Abstract
This paper leverages panel data collected from Jiangsu Province, China from 2001 to 2004 for examining the effects of school inputs such as class size and teacher education on educational attainment, represented by the percentage of middle school graduates who advance to high school or equivalent education. The results show that while middle school class size and educational investment do not have much impact, lower historic elementary school class size and higher teacher education have significant, positive effects on educational attainment. These conclusions differ from what is generally supported in western literature and contain additional policy implications for a developing region.

Acknowledgments: I would like to thank my thesis advisor, Greg Rosston, for “holding my feet to the fire” over this entire process. Without his guidance, intuition, and patience this project would never have been successful. I would also like to thank the supportive faculty at Stanford University, namely Eric Hanushek and Nick Pope, along with numerous school faculty and administrators in China for valuable discussions and information. Much gratuity goes to my family and friends, both in the United States and in China for the foundation that inspired this project and the support to help me carry it through. Finally I would like to thank the anonymous donor whose grant enabled me to conduct this research. Hopefully I didn’t let you down.
I. INTRODUCTION

Education is a top priority for governments around the world as additional schooling has a strong positive effect on long-term economic growth (Hanushek and Kimko, 2000). Education policy can have an especially high potential for impact in China, where the entire education system was both shut-down and rebuilt in the past 50 years, and is still undergoing constant change. Compared to most western countries, China has substantially higher inequality, especially in educational attainment across regions (Rong and Shi, 2001). As lower inequality results in higher overall welfare (Sheshenski, 1972), and education drives economic growth, the government has placed the development of basic education as a top priority since 2002.¹

In 1985, China established a nine-year mandatory education program (primary plus lower-secondary education²) that aimed to prepare capable workers to build the economy (Tsang, 1996). Although there are still students who do not complete the compulsory schooling, that percentage has fallen significantly in recent years. By 2001, the proportion of elementary school graduates continuing their study in middle schools or equivalent education reached 97.02% (China Statistical Yearbook, 2002). Because of this success, the focus of policy-makers has shifted to what happens after middle school graduation. What pushes students to keep advancing in school despite increased tuition, uniform, and book costs?

¹ “In 2002, the Chinese government affirmed that priority has to be given to the development of education as it plays a basic, leading and comprehensive role in the modernization drive of the country” – Chinese Education Minister Zhou Ji at the 32nd general conference of UNESCO (People’s Daily, 2003).

² For clarity, upper-secondary is the equivalent to the end of US high schools (Grades 10-12), lower-secondary to US middle schools (Grades 7-9), and primary to US elementary schools (Grades 1-6). The latter terms will be used in this paper. These nine years are tuition-free at public schools.
The goal of this study is to identify the factors that increase the level of educational attainment in a developing region. Facing limited resources, there is great value in determining what levers have the highest impact. Most education policy research to date has focused on the United States and other developed countries, areas which have had extended periods of stability and high average educational attainment. There is less analysis on poorer areas with potentially higher marginal rates of return due to lower starting values, cost of inputs, and quality of inputs. The results from this study provides initial evidence about areas for further analysis in Jiangsu and encourage research in other provinces in China and in similar developing countries.

The study uses data from Jiangsu province, one of the more economically developed provinces in China. Jiangsu was chosen as a region that is established enough to have long-term stability but still substantially underdeveloped according to western standards. Province-wide educational statistics have been formally collected since 2001 and will be combined with economic data from the yearly census to identify factors that most heavily influence the percentage of middle school graduates who attend standard or vocational high school, hence labeled “middle school grad-rise rate.” The data is broken down by the 13 prefecture-level cities within Jiangsu Province and include economic and educational data for 4 years, from 2001 to 2004.

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3 The yearly GDP per capita of Jiangsu residents in 2004 was ¥20,700 RMB, or the equivalent of approx. $2,700 US.

4 In China, each province is divided into subdivisions called “prefecture-level cities”. Prefecture-level cities are similar to counties in the United States, as the union of all the prefecture-level cities comprises each province with no overlap. Prefecture-level cities will be shortened to “prefectures” for the remainder of this paper.
In this paper, the primary input factors fall under the categories of teacher education, class size, and government expenditure. Three methods of analysis are used: controlling only for income, controlling for all location-based fixed effects, and controlling for both location and time-based fixed effects.

After identifying location-based fixed effects as the most robust method, results show that middle school class size and pure educational investment have an insignificant or irrelevant effect on the middle school grad-rise rate. The percentage of teachers with at least an Associate’s degree\(^5\) and smaller historic elementary school class sizes have significantly positive effects.

One additional area of note is the significantly negative effect from the percentage of a prefecture’s GDP produced by the first sector – agriculture.\(^6\) This effect is consistent with the concept that the opportunity costs of attending school is higher in areas where labor-intensive family farms are more prevalent, creating the need for specialized policy attention in those regions.

The paper proceeds as follows: Section II provides a basic overview of China’s education system, highlighting key differences from western structures. Section III develops the theoretical background from current literature on the three primary categories. Section IV outlines the methods, data used, and model. Section V presents the results, examining the data using multiple methods, and Section VI concludes.

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\(^5\) 2-year post high school degree. In China these are earned in specialized 2-year colleges as well as subsections of 4-year colleges.

\(^6\) In China, occupations are divided into three sectors. The first sector is agriculture, the second sector is industry, and the third sector is services.
II. CHINESE EDUCATION SYSTEM OVERVIEW

The Chinese government passed a series of resolutions in 1985 that set the framework for the present-day educational structure. The reforms primarily focused on two areas – compulsory education and decentralization.

The first set of reforms was to increase the amount of mandatory education and to ensure that this schooling was “free.” There are currently nine years of compulsory education, from first grade through middle-school graduation. Although the law states that students within this period do not have to pay tuition, there are fees such as books, supplies, and uniforms that can be difficult for lower-income families to afford (Kattan and Burnett, 2004).

The second primary area of reform was to decentralize financing and decision-making. This act gave local governments significantly more control over educational policy: the prefecture-level government is responsible for managing and financing high school, middle school, and elementary education (Tsang, 1996). The result is an environment in which there can be vastly different policy and investment decisions across prefectures within the same province.

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7 Although the phrase “year” is used, the compulsory education extends through middle school graduation, and is not subject to particular timelines. If a student is held back from advancing to the next grade, he/she will still need to complete the entire program.
Educational Progress

One aspect that differentiates China from many other countries is its absolute test-based advancement process. The following section is an introduction to how students progress through the system.\(^8\)

Formal schooling in China begins at age six with the first year of elementary school. Elementary school lasts for six years, followed by middle school and high school for three years apiece. Students are required to take an exam at the end of each level that dictates how the student could advance further in school.

Elementary schools are predominantly public. These government-funded schools are required to admit all age-appropriate students from the surrounding areas who apply. Any extra capacity is filled through an interview process for both the parents and the children, followed by a fee that depends on the demand for the school. At the end of the sixth grade, students are required to take a middle school entrance exam covering math, Chinese, history, science, English, and government.

Even though the middle school grades (7-9) are under the compulsory education edict, there is flexibility in school choice. Like the public elementary schools, public middle schools are required to admit students from their local area with no restrictions, but many of the top middle schools are not public. The key reason is that most top high schools aspiring for a higher ranking have spun off their middle schools as separate entities.\(^9\) The

\(^8\) Additional information can be found in Hawkins (2000), Tsang (1996), and Wang (2002).

\(^9\) The phrase “zhong xue”, in Chinese literally means “middle school”, which is between “xiao xue” (little school), elementary, and “da xue” (big school), college. Thus, middle schools have historically
corresponding tuition increase forces parents to make a difficult decision if their child tested high enough on the middle-school entrance exam: sending their child either to the weaker, closer school that is free or the stronger, farther school with tuition. As most parents place emphasis on better schooling, there has been tremendous growth in private schools. Tsang (2000) found that an estimated 500 registered non-governmental schools in 1994 schools had grown to 4,000 in 1997. By 2004, China had 78,500 private institutions, enrolling 17 million students (Asia Society, 2005).

Prior to 2001, the gap in enrollment of poor children compared to middle and upper income children emerged at the beginning of middle school due to a combination of higher costs and less qualified teachers (Hannum and Park, forthcoming). Due to aggressive targeting by the government, middle school dropout rates had fallen to insignificant amounts in cities and 3.91 percent in the countryside by 2001 (China Daily, 2006). At the end of middle school, each student takes another comprehensive exam that determines high school eligibility, acceptance, and cost.

Even though there is no free education after the ninth grade, there are public and private high schools. Unlike middle schools, many of the top high schools are public, usually named after the city or prefecture. Acceptance conditions, like at every level in China, is solely based on the entrance exam score. At the end of high school, students interested in attending college will take one more set of tests.

encompassed the entire 6-year period between grades 7-12. Recently, there has been government pressure to formally separate middle schools and high schools. Each middle school and high school is ranked by a star system, with five stars representing a top school nationwide. This system incorporates graduation percentages, teacher education levels and certifications, and fixed investment such as technology. In order to become a four-star or better high school, Jiangsu province regulations prohibit an attached, public, middle school.
These standardized examinations at each level become the measurement of success for both students and teachers. Even though China’s educational policy makers have stressed developing diverse holistic skills, not just promoting test-taking skills, the fact that advancing to the next level of education is wholly determined by a test score naturally skews the incentives for everyone involved (Hannum, Park, and Cheng, forthcoming; Ding and Lehrer, 2000).

Class and Instructor Placement

Within each school, administrators divide the incoming students into classes and assign classes to teachers. There are two methods of accomplishing both tasks – random and skewed. Random involves drawing lots for both the teachers and the students and operates as expected. Under the skewed method, students and teachers are placed in a strategic manner, usually to maximize the percentage of students moving onto the next level of education. Students are either numbered so that the each class is seeded from best to worst\(^\text{10}\), or separate “fast” and “experimental” classes would congregate all of the top scorers.\(^\text{11}\)

Students in the highest grade offered within a school are part of the “graduating classes”. The preparation these classes receive through the year has a strong influence on how well they score on the comprehensive exam in May or June. In schools that are attempting to

\(^{10}\) For example, if 100 students were to be divided into 3 classes and were ranked from 1-100, then the students numbered 1, 4, 7, 10, etc would be placed into the first class, 2, 5, 8, 11, etc would be placed into the second class, and 3, 6, 9, 12, etc would be placed into the third.

\(^{11}\) Using the above example, the top 33 students would be put into one “fast” class and the rest would be seeded randomly in the two remaining classes.
maximize the number of students that advance, only the senior and best instructors are assigned to teach graduating class students. Most of the top schools that are less concerned about meeting specific graduation and grad-rise rates utilize the random method to maximize the diversity of each class.\textsuperscript{12}

**Investment Inequality**

Income inequality grew steadily within both urban and rural environments from 1978 through 2000 (Chang, 2002). Despite having the fifth highest GINI coefficient in the world behind South Africa, Brazil, Malaysia, and the Philippines, Chow and Shen (2005) found that inequality in primary and secondary education is less than inequality in income. Merit-based scholarships at the best schools have enabled many poorer students to attend despite costs. For example, of the 2,000 students at Sihong Middle School, the best school\textsuperscript{13} in the poorest prefecture of Jiangsu, the top 100 admitted students in the middle school entrance examinations receive full scholarships and the next 100 receive half scholarships.

The 1985 decentralization of the education system created a fundamental disparity in school funding levels. By the start of the 21st century, the provincial primary educational expenditures per student in Shanghai were more than ten times greater than the lowest

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\textsuperscript{12} This information is collected through a series of interviews from June through September, 2006 with Jie Wang, elementary teacher at Langyalu Elementary, He Xiao Bao, principle at Meihua Elementary, Liang Dong Li, professor at Nanjing University, Song Jing Zhang, dean at Jiangsu University, and Cai Bao Shu, director of middle school education in Sihong prefecture. All schools are within Jiangsu Province.

\textsuperscript{13} School rankings in China have a certain meritocracy feel to them, as the top schools are determined by the test scores of the incoming students. There are other factors from governmental star systems to yearly statistics, but predominantly the top schools maintain their rankings year after year through drawing the best applicants.
provinces (Tsang, 2002). Although the initial gap is large, the inequality is not increasing due to recent fiscal reforms. When analyzed at the provincial, prefecture, and village levels for Gansu Province and China as a whole from 1993 to 2004, Park, Li and Wang (2003) found that overall inequality across each level did not change substantially. The question remains on how this high level of continued, albeit constant inequality in educational spending between provinces and prefectures affects the quality of education.
III. LITERATURE REVIEW

Although there is limited research on educational quality factors in China, there is substantial question on whether factors such as investments, class size, and teacher education have a significant effect on educational quality in the United States. Most of the literature agrees that additional years of education increase lifetime income and performance in school affects how much schooling students receive. But in contrast to research on factors that cause performance in the U.S., there has been little such research in China.

In the U.S. male high school seniors who score one standard deviation higher on basic math in high school earned 7.7% higher 6 years later while females earned 10.9% higher (Murnane, Willet, Levy, 1995). Studies have also shown that students who do well on tests go further in school (Dugan, 1976; Manki and Wise, 2003). In poor countries, surveys have found that performance in primary school affect whether or not students advance to middle school (Brown and Park, 2003).

Educational Investment

Within this framework, there is uncertainty about which factors play the largest role in determining educational quality. Some studies have tried to show that input investment can have a significant effect on student performance. A 10% increase in spending is associated with 1-2% higher annual earnings for students later in life (Card/Krueger, 1994). Over time, Hedges (1993) found that the data is consistent with some positive relationship between investment, education and output. However, this view is challenged when examining an aggregation of studies in an international setting. Hanushek’s (2003)
analysis of countries in various stages of development has concluded that “overall resource policies have not led to discernible improvements in student performance.” Woessmann (2000) also found that resources bore little consistency to differences in test scores among 13-year olds in 39 countries. Extrapolating to China, the literature suggests that educational investment is closer aligned with no effect than with positive effects.

Class Size

The class size debate generates two predictions for a lower average class size. The first is that smaller class sizes would increase efficiency within the classroom. According to the Lazear (2001) model, if each student’s interruption behavior is an independent function, then larger class sizes would have more disruptions and lower productivity. Data that suggests otherwise may be affected by the incentive for administrators to place more disruptive students in smaller classes (Lazear, 2001). Results that support this view include: lower pupil-teacher ratios in Illinois led to significantly higher graduation rates (Sander, 1993); and lower statewide pupil-teacher ratios reduced the percentage of high school dropouts (Heckman, Layne-Farre, and Todd, 1996).

The other argument centers around the fact that smaller class sizes result in the need for more teachers, thus lowering the median quality of instruction. Given that teacher quality is a significant predictor of student achievement, the lower quality more than compensates for any gains from smaller classes. Hanushek (1992) found that top teachers are able to impart 1.5 grades worth of material while poor teachers only advance their students by .5 grades. Arguing against smaller class sizes, Hanushek (2003) found through the aggregation of 276 estimates of the effect of pupil-teacher ratios on
educational performance, there were the same number of positively and negatively significant results. After analyzing 649 elementary schools, Hoxby (2000) found that smaller class size does not even have modest effects\textsuperscript{14} on student achievement.

The STAR Project was carried out in Tennessee from 1985-1990 to shed light on whether or not smaller classes increase student achievement. After designing an experiment separating control classes from test classes of eight fewer students, the result was that 40 out of the 79 test classes did statistically better than their control counterparts on regular performance exams (random should expect 26 to do better). Overall, the total gain in performance from reducing class size by 8 students was .2 standard deviations (Word, et al., 1990).

There are two fundamental weaknesses to STAR’s results – the lack of increased separation and the lack of control in teacher and administrator behavior. The gains from smaller classes increase until third grade and then become constant. If smaller classes enable more learning then the gap in performance should expect to increase year over year. These results suggest effects of socialization and introduction of behavior, essentially one-time effects of implementation, instead of real gains created by smaller classes (Hanushek, 2003). Due to knowledge of implications and future funding, behavior of teachers and administrators were also affected if the school was chosen to be in the test pool (Hoxby, 2000). Even though The STAR Project aimed to provide an explanation, the results continue to invite more questions than answers.

\textsuperscript{14} Hoxby defines modest effects as a 2-4 percent standard deviation increase in test scores per 10 percent reduction in class size.
Teacher Education

The argument for advanced teacher degrees has become increasingly prominent in recent years. Because virtually all teachers in the United States have at least a bachelor’s degree (Lewis, et al, 1999), the debate is on whether a master’s or other advanced degree has an effect on teacher quality. A study of grades 4 (math and reading) and 8 (math) in 1992 and 1996 showed that the percent of teachers with Master’s degrees exhibited a small, generally positive, but statistically insignificant effect (Darling-Hammond, 2000). Rice (2003) found teachers with advanced degrees in math and sciences have a positive effect on student performance in those areas. Using performance on standardized tests, Eide and Showalter (1997) found that the fraction of teachers with advanced degrees have an insignificant effect on test score gains.

After compiling 63 studies from developing countries, Hanushek (1995) found teacher education had a significantly positive effect in 35. Hanushek (1995) also found that the sum of teacher education, expenditure per pupil, and facilities has a significantly positive effect, but each component is not overwhelming. What this finding suggests is that educational progress may be subject to a limiting factor. There needs to be a baseline level for each component in order for the system as a whole to improve. Dedicating more resources to the area that is most lacking will result in better returns than developing all factors at the same time.
IV. METHODOLOGY

This study is tests the effect of investment and education inputs in the Jiangsu Province of China. Jiangsu borders Shandong in the north, Anhui to the west, and Zhejiang and Shanghai to the south. Jiangsu has the second highest total GDP after Guangdong and the second highest GDP per capita after Zhejiang. The thirteen prefecture-level cities that compose the province and their summary statistics are included in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Prefecture-level Cities in Jiangsu Province Summary (2004)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population (Millions)</strong></td>
</tr>
<tr>
<td>Suzhou</td>
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<tr>
<td>Wuxi</td>
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<tr>
<td>Changzhou</td>
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<tr>
<td>Zhenjiang</td>
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<tr>
<td>Nanjing</td>
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<tr>
<td>Yangzhou</td>
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<tr>
<td>Yanchen</td>
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<tr>
<td>Nantong</td>
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<tr>
<td>Taizhou</td>
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<tr>
<td>Xuzhou</td>
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<tr>
<td>Huaiian</td>
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<tr>
<td>Lianyungang</td>
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<tr>
<td>Suqian</td>
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</tbody>
</table>

<sup>a</sup> Data from Jiangsu Province Statistical Yearbook (2005).
<sup>b</sup> Percent GDP denotes the percentage of that prefecture’s GDP that is produced from activity in each of the three sectors.

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<sup>15</sup> A map can be found in Appendix B.
<sup>16</sup> Not counting special administrative districts Beijing, Tianjin, and Shanghai.
Systematic province-wide data accumulation on education statistics began in 2001. Annual data on class sizes, graduation/advancement rates, and teacher education was obtained from the Jiangsu Province Department of Education for a four-year stretch between 2001 and 2004. Economic variables from the Chinese City and Town Statistical Yearbook and the Jiangsu Province Statistical Yearbook for the same four years are included in the data set. Table 2 provides the summary statistics for the educational variables. A full list of variables can be found in Appendix A.

<table>
<thead>
<tr>
<th></th>
<th>Elementary</th>
<th>Middle School</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Entrance (%)</td>
<td>Graduation (%)</td>
</tr>
<tr>
<td>Nanjing</td>
<td>100</td>
<td>99.72</td>
</tr>
<tr>
<td>Wuxi</td>
<td>100</td>
<td>99.77</td>
</tr>
<tr>
<td>Xuzhou</td>
<td>99.29</td>
<td>99.03</td>
</tr>
<tr>
<td>Changzhou</td>
<td>100</td>
<td>99.76</td>
</tr>
<tr>
<td>Suzhou</td>
<td>100</td>
<td>99.98</td>
</tr>
<tr>
<td>Nantong</td>
<td>100</td>
<td>99.85</td>
</tr>
<tr>
<td>Lianyungang</td>
<td>99.74</td>
<td>99.51</td>
</tr>
<tr>
<td>Huaian</td>
<td>99.67</td>
<td>99.09</td>
</tr>
<tr>
<td>Yanchen</td>
<td>99.98</td>
<td>99.61</td>
</tr>
<tr>
<td>Yangzhou</td>
<td>100</td>
<td>99.79</td>
</tr>
<tr>
<td>Zhenjiang</td>
<td>99.88</td>
<td>100.01</td>
</tr>
<tr>
<td>Taizhou</td>
<td>100</td>
<td>100.33</td>
</tr>
<tr>
<td>Suqian</td>
<td>98.66</td>
<td>98.27</td>
</tr>
</tbody>
</table>

*ES = Elementary, MS = Middle school, HS = High School, Fac AA = faculty with at least an Associate’s degree, Entrance percentages are % of school-aged residents in that prefecture-level city who enter the appropriate school. Percentages over 100 are due to non-residents. Data from Jiangsu Province Education Statistical Yearbook (2005).

Given that 9 years (first grade through ninth grade) of education is compulsory and mandated by law, a key measurement of educational progress and effectiveness is how
many of the students who graduated middle school (ninth grade) pursued further education in the form of either a standard or technical high school education. This measurement is referred to as the “middle school grad-rise rate.” As the textbooks and exams for each grade are uniform throughout the country, each middle school graduate is assumed to have a similar baseline level of education.

Elementary entrance, elementary graduation, middle school entrance, and middle school graduation were close enough to 100 percent in all thirteen of the prefectures in the province that the middle-school grad-rise rate is not significantly affected by variability at the earlier levels.

The basic model uses middle school grad-rise rate as the dependent variable and investigates the impact of educational inputs and demographic factors. Initially, the model uses local income as control for non-educational related factors.

The basic model is constructed as:

\[ G_{ij} = \alpha C_{ij} + \beta T_{ij} + \phi I_{ij} + \gamma W_{ij} \]

\( G \) is the middle school grad-rise rate, \( C \) is average class size, \( T \) is teacher education, \( I \) is educational investment, and \( W \) is a control for income. \( i \) and \( j \) denote the prefecture (1-13) and year (2001-2004) respectively. Coefficients represent the effect of each factor on the middle school grad-rise rate. Each prefecture and year would be a specific observation, such as Nanjing2002. With 13 prefectures and 4 years, there are 52 total observations.

There is substantial literature asserting that children from higher income families are more likely to advance farther in school (Bowles, 1972; Psacharopoulos, 1997). There
are two different income measurements that can be used as a control for the regressions: urban average income and rural average income. Each prefecture in Jiangsu Province contains both urban and rural households, as seen in Table 1. Table 3 presents summary statistics and the results of regression of two different measures of income on middle school grad-rise rate. Urban average income has a substantially higher mean as well as a significantly higher standard deviation. The coefficient and R-squared represent the impact and explanatory value of these two income variables when they are used as the only variable impacting the middle school grad-rise rate. Each ¥1,000 RMB increase in urban average income and rural average income is correlated with an improvement in middle school grad-rise rate of 1.94 percent and 8.15 percent respectively.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (¥)</th>
<th>Standard Deviation</th>
<th>Coefficient</th>
<th>Adjusted R-squared</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Average Income</td>
<td>13,681</td>
<td>4,162</td>
<td>0.00197***</td>
<td>0.4867</td>
<td>55.98</td>
</tr>
<tr>
<td>Rural Average Income</td>
<td>4,198</td>
<td>1,026</td>
<td>0.00891***</td>
<td>0.6285</td>
<td>45.47</td>
</tr>
</tbody>
</table>

*Standard Errors are in parentheses. Significantly different than zero at 99(***)**, 95(**), and 90(*) percent confidence.

Rural average income more closely explains the middle school grad-rise rate, has a larger impact, and is more significant. The data agrees with intuition, in which the children that do not continue in school come from the poorer families, and poorer families are over-represented in the rural, agriculture-heavy areas of China. In addition, rural families are more reliant on income from the young, (Jalan and Ravallion, 2001) and so the total cost (including the opportunity cost) for sending their children to schools is higher than for
most urban residents. Due to these reasons, rural average income will be used as a control for variability between prefectures for the initial set of regressions.
V. RESULTS

Table 4 presents the results of several regressions using rural average income to control for income disparity between prefectures. Each coefficient in Table 4 represents the impact that specific factor had on middle school grad-rise rate. Both same-year middle school class size and 2001 elementary school class size have significant, negative effects (higher class sizes resulted in lower grad-rise rates) as shown in Regressions (1) and (4). The percentage of middle school faculty with at least an Associate’s degree has a significantly positive effect (2) while the amount of government expenditure on education has an insignificant, negative effect (3).

Table 4: Regressions using Rural Average Income as Control

<table>
<thead>
<tr>
<th>Regression</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle school class size</td>
<td>-0.79*** (0.27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle school faculty</td>
<td></td>
<td>1.49*** (0.31)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with Associate's Degree (%)</td>
<td></td>
<td></td>
<td>1.55*** (0.27)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government education expenditure (millions)</td>
<td></td>
<td></td>
<td></td>
<td>-0.0028 (0.0018)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001 Elementary class size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-1.71*** (0.58)</td>
<td>-1.83*** (0.45)</td>
<td>-1.65*** (0.47)</td>
</tr>
<tr>
<td>GDP from agriculture (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural Average Income</td>
<td>.0061*** (0.0013)</td>
<td>.0070*** (0.0009)</td>
<td>.0102*** (0.0013)</td>
<td>0.0080*** (0.0010)</td>
<td>.0028* (0.0014)</td>
<td>.0060*** (0.0008)</td>
<td>.0052*** (0.0010)</td>
</tr>
<tr>
<td>Adj R-Squared</td>
<td>0.67</td>
<td>0.74</td>
<td>0.63</td>
<td>0.67</td>
<td>0.76</td>
<td>0.80</td>
<td>0.80</td>
</tr>
</tbody>
</table>

*Standard Errors are in parentheses. Significantly different than zero at 99 (***)**, 95 (**), and 90 (*) percent confidence.
Educational expenditure becomes insignificant both in the statistical and the literal sense as each ¥1 million RMB increase in educational expenditure lowers middle school grad-rise rate by .0028 percent. When regressions were run with educational expenditure combined with other factors, education expenditure continued to be insignificant. These results did not add any insight and were not included in the paper. Regression (1) highlights that each additional student in a middle school classroom lowers the middle school grad-rise rate by 0.79 percent. However, middle school class size becomes insignificant when it is combined with the percent of middle school faculty with at least an Associate’s degree and 2001 elementary class size (7).

The 2001 elementary school class size is designed to represent the conditions that existed when each class of middle school graduates was in elementary school. Unfortunately, elementary data has not been recorded long enough to enable perfect matching for each middle school graduation class. However, there was very slight growth in elementary school class sizes and variation across the prefectures over the period of this study as seen in Table 5.

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>41.59</td>
<td>41.8</td>
<td>1.67</td>
<td>38.9</td>
<td>44</td>
</tr>
<tr>
<td>2002</td>
<td>41.49</td>
<td>41.75</td>
<td>1.96</td>
<td>38.8</td>
<td>44.5</td>
</tr>
<tr>
<td>2003</td>
<td>42.38</td>
<td>42.05</td>
<td>2.07</td>
<td>39.9</td>
<td>45.5</td>
</tr>
<tr>
<td>2004</td>
<td>42.86</td>
<td>42.25</td>
<td>2.04</td>
<td>40</td>
<td>46.2</td>
</tr>
</tbody>
</table>


If the elementary class sizes are relatively constant for the years prior to the study as well, then the 2001 elementary school data serves as the best available representation of actual elementary conditions for the middle school graduates. Holding 2001 data constant
represents a lagged effect of how conditions in the past may impact the eventual middle school grad-rise rate.

Overall, this analysis is not ideal, as the rural average income is only one of many economic factors that may influence the middle school grad-rise rate between prefectures. To isolate out the specific effects of the educational input factors, additional regressions need to be run holding prefecture-level characteristics fixed, which is discussed below.

**Location Fixed Effects**

A more involved model is used for location fixed effects:

\[
G_{ij} = \alpha E_{01i} + \chi M_{ij} + \beta T_{ij} + \phi I_{ij} + \eta A_{ij} + YF_j
\]

\(E\) represents elementary school class size from 2001, \(M\) represents middle school class size, \(T\) represents teacher education, \(I\) represents government investment in education, \(A\) represents the percentage of the prefecture’s GDP that comes from agriculture, and \(F\) is the fixed effect for all prefectures. Each element of \(F\) (1-13) has a different coefficient, denoted by \(Y\) with the baseline coefficient equal to 0. Observation denominations \(i\) and \(j\) represent year and prefecture respectively.

Dummy variables were assigned to every prefecture to reveal a prefecture-specific coefficient involving all of the economic factors recorded.\(^{17}\) Suqian is the prefecture with the lowest overall values and so serves as the baseline. In this case, income

\(^{17}\) All of the economic factors are listed in Appendix A.
disparity will be accounted for by the prefecture level fixed effects. Regression results are shown in Table 6.

Table 6: Regressions Using Location Fixed Effects

<table>
<thead>
<tr>
<th>Regression</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
<th>(13)</th>
<th>(14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle school class size</td>
<td>0.36</td>
<td></td>
<td>0.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.35)</td>
<td></td>
<td>(0.26)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle school faculty</td>
<td></td>
<td>2.20***</td>
<td>2.20***</td>
<td>2.19***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with Associate's degree (%)</td>
<td></td>
<td>(0.40)</td>
<td>(0.40)</td>
<td>0.39)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government education expenditure (millions)</td>
<td>0.0036**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0016)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001 Elementary school class size</td>
<td></td>
<td>-6.45***</td>
<td>-4.00***</td>
<td>-4.61***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.77)</td>
<td>(0.72)</td>
<td>(0.86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP from Agriculture (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.23***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-Squared</td>
<td>0.78</td>
<td>0.87</td>
<td>0.80</td>
<td>0.78</td>
<td>0.91</td>
<td>0.87</td>
<td>0.88</td>
</tr>
</tbody>
</table>

Standard Errors are in parentheses. Significantly different than zero at 99 (***), 95 (**), and 90 (*) percent confidence.

Class Size

Although the limited number of observations precludes deep analysis of the statistically insignificant factors, it is interesting to note in Regression (8) that the sign for middle-school class size is positive, suggesting that each additional student per class raises the grad-rise rate by 0.36 percent.

A significant limitation with using same-year class size data is that it only incorporates class sizes during the student’s final year in middle school. A modified version of middle
school class size using rolling averages can alleviate some of this concern. A new variable combining the average middle school class size from the previous three years is better measurement for the actual conditions faced by the students. Due to the scope of the data, 2001 figures will be dropped and 2002 figures will consist of the averages from 2001 and 2002 only. 2003 and 2004 figures will be the average class size from 2001-2003 and 2002-2004 respectively. Results are presented in Table 7.

<table>
<thead>
<tr>
<th>Regression</th>
<th>Rolling (15)</th>
<th>Same-Year (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>1.26</td>
<td>0.36</td>
</tr>
<tr>
<td>Standard Error</td>
<td>(0.83)</td>
<td>(0.35)</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.83</td>
<td>0.78</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>39</td>
<td>52</td>
</tr>
</tbody>
</table>

The results of this Rolling Regression (15) are similar to the Same-Year Regression (8). The effect of middle school class size is still positive and insignificant, although the magnitude is larger.

There may be a few explanations for this counterintuitive finding. First, the results are not statistically significant, as the 95% confidence interval for Regression (15) ranges from -0.37 to 2.89 percent. Second, market-based factors may alter the expected result. In recent years, high demand for the top schools has resulted in increased enrollment.\textsuperscript{18} Although the schools are responsible for recruiting additional teachers, there may be

\textsuperscript{18} The total enrollment of middle school students in Jiangsu increased by 433,000 between 2001 and 2005.
instances when not enough qualified teachers are available and additional students are added to each existing class. Without stabilization in total supply and demand, there is no way to be certain regarding the effect of smaller class sizes on the middle school grad-rise rate.

As shown in (11), elementary class size measurements from 2001 are significant and negative. Every additional student in the historic elementary school class is correlated with a 6.45 percent lower middle school grad-rise rate. This effect is one of the most interesting findings of this study and warrants further research.

The result is consistent with the hypothesis that smaller class sizes have a much higher impact when the student is younger and in elementary school than when the student is older and in middle school. The literature on the topic supports both halves of this hypothesis. Experimental evidence shows that small classes can lead to increased gains in performance in the first years of schooling and that these effects are greatest in the early grades and with disadvantaged pupils (Blatchford and Mortimor, 1994). Hanushek and Luque’s (2002) analysis of educational factors in 40 developing countries found that smaller classes is associated with increased performance in 14 out of 17 countries for 9-year olds (3-4 grades in elementary school). The effect on 13-year olds (7-8 grades in middle school) is reversed, with smaller classes associated with lower performance in 23 out of 33 countries.

As the average public elementary school class size in the United States was 21.1 in 2004 (NCES, 2005) while the average elementary class size in Jiangsu Province was nearly 43, there may also be a case of diminishing returns. If the STAR experiment were replicated
in China, the gains in lowering class sizes from 43 to 32 might be significantly larger than the gains from lowering class sizes from 25 to 17, which would be consistent with the Lazear model of interruption behavior. If further studies support this to be case, then there are considerable benefits to increasing the number of classes in an elementary school by a small amount.

The other area of interest is what happens to the early gains from smaller classes as the students grow older. A review of 300 early intervention programs found a pattern of initial gains that faded over time (White, 1985). Barnett (1992) also observed that most achievement effects disappear by the eighth grade. In contrast, a five-year follow-up study to the Tennessee STAR project found that the gains from smaller classes from kindergarten through third grade did not reduce in magnitude by the eighth grade (Nye, Hedges, and Konstantopoulos, 1999).

In this study, the effects of smaller class sizes in elementary school were still present by the end of the ninth grade. However, the collected elementary data more accurately represents conditions while the middle school graduates were in the fifth and sixth grades as opposed to kindergarten through the third grade, when smaller class sizes have the largest gains. A follow-up study with additional years of data can determine if the effects from the later elementary years are residuals from conditions during the first few years of school and which years matter the most.
**Teacher Education**

The Jiangsu Province Department of Education only tracks the percentage of middle school teachers with at least an Associate’s (2-year post-high school) degree. A summary of this data is provided in Table 8.

### Table 8: Percentage of Middle School Teachers with an Associate's Degree

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>Median</th>
<th>Std Deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>91.84</td>
<td>91.92</td>
<td>3.73</td>
<td>84.47</td>
<td>98.55</td>
</tr>
<tr>
<td>2002</td>
<td>93.12</td>
<td>93.59</td>
<td>3.17</td>
<td>85.86</td>
<td>98.23</td>
</tr>
<tr>
<td>2003</td>
<td>93.95</td>
<td>94.20</td>
<td>2.85</td>
<td>87.03</td>
<td>98.19</td>
</tr>
<tr>
<td>2004</td>
<td>95.10</td>
<td>95.26</td>
<td>2.50</td>
<td>88.55</td>
<td>99.22</td>
</tr>
</tbody>
</table>


Over time, the mean has increased and standard deviation decreased, in part due to the increase by more than four percentage points in the minimum percentage of teachers with an Associate’s degree. However, the median tracing the mean closely suggests a relatively even distribution and growth. Regression (9) shows that the percentage of middle school teachers with at least an Associate’s education has a positive, significant, and considerable effect on the middle school grad-rise rate. A one percent increase in teachers with an Associate’s degree results in a 2.2 percent increase in the middle school grad-rise rate.

There are a few limitations with this analysis, as it also associates grad-rise rates with conditions during the last year of middle school. A modified version of middle school teachers with an Associate’s degree, similar to what was used before with middle school class size can be used to alleviate some of those concerns. The new variable combines the average percentage of teachers with an associate’s degree from the previous three
years. Due to the same limitations in the data, 2001 figures will be dropped and 2002 figures will consist of the averages from 2001 and 2002 only. 2003 and 2004 figures will be the averages of percentage of middle school teachers with an associate’s degree from 2001-2003 and 2002-2004 respectively.

**Table 9: Rolling Average Teacher Education Regressions**

<table>
<thead>
<tr>
<th>Regression</th>
<th>Rolling (16)</th>
<th>Same-Year (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>2.58***</td>
<td>2.20***</td>
</tr>
<tr>
<td>Stanford Error</td>
<td>(0.73)</td>
<td>(0.40)</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.88</td>
<td>0.87</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>39</td>
<td>52</td>
</tr>
</tbody>
</table>

*Significantly different than zero at 99 (***) , 95 (**), and 90 (*) percent confidence.

After using rolling averages, the magnitude of the effect from teacher education is higher and still significant at the 99 percent level (16). Each additional percent of teachers with an Associate’s degree over the course of a middle school career is expected to increase the middle school grad-rise rate by 2.58 percent.

Due to the lenient measurement of teacher education, it seems very reasonable that this estimate would have a strong, positive effect. Any less than an Associate’s degree and the teachers potentially have less than three years of education more than their students. Once the percentage of middle school teachers with at least a Bachelor’s (4-year post high school) degree is tracked, it would be interesting to see if the additional degree also has significantly positive effects.
Government Expenditure

Location-based fixed effects also change the results for government expenditure. Regression (10) shows that government expenditure on education has a significant, positive effect. Although the coefficient suggests that each additional dollar the local government spends on education increases its school quality, the magnitude of this effect should be taken into account before making any conclusions. The coefficient means each ¥1 million RMB (approx. $130,000 US) increase in educational expenditure raises the middle school grad-rise rate by 0.0036 percent. The average educational expenditure during this period was ¥12.76 million RMB with a maximum of ¥38.02 million RMB and a minimum of ¥5 million RMB for any prefecture. The estimated effect of educational expenditures between the highest and the lowest spenders is 0.12 percent, which is more in line with no effect than any real positive effect. These results are consistent with the fact that there is no conclusive answer within the literature regarding effects of additional resources on educational performance.

Time and Location-Based Fixed Effects

The next step when analyzing panel data is to include both location-fixed and time-fixed effects. The model is the same as location based fixed effects with one additional term:

\[ G_y = \alpha E_{01j} + \chi M_y + \beta T_y + \phi I_j + \eta A_j + YF_j + ZE_j \]

Each element of E representing the year fixed effects has a year-specific coefficient denoted by Z. Before delving into the results and analysis, it is important to note that due to limits of the dataset, adding time-fixed effects to the location-fixed analysis reduces
the dataset down to 13 observations. This limitation is the reason why the location-fixed effects form the crux of the analysis. Time and location fixed effects are shown in Table 10.

### Table 10: Regressions of Time and Location Based Fixed Effects

<table>
<thead>
<tr>
<th>Regression</th>
<th>(17)</th>
<th>(18)</th>
<th>(19)</th>
<th>(20)</th>
<th>(21)</th>
<th>(22)</th>
<th>(23)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle school class size</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
<td>0.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.27)</td>
<td></td>
<td></td>
<td></td>
<td>(0.27)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle school faculty with Associate's degree (%)</td>
<td>0.80</td>
<td></td>
<td>0.80</td>
<td>0.88</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.30)</td>
<td></td>
<td>(0.77)</td>
<td>(0.78)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government educational expenditure (millions)</td>
<td>-0.0059**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0018)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001 Elementary class size</td>
<td>-6.45***</td>
<td>-5.45***</td>
<td>-5.75***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.56)</td>
<td>(0.98)</td>
<td>(1.05)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP from agriculture (%)</td>
<td></td>
<td></td>
<td></td>
<td>-2.19***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.62)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-Squared</td>
<td>0.88</td>
<td>0.88</td>
<td>0.91</td>
<td>0.88</td>
<td>0.91</td>
<td>0.88</td>
<td>0.88</td>
</tr>
</tbody>
</table>

*a Standard Errors are in parentheses. Significantly different than zero at 99 (***) , 95 (**) , and 90 (*) percent confidence.

With so few distinct observations, the percentage of teachers with an Associate’s degree (18) is still positive but no longer significant. Elementary class size in 2001 continues to be negative and significant at the 99 percent level (20). It is interesting to note that government expenditure on education is still significant, but adding the time-fixed effects has flipped its sign to negative (19). Because the order of magnitude is still very small, the actual effect is still not large enough to warrant close analysis. All other variables are not significant.
Due to the limited number of observations, the analysis from using only the location fixed effects is deemed the most robust for this study. After additional years of data are collected, these results should be re-analyzed with more scrutiny.

**Lagged Effects**

One of the most difficult aspects of education research is the adjusting nature of schools at a micro level. Governments and administrators may act on the observed data and thus make some of the independent variables endogenous. Better teachers may be assigned larger classes, more educated teachers may be shifted to struggling schools, and more educational investment may be applied to weaker areas.

To combat this endogeneity problem, a system of time-lagged effects can be used. The government collects the data in real time but does not publish the information until a later date, which allows analysis of decisions before the data is public. This delay provides an opportunity to reduce some of these endogenous effects. For example, in August 2006 the Jiangsu Province Department of Education was preparing to publish the 2006 statistics, which covers data from 2005. The first middle school grad-rise data was published in mid-2002. At that point in time, all of the policy decisions regarding 2001 had already been made and executed. Thus, regressions run with 1 year delays on all of the education and economic data would remove some of the effects of adaptive policies. The middle school grad-rise rates in 2002 would be regressed with the middle school class size in 2001 along with all of the location fixed effects from 2001 and so on. The results of this regression using location-based fixed effects are shown in Table 11. Using lagged
effects reduces the number of observations from 52 to 39 due to the lack of data prior to 2001.

**Table 11:** Regressions using location fixed effects and 1 year lag

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle school class size</td>
<td>1.33**</td>
<td>0.76</td>
<td>(0.57)</td>
<td>(0.60)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle school faculty</td>
<td>1.66***</td>
<td>1.66***</td>
<td>1.308**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with Associate's degree (%)</td>
<td>(0.56)</td>
<td>(0.56)</td>
<td>(0.62)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government education expenditure (millions)</td>
<td>0.0020</td>
<td>(0.0019)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001 Elementary class size</td>
<td>-5.85***</td>
<td>-3.72***</td>
<td>-5.484***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP from agriculture (%)</td>
<td>-2.02***</td>
<td>(0.37)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.85</td>
<td>0.86</td>
<td>0.82</td>
<td>0.82</td>
<td>0.91</td>
<td>0.86</td>
<td>0.87</td>
</tr>
</tbody>
</table>

*a* Standard Errors are in parentheses. Significantly different than zero at 99 (***) , 95 (**), and 90 (*) percent confidence.

The lagged regressions feature two distinctly different results. Middle school class size is now positively significant at the 95 percent level (24) and government expenditure on education has an insignificant effect (26). The other factors continue to be significant, but each has a slightly lower magnitude than in the real-time analysis (Table 6).

Every additional student in an average middle school class is correlated with a 1.3 percent increase in the grad-rise rate. However, the class size variable being significantly positive is most likely induced by other confounding effects. As mentioned earlier, one
of the largest effects not accounted for in this study are school quality effects. If the top schools increase enrollment faster than they expand the infrastructure, average class size will increase among a pool of students who are more likely to advance farther in school.

One way to test this hypothesis is through excluding less populated areas from the analysis. Prefectures with lower populations will have fewer schools and thus the impact from the top schools increasing their enrollment will be higher. Another characteristic to exclude would be the poorer regions, where public schools are more likely to be under-funded. Given that most of the top middle schools are private, the lower quality of public schools would force more parents to turn to private institutions, increasing their enrollment and class sizes. Regressions were run on the lagged effects first excluding the least populated regions and then excluding the 5 poorest regions (according to gdp per capita). If the hypothesis is correct, both of these regressions should feature smaller coefficients for middle school class size than in the standard lagged case. The results are shown in Table 12.

<table>
<thead>
<tr>
<th>Regression</th>
<th>Excluding None (31)</th>
<th>Excluding 5 Least Populated (32)</th>
<th>Excluding 5 Poorest (33)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>1.33**</td>
<td>1.10</td>
<td>0.58</td>
</tr>
<tr>
<td>Standard Error</td>
<td>(0.57)</td>
<td>(0.76)</td>
<td>(0.28)</td>
</tr>
<tr>
<td>Number of Observations</td>
<td>39</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Adjusted R-Squared</td>
<td>0.85</td>
<td>0.77</td>
<td>0.98</td>
</tr>
</tbody>
</table>

\(^a\) Standard Errors are in parentheses. Significantly different than zero at 99 (***) , 95 (**), and 90 (*) percent confidence.
Although the effects of middle school class size are still positive for the new regressions, the magnitudes are reduced and neither is statistically significant. These results lend weight to the argument that school quality was impacting the analysis and creating the unexpected positive coefficient.

**Limitations and Future Research**

The primary limitations of this study originate from the lack of data and the dynamic nature of the regions studied. A highly fluid environment resulting from China’s rapid growth reduces the ability to isolate impacts of individual components. More data collected over a longer timeline within Jiangsu and other similar provinces can help lend weight to the conclusions found in this study.

For class size measurements, there is usually ambiguity resulting from assignment policies within schools. In particular, if principals tended to place students who have specific problems or are simply doing poorly in smaller classes, the compensatory placement policies could yield misleading results. In such cases, being in a small class may simply identify prior poor performance as recognized by the administration. In this study, the data is aggregated at a prefecture level, which contains hundreds of schools. Including class size as a prefecture average removes this limitation as the movement of students within each school does not significantly affect the average class size for the region.

On the other hand, the process that students and teachers are assigned in classrooms presents another opportunity for future study. Quality impacts from each of the assignment policies – randomizing teachers, randomizing students, seeding students, and
having accelerated classes can be examined to determine the optimal policies depending on local characteristics and school priorities.

With more years of data, stronger analysis can be applied to the elementary school class size argument. In four years, regressions can decipher the class size effect from each elementary school grade on the middle school grad-rise rate. By 2011, there will be data tracing middle school graduates from first through sixth grade instead of relying on only sixth grade numbers.

Additional government expenditure on education allows schools to purchase more hardware (classrooms, technology) and software (teachers). Each of these components will affect performance differently depending on the conditions of the area. If educational expenditure can be broken down by these two areas, analysis on each can help determine the optimal distribution of funds.

Even though there is significant disparity between prefectures in the percentage of middle school students who attend high school, high school is not the standard goal of education. The impact of various factors may be more obvious if the percentage of high school students who enter college is included as well. Due to government efforts to minimize intra-school competition and to encourage a holistic education, official tallies of percent of high school graduates who attend college are not published. Local newspapers feature yearly summaries of this figure and could be used to compile a follow-up study.

If data on middle school teachers is stratified by level, it could allow an interesting examination of the optimal amount of teacher education. Middle school teachers would be categorized by Associate’s, Bachelor’s, and Master’s degrees. In addition, those with
Bachelor’s degrees can be broken down into those who enter teaching specific universities\textsuperscript{19} and those who enter general universities to determine if specialized training has a positive effect on teacher quality. In a micro study, students can be tracked to a specific teacher or school for impact later on in life.

Finally, there is a new school of thought that places emphasis on teacher certification (Goldhaber and Brewer, 2000, Walsh, 2001). In China, teachers receive one of three levels of certification depending on experience, performance, recommendations, and publications. Most of this data is currently only aggregated at the local level. After collecting this information across a province, a study can determine whether these certifications are a better measurement of teacher quality than teacher education.

\footnote{\textsuperscript{19} Called “Normal Universities”}
VI. Conclusion

When looking at the results from Jiangsu Province, it seems that many of the same conclusions reached by economists studying the United States education system still apply. However, other results have the potential for innovative policy considerations.

The first is the effect from smaller class sizes during elementary school. Although China has always operated with class sizes of 35-60 students from first grade through high school graduation, it may warrant additional investigation on whether a few small classes early on in students’ academic careers may have a long-lasting positive impact.

The second is that teachers need to have a collegiate-level degree. Although the impact of graduate level degrees on student performance is debated, a standard needs to be set for minimal teacher education. Those teachers that have been in the system for a significant amount of time should still attend further training to receive at least an Associate’s degree. Eventually raising all teacher education to western standards of a bachelor’s degree should be tested.

Finally, the effect of a non-educational factor, the percentage of the prefecture’s GDP that comes from agriculture, should be considered when analyzing tuitions and subsidies. Because the opportunity cost for attending school for farming-based students is higher, there should be additional rebates for those students and families to reduce the extra burden.

This study will hopefully lead to more analysis from elsewhere in China and the developing world. Given that Jiangsu Province has the second-highest GDP per capita in
China, there are many other provinces that have the potential for accelerated development with more optimal educational policy and incentives.
Appendix A: List of Variables:

Economic Variables (Year-end):

- Population
- Population growth rate
- Households
- Rural households
- Population density
- State-owned enterprise employees
- Private employees
- Employment percentage
- Employment in the first sector
- Employment in the second sector
- Employment in the third sector
- GDP
- Percent of GDP from the first sector
- Percent of GDP from the second sector
- Percent of GDP from the third sector
- Total trade
- Foreign investments
- Government tax revenue
- Government construction expenditure
- Government education expenditure
- Government social security expenditure
- Urban average income
- Rural average income
- Hospital beds
- Telephone penetration
- Mobile phone penetration
- Internet penetration
- Water Use
- Electricity Use
- Public bus use

Educational Variables:

- HS class size
- MS class size
- ES class size
- % HS faculty with BA
- % MS faculty with AA
- % ES faculty with HS
- MS grad-rise percent
- ES grad-rise percent
- MS graduation percent
- ES graduation percent
- ES enter percent
- HS students
- MS students
- ES students
Appendix B: Map of Jiangsu Province

Source: Asia Times
References


