

Public School Resources and Private Substitutes in Urban China

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Abstract

Whether increases in school inputs lead to better education outcomes is essential for education policy-making. While empirical studies that aim to estimate this causal relationship abound, a consensus is lacking. One confounding factor that has mostly been ignored in the literature is the behavioral response of households to changes in public education policies by varying their own education inputs. This paper studies how increases in government spending on public schools affect household education spending in urban China. We use detailed information about household spending on public school tuition, textbooks, and private tutoring from the 2002-2006 Urban Household Survey data and focus on households with children in compulsory education (Grades 1-9). We provide evidence that municipal public education spending in China is exogenous to household preferences, and this allows us to identify a causal relationship. In a model controlling for city fixed effects, year-province fixed effects, local per capita GDP and growth rate of number of basic education students, and a wide range of household characteristics, we find that increases in public education spending lead to significant decreases in household spending on public school tuition and private tutoring but no change in spending on textbooks. In addition, while the reduction in household spending on tuition is quite homogeneous across income quintiles, the reduction in household spending on private tutoring comes primarily from the lowest income households, suggesting diverse educational demand. Moreover, the impact on private tutoring spending differs for metropolitan areas and smaller cities.

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1. Introduction

Most governments devote considerable resources to the provision of universal basic education. There is also a global trend of ever growing government spending on education. This naturally raises the question of whether increases in school inputs lead to better educational outcomes. The answer to this question is essential for education policy-making. Empirical studies aiming to estimate this causal relationship abound; however, a consensus is lacking.¹ One confounding factor, as clearly discussed in Todd and Wolpin (2003), that has largely been ignored in the literature is the behavioral response of households to changes in public education inputs by varying their own education inputs such as parents' time and effort on children's school work and spending on learning materials and private tutoring. Todd and Wolpin point out that estimates based on the production function approach will capture a "policy-effect" that incorporates both a direct impact of school inputs on outcomes and an indirect impact through household responses to such inputs. This negligence is of particular importance for developing countries where household spending is an important contributing factor in the entire education system.²

This paper studies how increases in government spending on public schools affect household education spending in urban China. We extract detailed information about household spending on public school tuition, textbooks, and private tutoring from the 2002-2006 Urban Household Survey data and focus on households with children in compulsory education (Grades 1-9). A simple theoretical model indicates that different types of household spending respond differently to government spending. We provide evidence that municipal public education spending in China is exogenous to household preferences, and

¹ Hanushek (2002) and Glewwe et al. (2011) survey these studies in both developed and developing countries.

² Bray (2003) and Dang and Rogers (2008) are two recent surveys that summarize evidence on the prevalence of private tutoring in both developing and developed countries; also see Kim and Lee (2010) and references therein. Chi, Qian, and Wu (2011) document household education spending in urban China for 2007. These studies mostly investigate what household characteristics may affect household spending and do not consider the interaction with government inputs.

this allows us to identify a causal relationship. In a model controlling for city fixed effects, year-province fixed effects, local per capita GDP and growth rate of number of basic education students, and a wide range of household characteristics, we find that increases in public education spending lead to significant decreases in household spending on public school tuition and private tutoring but no change in spending on textbooks. In addition, while the reduction in household spending on tuition is quite homogeneous across income quintiles, the reduction in household spending on private tutoring comes primarily from the lowest income households. Moreover, the impact on private tutoring spending differs for metropolitan areas and smaller cities.

The reduction in household spending on public school tuition reflects a technical substitution relationship with public spending, part of which is used to replace tuition. The homogeneity of response across income groups suggests that this type of public spending is equivalent to a lump-sum income transfer to households with school-aged children. On the other hand, changes in household spending on private tutoring capture households' behavioral responses. To the extent that private tutoring sessions and school instruction are substitutes in student learning, the findings imply that recent increases in school spending in urban China lead to an improvement in public school quality. We believe this is plausible: Increases in public spending is partially used to increase the teacher salary, and this could reduce teachers' incentive to withhold materials in formal classroom instruction and teach these in private sessions in order to earn extra income. The differential responses in private tutoring spending from households of different income suggest the diversity of demand for education. While improved school teaching may substitute low-income households' demand for the most basic education experience, once this is satisfied, higher-income households tend to raise the demand for more advanced materials or for "luxury" courses.

In contrast to the large literature that studies individual behavioral responses to

government programs in other areas such as charitable giving, social insurance, and welfare, the literature that studies how changes in public education resources affect private input, both in time and money, is relatively small, in large part due to data limitation. Kim (2001), using PSID data, finds that increases in school expenditure lead to a reduction in child care time of mothers with high-school education or less but no change for college-educated mothers. Houtenvill and Conway (2008) find that parents appear to reduce their effort in response to increased school resources; they also find that parental effort has a strong positive effect on children's achievement.

Using data collected from the rural areas of India and Zambia, Das et al. (2011) estimate that households reduce spending on textbooks or writing materials when they expect an increase in public spending on corresponding items. They also find that unanticipated increase in public spending that is not accompanied by a corresponding reduction in private spending leads to an increase in student test scores. Shi (2012) shows that when school fees are reduced for households in rural China, households increase their spending on school supplies for the same children. Both papers study households that have considerably lower income than households in our sample, and the margin of response is rather different.

The paper is organized as follows. Section 2 provides background information about the public finance of China's basic education system and the roles played by household spending. Section 3 outlines the theoretic framework and the empirical specification. Section 4 describes the data and summary statistics of key variables in the empirical analysis. Section 5 presents the estimation results. Section 6 concludes with a brief discussion of policy implications and future work.

2. Background of China's Basic Education System

2.1 Public Finance of Basic Education in China

Basic education in China spans primary school (Grades 1-6), middle school (Grades 7-9), and

high school (Grades 10-12) education. The Compulsory Education Law of 1986 stipulated that primary and middle school education is compulsory for all children. It also established a decentralized system of finance and management of basic education with the municipality governments assuming the primary responsibility.³ The Education Law of 1995 further mandates a “two-growth” rule for local education spending: (1) the growth rate of the budgeted education spending should be higher than the growth rate of regular government revenue at the locality; (2) per student budgeted education expenditure (both personnel and non-personnel) should increase year by year. However, the 1995 law falls short of specifying a target spending level or growth rate and hence leaves local government with substantial discretion; consequently, the growth of per-student spending exhibits great variation across localities and within a locality over time, translating to sizeable variation in the level of per-student spending over time and space.

Given the growth requirement, the actual per-student spending level is closely related to local economic circumstances, preferences of local officials, and demographics. First, basic education is financed out of the local tax revenue, which, in the tax-sharing system created by the fundamental tax reform of 1994, consists of the local share of the tax levy (including tax refunds) and transfers from the provincial and central governments. In urban areas, the former is the main source of the local tax revenue; therefore, since they cannot alter tax rates, the fiscal capacity of municipalities is primarily constrained by local economic development. Second, given fiscal capacity, the education spending level varies with the preferences of local officials. Under China’s centralized personnel control system, the evaluation and promotion of local officials are in the hands of the upper level government, and until very recently the evaluation is based first and foremost on local economic growth and tax

³ In rural areas the responsibility was delegated to the township government till 2001. The county (municipality) government re-assumed the responsibility at the mandate of the State Council following the 2000 reform that abolished the education surcharges on rural households. Tsang (1996) critically reviewed the financial reforms of China’s basic education since the early 1980s.

revenue.^{4, 5} Thus local officials' priority in allocating public resources is to activities that directly promote short-term economic performance, rather than to public goods provision such as basic education – underlying the necessity of the “two-growth” mandate. Anecdotal evidence suggests that local officials may choose to spend more on basic education because of personal concerns for children's wellbeing or visions for long-term economic development and the important role played by education.⁶ Wang (2002) provides an interesting case study about the local budgeting process, which involves little input from local residents and is largely determined by the few officials in charge. Third, given spending level, larger school-aged population translates into smaller per-student spending.

To summarize, local residents play virtually no part in determining local education spending. This, combined with the rigid residence registration system (Hukou) that restricts households' ability to move to a municipality of desired education quality, renders the local education spending to bear little relation to the preferences of local residents.⁷

Figure 1 depicts China's public education spending per student in elementary, middle, and high schools from 1996 to 2008. Chinese government's spending on basic education has been growing over the entire period, especially after 2002. The growth is faster for the compulsory education schools than for high schools. This increase shows up in all three categories of spending: personnel, current operating funds, and infrastructure.

⁴ Li and Zhou (2005) study the promotion of the provincial leaders in this framework. The same mechanism is imitated by all lower level governments.

⁵ In 2009, the CCP Central Committee issued guidelines pertaining to the creation of new mechanisms and standards to evaluate the cadres' performance. For the first time, it explicitly included public goods provision (education, health care, social security, etc) as important performance measures.

⁶ For example, a low-income municipality in Shaanxi Province waived fees for all children to attend 15 years of pre-school and basic education (<http://www.huaxia.com/zjx/xwsc/2011/09/2600594.html>); a municipality in Yunnan Province devoted large amount of revenues to schools instead of renovating the forty-year old office building (<http://politics.people.com.cn/GB/101380/15987329.html>). In both cases, local officials' long-term vision was cited as the underlying reason. The primary newspaper of CCP, People's Daily, extols the personal moralities of local officials for their devotion to the cause of “people's livelihood” (http://paper.people.com.cn/rmrb/html/2012-02/17/nw.D110000renmrb_20120217_1-01.htm?div=-1). There are also cases that local officials were forced to give education higher priority by the upper-level government, or they lost the quota for new chauffeured vehicles (http://news.xinhuanet.com/local/2012-02/03/c_122653726.htm).

⁷ While local Hukou is no longer a binding constraint in the labor market, it is strictly enforced in basic education.

2.2 Household Educational Spending

Despite continued growth, the *level* of public education spending in China has been quite low. Chinese households are required to pay tuition and fees determined by municipal governments to supplement school current operating expenses.⁸ In addition, schools quite often charge extra fees to compensate for their meager budgets. Rampant fee hikes are documented for the 1990s and early 2000s; government action was haphazard until 2006 when it started to tackle the problem by revamping and more strictly enforcing the Compulsory Education Law (Qin 2008, Zhang 2008). Beginning in September 2007 and September 2008 tuition and fees for compulsory schooling were abolished in rural and urban areas respectively. Households however continue to pay for textbooks and other learning materials.

Urban Chinese households spend a substantial amount of income on private tutoring and after-school classes to supplement school teaching. This service is provided by college students, private education institutions, or public school teachers themselves. There are two main reasons for households' demand for private tutoring. One is dissatisfaction with regular school teaching and education quality, due in part to lack of incentives of teachers because of low salaries. Indeed, because Chinese teachers are not prohibited from providing private tutoring, they tend to withhold some materials in their formal instruction and only teach these during private sessions for a fee; most parents have no choice but to enroll their children in these classes. This has become an important avenue for teachers to earn extra income. Another reason is for children to gain a competitive advantage. In this case, parents tend to enroll children in sessions that teach advanced materials in various subjects (most commonly math and English) or in arts and sports classes. Alongside these types of private classes is an industry that tests and certifies student skills in these various subjects. Students with these

⁸ For example, the annual tuition and fees during the 2004 school year for primary and middle schools are 240 Yuan and 310 Yuan respectively in Taiyuan of Shanxi Province. The annual tuition for high school ranges from 800 Yuan to 1,600 Yuan depending on the quality of the high school.

certificates may have the edge in the process of admission to prestigious schools. This phenomenon is particularly prevalent in metropolitan areas, where competition is more fierce, but smaller cities are also catching up, consistent with the discussion of Bray (2003) and Dang and Rogers (2008) that demand for private tutoring differs between urban and rural regions.

3. Model

3.1 Conceptual Framework

We outline a simple household utility maximization problem here to illustrate how to organize our empirical investigation. Each household is assumed to have one child in the compulsory schooling stage; household utility is a function of total household consumption (C) and the child's school performance (Q), which is jointly produced by school inputs and household educational spending. A household maximizes utility by choosing its consumption level and spending on child's education subject to its budget constraint and given government spending on schools:⁹

$$\text{Max}_{\{C, H_2\}} U(C, Q(G + H_1, H_2))$$

subject to

$$C + H_1 + H_2 \leq (1 - t)Y ,$$

where G is government per student spending in public schools, H_1 is the mandatory household spending to complement enrollment in a public school such as tuition and spending on textbooks and other materials; thus total per-student spending in public schools is $G + H_1$. H_2 is any supplementary spending on child's education chosen by households. Y is total household income, and t is the linear income tax rate to finance the public schools and other government functions that do not enter directly into the household utility function. Both consumption and child's school performance are normal goods, and the utility function is

⁹ Because we do not have household time use data, time input by household is not modeled here or considered in the empirical analysis.

concave.

Several features of the model are worth further discussion. First, in the Chinese context, H_1 is essentially a parameter faced by households in their decision making – tuition is set by the municipal government, and students are required to purchase the textbooks listed on the curriculum, which is uniform across the municipality. When increased government spending is partially allocated to increase schools' current spending, the municipal government may set a new, lower tuition. Assume that household spending on textbook does not change, then $\partial H_1 / \partial G < 0$ reflects a mechanical relationship regarding the sharing of duty between the government and the households in financing school current spending.

Second, changes in H_2 represent household behavioral response to government spending; however, because it is theoretically ambiguous whether household spending on private education is a complement or supplement to school inputs, the sign of $\partial H_2 / \partial G$ is uncertain. When increased government spending improves public school quality, households may reduce own spending on children's education if private classes supplement school teaching; for example, when math teachers give a fuller discussion of materials in class, parents may no longer need to pay for a math tutor. On the other hand, household spending may increase if better school teaching induces more education demand from the households; for example, improved music classes in school may stimulate students' interest, which in turn may lead parents to pay for extra private music lessons.¹⁰

Third, we assume that household decision is on the intensive margin, i.e., to what extent to supplement public school teaching. Thus, we assume that changes in public school spending do not affect enrollment decisions. We believe this is plausible given that virtually all compulsory school-aged children in urban China are enrolled (China Statistics Yearbook),

¹⁰ Here we ignore the general equilibrium effects from changes in household budget constraint due to potential changes in tax rate. One plausible argument is that the increased government education spending reflects the reallocation of public funds from other usages to public education without increasing the tax rate.

and very few of them are enrolled in private schools.¹¹

To what extent household response to government spending varies with household characteristics such as household income and parental education carries important policy implications. As discussed by Nordblom (2003), if low-income households are more likely to substitute public spending for private inputs, more public spending may widen the education attainment gap. This is inherently an empirical question, and we address it in our empirical analysis.

3.2 Empirical Specification

As discussed in the next section, our data contain repeated cross sections of households. We therefore estimate the impact of government educational spending on household inputs in the following model:

$$H_{ikpt} = \alpha_k + \alpha_{pt} + \beta \cdot G_{kt} + \gamma \cdot X_{ikpt} + \varepsilon_{ikpt}, \quad (1)$$

The dependent variable H_{ikpt} is the per-student education spending by household i living in city k of province p in year t . α_k and α_{pt} are city and province-year fixed effects respectively. G_{kt} is per-student government educational spending by local government k in year t . X_{ikpt} is a vector of control variables for household and city characteristics, including household average disposable income and its square, father's and mother's education, share of students in the household and their average age, local per capita GDP, and growth rate of local school-aged population; these variables potentially affect household demand for education. ε_{ikpt} is a stochastic error term.

The parameter of interest is β , which measures the change in household educational spending for a unit increase in government spending. Consistent estimation of β requires that G_{kt} be uncorrelated with the error term in the household spending equation. In Equation (1),

¹¹ In 2003, 2.4% and 3.8% of elementary and middle school students enrolled in private schools; the numbers increased to 4.2% and 7.1% in 2007 – these include a large number of migrant workers' children who attend inadequately funded and regulated schools in cities (China Education Statistics Yearbook 2004, 2008). For registered urban residents (with Hukou), our data suggest that less than 5% of children enrolled in private elementary and middle schools

the city fixed effects capture constant city characteristics such as geography, culture, and historical educational spending that may bear on both the current local public spending level and household taste for education, and the province-year fixed effects capture the province-specific common time trend that may affect both local public and private spending. Thus, β is identified off of the within-city variation in public spending over time, and this variation is plausibly exogenous to unmeasured household taste for education given China's specific education finance institution as discussed in Section 2. To briefly recapitulate, while the annual growth in local public education spending is mandated by the Education Law of 1995, the precise growth rate and hence the per-student spending level in a given year depend on the preference of local officials. Since officials are not elected by local residents and their promotion does not depend on residents' satisfaction with local public goods provision, their preference for public goods is not necessarily consistent with local residents'. Additionally, households' ability to move in order to take advantage of better educational resources elsewhere is extremely limited. Consequently, in any given year, households face a public education spending level set by local officials that is independent of their own preferences.

In most specifications of our empirical analysis, we control for time-varying local economic and demographic conditions, primarily per capita GDP and growth rate of school-aged population. Given local officials' preferences, these are the most important factors constraining per-student local public education spending level. Meanwhile, these factors may also affect household spending through channels such as competition in the education promotion process and expectations about labor demand. We control for these variables to remove this potential bias.

We consider separately spending on public school tuition, textbooks, and private tutoring and after-school classes separately. From the discussion of China's basic education finance and the simple model, we expect increased public spending to reduce household

spending on public school tuition and have no effect on spending on textbooks, but its impact on spending on private tutoring and after-school classes is uncertain.

To address the possibility that households of different income may respond differentially to public education spending, we estimate the following models:

$$H_{ikpt} = \alpha_k + \alpha_{pt} + \beta_1 \cdot G_{kt} + \beta_2 \cdot G_{kt} \cdot inc_{ikpt} + \gamma \cdot X_{ikpt} + \varepsilon_{ikpt}, \quad (2)$$

$$H_{ikpt} = \alpha_k + \alpha_{pt} + \sum_{j=1}^5 \beta_j \cdot G_{kt} \cdot qinc_{ij} + \gamma \cdot X_{ikpt} + \varepsilon_{ikpt}, \quad (3)$$

where inc_{ikpt} is the average disposable income of household i , and $qinc_{ij}$ equals 1 if average disposable income of household i falls in the j^{th} quintile of the income distribution of city k in year t and 0 otherwise. Equation (2) assumes that the differential response varies linearly with household average income, while Equation (3) allows household response to vary nonlinearly with household average income.

4. Data

Our empirical analysis combines data from several sources. Household characteristics and educational spending information come from the annual Urban Household Survey (UHS) conducted by the National Bureau of Statistics (NBS) of China. The UHS uses a stratified random sampling method to select households to be representative of the urban population.¹² Selected households are required to report the demographic and income information of each member and to keep a diary of itemized expenditure. We use survey data for the years 2002-2006, when detailed information about household spending on education is available. While the UHS covers all provincial units (including directly administered metropolises), due to restricted access to the full data our sample is a subset of nine provinces: Beijing, Liaoning, Zhejiang, Anhui, Hubei, Guangdong, Sichuan, Shaanxi, and Gansu, which are picked from the three broadly defined regions in China (costal, central, and western) and are deemed to be

¹² The UHS does not survey households of migrant workers mostly because they lack a fixed residence; it also under-samples the extremely wealthy households due to lack of access to their residence.

representative of the national population. This subset contains about 15,000 households in just below 160 municipalities each year. The UHS sample is by design a rotating panel with one third of households replaced each year; however, the survey does not provide adequate information that allows us to precisely match households over time, and thus we treat the sample as repeated cross sections.

Local budgetary public education spending data are extracted from the Municipal Public Finance Statistics Yearbooks published by the Ministry of Finance. Information on number of students in basic education, per capita GDP, and per capita value-added in manufacturing and service sectors is from various City Statistics Yearbooks. These are all publicly available.

We focus on households with children in the compulsory education stage, Grades 1-9.¹³ We drop 0.5% of households with the highest education spending relative to household disposable income and 100 households in three districts with extremely high or low public per-student educational spending. This leaves us with 21024 observations, about 4200 households per year.

Table 1 reports summary statistics of per-student education spending by local governments and by households for all five years under study and for each year separately. All monetary values are in constant 2002 RMB.

Per-student public education spending is created as the ratio between local budgetary education spending and the number of elementary, middle, and high school students. Due to data limitation, we are unable to create precise per-student spending at the compulsory schooling level for municipalities; however, the variable thus created appears to be comparable to the provincial level pre-student spending on elementary and middle schools over time, lending us confidence that it captures rather well the underlying true spending

¹³ We do not consider households with students in high school level because the survey questions do not allow us to separately measure household spending on public school tuition and on private schooling.

variable. Over the 5-year period, the 150 plus municipalities on average spend 1,340 Yuan per student. However, the median spending is only 790 Yuan, and, at a standard deviation of 1,650 Yuan, the dispersion of spending is tremendous. This spending is highly correlated with local per capita fiscal revenue and per capita GDP, the correlation coefficients being 0.63 and 0.41 respectively.

Overall, households spend 1,510 Yuan on each child's education annually, slightly higher than the public per-student spending; this is composed of 530 Yuan on public school tuition, 175 Yuan on textbooks, and 800 Yuan on private tutoring and after-school classes.¹⁴ Total spending on children's education accounts for 6.6% of total household disposable income. It is apparent that spending on private tutoring and after-school classes accounts for the lion's share of household education spending. In addition, this spending is not concentrated on a small number of households; rather, 79.7% of households report positive spending in this category, ranging from 71% for households in the lowest quintile of income distribution to 87% for households in the highest income quintile.

The remaining columns of Table 1 provide the time trend of education spending over the five-year period. We also depict the mean of the spending variables in Figure 2. Several features stand out. First, per-student public education spending maintains a high growth rate over the entire period, averaging almost 13% annually. This continued effort of the Chinese government to improve school inputs is accompanied by much slower growth of household education spending, at an annual growth rate of 4.9%. Consequently, while it is about 400 Yuan below household spending in 2002, public spending surpasses household spending by more than 100 Yuan in 2006, and Figure 1 suggests that this trend is likely to continue.

Second, household spending on public school tuition declines continuously over the entire

¹⁴ A fourth type of educational spending that a household may incur is the private school tuition and school choice fee. However, only 5% of the households in our sample incur these fees, and they spend an average of 6,000 Yuan. These fees are usually paid lump-sum at the beginning of elementary or middle school; therefore, it is not comparable to the other annual fees incurred by households. Summary statistics and results of regression analysis for this variable are available from the authors by request.

period, suggesting that a portion of the increased public spending has been used to replace the tuition charges. Third, household spending on private tutoring has increased over the five-year period, from 590 Yuan in 2002, about the same as public school tuition, to almost 1000 Yuan in 2006, more than twice the public school tuition. This increase stems in part from the growth in household income over this period. Meanwhile, the simultaneous slowdown in the growth of private tutoring spending and speedup in the growth of public education spending during 2004-2006 suggest that households respond to government spending when making the decision on investing in children's education. The regression analysis below seeks to separate these different forces.

There is substantial disparity in household education spending across households of different income. Table 2 reports the mean of household education spending by year and by household income. We group households into quintiles based on per person disposable income in each year and in city of residence. First, in each year household spending on children's education increases monotonically with household disposable income, but the spending constitutes a monotonically smaller share of household disposable income – 4.8% and 9.9% for the top and bottom quintiles in 2002, 4.2% and 8.2 in 2006. Second, household spending on public school tuition does not vary significantly across income quintiles, and decrease in public school tuition over the period is universal for all households regardless of income, but this amounts to a larger reduction in education spending burden for lower-income households.

Third, household spending on private tutoring exhibits substantial variation across income quintiles: high income groups devoted significantly more resources than low income groups. It also increases over time for each income group, but the increase is much more substantial for the higher income group, reflecting in part the cross-the-board growth in household income but even larger growth for the more wealthy. These statistics suggest that

there appears to be a universal gap between public school teaching and household education demand, and households tend to supplement it with instructions provided by the private sector. The question of interest is to what extent increased government spending narrows this gap and for which income groups.

Table 3 reports summary statistics of control variables. Household average disposable income has a mean of 8,960 Yuan and standard deviation of 6,910 Yuan. Thus the coefficient of variation is 0.77, smaller than that for household overall education spending (0.91) and much smaller than that for household spending on private tutoring (1.46), suggesting that the disparity in education spending is larger than the disparity in household income. Most households (95%) are composed of a couple and a child, typical of the nuclear family in urban China, and children are aged between 5 and 16 with a mean of 12 years. Fathers are in general more educated than mothers – 39% of fathers and 28% of mothers have at least a three-year college education, while 23% of fathers and 30% of mothers have less than a high school education.

Of the city-level control variables, it is notable that while the mean of the growth rate of student number is 3%, more than half of municipalities in the sample experience a negative growth rate, in particular the larger cities; this is most likely due to the low fertility rate in the urban area following the one-child policy. GDP in the urban area almost exclusively comes from the value-added in the industrial and service sectors, and the majority of the cities experience impressive economic growth.

5. Estimation Results

This section presents estimated impacts of public education spending on household spending. Since for each dependent variable some households report zero spending, we employ a Tobit model for all estimation; all standard errors are robust and clustered at city level. We start with estimates for public school tuition, which both provide a benchmark to gauge the quality

of our data and allow us to make comparison with results in the literature. We then present results for household spending on textbooks, private tutoring, and total spending on compulsory education. Finally, we report results for metropolises and smaller cities separately.

5.1 Results for household spending on public school tuition

Table 4 reports the estimated response of household spending on public school tuition to public education spending. All specifications control for city and year-province fixed effects, household average disposable income and its square, fraction of students in a household and their average age, and father's and mother's education levels.

Column 1 is the baseline, and the sign of coefficient estimates are all as expected. Consistent with the mandatory nature of the uniform public school tuition, per-student household spending is not systematically related to household disposable income, fraction of students in household, and parents' education; it does increase with the age of students as public school tuition in general rises with grade.¹⁵ The estimate on public education spending is negative and significant at 1% level: for a 1000-Yuan increase in per-student public spending, household spending on tuition decreases by 36 Yuan. Column 2 includes additional controls of local per capita GDP and growth rate of students in basic education. Coefficient estimates on these variables are small and statistically insignificant. Furthermore, estimates on other control variables barely change, and estimate on public spending is not statistically different from that in Column 1. Column 3 estimates the specification in Equation (2), allowing the impact of public spending to vary with household income linearly. Estimate on the interactive term between household income and public spending however is insignificant. In Column 4, we replace this interactive term with interactions between public spending and indicators for household income quintiles (Equation (3)). The coefficient estimates on the five

¹⁵ The estimate on the square of household disposable income is negative and significant, but the magnitude is small.

interactive terms are not significantly different from each other – the p-value for an F test of joint equality is 0.14.

In sum, increased public spending results in reduction in household spending on public school tuition, but we find no heterogeneity in this impact across households of different disposable incomes, suggesting that tuition reduction following the increase in public spending is largely a lump-sum income transfer to households. This is consistent with the findings of Das et al. (2011) about school grants for learning materials. However, in urban China, the school current funds increases much more than the reduction in household tuition payment. Data for Figure 1 indicate that from 2002-2006, about 30%, or 300 Yuan, of the increase in public education spending for elementary and middle schools is devoted to the increase in school current funds; thus, just above 10% of the increased school current funds are used to replace tuition charges. To the extent that a non-trivial fraction of the remaining is spent on improving classroom and laboratory equipment, library, and other learning materials, the environment of public schools has become more conducive to learning.

The significant estimates in Table 4, in particular the homogeneous impacts across income groups, also suggest that our measure of per student public education spending captures reasonably well the true underlying school inputs.

5.2 Results for household spending on textbooks

Household spending on textbooks can be considered as another required spending as long as children go to school. Since it is not intended to substitute for household purchase of textbooks, increases in public spending are expected to have no impact on household textbook expenditure. This is born out by estimates in Table 5, where the specifications are the same as in Table 4. In Columns 1-3, the estimate on public education spending is positive but statistically insignificant, except for in Column 1 where it is marginally significant. In Column 4, none of the estimates on the interactive terms between public spending and

income quintile indicators are significantly different from zero, and we cannot reject the hypothesis of joint equality.

Meanwhile, household spending on textbooks increases with household disposable income, parents' education, and average age of students in the household and decreases with the fraction in the household. This suggests that some of the reported spending on textbooks is actually spending on optional learning materials such as reference books. Households of better socio-economic background tend to spend more on these optional materials. *Ceteris paribus*, a 1,000 Yuan increase in household income is associated with a roughly 8 Yuan increase in spending on textbooks, an income elasticity of 0.4 evaluated at the sample mean, and households with both college-educated parents spend about 50 Yuan more than households with both parents having less than high school education. Note that households with more children spend less perhaps because these books can be shared, but the difference is small – a household of four with two children spends about 5 Yuan less than a household of three with one child. As children proceed in grade, households also spend more on books.

5.3 Results for household spending on private tutoring

Households may purchase private tutoring services if the public school education does not meet their demand. Therefore, the impact of public spending on household private tutoring spending reflects household behavioral responses to changes in school quality that may result from changes in school inputs and allows us to infer changes in school quality.

Estimation results are reported in Table 6, which follows the structure of Table 4. In sharp contrast to estimates for public school tuition, household socio-economic status has a substantial impact on spending on private tutoring. For all specifications, spending on private tutoring increases significantly with household income – *ceteris paribus*, a 1,000 Yuan increase in income is associated with about 80 Yuan increase in spending on private tutoring,

and this increasing pattern applies to almost all households in the sample.¹⁶ The income elasticity is 0.9 when evaluated at the sample mean, more than twice as large as the elasticity for spending on textbooks. Parents' education also has a positive and significant effect on the spending, and a college-educated mother has almost twice the impact as a similarly educated father relative to parents with less than high school education. This is perhaps because mothers are usually the one parent who devotes more time and effort to children's education, and hence they have more influence in making the decision about children's education. Here again, households with older children spend more, and households with more children spend less – likely reflecting a quantity-quality tradeoff (Becker and Lewis 1973). In Columns 2-4, local per capita GDP has a negative and significant effect on tutoring spending, but the magnitude is small, and its inclusion barely changes the estimates on other variables.

The impact of public education spending on household tutoring spending is negative and significant. While Column 3 shows that this impact does not vary linearly with household income, estimates in Column 4 indicate that households of different income groups indeed respond differentially to public spending. For a 1,000 Yuan increase in public education spending, household in the bottom quintile of income distribution reduces their tutoring spending by almost 80 Yuan, significant at 1% level; the spending reduction by household in the second lowest quintile is 46 Yuan and marginally significant; we also observe a spending reduction of 54 Yuan by the top income quintile, significant at 10% level. Nevertheless, we cannot reject the hypothesis of joint equality of these three estimates. On the other hand, increased public spending hardly alters private tutoring spending by households in the middle and second highest income quintiles.

Given that private tutoring plays an important role in narrowing the gap between household demand for education and that provided by public schools, the estimates in

¹⁶ The spending on private tutoring starts to taper off when household disposable income reaches about 60,000 Yuan. However, less than 0.1% of the households attain such high income level.

Column 4 suggest that schools attended by children from the top and bottom income groups appear to have been more successful than schools attended by children from the middle income groups in using the expanded public funds to provide the school teaching that better meets household demand. However, this does not necessarily imply that schools attended by children from the middle income groups lack improvement. Rather, we believe a more plausible interpretation is that households of different income have *diverse* educational demand, which may or may not be satisfied by improvement in public schools. More specifically, under this supposition, when extra government inputs allow public schools to improve basic teaching in subjects such as math and language, households respond differently. All households may now have lower demand for private tutoring services in corresponding subjects and materials; while low-income households may not demand for any additional tutoring, middle-income households may be induced to purchase tutoring services in other subjects and more advanced topics, which have been purchased by high-income households all along. As a result, spending on private tutoring decreases for low- and high-income households but remains unchanged or may even increase for middle-income households, consistent with our estimation results.

Several comments are in order. First, increasing public education spending reduces the burden on low-income households. Second, human capital accumulation of children from low-income households may increase to the extent that school teaching is more productive than tutoring. Third, the gap in human capital accumulation between low-income households and other remains and may even increases, given that increases in public spending do not displace private spending as much for the latter. Fourth, the fact that low-income households continue to spend a significant amount on private tutoring (Table 2) suggests that greater redistribution can be achieved through further increase in public education spending, assuming additional resources are productive. However, as clearly argued by Besley and

Coate (1991) and Epple and Romamo (1996), the optimal spending is not the amount that entirely erases the gap in human capital investment between different income groups.

5.4 Estimation results for total spending

Results for total household educational spending are reported in Table 7. The results are consistent with those reported in Tables 4-6, and reflect largely the pattern for private tutoring spending given its importance in household overall education spending.

We conduct a series of sensitivity analyses to confirm the robustness of the results in Tables 4-7. First, we estimate the models controlling for per capital value added of the industrial and service sectors instead of per capita GDP, assuming that economic structure rather than the aggregate economic activity may have a more direct impact on households' expectation of future labor demand and hence their current investment on children's education. Second, we added a full set of interactive terms between per capita GDP (or per capita value-added of industrial and service sectors) and household income quintile indicators, and between growth rate of student number and household income quintile indicators. Third, we conduct all analyses for typical urban nuclear families – parents and one child. In all these cases, the results are almost identical.¹⁷

5.5 Estimation by City Size

As described in Section 2, household education spending in smaller cities exhibits a different pattern from that in the metropolises and appears to follow their lead. This may reflect the great disparity in economic activities and income between the two broad types of cities. In this part we explore whether this is also manifested in heterogeneous household response to changes in local public education spending.¹⁸

¹⁷ Results are available from the authors upon request.

¹⁸ Indeed, even greater disparity in economic activities and provision of public services exists between urban and rural areas. Recent policy initiatives by the central government have aimed at bridging many of these gaps, including the creation of a new cooperative medical scheme in the rural area and exemption of fees and provision of more subsidies for rural students, among many others.

We estimate Equation (3) for metropolises and smaller cities separately.¹⁹ The results are reported in Table 8. In both types of cities household spending on public school tuition decreases in response to increases in public spending, and the response is not statistically different across income groups. However, the magnitude of estimates for the metropolises is much larger than the smaller cities, albeit less precise due to smaller sample. For both, household spending on textbooks is hardly affected by public spending; the estimates for metropolises are large but very imprecise. There is, however, striking differences in how public spending affects household spending on private tutoring and hence total spending. In smaller cities, household spending on private tutoring decreases for the two lowest income groups and are generally unchanged for other income groups; in sharp contrast, in metropolises, household spending on private tutoring *increases* for all income groups, with even larger increases for the middle income groups. Additionally, the elasticity of private tutoring spending with respect to household disposable income is larger in metropolises (1.03) than in smaller cities (0.75).

Because of the small sample size of the metropolises, we need to exercise caution in interpreting the results. Nevertheless, the estimates suggest that there exists a strong mismatch between school education supply and household education demand in metropolises. Without fundamental reforms of the education system regarding such as student admission and promotion rules, further increase in public spending will not help stem the growth of household education spending. This is also a valuable lesson for smaller cities over the long run.

6. Conclusion

Understanding whether increases in school financial resources will improve student

¹⁹ Metropolises include capital cities of the eight provinces (Shenyang, Hangzhou, Hefei, Wuhan, Guangzhou, Chengdu, Xi-an, and Lanzhou); a few other large cities (Dalian, Shenzhen, Zhuhai, Shantou, and Foshan); and the three largest and wealthiest districts of Beijing (Dongcheng, Xicheng, and Haidian). Appendix Table 1 reports the mean of per capital GDP, average household disposable income, and per-student public and household education spending, and the disparity is quite salient.

achievement is fundamental to education policy making. The large education production function literature provides mixed answers to this question. There may be two explanations: First, measured school inputs do not affect student outcome. Second, household inputs that affect student outcome respond to school input, and not accounting for this response causes omitted variable bias in the estimate. This paper provides evidence that household spending on children's education indeed responds to changes in public spending on schools. Using household survey data from urban China, we find that increases in public education spending lead to significant decreases in household spending on public school tuition and private tutoring and no change in spending on textbooks. In particular, the reduction in private tutoring spending is likely to capture the household behavioral response to improvement in public school instruction as a result of increased public school spending. We also find that decreases in private tutoring spending largely concentrate on households in the lower part of the income distribution. However, these households continue to spend a substantial amount and share of household income on private tutoring, suggesting that to further enhance the redistribution role of the public education system continued government efforts to improve the quality of public schools is desirable.

While our results on private tutoring spending provide evidence of school quality improvement, data limitation does not allow us to infer the efficiency of public school spending and hence whether further increases in spending is necessary to improve school quality. For example, if increased education appropriation is "captured" by the local education bureau instead of being distributed to schools or if newly-hired teachers are under-qualified or absent from classrooms, phenomena not uncommon in developing countries ((Reinikka and Svensson 2004, Kremer et al. 2005), then additional resources are neither necessary nor sufficient to further improve school quality. Increases in resources should be accompanied by other measures that improve the transparency of public sector

administration. Future work will investigate the efficiency of public spending and whether and how it varies with local circumstances.

The advantage of using municipal-level education spending measure is that it is exogenous to household preferences for education spending, essential to identify a causal relationship, but it also masks the heterogeneity in public spending across schools within a city. Future work will also explore different dimensions of within-city heterogeneity in education spending, including variation over schooling levels and associated variations in school admission and promotion rules.

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Table 1: Mean and Standard Deviation of Education Spending Variables

| year | all years | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| per student public education spending (1,000 Yuan) | 1.34 (1.65) | 0.97 (1.22) | 1.08 (1.32) | 1.29 (1.53) | 1.56 (1.89) | 1.77 (1.99) |
| per student total HH spending | 1509.56 (1380.88) | 1313.89 (1125.22) | 1398.09 (1240.94) | 1573.07 (1424.49) | 1580.38 (1478.20) | 1666.40 (1543.82) |
| total HH spending as % of HH disposable income | 6.61 (5.65) | 6.81 (5.66) | 6.90 (5.99) | 6.92 (5.77) | 6.41 (5.62) | 6.04 (5.14) |
| per student HH spending on public school tuition | 533.68 (514.79) | 570.90 (514.08) | 551.83 (500.95) | 545.00 (522.17) | 532.55 (535.94) | 470.25 (493.74) |
| per student HH spending on textbooks | 175.42 (233.15) | 150.23 (199.55) | 171.75 (251.96) | 179.25 (242.77) | 175.39 (223.70) | 198.73 (239.51) |
| per student HH spending on private tutoring | 800.46 (1169.67) | 592.77 (896.42) | 674.51 (1015.21) | 848.82 (1200.43) | 872.44 (1255.02) | 997.42 (1358.79) |

Table 2: Mean of Per Student Household Education Spending and Household Education Spending as % of Household Disposable Income

| | | per student HH education spending | | | | | HH edu spending as % of disposable income | | | | |
|-----------------|-----------------|-----------------------------------|---------|---------|---------|---------|---|-------|------|------|------|
| | income quintile | year | | | | | year | | | | |
| | | 2002 | 2003 | 2004 | 2005 | 2006 | 2002 | 2003 | 2004 | 2005 | 2006 |
| all | 1 | 1011.42 | 1025.96 | 1130.65 | 1092.35 | 1167.63 | 9.92 | 10.04 | 9.66 | 8.79 | 8.16 |
| | 2 | 1128.48 | 1217.77 | 1337.24 | 1369.46 | 1436.92 | 7.29 | 7.39 | 7.53 | 7.01 | 6.55 |
| | 3 | 1277.29 | 1397.45 | 1609.54 | 1565.88 | 1590.94 | 6.35 | 6.56 | 6.87 | 6.04 | 5.74 |
| | 4 | 1411.93 | 1548.50 | 1723.61 | 1838.04 | 1984.48 | 5.52 | 5.58 | 5.64 | 5.70 | 5.41 |
| | 5 | 1765.78 | 1828.81 | 2092.52 | 2071.18 | 2184.45 | 4.83 | 4.70 | 4.81 | 4.34 | 4.24 |
| pub sch tuition | 1 | 540.91 | 513.79 | 504.38 | 496.67 | 470.05 | 5.57 | 5.35 | 4.70 | 4.26 | 3.53 |
| | 2 | 572.03 | 556.46 | 528.61 | 533.66 | 467.83 | 3.79 | 3.57 | 3.12 | 2.90 | 2.27 |
| | 3 | 578.56 | 549.62 | 563.76 | 544.57 | 461.61 | 3.04 | 2.72 | 2.61 | 2.26 | 1.78 |
| | 4 | 556.61 | 568.46 | 547.14 | 553.29 | 485.13 | 2.29 | 2.20 | 1.90 | 1.82 | 1.44 |
| | 5 | 609.42 | 573.16 | 583.44 | 535.81 | 466.39 | 1.80 | 1.61 | 1.48 | 1.24 | 0.99 |
| textbooks | 1 | 125.63 | 145.20 | 145.95 | 142.79 | 173.04 | 1.30 | 1.42 | 1.31 | 1.23 | 1.28 |
| | 2 | 129.23 | 160.15 | 168.98 | 149.92 | 175.25 | 0.88 | 0.95 | 0.97 | 0.80 | 0.85 |
| | 3 | 144.99 | 166.36 | 177.03 | 176.69 | 198.37 | 0.75 | 0.79 | 0.80 | 0.73 | 0.77 |
| | 4 | 164.80 | 175.46 | 183.83 | 196.12 | 212.39 | 0.66 | 0.64 | 0.63 | 0.65 | 0.64 |
| | 5 | 188.41 | 214.13 | 222.89 | 214.11 | 236.67 | 0.53 | 0.56 | 0.54 | 0.48 | 0.48 |
| priv tutoring | 1 | 344.87 | 366.97 | 480.32 | 452.89 | 524.54 | 3.04 | 3.28 | 3.65 | 3.30 | 3.35 |
| | 2 | 427.22 | 501.16 | 639.65 | 685.88 | 793.84 | 2.62 | 2.88 | 3.43 | 3.30 | 3.43 |
| | 3 | 553.74 | 681.46 | 868.75 | 844.63 | 930.96 | 2.57 | 3.06 | 3.46 | 3.05 | 3.19 |
| | 4 | 690.52 | 804.58 | 992.64 | 1088.63 | 1286.96 | 2.56 | 2.74 | 3.12 | 3.23 | 3.33 |
| | 5 | 967.95 | 1041.52 | 1286.19 | 1321.26 | 1481.39 | 2.49 | 2.53 | 2.79 | 2.62 | 2.77 |

Note: Income quintiles are defined by year and city of residence.

Table 3: Summary Statistics of Control Variables

Panel A

| variable | N | mean | median | st.dev |
|--|-------|-------|--------|--------|
| Average HH dispoable income (1,000 Yuan) | 21024 | 8.96 | 7.13 | 6.91 |
| Fraction of students in HH | 21024 | 0.33 | 0.33 | 0.06 |
| Average age of students in hh | 21024 | 11.77 | 12 | 2.83 |
| Father's education | < HS | 19512 | 0.23 | |
| | = HS | 19512 | 0.38 | |
| | > HS | 19512 | 0.39 | |
| Mother's education | < HS | 20125 | 0.3 | |
| | = HS | 20125 | 0.43 | |
| | > HS | 20125 | 0.27 | |
| Growth rate of stu number, % | 20236 | 3.00 | -0.38 | 25.49 |
| Local per capita GDP | 20879 | 25.36 | 17.86 | 34.53 |
| Local per capital value-added of industrial sector | 20678 | 11.99 | 8.62 | 15.13 |
| Local per capital value-added of service sector | 20626 | 11.43 | 6.68 | 20.58 |

Panel B

| | income quintile | year | | | | |
|--|--------------------|-------|-------|-------|-------|-------|
| | | 2002 | 2003 | 2004 | 2005 | 2006 |
| Average HH dispoable income (1,000 Yuan) | 1 | 3.70 | 3.83 | 4.04 | 4.56 | 5.03 |
| | 2 | 5.38 | 5.62 | 6.04 | 6.65 | 7.30 |
| | 3 | 6.86 | 7.36 | 7.91 | 8.76 | 9.48 |
| | 4 | 8.77 | 9.63 | 10.51 | 11.23 | 12.46 |
| | 5 | 12.91 | 14.93 | 16.05 | 17.31 | 19.08 |

Table 4: Regression Results for Household Per Student Spending on Public School Tuition

| | 1 | 2 | 3 | 4 |
|---------------------------------|-----------------------|------------------------|------------------------|------------------------|
| avg hh disposable inc | 1.993 [1.450] | 2.285 [1.508] | 1.241 [1.745] | 1.67 [1.622] |
| avg hh disposable inc ^2 | -0.046 [0.018]* | -0.049 [0.019]** | -0.068 [0.034]* | -0.041 [0.015]** |
| fraction of students in hh | 46.097 [71.745] | 30.821 [71.776] | 29.415 [71.939] | 29.592 [72.206] |
| avg age of students in hh | 30.625 [2.359]** | 30.024 [2.421]** | 30.026 [2.426]** | 30.007 [2.409]** |
| 1(father edu = HS) | 23.214 [10.472]* | 25.124 [10.784]* | 25.65 [10.768]* | 24.196 [10.810]* |
| 1(father edu > HS) | 13.66 [11.815] | 13.374 [12.079] | 13.892 [12.104] | 11.629 [12.259] |
| 1(mother edu = HS) | 13.215 [9.375] | 9.618 [9.441] | 10.424 [9.384] | 8.556 [9.454] |
| 1(mother edu > HS) | 11.094 [13.069] | 10.46 [13.571] | 11.511 [13.645] | 9.744 [13.434] |
| per student pub edu spending | -35.809 [12.648]** | -25.329 [11.126]* | -32.75 [10.894]** | |
| avg hh inc * per stu pub edu sp | | | 0.769 [0.626] | |
| per stu pub edu sp * hh inc q1 | | | | -35.734 [10.693]** |
| per stu pub edu sp * hh inc q2 | | | | -22.425 [11.357]* |
| per stu pub edu sp * hh inc q3 | | | | -20.03 [11.208]+ |
| per stu pub edu sp * hh inc q4 | | | | -19.073 [15.027] |
| per stu pub edu sp * hh inc q5 | | | | -28.584 [14.521]* |
| local per capita GDP | | 1.057 [1.112] | 0.913 [1.161] | 1.034 [1.111] |
| growth rate of stu number, % | | 0.098 [0.119] | 0.099 [0.118] | 0.098 [0.119] |
| Constant | 790.233 [94.422]** | 685.336 [109.840]** | 701.799 [108.553]** | 693.952 [111.100]** |
| Observations | 19302 | 18531 | 18531 | 18531 |

Robust standard errors clustered at city level in brackets

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 5: Regression Results for Household Per Student Spending on Textbooks

| | 1 | 2 | 3 | 4 |
|---------------------------------|-----------------------|-----------------------|----------------------|-----------------------|
| avg hh disposable inc | 7.892 [0.757]** | 8.04 [0.776]** | 7.449 [0.845]** | 8.006 [0.989]** |
| avg hh disposable inc ^2 | -0.094 [0.018]** | -0.094 [0.018]** | -0.112 [0.015]** | -0.093 [0.019]** |
| fraction of students in hh | -62.483 [38.366] | -67.271 [39.785]+ | -68.445 [39.854]+ | -66.974 [39.644]+ |
| avg age of students in hh | 19.392 [1.011]** | 19.788 [1.028]** | 19.785 [1.029]** | 19.784 [1.031]** |
| 1(father edu = HS) | 11.757 [4.897]* | 10.455 [4.939]* | 10.763 [4.894]* | 10.414 [4.962]* |
| 1(father edu > HS) | 23.424 [5.318]** | 21.688 [5.427]** | 21.837 [5.382]** | 21.632 [5.440]** |
| 1(mother edu = HS) | 18.863 [5.688]** | 20.19 [5.823]** | 20.692 [5.903]** | 20.133 [5.828]** |
| 1(mother edu > HS) | 26.085 [6.901]** | 29.05 [7.049]** | 29.604 [7.061]** | 29.085 [7.062]** |
| per student pub edu spending | 14.646 [8.468]+ | 14.39 [10.031] | 9.034 [10.031] | |
| avg hh inc * per stu pub edu sp | | | 0.551 [0.426] | |
| per stu pub edu sp * hh inc q1 | | | | 13.956 [10.082] |
| per stu pub edu sp * hh inc q2 | | | | 13.958 [10.315] |
| per stu pub edu sp * hh inc q3 | | | | 16.002 [10.793] |
| per stu pub edu sp * hh inc q4 | | | | 13.708 [10.340] |
| per stu pub edu sp * hh inc q5 | | | | 14.361 [10.561] |
| per capita GDP | | 0.707 [0.908] | 0.6 [0.838] | 0.703 [0.908] |
| growth rate of stu number, % | | -0.134 [0.106] | -0.133 [0.106] | -0.134 [0.106] |
| Constant | -115.784 [57.419]* | -169.461 [91.150]+ | -158.07 [85.221]+ | -168.638 [89.080]+ |
| Observations | 19302 | 18531 | 18531 | 18531 |

Robust standard errors clustered at city level in brackets

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 6: Regression Results for Household Per Student Spending on Private Tutoring

| | 1 | 2 | 3 | 4 |
|---------------------------------|-------------------------|------------------------|-------------------------|-------------------------|
| avg hh disposable inc | 80.448 [5.744]** | 81.556 [5.752]** | 80.174 [5.989]** | 77.342 [6.337]** |
| avg hh disposable inc ^2 | -0.615 [0.125]** | -0.63 [0.122]** | -0.668 [0.125]** | -0.551 [0.104]** |
| fraction of students in hh | -475.959 [171.693]** | -466.96 [176.395]** | -469.962 [175.845]** | -467.638 [172.818]** |
| avg age of students in hh | 48.031 [4.694]** | 50.329 [4.767]** | 50.32 [4.771]** | 50.126 [4.720]** |
| 1(father edu = HS) | 94.297 [25.660]** | 102.148 [25.832]** | 102.776 [25.741]** | 98.197 [25.364]** |
| 1(father edu > HS) | 159.803 [35.068]** | 165.528 [35.588]** | 165.811 [35.670]** | 158.355 [35.142]** |
| 1(mother edu = HS) | 167.449 [23.206]** | 164.104 [23.726]** | 165.212 [23.950]** | 159.696 [23.419]** |
| 1(mother edu > HS) | 320.418 [41.878]** | 310.83 [43.246]** | 312.104 [43.175]** | 309.412 [43.272]** |
| per student pub edu spending | -39.014 [23.368]+ | -36.236 [21.827]+ | -48.616 [23.949]* | |
| avg hh inc * per stu pub edu sp | | | 1.25 [1.206] | |
| per stu pub edu sp * hh inc q1 | | | | -78.601 [28.553]** |
| per stu pub edu sp * hh inc q2 | | | | -45.893 [29.994] |
| per stu pub edu sp * hh inc q3 | | | | 14.656 [24.681] |
| per stu pub edu sp * hh inc q4 | | | | -15.106 [28.180] |
| per stu pub edu sp * hh inc q5 | | | | -53.987 [31.846]+ |
| per capita GDP | | -5.696 [2.378]* | -5.931 [2.329]* | -5.877 [2.426]* |
| growth rate of stu number, % | | -0.054 [0.231] | -0.052 [0.232] | -0.058 [0.232] |
| Constant | -236.587 [189.678] | 96.785 [242.419] | 123.161 [240.559] | 155.87 [239.237] |
| Observations | 19302 | 18531 | 18531 | 18531 |

Robust standard errors clustered at city level in brackets

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 7: Regression Results for Total Household Per Student Education Spending

| | 1 | 2 | 3 | 4 |
|---------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| avg hh disposable inc | 77.218 [4.732]** | 78.785 [4.805]** | 75.532 [5.073]** | 72.059 [6.330]** |
| avg hh disposable inc ^2 | -0.588 [0.086]** | -0.608 [0.088]** | -0.706 [0.102]** | -0.51 [0.083]** |
| fraction of students in hh | -608.802 [163.221]** | -625.82 [166.366]** | -631.565 [165.663]** | -628.018 [163.518]** |
| avg age of students in hh | 86.973 [4.793]** | 88.131 [4.867]** | 88.125 [4.884]** | 87.945 [4.819]** |
| 1(father edu = HS) | 85.442 [22.464]** | 92.953 [22.717]** | 94.612 [22.563]** | 89.403 [22.144]** |
| 1(father edu > HS) | 146.826 [29.587]** | 150.421 [29.833]** | 151.317 [30.014]** | 143.041 [29.816]** |
| 1(mother edu = HS) | 132.91 [21.196]** | 127.738 [21.697]** | 130.36 [21.928]** | 123.7 [21.481]** |
| 1(mother edu > HS) | 279.301 [39.795]** | 271.451 [41.087]** | 274.523 [41.260]** | 270.132 [41.206]** |
| per student pub edu spending | -52.481 [26.174]* | -36.498 [19.105]+ | -65.593 [23.935]** | |
| avg hh inc * per stu pub edu sp | | | 3.026 [1.368]* | |
| per stu pub edu sp * hh inc q1 | | | | -90.995 [26.427]** |
| per stu pub edu sp * hh inc q2 | | | | -46.462 [28.346] |
| per stu pub edu sp * hh inc q3 | | | | 11.989 [22.163] |
| per stu pub edu sp * hh inc q4 | | | | -8.539 [25.217] |
| per stu pub edu sp * hh inc q5 | | | | -46.506 [30.808] |
| per capita GDP | | -2.486 [2.079] | -3.061 [1.933] | -2.636 [2.166] |
| growth rate of stu number, % | | -0.093 [0.148] | -0.09 [0.147] | -0.094 [0.148] |
| Constant | 945.539 [177.114]** | 1,021.73 [213.341]** | 1,080.84 [207.529]** | 1,104.21 [211.410]** |
| Observations | 19302 | 18531 | 18531 | 18531 |

Robust standard errors clustered at city level in brackets

+ significant at 10%; * significant at 5%; ** significant at 1%

Table 8: Regression Results for Metropolises and Smaller Cities Separately

| | smaller cities | metropolis | smaller cities | metropolis | smaller cities | metropolis | smaller cities | metropolis |
|--------------------------------|--------------------|------------|----------------|------------|------------------|-------------|----------------|-------------|
| | pub school tuition | | textbook | | private tutoring | | total | |
| avg hh disposable inc | 2.853 | 0.712 | 7.015 | 9.979 | 64.157 | 105.579 | 61.798 | 90.515 |
| | [2.936] | [1.823] | [1.100]** | [2.055]** | [6.104]** | [15.557]** | [7.140]** | [15.366]** |
| avg hh disposable inc ^2 | -0.064 | -0.034 | -0.098 | -0.105 | -0.39 | -0.976 | -0.413 | -0.776 |
| | [0.043] | [0.011]** | [0.017]** | [0.026]** | [0.078]** | [0.231]** | [0.093]** | [0.233]** |
| 1(father edu = HS) | 9.337 | 75.39 | 15.809 | -7.444 | 86.367 | 166.537 | 71.726 | 185.517 |
| | [11.707] | [23.696]** | [5.035]** | [12.742] | [27.520]** | [66.856]* | [24.462]** | [56.479]** |
| 1(father edu > HS) | 11.116 | 6.358 | 24.802 | 6.156 | 124.278 | 288.508 | 115.1 | 251.947 |
| | [13.538] | [27.100] | [5.309]** | [18.144] | [40.686]** | [57.244]** | [33.974]** | [61.908]** |
| 1(mother edu = HS) | 4.226 | 20.415 | 23.042 | 6.474 | 157.883 | 173.387 | 121.803 | 148.979 |
| | [11.417] | [14.186] | [5.960]** | [15.782] | [26.591]** | [42.701]** | [24.545]** | [43.995]** |
| 1(mother edu > HS) | 6.557 | 11.192 | 32.38 | 19.617 | 267.32 | 448.612 | 229.985 | 413.159 |
| | [14.612] | [32.762] | [7.781]** | [14.707] | [46.055]** | [96.810]** | [45.534]** | [85.370]** |
| per stu pub edu sp * hh inc q1 | -30.417 | -102.656 | 13.362 | 86.661 | -82.725 | 618.589 | -90.932 | 506.886 |
| | [10.113]** | [112.773] | [9.667] | [199.374] | [30.528]** | [260.503]* | [29.820]** | [179.938]** |
| per stu pub edu sp * hh inc q2 | -28.028 | -64.594 | 14.287 | 85.183 | -64.774 | 693.591 | -69.682 | 614.63 |
| | [9.154]** | [121.857] | [9.799] | [199.765] | [25.310]* | [246.812]** | [25.300]** | [175.341]** |
| per stu pub edu sp * hh inc q3 | -13.676 | -90.353 | 17.715 | 84.358 | -11.595 | 776.927 | -5.797 | 666.32 |
| | [11.229] | [118.262] | [10.575]+ | [200.361] | [19.496] | [267.377]** | [19.983] | [200.428]** |
| per stu pub edu sp * hh inc q4 | -15.735 | -80.871 | 18.459 | 75.975 | -29.681 | 724.234 | -16.679 | 632.206 |
| | [15.210] | [109.753] | [9.048]* | [204.044] | [23.688] | [279.845]** | [24.331] | [209.445]** |
| per stu pub edu sp * hh inc q5 | -21.547 | -97.791 | 19.377 | 78.948 | -23.601 | 599.464 | -6.792 | 506.677 |
| | [14.564] | [106.486] | [9.793]* | [202.361] | [34.209] | [252.328]* | [35.589] | [186.819]** |
| Observations | 14503 | 4028 | 14503 | 4028 | 14503 | 4028 | 14503 | 4028 |

Robust standard errors clustered at city level in brackets

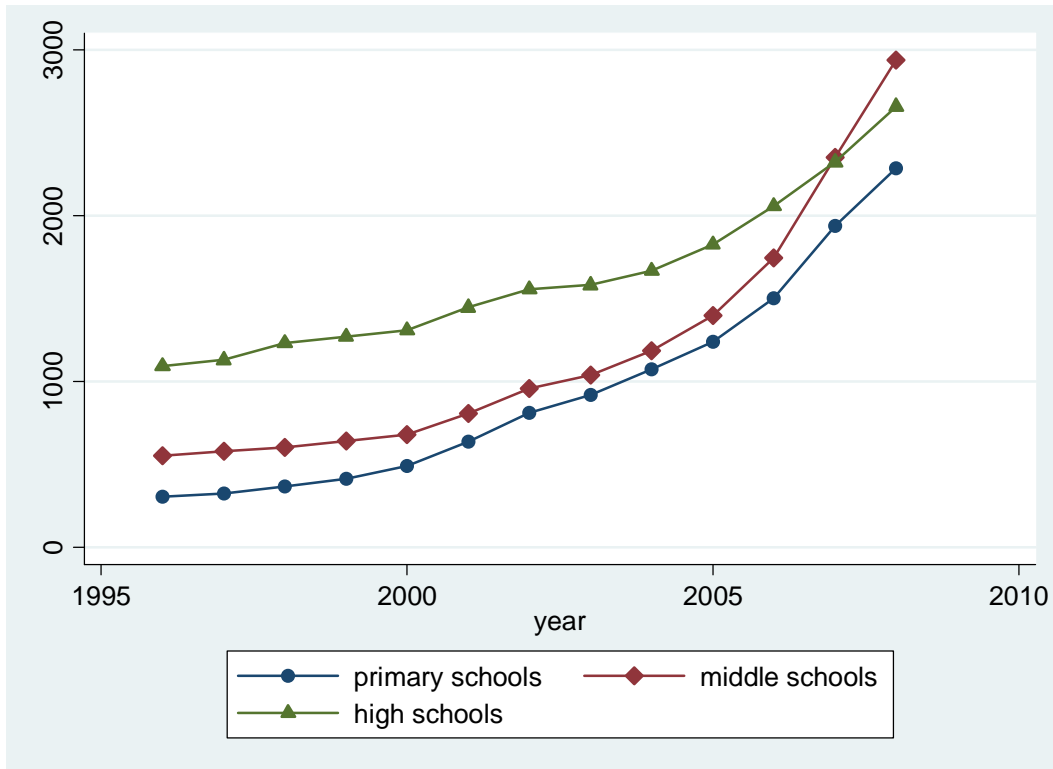
+ significant at 10%; * significant at 5%; ** significant at 1%

Appendix Table 1: Income and Education Spending for Metropolises and Smaller Cities

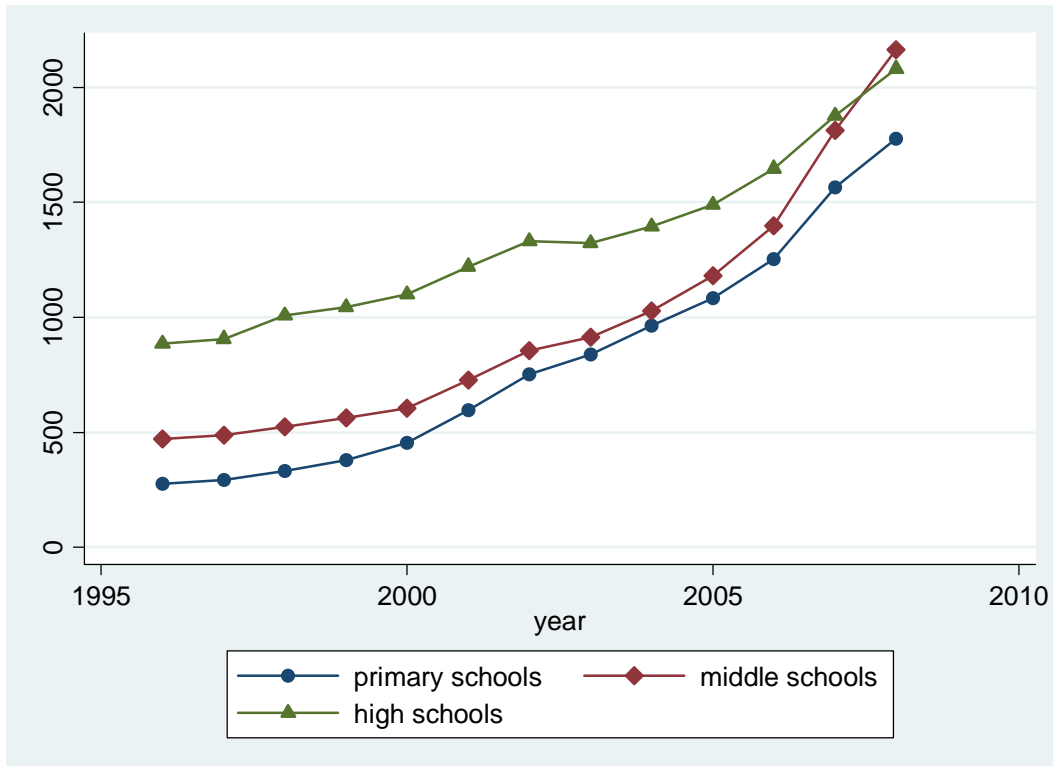
| year | Metropolises | | | | | | Smaller Cities | | | | | |
|---|--------------|-------|-------|-------|-------|-------|----------------|-------|-------|-------|-------|-------|
| | All years | 2002 | 2003 | 2004 | 2005 | 2006 | All years | 2002 | 2003 | 2004 | 2005 | 2006 |
| Local per capita GDP (1,000 Yuan) | 45.05 | 35.51 | 36.21 | 37.06 | 51.48 | 64.50 | 19.46 | 13.68 | 16.92 | 19.46 | 21.76 | 24.94 |
| Average HH dispoable income (1,000 Yuan) | 11.08 | 9.41 | 10.31 | 10.91 | 11.84 | 12.91 | 8.32 | 6.80 | 7.52 | 8.24 | 8.94 | 9.95 |
| Per stu public education spending (1,000 Yuan) | 1.42 | 1.14 | 1.16 | 1.28 | 1.65 | 1.87 | 1.37 | 0.91 | 1.05 | 1.29 | 1.54 | 2.00 |
| Per stu total HH edu spending | 1937 | 1707 | 1723 | 2063 | 2031 | 2164 | 1388 | 1183 | 1298 | 1438 | 1450 | 1550 |
| Per stu HH spending on pub sch tuition | 597 | 666 | 603 | 597 | 574 | 545 | 512 | 534 | 533 | 526 | 518 | 450 |
| Per stu HH spending on textbooks | 204 | 168 | 200 | 219 | 213 | 219 | 168 | 144 | 163 | 169 | 165 | 197 |
| Per stu HH spending on priv tutoring | 1136 | 873 | 920 | 1247 | 1244 | 1400 | 708 | 505 | 602 | 742 | 767 | 903 |

Figure 1: Per Student Spending at Primary, Middle, and High Schools, National Average

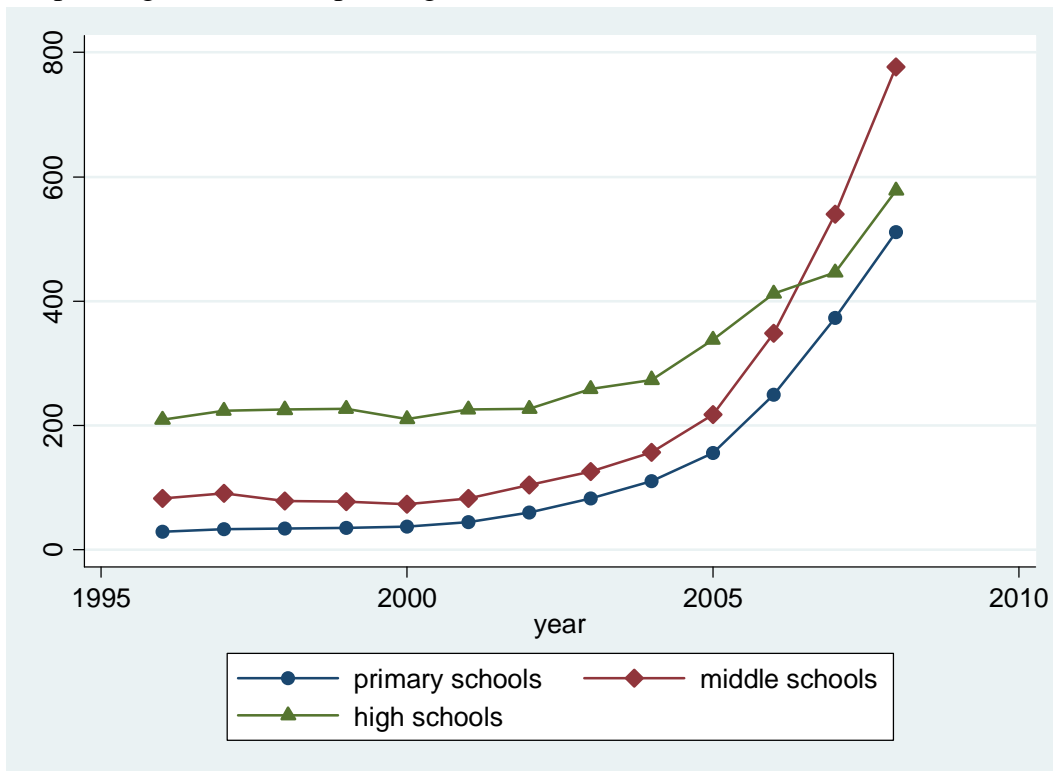
A. Total Spending



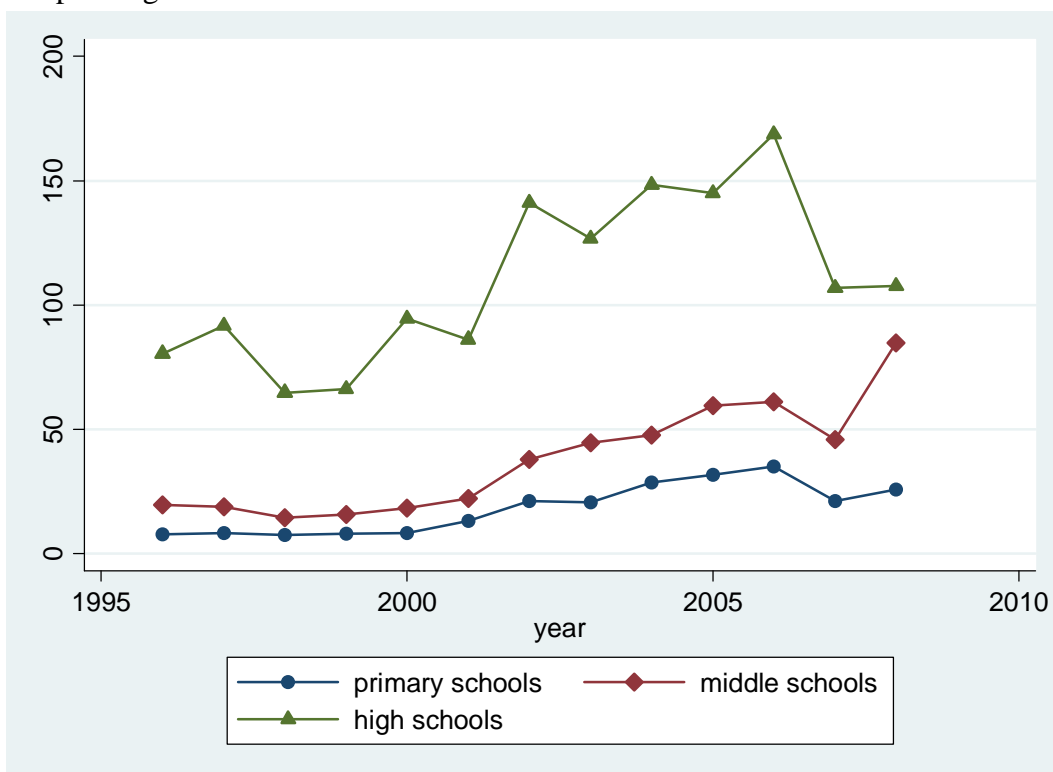
B. Spending on Personnel



C. Spending on Current Operating



D. Spending on Infrastructure



Notes: All spending variables are in 2002 constant RMB. Data source: Statistics Yearbook of Education Finance.

Figure 2: Public and Household Per Student Educational Spending

