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The Changing Determinants of High School Attainment in Rural China

Abstract:

The substantial shift in rural schooling levels and the contemporaneous changes in educational finance policy including tax and fees reform, two exempt and one compensation policy and school rearrangement policy, raise the need for a fresh look at the determinants of rural education. In this paper we have examined the determinants of rural high school attainment and changes in those determinants between the years 2002 and 2007 at multiple levels (individual, family and community level). We find that the increasing importance of community versus household and individual factors in determining rural children's schooling attainment between 2002 and 2007. In addition, government expenditures have a significant and positive impact on high school attainment in both years, with a shift in the relative importance of budgetary versus extrabudgetary funding.

Key words: rural education, high school attainment, family background, public finance, human capital, China

1. Introduction

Studies of education in China have long noted the large and persistent gap in educational attainment between China's urban and rural populations (Knight and Li 1993, Knight, Sicular and Yue 2013). Although rural education levels continue to lag behind those in urban areas, the past fifteen years have seen a remarkable change in rural schooling attainment: attending high school is increasingly common (Connelly & Zheng, 2010). This change is evident in official statistics on school progression rates as well. Nationwide (including both urban and rural areas) between 2000 and 2009 the progression rate from junior high to high school (including both vocational and academic high schools) increased from 50 percent to over 80 percent (Figure 1). Separate statistics on rural progression rates are not available, but in view of the facts that over 60 percent of children aged 15-17 are rural and that urban progression rates were already relatively high in 2000, we deduce that this increase reflects significant change in rural areas.[1] This pattern is also evident in rural household survey data, including the survey data analyzed here (discussed in more detail later), which show an increase in high school attainment among children aged 16 through 20 years from less than 30 percent in 2002 to nearly 40 percent in 2007.

<Figure 1>

The expansion of high school attainment in rural China is related to several recent policy initiatives in the area of rural education, including the rolling out of free, compulsory nine-year education, the reform of rural educational finance, and substantial increases in government expenditures on rural education. In 2000 the Chinese government implemented the tax and fee reform in rural areas, which helped to reduce the financial burden of education on rural families. Around the same time, the government initiated the "two exempts and one compensation" program, which exempted poor rural students from the costs of textbooks and other miscellaneous educational fees and provided them compensation for living expenses in school dormitories. Expansion of free compulsory education occurred after 2000, especially in 2005 in poor areas and again in 2007 when free nine-year education was extended

[1] Published statistics do not easily permit separation of progression rates between urban and rural students, in part because most rural high school children attend high schools located in towns and cities, not in villages. Consequently, statistics for rural high school enrolments undercount the number of rural children in high school, and statistics for urban high school enrolments include rural students. These issues are discussed in Rozelle et al. (2009), which also reports the share of children aged 15-17 who are rural.

nationwide. Concurrently with the implementation of these policies, government education spending per student increased substantially, and most rapidly for rural junior high school (figure 2).

<Figure 2>

Increased schooling levels in rural China, however, may also be the result of changes in household resources and choices. After 2000 rural households enjoyed a period of rapid income growth. Also, family sizes declined, and levels of parental schooling was increasing. Past studies have found that such household characteristics are associated higher levels child schooling. It is also possible that the wage premium on a high-school education has increased; if so, this would lead rural families to increase investments in high school education for their children.

Much of the discourse about schooling in rural China has been in the context of the educational landscape that prevailed before these more recent developments. Most available studies about rural educational attainment in China use data from before 2005. Some analyses use more recent data, but focus on education in poor or minority areas, or of other subgroups for which educational attainment has not kept pace with broader trends.[2]

The substantial shift in rural schooling levels and the contemporaneous changes in the macro and micro variables that underlie schooling outcomes raise the need for a fresh look at the determinants of rural education. This is the aim of our analysis, which examines changes in the determinants of high school attainment in rural China. Economists typically view schooling in developing countries as a household investment decision, and empirical analyses estimate the impact of family characteristics such as income, parental schooling, and the number of siblings on children's schooling outcomes (Becker & Lewis 1973, Ashenfelter & Rouse 1998, Björklund et al. 2010, Lazear 1980). Some studies also consider community or school district factors related to local economic development and school supply that may influence educational outcomes (Strauss, 1995). In our analysis we examine the role of individual and household-level variables, local community variables, and, given the marked expansion in government funding of rural schools, local government educational

[2] For an extensive review and thorough list of published articles on the determinants of educational differentials in China, see Zhang et al. (2012).

expenditures.

Changes in the determinants of school outcomes have been noted in other countries. For example, the cohort-specific effects of years of parents' education on years of child's education have been found to be higher for older cohorts and lower for younger cohorts (e.g. Hertz et al., 2007). Some studies report that in developed countries the impact of family income is less significant after the expansion of education (Shavit ＆Blossfeld 1993, Erikson ＆ Jonsson 1996b). These findings raise the question of whether with economic growth and the expansion of education in rural China, the impact of parental schooling and income has similarly declined.

The literature on the determinants of Chinese children's schooling is now fairly extensive, and studies have found that the impact of family background and household characteristics has changed over time. Knight et al. (2011) investigate intergenerational mobility by cohort group using data for 2007. They report that the correlation between parental schooling and children's schooling has risen over time, but in recent years this trend has been reversed in rural areas. They attribute the reversal to the recent rural policy of free compulsory nine-year education. Li (2010) shows that the expansion of higher education has augmented the impact of family background on children's educational attainment, and that educational inequality between rural and urban areas is enlarging. Liu (2008) analyzes the influence of family background on children's educational attendance of primary school and middle school using national census data from 1980, 1990 and 2000. He reports that that the significance and magnitude of the influence of parental education has increased over time, but the impact of the father's career has remained unchanged.

Our analysis makes several contributions. First, it provides new, relatively recent evidence on the determinants of rural high school attainment during this recent period of change. Our analysis makes use of rural household survey data from the China Household Income Project (CHIP) for the years 2002 and 2007. These two years are well suited for this study as 2002 was before (or mostly before) the rural education policy changes, and 2007 is after most of the key policy changes had been implemented nationally.

Second, our analysis combines household data with village-level data and also with administrative data on local government education expenditures. By so doing, we are able

to investigate the relationship of schooling outcomes with household characteristics and also community-level characteristics. In this regard our analysis contributes to a growing body of work on the role factors outside the household that may influence household schooling decisions in rural China (e.g., Yang 2007), as well as to the more general literature on the impact on schooling outcomes of school resources and public educational spending (Card and Krueger 1992a, Hanushek 1997 and 2006, Cascio et al. 2011). Our hypothesis is that community characteristics and public expenditures are significant determinants of high school attainment; in addition, we propose that between 2002 and 2007 the importance of household variables has declined, while that of community and government expenditure variables has been stable or even increased.

Third, in our empirical analysis we employ a multilevel model. The empirical literature on high school attainment in general and in China often uses a standard probit or logit model (Jensen 1997, Al-Samarrais 1998, Sawada 2001, Yang 2007). As discussed, however, the factors that affect household educational choices are multilevel. Schooling decisions within the same community may be not be independent, and variances may differ among communities. Multilevel estimation methods can explicitly handle these factors and is well suited to hierarchically structured data such as that for students clustered within communities. Multilevel models, also known as hierarchical linear and mixed effects models, have been used elsewhere in the literature to examine how students' test scores are influenced by both individuals and school-level factors.

In the next section we outline our empirical approach. Section three describes the data and provides some relevant policy background. Section four reports the estimation results. As discussed in the concluding section, we find that some community variables and government expenditures are significantly related to high school attainment, and that in the wake of China's rural education reforms, the significance of family income as a determinant of high school attainment has declined.

2. Empirical Approach

We are interested in estimating the effects of individual-level and community-level factors on an individual-level binary outcome variable. In this context, observations within the same community are likely to be correlated, and the assumptions of the standard

regression model may be violated. We therefore use a multilevel or hierarchical regression model with random intercepts. This model estimates slope coefficients that are uniform for the entire sample, but allows the intercept to vary across communities. A standard, single-level model is nested within the multilevel model, so that one can test which specification is appropriate. Since our outcome variable is binary, we use a logit multilevel model. In-depth discussion of such models can be found in Goldstein (2003), Snijders and Bosker (1999), Steele (2009) and Leckie (2010).

Let H_{ij} be a binary variable that equals one if individual *i* in community *j* attends or has attended high school. The probability of high school attainment p_{ij} can be then written as

$$\text{Prob}(H_{ij} = 1) = p_{ij} \quad . \tag{1}$$

Using (1), we can then write the first-level logit regression equation as

$$\log(\frac{p_{ij}}{1-p_{ij}}) = \beta_{0j} + \beta_1 x_{1ij} + ... + \beta_K x_{Kij} \quad , \tag{2}$$

where β_{0j} is the intercept for community *j*, and the β_k are slope parameters on *K* individual-level characteristics x_{kij}.

In a multilevel model both the intercept and slope parameters can be functions of community-level characteristics. Due to the large number of individual and community characteristics relevant to high school attainment in our application of the model, a full multilevel model would yield an unwieldy number of interaction terms. We therefore use a random intercept model in which community-level characteristics enter only through the intercept. The second level regression equation is thus

$$\beta_{0j} = \gamma_{00} + \gamma_{01} q_{1j} + ... + \gamma_{0M} q_{Mj} + u_{0j} \quad , \tag{3}$$

where γ_{00} is the intercept, γ_{0m} are slope parameters on *M* community-level characteristics q_{mj}, and u_{0j} is a random error term, normally distributed with mean zero.

Equation (3) can be substituted into (2) to obtain a mixed multilevel logit regression equation that contains an intercept, individual-level characteristics, community-level characteristics, and an error term:

$$\log(\frac{p_{ij}}{1-p_{ij}}) = \gamma_{00} + \beta_1 x_{1ij} + ... + \beta_K x_{Kij} + \gamma_{01} q_{1j} + ... + \gamma_{0M} q_{Mj} + u_{0j} \quad . \qquad (4)$$

This is the regression equation that we estimate.

According to Raudenbush & Bryk (2002), estimation of a fully unconditional model without any predictors can provide information on how much variation lies at the community level and how much is due to individuals' characteristics. As an initial step in multilevel analysis, then, it is useful to run an intercept only or "null" model

$$\log(\frac{p_{ij}}{1-p_{ij}}) = \gamma_{00} + u_{0j} \quad . \qquad (5)$$

Estimation of equation (5) yields an estimate of the average log odds of high school attainment $\hat{\gamma}_{00}$. The intercept for each community *j* is $\hat{\gamma}_{00} + \hat{u}_{0j}$, and the estimated variance among communities is $\hat{\sigma}^2_{u_0}$. A test of the hypothesis $\hat{\sigma}^2_{u_0} = 0$ indicates whether variance among communities is significant.

3. Data, Descriptive Statistics and Policy Background

In our analysis we use data from two sources. Data on individual, household and village characteristics are from the Chinese Household Income Project (CHIP), and data on public educational expenditures are from the Ministry of Education. The CHIP has conducted four rounds of household surveys of urban, rural and migrant households providing data for the years 1988, 1995, 2002 and 2007. In view of substantial differences in educational policies and educational access between urban and rural areas, we use only the rural data. Since educational policies as well as the economic environment have changed dramatically over time, and since we have matching data for county-level public education expenditures only for later years, we confine our analysis to the two most recent rounds of the survey (2002 and 2007).

The CHIP rural datasets contain household survey data with comprehensive information about individual and household characteristics, including education and schooling attainment. The CHIP also conducted village-level surveys so as to collect information about the communities within which the sample households reside. The village data include information on schools and other community-level characteristics relevant to educational

outcomes. We use data from the household survey for the first level, and data from the village survey for the second level, of the multilevel analysis. The CHIP 2002 rural survey covers 22 provinces, 9200 households, and about 38000 individuals in 961 villages. The CHIP 2007 rural survey covers 9 provinces, 8000 households, and more than 31000 individuals in 800 villages.

In our analysis we restrict the sample to children who reside with their parents and who are 16 through 20 years old, inclusive. By restricting the sample to children who reside with their parents, we have full, matched information about the children, their parents and their natal households. In China children generally begin school at ages 6 through 8 and complete compulsory education (primary school and junior high school) in 8 to 9 years. The decision to continue on into high school thus occurs by age 16.[3] We choose age 20 as upper limit on the age range in order to include as many observations as possible in the sample while minimizing selection bias that could arise due to older children moving out for work or to marry and establish their own households. In the CHIP datasets a trivial number (only 3 in each year) of household heads and spouses of household heads are below the age of 21. We therefore conclude that it is rare for children to marry and establish a new household before age 21. With respect to migration, some children in this age range do engage in migrant work, but usually of a short-term nature. Consequently, they continue to be treated as members of their natal households and are included in the survey. In order to check for selection bias that might arise if some older children have left the households, we carried out the estimation using an alternative maximum age cutoff of 18 rather than 20. The results were stable, and so we conclude that using the older maximum age cutoff of 20 does not bias the results. The restricted sample contains 3973 individuals in 2002 and 2559 in 2007.

We match the CHIP data with county-level data from the Ministry of Education on public expenditures on junior high school education for the years 1999 through 2007. These data allow us to analyze the impact on high school attainment of public education

[3] Some may argue that attending high school requires passing certain qualification exams and that not all students are qualified to attend high school. Some key high schools do indeed require a comparatively high examination score, but other types of high schools do not have selection criteria. In our analysis high school includes all types of secondary schools, including regular senior middle schools, adult senior middle schools, regular secondary technical schools, vocational secondary schools, technical secondary schools, and adult technical secondary schools.

expenditures.[4] Specifically, we estimate the impact on the likelihood of high school attainment of public budgetary (*yusuannei*) and extrabudgetary (*yusuanwai*) operating expenditures (*shiye zhichu*) per student in junior high schools, the level of school immediately preceding high school. We expect that public expenditures at the junior high school level are relevant to high school attainment because these expenditures are correlated with the quality and cost of education during the three years of education that precede high school, and so influence the willingness and ability of children to continue on to high school.

In rural China the level and structure of public educational funding changed during the years under study here. Between 2002 and 2007, China adopted nationwide a policy of free public education through primary and junior high school. This policy was accompanied by increased public budgetary spending (see Figure 2), and the costs of education during the first nine years borne by households were reduced. This increase in government funding and reduction in costs borne by households could have altered the relative importance of household income versus public expenditures in determining children's school attainment.

The increase in government funding of rural primary and junior high school education was accompanied by policy measures aimed at reducing the role of extrabudgetary finance as a source of education funding. In China, extrabudgetary funding for schools has included revenues from various sources such as a dedicated education fee (*jiaoyu fujiafei*) assessed on rural enterprises and households (starting in 2002 the rural tax and fee reform prohibited the assessment of such fees on rural households), tuition and fees, other revenues raised by schools themselves, and funding for schools paid directly by institutions or enterprises (Kipnis and Li 2010, Li, Park and Wang 2007). Although policy reforms have reduced the relative importance of extrabudgetary funding for schools, they may remain important (Kipnis and Li 2010, Li, Park and Wang 2007) and ideally should be included in the analysis.

Since we are analyzing high school attainment for individuals who are already of high school age or older, in our analysis we use public expenditure data for the preceding years, that is, in our analysis of high school attainment of individuals in the 2007 CHIP dataset, we

[4] We acknowledge that the official data on educational expenditures in China do not capture all sources of public and quasi-public funding. We expect, however, that the officially reported expenditures are correlated with unreported and quasi-public funding. See Kipnis and Li (2010) for a discussion of the nature of such unreported funds based on fieldwork in Shandong province.

use average public expenditure data for the years 2004-2006, and in our analysis of individuals in the 2002 CHIP dataset, we use average public expenditure data for the years 1999-2001.

The Ministry of Education data after 2001 are more complete than those for 1999-2001. Starting in 2002 the dataset contains both budgetary and extrabudgetary spending on operating expenses per student, which together add up to total public expenditures on operating expenses for junior high school per student. For 1999-2001 the data contain budgetary expenditures, but not extrabudgetary expenditures. The 1999-2001 data, however, contain information on total and budgetary operational expenditures per capita (*renjun jiaoyu jingfei zong zhichu* and *qizhong renjun caizheng yusuannei jiaoyu jingfei zhichu*) for primary school and junior high school together. With this information we calculate the ratio of extrabudgetary to budgetary spending for both levels of school. We use this ratio to calculate county-level estimates of extrabudgetary expenditures per student for junior high school. This approach assumes that within each county the ratio of extrabudgetary to budgetary spending for junior middle school is the same as that for primary school.[5]

We note that county-level data are not available for all the counties in the CHIP surveys. In 2002 the CHIP survey covers 122 counties, but county-level data for the three years 1999-2001 are missing for 21 of these counties. The matched dataset therefore covers 101 counties. In 2007 county-level data are missing for one of the 82 CHIP counties, so the matched dataset covers 81 counties. The numbers of individuals aged 16-20 in the matched datasets are 2796 and 2427 in 2002 and 2007, respectively. The reasons for missing counties are unclear, but we believe they are related to the renaming, reconfiguration, or reclassification of counties.

Figure 3 compares budgetary educational expenditures per student in junior high school in the sample counties with the national and regional averages. Expenditure levels in the sample counties are similar to, although slightly lower than, the national average. This pattern basically holds for the different regions (East, Center and West), although we note that

[5] Since the dataset contains information on both budgetary and extrabudgetary expenditures for junior middle school and for other levels of school for the years 2002-2006, we can check whether this assumption is reasonable. Using the data for 2002, we have compared the ratio of budgetary to extrabudgetary spending for junior middle school to the ratio for all levels of school. We found that the ratio is almost 1:1, and it holds for year 2003-2006 as well.

the expenditure levels differ by region. Per student expenditures are highest in the East and lowest in the West. We conclude that the counties in our sample are not unusual with respect to the levels of public investment in education.

< Figure 3>

<Tables 1 and 2>

Table 1 reports the definitions of and Table 2 gives descriptive statistics for variables used in our analysis. Descriptive statistics are reported both for the full restricted sample of individuals aged 16 through 20 and for the reduced sample for which we have matched county-level data. The characteristics of the full and reduced samples are not significantly different.

High school attainment is measured by the dummy variable *chigh*, which equals one if the child is attending or has ever attended high school. On average in our full sample, the rate of high school attainment for individuals aged 16 through 20 increased from 28% in 2002 to 38% in 2007. The total years of schooling of their parents (sum of the mother's and father's education years) also increased, from 13.1 years in 2002 to 14.7 years in 2007. In both years males made up slightly more than half of the sample. The number of siblings declined, reflecting the impact of the one-child (or, in some rural areas, one-and-a-half child) policy, and perhaps also due to changing preferences for family size.

These five years were a period of fairly rapid macroeconomic growth, as reflected in increases in household income per capita as well as in public expenditures on education. In nominal terms, household income nearly doubled. Government per student expenditures on junior high school also nearly doubled (in nominal terms). The composition of government expenditures changed, with the share of extrabudgetary expenditures declining from 41% to 27%. This change is consistent with fiscal reforms that occurred during this time frame.

Some other potentially important policy changes also took place between 2002 and 2007. Starting in the late 1990s, but especially during first decade of the 2000s, China carried out a "school consolidation" policy that involved pooling students into fewer, complete primary schools so as to improve the quality of schooling (see Chen et al. 2011). This policy resulted in a marked reduction in the number of rural primary schools. Between 2002 and 2007 the number of rural primary schools nationwide declined by 29 percent (from 384,004 to

271,584) and the number of rural junior middle schools declined 12 percent (from 39735 to 32865) (NBS 2008 and 2003).[6]

These changes are reflected in the CHIP village data. The share of villages in our sample without primary schools or teaching points increased from 34% to 57%.[7] These changes in the supply of schooling within villages at the primary level may have affected schooling choices. We also include in our analysis a variable that captures the supply of, or access to, junior high schools. We note that the village-level information about junior high schools is not consistent for the two years. In 2002 we have information on the distance (kilometers) to the nearest junior high school, and in 2007 we have information on the travel time (hours) to the nearest junior high school.

4. Estimation Results

Table 3 reports results from the null model. For both 2002 and 2007 the estimated variance of the error term $\hat{\sigma}^2_{u_0}$ exceeds 0.5. A test of the hypothesis $\hat{\sigma}^2_{u_0} = 0$ is rejected, indicating that variance among communities is significant. We conclude that community-level characteristics play a role in explaining variation in high school attainment.

<Table 3>

Table 4 contains results from estimation of multilevel logit models that contain individual and family characteristics, but no village-level variables. Village-level effects, however, enter through the random intercept. Table 4 reports estimates for two models that differ only in the way that household income enters the model. In model 1, income enters the regression as the continuous variable *lnhincome* (the log of household income per capita). In model 2, income enters as a set of dummy variables, *lowhincome* (=1 if household income per capita is in the bottom quarter of the sample income distribution) and *highhincome* (=1 if household income per capita is in the top quarter of the sample income distribution), with the omitted category being income per capita falling in the middle two quarters of the sample income distribution. Model 2 allows us to explore whether the coefficient on income is different for low and high income groups. Such could be the case if credit constraints

[6] These statistics on numbers of schools count regular primary and regular secondary schools; they do not include other types of schools such as primary teaching points and vocational secondary schools.
[7] Teaching points are one-room schools that provided schooling for early grades, typically grades 1 through 4. See Chen at al., 2011.

differentially constrain education investments. Because household incomes increased substantially between 2002 and 2007, and because of the educational reforms that eliminated tuition costs for junior high school education in rural areas, we expect that the estimated coefficients on these income variables may have changed between the two years.

<Table 4>

Otherwise, models 1 and 2 are the same. Both include as independent variables the age and age squared of the child, the number of siblings, and dummy variables for whether the child is male, has a single parent, lives with a grandparent, and has an ethnic minority father. Both models also include province dummy variables to control for provincial-level fixed effects.

Empirical studies find that in developing countries family income plays an important role in children's educational attainment (Jacoby, 1997, Sawada & Lokshin, 2001, Ota & Moffatt, 2002). Studies for rural China generally report similar findings (e.g., Zhao & Glewwe 2010). Our estimates for 2002 are consistent with the literature (Table 4). For 2002, in model 1 the coefficient on household income per capita is significant and positive, implying that higher income is associated with a higher probability of high school attainment. In model 2, compared to children in the middle two income quartiles, children in the poorest quartile have a lower probability, and children in the richest quartile a higher probability, of progressing to high school. These findings are consistent with what one would expect if poorer households face binding credit constraints that make it difficult for them to finance their children's high school education, and also if poorer households are more likely to withdraw children from school earlier so that the children can enter the labor force and contribute to household income. Furthermore, low-income parents may not expect the same economic returns to their children's education as do higher-income parents (Lazear 1980).

Interestingly, in 2007 none of the household income variables is significant, that is, household income is not significantly correlated with high school attainment. We suggest several possible explanations for this result. One explanation is that due the substantial increases in household incomes between 2002 and 2007 relaxed credit constraints faced by lower income families. Another explanation is that increased government expenditures on rural education may have reduced the importance of family resources. We explore this

mechanism further in the next section of the paper by introducing government educational expenditures into the regression model.

Most of the other explanatory variables in models 1 and 2 have the expected signs. The impact of parental schooling on children's educational achievement has received attention in the economics literature. Studies have found that one or both parents' education has a significant impact on children's schooling (e.g.,Behrman & Knowles 1999, Handa 1996, Oreopoulos 2006, and Tansel 1997). In the research on China, Hannum (2005), Connelly & Zheng (2003) and Liu (2007) report that parental education is significant, but Brown & Park (2002) and Li & Tsang (2003) report that neither parents' education is significant. We find that the coefficient on parental schooling (the sum years of schooling of the mother and father) is significant and positive in both 2002 and 2007.[8] The magnitude of the coefficient is a bit smaller, however, in 2007. We note that since we do not include any measures of children's ability in our regression, the coefficient on parents' education may be capturing the unobserved ability of the parents, which is likely correlated with the ability of their children.

Studies have found that boys are more likely to attend high school (Admas & Hannum, 2005, Connelly & Zheng, 2003, Hannum, 2003). Our findings show that the coefficient on the male dummy variable is significant and positive in 2002, but it becomes smaller and less significant in 2007, suggesting some erosion of the privileged position of boys. This would be consistent with a story in which as incomes increase, the costs of schooling decline, and family sizes shrink, households are less financially constrained and so do not have to choose boys over girls. Our results regarding number of siblings are also consistent with this story. We find that children with more siblings are less likely to attend high school, but the magnitude and significance of the relationship are smaller in 2007 than in 2002. Other studies on China have also found a negative relationship between number of siblings and school attainment (Connelly & Zheng 2003, Hannum 2003).

Children's health status has a significant, negative impact on high school attainment in

[8] Parental schooling for children in a single family are calculated by the schooling of household head plus household spouse. If either mother or father's schooling is missing, the missing value is replaced by the average schooling of spouse for matched marriage. For example, if father's schooling of children who live with a single mother is missing and the highest qualification of this single mother is upper secondary school, then this child's father's schooling is replaced by 13, since the average schooling of husband for women with an upper secondary school qualification is 13 years. This processing method may be not reasonable, but the missing values is less than 5% and will not largely affect our results.

2002, but not in 2007. The reasons for this change again may be related to the increased income levels, which provide families with more resources to invest in health and pay for health care. It may also reflect the implementation of the new rural cooperative medical care scheme, which was initiated in 2003; by 2007 the national participation rate of rural residents in this scheme had reached 86 percent (NBS 2011, Table 21-21). The new rural cooperative medical scheme is a voluntary program that provides coverage of inpatient medical care and insurance against catastrophic costs for a modest enrolment fee (Li, Sato and Sicular 2013). In 2002 the rural cooperative medical scheme was not yet available, and most rural households had no access to health insurance.

The estimated coefficients on the dummy variable for minority status are not significant in either year. Research about the effect of minority status on schooling in rural areas is limited, but a study by Connelly & Zheng (2003) found that minority pupils have limited educational opportunity. Having a single parent also does not have a significant coefficient in either year. This result is at odds with evidence for the U.S. that finds children living with both parents are more likely to attend high school (Oreopolous et al. 2006). A possible reason for a different finding in rural China is that with the expansion of migrant work, it is now common for a parent to be absent even in households that have not experienced the divorce or death of a parent. Also, the presence of other adult relatives such as grandparents could compensate for the absence of a parent. Indeed, our estimates for 2002 indicate that children who lived with a grandparent were significantly more likely to attend high school. The role of grandparents, however, is no longer significant in 2007.

Table 5 reports results from estimation of multilevel logit regression models that contain community characteristics as well as individual and family characteristics. We have estimated three alternative specifications. Model 3 includes village-level characteristics but not government expenditure variables. Model 4 includes village-level characteristics and total county government expenditures per student on junior high school. Model 5 is the same as model 4 except that budgetary and extrabudgetary expenditures enter separately, so that we can identify whether these two sources of funds have had different effects on our outcome variable. Government expenditure variables enter the model in log form. In all the models in Table 5, household income is measured using the continuous variable *lnhincome*.

These three models also include all the other individual and household variables in models 1 and 2, as well as provincial dummy variables.

The village-level variables we use in these models are related to community educational resources and to the overall socio-economic environment in the village. The variable *vnoprimary* is a dummy variable that equals one if the village does not have a primary school, *vmiddistan* is a measure of the distance from the village to the nearest junior middle school (2007 in kilometers; 2002 in travel time), and *lnvincome* is the log of average household income per capita in the village. We also estimated alternative specifications that included a variety of other village-level variables, and we examined whether village characteristics were correlated with individual and household characteristics by including the village means of household net income per capita and parental schooling as centering variables, but these variables were not statistically significant, so we do not report the results here.[9]

The potential impact of these village-level variables on children's high school attainment is not entirely straightforward. We would expect that the presence of a primary school in the village and shorter distance to a junior high school would, all else equal, reduce the costs of education and so increase the probability of continuing on in school. It is possible, however, that a trade-off exists between numbers of rural schools and their quality, and that the consolidation of village schools between 2002 and 2007 was accompanied by an improved quality of education in the remaining, more distant schools. Research has found that school quality is important to students' educational achievement and to schooling decisions (Card & Krueger, 1992, Tan et. al. 1997). Low-quality schools may induce pupils to lose interest in their studies and push students out of schools.

Unfortunately we do not have any measures of school quality in our dataset, so we cannot measure the impact of school quality directly. Average village income, however, may be correlated with and so capture some of the effects of school quality. Also, models 4 and 5 include government expenditure variables, which may be correlated with school quality.

With respect to village average income, on one hand it is possible that the opportunity

[9] Other village-level variables included the village population (or number of households), the percentage of individuals in the village who are members of an ethnic minority, the percentage of the village labor force engaged in migrant employment, the percentage of the village labor force not working in agriculture, the local wage for unskilled labor, and distance to the nearest town or city.

cost (foregone income earned by the child) of keeping children in school is greater in villages with a high average income per capita. Consequently, students in such villages may leave school at an earlier stage. On the other hand, villages with higher incomes and better socio-economic conditions may have more community resources to support schooling, and also their richer cultural environment and positive peer effects may raise schooling levels for all families. Household budget constraints may be less constraining in richer villages, because such villages sometimes provide subsidies to children of low-income families and school quality may be higher, which can increase the expected returns to education (Knight et al. 2009).

Comparing model 3 to model 1, we find that including village-level variables improves the fit of the regression model slightly, as the AIC and BIC statistics of model 3 are smaller. Nevertheless, few of the village-level variables are significant. The only significant village characteristic is average village income in 2007. The log of average village income has a positive coefficient in both years, but is significant only in 2007. This finding suggests that the influence of the community's economic environment on educational attainment became more important between 2002 and 2007.

We note that the results for model 3 indicate that the presence or absence of a primary school within the village is not a significant determinant of high school attainment. Model 3, however, does not control for differences school quality between village schools and schools in townships where students from surrounding villages are pooled. The findings of models 4 and 5, which include government expenditure variables, provide additional insights on this point.

<Table 5>

Models 4 and 5 add government expenditure variables to the set of community-level characteristics (see Table 5). Model 4 includes total expenditures on junior high schools per student (the sum of budgetary and extrabudgetary expenditures), and in model 5, budgetary and extrabudgetary expenditures enter the model separately. To investigate whether government funding of schools has larger effects for poorer households, and for girls than boys, we also estimated alternative model specifications that included interactions between government expenditures and household income and interactions between government

expenditures and the gender of the child. None of the interaction terms was significant, however, so we do not report the results here.

Adding government expenditure variables further improves the fit of the regression models, especially in 2002, and the results support the conclusion that government expenditures are positively and significantly related to high school attainment. The estimates for model 4 give significant, positive coefficients on total government expenditures for both 2002 and 2007. The magnitude of the coefficient is similar in 2002 and 2007, indicating that the substantial increases in government expenditures on rural schools between the two years did not diminish the size of the relationship between government expenditures and the outcome variable.

The estimates for model 5 reveal differences in the impact of budgetary versus extrabudgetary finance. In both years budgetary expenditures have a positive, significant coefficient, with the coefficient increasing slightly and becoming more significant in 2007. In 2002 the coefficient of extrabudgetary expenditures is positive and significant, although smaller in magnitude than budgetary expenditures. In 2007 it is no longer significant. These results suggest that China's school finance reforms may have had the intended effect of increasing the role of budgetary funds and reducing the role of extrabudgetary funds in rural education.

Comparing the results for models 4 and 5 with model 3, we find that including government expenditure variables does not much alter the estimated coefficients of other independent variables. One coefficient that does change, however, is that for *vnoprimary*, which is not significant in model 3 but becomes significant in 2002 when government expenditures are included in the regression. We would explain this as follows: all else equal, students who live in villages without schools are less likely to progress to high school. All else equal, students at low quality schools are also less likely to progress to high school. Village schools tend to be lower quality schools, so the positive effect of having a school in the village will be offset by the quality of education unless the regression controls for the quality of schooling. Consequently, the coefficient on *vnoprimary* will be biased upward. If government expenditures are correlated with school quality, then including controls for government expenditures could reduce this bias. This would explain why the coefficient on

vnoprimary becomes significant in models 4 and 5.

We conclude this section with some observations about the coefficients on the household and village income variables. In all the models household income per capita is significant in 2002 but not in 2007. These results point to a decline in the importance of household income as a factor affecting whether or not children continue into high school, although other household-level characteristics such as parents' education continue to be significant. In contrast, village average income is not significant in 2002 but becomes significant in 2007. Community-level resources, then, appear to have become more important. Government expenditures are significant in both years. The fact that the coefficients on both household and village income decline somewhat when government expenditures are added in the model suggests that regressions that do not include government spending may overstate the role of individual and village incomes.

5. Conclusions

In this paper we have examined the determinants rural high school attainment and changes in those determinants between the years 2002 and 2007. Our analysis examines determinants at multiple levels: at the individual and family levels, and at the community level. In our analysis we employ a multilevel binary response model, which addresses some of the empirical issues associated with hierarchical, clustered data and heteroscedasticity. Although our sample does not cover all provinces in China, all major regions are represented and the findings can provide some valuable insights.

We find that household and individual characteristics continue to influence high school attainment, but their importance declined between 2002 and 2007. The effects of parental schooling and the child's gender are positive and significant in both years, but their magnitude decreases. The effects of the number of siblings and household income are significant in 2002, but no longer so in 2007. We believe that these results are consistent with changes that occurred during this period: the relaxation of financial constraints on rural households due to increases in household incomes, and reduced out-of-pocket costs of primary and junior high school education. We note, however, that the relationship between income and schooling outcomes does not appear to differ systematically between poorer and richer households.

We find the opposite direction of changes for village-level variables. Average village

income and the presence or absence of a primary school within the village are not significant in 2002, but they become significant in 2007. These results suggest the increasing importance of community versus household and individual factors in determining rural children's schooling attainment. The significant impact of the presence of a village primary school raises questions about China's rural school consolidation policy. It suggests that if the quality of village schools can be improved, then maintaining some schools in villages may encourage more rural students to continue in school.

Government expenditures have a significant and positive impact on high school attainment in both years, with a shift in the relative importance of budgetary versus extrabudgetary funding. This finding confirms the importance of public education finance as a factor contributing to increases in rural school attainment. Although the average level of public expenditures per student has risen, large disparities persist among regions and localities (as reflected in Figure 3). Despite increased central funding, local educational finance continues to depend on the resources of local governments, and richer localities have more resources than do poorer localities. In the future, then, educational funding policies should pay attention not only to the average level of funding, but to the distribution of funding. The same considerations apply to private and quasi-public funding for schools, which are not captured in our analysis (Kipnis and Li 2010). These hidden forms of education funding warrant closer attention in future research.

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Table 1. Definitions of the variables

Variable	Definition
Chigh	High school attainment: if the child has ever attended or is currently attending high school ＝1, otherwise ＝0
Male	Male=1, female =0
Age	Child's age
Age2	Child's age, squared
Badhealth	If the child's health status is somewhat poor or poor =1, otherwise =0
Sib	Number of siblings
Hincome	Household annual net income per capita (unit: 10 thousand yuan; logged in the regressions)
Highhincome	If household annual net income per capita is in the highest quartile of the sample distribution =1, otherwise =0
Lowhincome	If household annual net income per capita is in the bottom quartile of the sample distribution =1, otherwise =0
Pschool	Sum of father's and mother's years of schooling
Single	If the child has a widowed or divorced parent =1, otherwise =0
Grandparent	If a grandparent lives in the household =1, otherwise =0
Fminority	If father is an ethnic minority (not Han) =1, otherwise =0
Vnoprimary	If the village has no primary school or teaching point =1, otherwise =0
Vmiddistan	Distance to the nearest junior middle school (unit: kilometers in 2002; hours of travel time in 2007)
Vincome	Average household annual net income per capita in the village (unit: 10 thousand yuan; logged in regressions)
Total govedu	Average government operational expenditures on junior high school, per student, during the prior three years (note: equals the sum of budgetary and extrabudgetary expenditures) (unit: 1 thousand yuan)
Budgetary govedu	Average government budgetary operational expenditures on junior high school, per student, during the prior three years (unit: 1 thousand yuan; logged in regressions)
Extrabudgetary govedu	Average government extrabudgetary operational expenditures on junior high school, per student, during the prior three years (unit: 1 thousand yuan; logged in regressions)

Table 2. Descriptive statistics

	2002		2007		2002		2007	
Variable	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
chigh	0.282	0.450	0.383	0.486	0.287	0.452	0.385	0.487
male	0.525	0.499	0.518	0.500	0.523	0.500	0.519	0.500
age	17.89	1.430	18.11	1.373	17.91	1.430	18.11	1.373
age2	322.1	51.39	329.8	49.64	322.7	51.40	329.8	49.61
badhealth	0.0327	0.178	0.0686	0.253	0.0311	0.174	0.0669	0.250
sib	1.486	0.993	1.166	0.931	1.415	0.935	1.137	0.913
hincome	0.263	0.215	0.516	0.409	0.263	0.201	0.514	0.414
highhincome	0.250	0.433	0.250	0.433	0.263	0.440	0.243	0.429
lowhincome	0.250	0.433	0.250	0.433	0.252	0.434	0.254	0.435
pschool	13.14	4.472	14.70	3.552	13.14	4.551	14.73	3.533
single	0.0201	0.140	0.00662	0.0811	0.0154	0.123	0.00685	0.0825
grandparent	0.132	0.338	0.0245	0.155	0.128	0.334	0.0254	0.157
fminority	0.146	0.353	0.00779	0.0879	0.153	0.360	0.00806	0.0895
vnoprimary	0.340	0.474	0.565	0.496	0.351	0.477	0.573	0.495
vmiddistan	3.682	4.870	2.028	0.817	3.511	3.880	2.046	0.818
vincome	0.240	0.137	0.426	0.245	0.240	0.121	0.426	0.250
total govedu					1.076	0.597	2.107	3.173
budgetary govedu					0.631	0.374	1.531	2.816
extrabudgetary govedu					0.445	0.292	0.576	0.556
observations	3973	3973	2559	2559	2796	2796	2514	2514

Table 3. Null logit model of high school attainment, with only village fixed effects

	2002		2007	
Fixed effect	Coeff.	Std. Err.	Coeff.	Std. Err.
Intercept (γ_{00})	-1.136	0.072	-0.756	0.073
Random effect	Coeff.	Std. Err.	Coeff.	Std. Err.
Residual $\sigma^2_{u_0}$	0.644	0.125	0.548	0.120
observations	2664		2131	
LR test vs. logistic regression $\overline{\chi}^2$ (Prob $\geq \overline{\chi}^2$)	87.86 (2) (0.000)		65.90 (2) (0.000)	

Table 4. Multilevel logit model of high school attainment, without community-level characteristics

	Model 1		Model 2	
	2002	2007	2002	2007
male	0.199**	0.164*	0.204**	0.159
	(2.403)	(1.688)	(2.474)	(1.641)
age	6.716***	2.890***	6.719***	2.975***
	(7.680)	(2.775)	(7.628)	(2.839)
age2	-0.185***	-0.089***	-0.186***	-0.091***
	(-7.623)	(-3.064)	(-7.570)	(-3.128)
badhealth	-0.514**	0.296	-0.508**	0.300
	(-1.999)	(1.506)	(-1.972)	(1.525)
sib	-0.179***	-0.123*	-0.186***	-0.113*
	(-3.338)	(-1.872)	(-3.473)	(-1.671)
log hincome	0.360***	0.115		
	(4.577)	(1.207)		
lowhincome			-0.303***	-0.057
			(-2.632)	(-0.463)
highhincome			0.246**	0.008
			(2.316)	(0.064)
pschool	0.102***	0.072***	0.105***	0.074***
	(9.419)	(4.949)	(9.663)	(5.082)
single	0.095	-0.663	0.134	-0.679
	(0.292)	(-0.923)	(0.410)	(-0.946)
grandparent	0.444***	0.321	0.439***	0.338
	(3.698)	(1.044)	(3.649)	(1.101)
fminority	-0.191	0.582	-0.190	0.536
	(-0.934)	(0.885)	(-0.929)	(0.816)
Constant	-61.868***	-25.030***	-62.481***	-25.760***
	(-7.905)	(-2.678)	(-7.925)	(-2.740)
observations	3,973	2,559	3,973	2,559
groups	880	705	880	705
random effect intercept	0.471 (0.105)	0.698 (0.145)	0.475 (0.105)	0.691 (0.144)
AIC	4260.114	3199.925	4268.234	3208.356
BIC	4461.307	3324.025	4475.714	3325.366
LR test versus logistic regression $\bar{\chi}^2$ (df) (Prob $\geq \bar{\chi}^2$)	39.50 (32) (0.000)	55.29 (19) (0.000)	40.51 (33) (0.000)	54.25 (20) (0.000)

Notes: t-statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5. Multilevel logit model of high school attainment, with community-level characteristics

	Model 3		Model 4		Model 5	
	2002	2007	2002	2007	2002	2007
Male	0.200**	0.169*	0.241**	0.176*	0.230**	0.175*
	(2.413)	(1.750)	(2.502)	(1.763)	(2.394)	(1.747)
age	6.716***	2.891***	6.026***	2.846***	5.911***	2.850***
	(7.672)	(2.760)	(5.924)	(2.660)	(5.822)	(2.626)
age2	-0.185***	-0.089***	-0.166***	-0.088***	-0.163***	-0.088***
	(-7.616)	(-3.050)	(-5.873)	(-2.949)	(-5.772)	(-2.910)
badhealth	-0.511**	0.279	-0.448	0.254	-0.450	0.253
	(-1.989)	(1.420)	(-1.475)	(1.243)	(-1.485)	(1.236)
sib	-0.178***	-0.083	-0.199***	-0.056	-0.209***	-0.058
	(-3.314)	(-1.253)	(-3.109)	(-0.794)	(-3.286)	(-0.814)
log hincome	0.345***	0.036	0.278***	0.023	0.281***	0.024
	(4.192)	(0.370)	(2.863)	(0.226)	(2.892)	(0.243)
pschool	0.101***	0.069***	0.097***	0.063***	0.098***	0.063***
	(9.327)	(4.744)	(7.900)	(4.200)	(7.976)	(4.204)
single	0.092	-0.623	0.147	-0.590	0.151	-0.595
	(0.282)	(-0.874)	(0.350)	(-0.822)	(0.360)	(-0.827)
grandparent	0.447***	0.288	0.325**	0.416	0.327**	0.415
	(3.715)	(0.936)	(2.270)	(1.296)	(2.285)	(1.293)
fminority	-0.172	0.749	-0.190	0.495	-0.259	0.505
	(-0.840)	(1.141)	(-0.832)	(0.747)	(-1.113)	(0.760)
vnoprimary	-0.121	0.076	-0.008	-0.247**	-0.003	-0.208*
	(-1.115)	(0.608)	(-0.059)	(-2.042)	(-0.022)	(-1.729)
vmiddistan	-0.005	-0.074	-0.020	-0.111	-0.025	-0.114
	(-0.484)	(-0.980)	(-1.270)	(-1.426)	(-1.528)	(-1.460)
log vincome	0.082	0.404***	-0.110	0.287**	-0.084	0.290**
	(0.628)	(3.475)	(-0.676)	(2.377)	(-0.516)	(2.397)
log totalgovedu			0.617***	0.560***		
			(3.429)	(3.754)		
log budgetary govedu					0.362*	0.417**
					(1.709)	(2.524)
log extrabudgetary govedu					0.287*	0.122
					(1.654)	(0.797)
constant	-61.645***	-24.341***	-59.089***	-24.157**	-57.112***	-23.866**
	(-7.869)	(-2.591)	(-6.379)	(-2.519)	(-6.223)	(-2.454)
observations	3,973	2,559	2796	2,427	2796	2,427
groups	880	705	624	673	624	673
random effect	0.460	0.663	0.277	0.577	0.273	0.581

intercept						
	(0.104)	(0.141)	(0.104)	(0.147)	(0.104)	(0.148)
AIC	4254.093	3189.939	3065.714	3007.491	3069.922	3010.306
BIC	4434.147	3318.581	3273.472	3140.762	3283.616	3149.372
LR test versus logistic regression: $\overline{\chi}^2$ (df) (Prob $\geq \overline{\chi}^2$)	36.35 (35) (0.000)	50.36 (22) (0.000)	11.00 (36) (0.000)	48.40 (23) (0.000)	10.41 (37) (0.000)	48.82 (24) (0.000)

Notes: t-statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

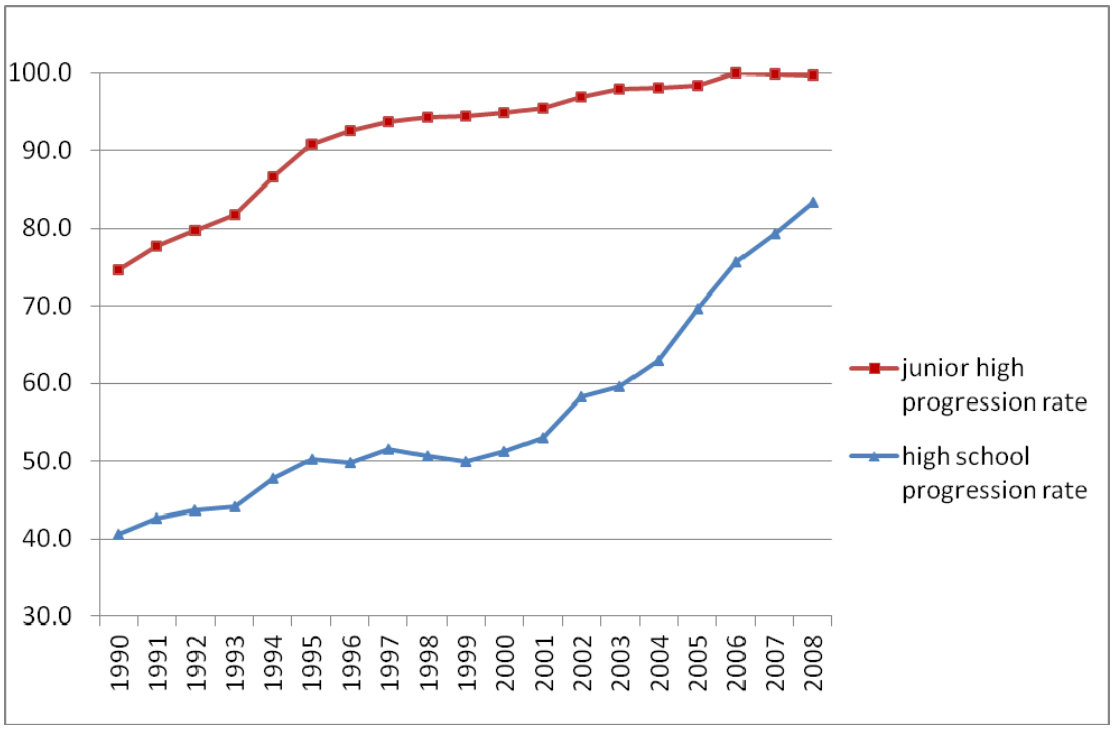

Figure 1. National junior high and high school progression rates, 1990-2008

Notes: Progression rates are calculated as the number of entrants to the given level of schooling divided by the number of graduates from the prior level of schooling. These data are from the same year; that is, entrants to school in August/September are divided by graduates who finished school several months earlier, that is, in June/July of the same year. The high school progression rate includes entrants to technical secondary schools.

Sources: NBS (1996, 2001, 2009); Ministry of Education, Department of Planning (1991); Ministry of Education, Department of Development and Planning (2008).

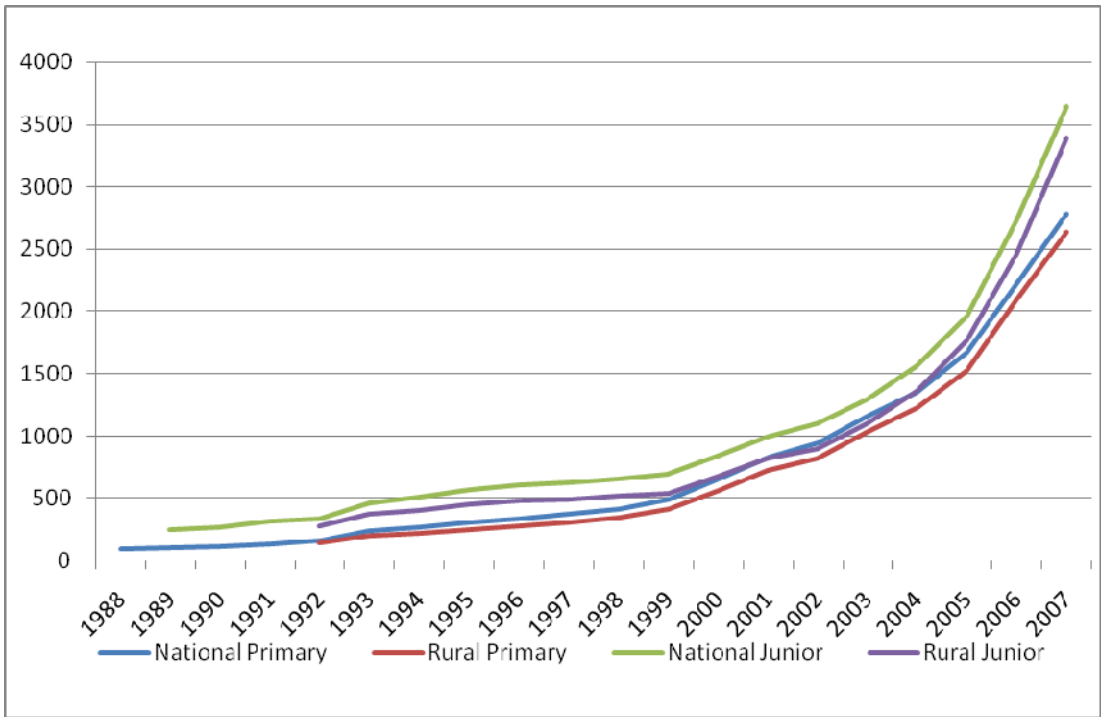

Figure 2 National average total educational expenditures per student, 1988-2008

Source: Ministry of Education data.

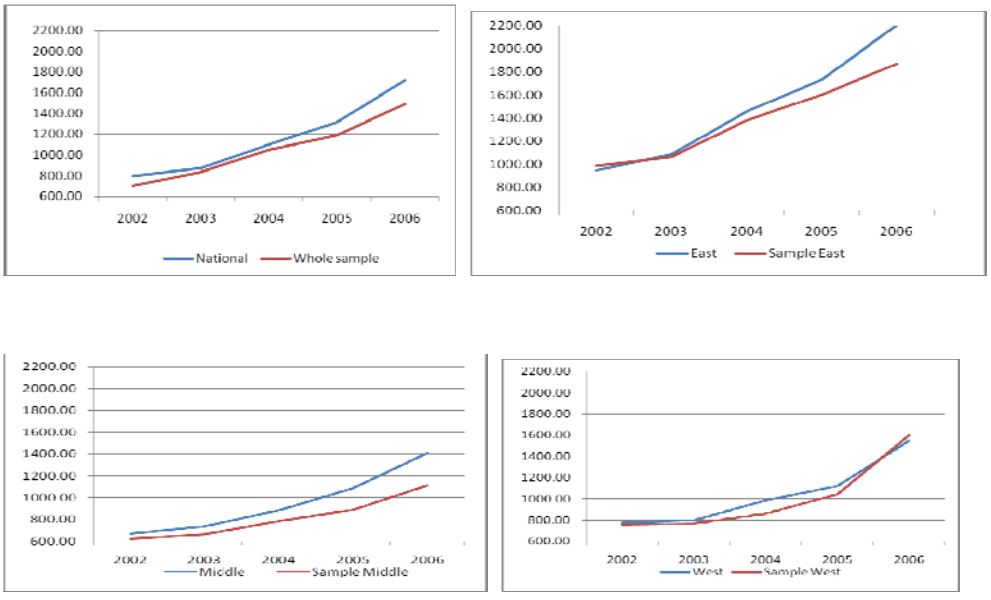

Figure 3 Budgetary educational expenditure on rural junior high school, per student

Source: Ministry of Education data.