US where education-funding inequality has been a widely discussed policy issue, the gap between top and bottom states regarding per-pupil education funding is typically lower than 3 times. See <http://blogs.census.gov/2011/05/25/funding-public-education/>.

transfers after 2003, the level of education finance inequality during the 2003-2005 remains higher than that of 1999.

Our Theil-index decomposition shows different results with different education levels and in different years, suggesting that caution should be exercised with the widely cited research finding that China's school finance has higher within-province variation than between-province variation (Tsang and Ding, 2005; Wang, 2001). In fact, evidences in recent years seem to suggest a widening gap across provinces, and that the inequality is driven predominantly by several provinces with a much higher education expenditure level and bigger population, especially by Municipalities such as Shanghai and provinces such as Zhejiang and Jiangsu. Moreover, our spatial decomposition, for the first time in literature, shed light on the existence of education inequality across four geographic and administrative levels in China. Above the provincial level, the inequality is more severe among provinces in the same region than across regions, especially when the Municipalities were included in the sample. Below the provincial level, the inequality is more severe across prefectures than among counties in the same prefecture.

This line of inquiry will have significant policy implications. After the Tax-For-Fee reform, the change of education finance responsibility to county-level governments does not lead to a more equitable distribution of education resources when the inequality is measured at or above county-level governments. The fact that the inequality is driven primarily by between-province and between-prefecture variations suggests that policy makers may consider designing equalizing education grants correspondingly to reduce the level of inequality. First, the central government should provide additional funding to assist provinces with limited fiscal capacity to provide public education. Second, provincial governments may in turn make additional equalizing education grants available to prefectures with lower fiscal capacity.

A caveat of this study is that results of inequality analysis are sensitive to the choice of variables and inequality measures. In future research we plan to employ additional inequality measures and approaches of inequality decomposition to study additional variables of education finance, such as different levels of schooling (elementary, secondary, or both), or different coverage of education expenditures (budgeting, extra-budgeting, or off-budgeting), or education expenditure for different groups of population (urban vs. rural, and Han vs. minorities). Moreover, equality of education funding amounts is not necessarily equivalent to equality of education provision, because the cost of education service delivery may vary significantly across localities. In future research we hope to study cost factors of education service delivery and incorporate cost information in studying the equity and adequacy of education finance in China. Lastly, looking at the bigger pictures of public education finance and service delivery, it is important to distinguish local governments'

choice or capacity in funding public education, and to account for their managerial capacities and performance in using education resources as inputs to generate program outputs toward education outcomes.

REFERENCES

Berne, R. and L. Stiefel (1984) *The Measurement of Equity in School Finance: Conceptual, Methodological, and Empirical Dimensions*, Baltimore: The Johns Hopkins University Press.

Brock A., W. Hu, and C. P. W. Wong (2008) “Free Compulsory Education: A Natural Next Step after ‘Two Exemptions and One Subsidy’ (TEOS)”, *Chinese Education and Society*, 41(1): 87-95.

Cheng, G. (2009) “Study on Provincial Compulsory Education Financial Equity Based on School-level Data from One Province”, *Chinese Education and Society*, 42(5): 26-46.

General Office of the State Council (2002) The Notice of Completing the Management System of Compulsory Education in Rural Areas (Guowuyuan bangongting guanyu wanshan nongcun yiwu jiaoyu guanli tizhi de tongzhi). Accessed May 11, 2011
(http://news.xinhuanet.com/zhengfu/2002-05/16/content_395826.htm).

Jiang, M, J. Xu, and H. Wang (1997) “Education Finance in China’s Counties in Poverty and the Cost of Basic Education: An Analysis on 491 National-level Counties in Poverty (Zhongguo Pingkunxian Jiaoyu Caizheng yu Chudeng Jiaoyu Chengben: 491 Ge Guojiaji Pingkunxian De Fenxi)”, *Education and Economics (Jiaoyu yu Jingji)*, No. 4, 31-55.

Kennedy, J. J. (2007) “From the Tax-For-Fee Reform to the Abolition of Agricultural Taxes: The Impact on Township Governments in North-West China”. *The China Quarterly*, 189(1): 43–59.

Legge, J. S. and Z. Zhao (2004) “Morality Policy and Unintended Consequences: China’s ‘One Child’ Policy”. *Chinese Public Administration Review*, 2(3/4): 30-45.

Li, X. (2008) *The Reform of the Compulsory Education Finance System in the Evolution of the Finance System in China (Woguo Caizheng Tizhi Bianqianzhong de Yiwu Jiaoyu Caizheng Zhidu Gaige)*, Beijing: Peking University Press.

- Lin, T. (2009) “Intra-provincial Inequality in Financing Compulsory Education in China: Exploring the Role of Provincial Leaders (1994-2001)”, *Asia Pacific Journal of Education*, 29(3): 321-340.
- Lu, W. et al. (2004) *The Public Investment Policy for Rural Compulsory Education (Nongcun Jichujiaoyu de Gonggong Touru Zhengce)*, The Economic and Social Development Research Institute of Northeastern University of Finance and Economics (*Dongbei Caijing Daxue Jingji yu Shehui Fazhan Yanjiuyuan Ketizu*). Accessed March 29, 2011 (http://academy.dufe.edu.cn/resources/neibuwengao/images/nongcunjichujiao_yugonggongturu.pdf).
- Murray, S. E., W. N. Evans, and R. M. Schwab (1998) “Education Finance Reform and the Distribution of Education Resources”, *American Economic Review*, 88(4): 789–812.
- OECD (2011) *Education at a Glance 2011: Country Note-China*, OECD Publishing.
DOI: <http://dx.doi.org/10.1787/eag-2011-en>.
- Pan, T. (2000) “On the Regional Disparity of Financing Compulsory Education across County Level (Woguo xianji yiwujiaoyu touzi de diqu cayi jiqi yingxiang yinsu fenxi)”, *Education and Economy (Jiaoyu yu jingji)*, 4: 36–44.
- Shah, A., and C. Shen (2008) “Fine-tuning the Intergovernmental Transfer System to Create a Harmonious Society and a Level Playing Field for Regional Development”, in: Jiwei Lou and Shuilin Wang (eds) *Public finance in China: Reform and Growth for a Harmonious Society*, pp.129–154, Washington, DC: World Bank.
- State Council (2001) *The Decision on the Reform and Development of Basic Education (Guowuyuan guanyu jichu jiaoyu gaige yu fazhan de jue ding)*. Accessed May 11, 2011 (<http://www.edu.cn/20010907/3000665.shtml>).
- Tsang, M. C. (1994) “Costs of Education in China: Issues of Resource Mobilization, Equality, Equity, and Efficiency”, *Education Economics*, 2(3): 287–312.
- Tsang, M. C. (2000) “Education and National Development in China Since 1949: Oscillating Policies and Enduring Dilemmas”, in: Lau Chung-ming and Jianfa Shen (eds) *China Review*, pp.579–618, Hong Kong: The Chinese University of Hong Kong.
- Tsang, M. C. (2002) “Establishing and Developing a Substantial and Regularized Scheme of Intergovernmental Grants in Compulsory Education in Chi-

na”, *Harvard China Review*, 5: 11–15.

Tsang, M. C. and Y. Ding (2005) “Resource Utilization and Disparities in Compulsory Education in China”, *China Review*, 5(1): 1–31.

Wang, R. (2001) “Regional Disparity in School Finances in China (Woguo Yiwu Jiaoyu de Diqu Chayi Yanjiu)”, Paper presented at the Peking University International Conference on the Economics of Education (Beijing Daxue Jiaoyu Jingjixue Guoji Yantaohui), Beijing, China.

Wang, W. and W. Duncombe (2009) “School Facilities Funding and Capital Outlay Distribution in the States”, *Journal of Education Finance*, 34(3): 324–350.

Wang, W., X. Zheng and Z. Zhao (2012) “Fiscal Reform and Public Education Spending: A Quasi-natural Experiment of Fiscal Decentralization in China”, *Publius: The Journal of Federalism*, 42(2): 334–356.

Wang, W. and Z. Zhao (2012) “Rural Taxation Reforms and Compulsory Education Finance in China”, *Journal of Public Budgeting, Accounting, and Financial Management*, 24(1): 136–162.

Wong, C. P. W. (1997) “Rural Public Finance”, in: Christine P. W. Wong (eds) *Financing Local Government in the People’s Republic of China*, pp.167–212, Hong Kong: Oxford University Press.

Wong, C. P. W. and R. M. Bird (2005) *China’s Fiscal System: A Work in Progress*, Working paper 05-20, International Studies Program, Andrew Young School of Public Policy, Georgia State University. Accessed March 29, 2011 (<http://aysps.gsu.edu/isp/files/ispwp0520.pdf>).

Xue, L. and T. Shi (2001) “Inequality in Chinese Education”, *Journal of Contemporary China*, 10(26): 107–124.

Yep, R. (2004) “Can ‘Tax-For-Fee’ Reform Reduce Rural Tension in China: The Process, Progress and Limitations”, *The China Quarterly*, 177: 42–70.

Yuan, X. (2009) “Current State of Guangxi Compulsory Education Equity and Countermeasures”, *Chinese Education and Society*, 42(5): 26–46.

Zhao, Z. (2009) “Fiscal Decentralization and Provincial-level Fiscal Disparities: A Sino-US Comparative Perspective”, *Public Administration Review*, 69: S67–S74.