

TEACHER MOBILITY IN RURAL CHINA: EVIDENCE FROM NORTHWEST CHINA

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ABSTRACT

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This study investigates an understudied but crucial dimension of education in China: teacher mobility. The primary goal is to provide a basic understanding of teacher mobility in rural China. The issue has been extensively studied in many developed countries, especially in the United States. However, there is little research in China, partly because of the lack of individual-level longitudinal data on teachers. Using a dataset from a longitudinal survey in Gansu province in rural Northwest China, this study is able to fill some of the gaps in the understanding of how teacher move among schools in rural China.

Three questions are examined in this study. First, are similarly qualified teachers distributed equally across schools? Second, how do school characteristics relate to teacher mobility? Third, how do individual teacher characteristics relate to teacher mobility?

First, I examine the distribution of teacher attributes across schools to find whether there is systematic sorting in terms of teacher quality in rural Gansu. The findings show that there are substantial differences among schools with regard to teacher quality. Because the teacher quality measures at the school level are highly correlated, schools that have less-qualified teachers as measured by one attribute are also likely to have less-qualified teachers based on other measures. As a result, there are large gaps among schools in the chances of students' access to more qualified teachers.

Second, I examine the relationship between teacher mobility measured at school level and school characteristics including wages, working conditions, and compositions of students and teachers. The findings show that higher wages are likely to reduce the proportion of teachers leaving a school, but only when district fixed effects are not added. The findings also show that the school location and teacher composition matter. Being a central school is related to lower proportion of teachers leaving the school and lower proportion of teachers coming to the school as well. Higher percentage of teachers with less

experience in a school is associated with higher proportion of teachers coming to the school. This pattern is related to the way of assigning novice teachers to rural schools and schools in remote areas.

In the teacher-level analysis, first I examine the effects of initial placement on teacher mobility. The results reveal the “draw of home”; teachers whose initial placements are not in their home district are more likely to switch schools and they are more likely to do so for their families rather than career development or involuntary transfer by governments. Next, I examine whether teachers with higher professional ranks and better evaluation scores are more likely to switch schools. The findings show that teachers with middle- or senior-level professional ranks are more likely to switch school in the long run. The findings also show that failing the end-of-year evaluation increases the probability of moving to another school the following year, while teachers in the middle tend to stay at their current schools.

There are several implications of this study. The findings suggest that localized recruitment and deployment of teachers have value in retaining teachers. If the government plans to use teacher rotation as a main strategy to improve the equal distribution of teachers, the policy should be carried out with consideration of the effects of draw of home. In addition, the successful implementation of the teacher transfer and rotation policies is closely related to prior institutional arrangement including the use of teacher transfer as reward and punishment, and other educational policies regarding the equal distribution of school resources and additional compensation for teachers working in hard-to-staff schools.

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1. Introduction

Teachers are unique and important input in education. Research shows that access to high-quality teachers is crucial for not only improving student learning but also for closing the achievement gap and improving educational equity (Aaronson, Barrow, & Sander, 2007; Hanushek & Rivkin, 2004; Nye, Konstantopoulos, & Hedges, 2004; Rivkin, Hanushek, & Kain, 2005a; Rockoff, 2004). The issue of teacher turnover has received lots of attention because teacher turnover in the forms of attrition and school transfer is thought to have negative effects on the quality of teaching and student learning (Bryk & Schneider, 2002; Guin, 2004; Hanselman, Grigg, & Bruch, 2014; Ingersoll, 2001; Ronfeldt, Loeb, & Wyckoff, 2013). If better teachers are more likely to leave teaching or leave hard-to-staff schools, teacher turnover would harm teaching and student achievement, especially for disadvantaged schools and students.

This study focuses on teacher mobility as an important part of teacher turnover. Prior research suggests that teacher mobility is a complex issue. Teachers have their own preference of whether and where to teach, and they respond to various pecuniary and non-pecuniary factors. In general, teachers prefer to work in schools with higher salaries and benefits, better working conditions and support network, lower enrollments and smaller classes with high-achieving students (Borman & Dowling, 2008; Guarino, Santibanez, & Daley, 2006; Lankford & Wyckoff, 2010). A substantial body of research has documented the sorting of more qualified teachers toward better schools and more advantaged students in both developed (Donald Boyd, Lankford, Loeb, & Wyckoff, 2005a; E. Hanushek, Kain, & Rivkin, 2004; Kalogrides, Loeb, & Beteille, 2012; Lankford, Loeb, & Wyckoff, 2002; Loeb, Darling-Hammond, & Luczak, 2005; Loeb & Reininger, 2004; Ronfeldt et al., 2013) and developing countries (Akiba, LeTendre, & Scribner, 2007; Ankrah-Dove, 1982; Chudgar, Chandra, & Razzaque, 2014; Luschei & Carnoy, 2010; Luschei & Rew, 2013). However, it does not mean that the sorting of teachers, especially those qualified teachers, to better schools and higher-achieving students occurs in the same way across countries. The relationship between individual and institutional factors and teacher mobility can vary across countries, depending on the structure of the teacher labor market and the policy effort of the governments. There are

nation- and region-specific rules that make the teacher labor market different from that of private sectors, for example, the inflexible wage schedule and job promotion scale, and the seniority-based rules of assigning and transferring teachers. In addition, the levels of centralization of the education system can influence the institutional arrangement in the teacher labor market and also affect the extent that teachers are able to make choices based on their own preferences.

The sorting of more qualified teachers toward better schools and more advantaged students also exists in China, especially among rural schools (Adams, 2012; Han, 2013; Paine, 1998). As the universal free compulsory education has been achieved around 2007 in rural areas, the educational quality, especially students' access to qualified teachers, has become the focus of educational policies in the recent years. Among the policies aiming at addressing the teacher shortage and improving the equal distribution of teachers in rural areas, policies encouraging transferring and rotating teachers across schools are frequently brought up by both central and local governments. While the policies encouraging teacher transfer have received lots of attention, there is little research on how teacher labor market works in rural China. Specifically, little quantitative research has examined how teacher- and school-level characteristics associate with teacher mobility. Little is known about how teachers move around schools. Moreover, little is known about how institutional factors affect teacher mobility. This study aims to fill some of the gaps in the understanding of teacher mobility in rural China. Specifically, I use a dataset from the Gansu Survey of Children and Families survey to examine the relationship between teacher mobility and characteristics of schools and individual teachers. This dataset, with a rich set of variables including school characteristics and teacher career history, provides a glimpse into teacher mobility in rural areas. The study aims to answer three questions. First, are similarly qualified teachers distributed equally across schools? Second, how do school characteristics relate to teacher mobility? Third, how do individual teacher characteristics relate to teacher mobility? The emphasis on teacher quality in the recent years makes this study especially relevant from the perspective of educational policy-making. The findings from this study can inform policies designed to improve the distribution of qualified teachers in rural areas.

In the next section, I review prior research on teacher turnover with a focus on institutional factors that affect teacher turnover. Section 3 introduces the educational management system in rural China with a focus on teacher personnel policies. Section 4 poses the research questions. Section 5 introduces the data and methods used to answer the questions. Section 6 provides descriptive analysis on the distribution of teachers and multivariate regression analysis on the relationship between school characteristics and teacher mobility. In section 7, first I use binomial and multinomial logit regression to examine how teacher-level characteristics relate to whether and why teachers choose to move. Next, I use survival analysis to examine whether better teachers are more likely to move. In the last section, I conclude with a reflection on the limitation of the study and plan for future work.

2. Review of literature

Previous research on teacher turnover takes two directions: One focuses on teacher attrition, or the departure of teachers from their jobs (Ingersoll, 2001); the other focuses on teacher mobility across schools, also known as school transfer or school migration. Research shows that in some countries more than half of the overall teacher turnover is in the form of teacher mobility (Ingersoll, 2001). This study focuses on teacher mobility as an important part of teacher turnover. Because teacher mobility is a sub-area of teacher turnover, this section reviews studies on teacher turnover as a whole. A substantial body of research on teacher turnover has examined the effects of pecuniary and non-pecuniary factors on teacher turnover, with particular interest in the supply of high-quality teachers. In this section, I look at research which examines the relationship between individual characteristics and teacher turnover, with a focus on teacher quality. Next, I look at research which examines the influences of institutional factors on teacher turnover. Then I bring in the international comparative perspective and look at how the different levels of centralization in educational system affect teacher turnover.

2.1 Individual characteristics and teacher turnover

Earlier research on teacher turnover has examined the characteristics of individuals who exit and remain in teaching in terms of gender, age, experience, and ability (Guarino et al., 2006). The findings regarding individual demographic characteristics are closely related to the context where the research was conducted. In this part, I focus on the relationship between teacher quality and turnover. One of the reasons why teacher turnover has received lots of attention is that frequent turnover is thought to have negative effects on the quality of teaching and student learning. If better teachers are more likely to leave teaching or leave hard-to-staff schools, teacher turnover would harm teaching and student achievement, especially for disadvantaged schools and students.

2.1.1 Measuring teacher quality

While teacher quality is found to be crucial in raising student achievement, it is difficult to identify the characteristics of a good teacher (Goldhaber & Brewer, 1997; Hanushek, 1971, 1992; Murnane & Phillips, 1981; Rivkin, Hanushek, & Kain, 2005b). Some studies find few evidences of significant and positive

effects of measurable teacher characteristics, such as educational background and teaching experience, on student achievement. Others argue that some attributes can be taken as proxies for teacher quality, such as the selectivity of teachers' undergraduate institution, test scores, and licensure (Ballou, 1997; Clotfelter, Ladd, & Vigdor, 2007; Greenwald, Hedges, & Laine, 1996; Sass & Harris, 2009). Still others find evidence of the effects of teachers' non-cognitive attributes such as personality and self-efficacy on student achievement (Rockoff, Jacob, Kane, & Staiger, 2011).

There are limited empirical studies on the teacher quality in Chinese context. In examining the impact of teacher attributes on student achievement in rural China, Adams (2012) found that students who are taught by teachers with 6–10 years of experience perform better on math examinations as compared to students who are taught by teachers with 0–2 years or more than 10 years of teaching experience; students taught by teachers with 3–5 years of experience scored even higher. The diminishing effects of experience found by Adams confirm the prior findings that teachers with 5–10 years of experience are more effective and that, the benefits level off after 5 years (Darling-Hammond, 2000). In examining the effects of educational inputs on student achievement, Park and Hannum (2001) used teacher professional rank as a proxy for teacher quality and found that teacher quality as measured by professional rank is important for student achievement.¹ Chu, Loyalka, Chu, Shi and Rozelle's (2014) findings confirm that having the higher professional rank, especially the highest rank, has a positive and significant impact on academic achievement of both poor and non-poor students, while their results also show that having a college degree does not have significant impacts on student learning. Another study using Gansu Survey of Children and Families found that teachers respond to promotion incentives by working harder (Karachiwalla, 2010).

2.1.2 The turnover and distribution of high-quality teachers

Research on the relationship between teacher turnover and teacher quality has found that teacher turnover rates tend to be higher for teachers with less experience, and lower for teachers with more experience (Adams, 1996; Boe, Bobbitt, Cook, Whitener, & Weber, 1997; Hanushek, Kain, & Rivkin,

¹ I will describe the system of teacher professional rank in detail in the following section.

2004; Harris & Adams, 2007; Ingersoll, 2001). Research also finds that teachers with higher measured ability, for example those with higher ACT scores, those who attended more selective undergraduate institutions (Lankford, Loeb, & Wychoff, 2002; Podgursky, Monroe, & Watson, 2004), those who passed their teacher certification exam (Clotfelter, Ladd, & Vigdor, 2006; Lankford, Loeb, & Wychoff, 2002), those in the top quartile on their college entrance exam (Henke & Zahn, 2000), and those with advanced degrees (Kirby, Berends, & Naftel, 1999) tend to have higher rates of turnover in terms of exiting teaching and transferring to better schools. On contrary, a growing body of research finds that teachers who remain at the same school tend to outperform those who leave (Boyd & Wyckoff, 2011; Goldhaber, Gross, & Player, 2007; Hanushek & Rivkin, 2010; Jackson, 2013). As a result, these studies argue that teacher turnover can improve the match between teachers and schools, and enables schools to retain better teachers and get rid of low-performing teachers.

Whether teacher turnover harms student learning or improves the distribution of qualified teachers, the fact is that qualified teachers are more concentrated in schools with higher socioeconomic status and higher achieving students (Guarino, Santibanez, & Daley, 2006; Hanushek & Rivkin, 2004; Kalogrides, Loeb, & Beteille, 2012; Lankford et al., 2002; Loeb & Reininger, 2004; Ronfeldt et al., 2013). Similarly, in developing countries, students in rural schools and students with lower socioeconomic status or academic performance are more likely to be taught by less-qualified teachers (Akiba, LeTendre, & Scribner, 2007; Ankrah-Dove, 1982; Chudgar et al., 2014; Luschei & Carnoy, 2010; Luschei et al., 2013). This pattern can be seen in rural China, where qualified teachers are concentrated in schools located in county and township seats (Adams, 2012; Han, 2013; Paine, 1998). However, less is known about how teachers move across schools in China. Few empirical studies have examined the mobility of teachers, especially high-quality teachers and their distribution in rural areas.

2.2 Institutional factors and teacher turnover

Besides individual characteristics of teachers, attributes of schools and community contexts, including student composition, school resources and environment, and other institutional characteristics such as personnel policies, also play important roles in teacher turnover. In general, research finds that teachers

prefer to work in schools and districts with higher wages and benefits, better working conditions and a supportive network of colleagues, lower enrollments and smaller classes, and with high-achieving students (Borman & Dowling, 2008; Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2002; Hanushek, Kain, & Rivkin, 2001). While teachers have their own preferences of where to teach, their personal preferences might be surpassed by institutional factors.

2.2.1 Teacher compensation

Lots of studies have examined the relationship between wages and teacher turnover. The findings show that teachers do respond to wages and that higher wages reduce the likelihood of teacher turnover (Boe, Bobbitt, Cook, & Whitener, 1997; Brewer, 1996; Dolton & van der Klaauw, 1995, 1999; Hanushek, Kain, & Rivkin, 1999; Imazeki, 2005; Kelly, 2003; Mont & Rees, 1996; Murnane & Olsen, 1990; Murnane, Singer, & Willett, 1989; Podgursky et al., 2004; Shen, 1997; Stinebrickner, 1998; Theobald, 1990; Theobald & Gritz, 1996). Some studies also examined the effects of higher wages on improving teacher quality and showed that raising wages can increase teacher quality (Figlio, 2002; Loeb & Page, 2000).

In examining the effects of wages, alternative opportunities are important to teachers, as well. Studies have shown that relative wages in other schools and districts affect teacher turnover (Brewer, 1996; Lankford, Loeb, & Wyckoff, 2002; Pas, 2007). The finding that teachers tend to have higher wages after moving to new schools or districts confirms that alternative opportunities within teaching matter (Boyd, Lankford, Loeb, & Wyckoff, 2002; Hanushek, Kain, & Rivkin, 2004). Studies also show that wages of other jobs outside teaching profession could influence decisions to enter and exit teaching (Dolton & van der Klaauw, 1995, 1999; Ingersoll, 2001, 2002), and the duration in teaching (Murnane & Olsen, 1989, 1990).

In addition, wage structures vary across countries and regions within a country. The basic components that determine the long-term wage usually include teachers' educational background and teaching experience (Ballou & Podgursky, 2001; Vegas, 2007). In some regions and countries, short-term rewards are linked to teacher or student performance. Thus there are mainly two sources of variation in teacher wages: One is the difference in individual teachers' education, experience and productivity; the other is

the difference in the wage schedules. Many studies on the effects of wages focus on the differences in the amount paid to teachers within regions with a uniform wage schedule, while other studies compare wages across regions and consider the differences in individual teacher attributes and in wage schedules.

2.2.2 Working conditions

Teachers also respond to non-pecuniary factors. One important non-pecuniary factor is student and community demographics. Research finds that teacher turnover is closely related to characteristics of the student body in schools, particularly race and student performance (Hanushek et al., 2004). Schools with more low-achieving, low-income, or minority students tend to have higher turnover rates (Boyd, Lankford, Loeb, & Wyckoff, 2005a; Carroll, Reichardt, Guarino, & Mejia, 2000; Guarino et al., 2006; Hanushek et al., 2004; Scafidi, Sjoquist, & Stinebrickner, 2007). On the other hand, some teachers prefer to teach students of a similar ethnic background to themselves rather than students with better academic performance or socioeconomic background, which is different from the general finding that teachers are less likely to teach in schools with higher proportion of non-white and low-income students (Cannata, 2010).

When examining teacher turnover, school and community demographics are important factors. However, demographics usually are beyond the control of educational policies, and the strategies to address the issues related to demographics, such as student demographics within a school and a community, are very limited. On the other hand, some other factors, such as wages and working conditions, are relatively amenable to policy influences. As a non-pecuniary factor, working conditions such as student discipline, school administrative and collegial support, professional development, and teacher autonomy are important in attracting and retaining teachers (Boyd et al., 2009; Buckley, Schneider, & Shang, 2005; Johnson, 2006; Kelly, 2003; Kirby et al., 1999; Loeb, Darling-Hammond, & Luczak, 2005; Shen, 1997; Stockard, 2004; Weiss, 1999).

In addition, the location of schools also matters. There are findings show that schools in wealthier areas tend to have lower teacher turnover rates (Ingersoll, 2001; Lankford et al., 2002), while schools in high-minority and high-poverty districts tend to have higher turnover rates (Carroll et al., 2000). On the other

hand, teachers care about comfort and familiarity when searching for jobs, and they often prefer to teach in areas close to where they grew up or attended high school, or areas with similar characteristics to their hometown (Boyd et al., 2005a; Cannata, 2010; Reininger, 2012). Research in rural China also finds that teachers who teach in schools in their home village are likely to have stronger community ties (Sargent & Hannum, 2005) and are more likely to stay regardless of the location and working conditions of the school (Li, 2012).

The effects of demographics, working conditions, and school location on teacher turnover might vary across countries, depending on the structure of the teacher labor market. For example, in the United States, the teacher labor markets are small and localized and teacher recruitment is decentralized at the district level, while in countries like Korea teacher recruitment occurs at the regional level and all teachers are required to transfer to other schools within the region (Kang & Hong, 2008). National or regional policies of hiring and assigning teachers would also affect the extent that teachers could choose where to teach based on their own preference of school location, working environment, and student demographics.

2.2.3 Personnel policy

Most research on teacher labor market is situated in the framework of the economic labor market and applies models that were developed for the private sector. In such models, the allocation of teachers is seen as a function of demand and supply, shaped by individual preferences and constraints. On the supply side, individuals choose to become teachers if they view the teaching profession as more beneficial and attractive than other professions. When deciding whether to enter or exit teaching, individuals try to find a preferable combination of monetary and non-monetary rewards, including wages, benefits, and working conditions. On the demand side, the demand for teachers is affected by enrollment, as well as school and district policies such as class-size and workload. When making decisions, both individuals and institutions are constrained by the information and resources at hand. However, there are also nation- and region-specific rules that make the teacher labor market different from that of private sectors.

One such difference is the inflexible wage schedule and job promotion scale. Teacher wages and promotions in many countries are completely determined by teachers' educational attainment and years of

teaching experience, regardless of which school they work at or the teacher's productivity (Boyd, Lankford, Loeb, & Wyckoff, 2002; Hanushek & Rivkin, 2010; Lankford & Wyckoff, 2010; Vegas, 2007). Examples include the input-based wage schedule and Buggins' turn, which awards promotions based on time served rather than merit. Critics argue that these policies do not reward extra efforts, thus they do not serve to allocate the most effective teachers to where they are most valued. In some countries, incentive policies are in place to retain talented teachers and these include bonuses, housing stipends, and loan forgiveness. However, these policies focus more on increasing the supply of teachers and retaining talented teachers in certain subject areas and difficult-to-staff schools rather than linking teachers' performance to short-term rewards (Loeb, Miller, & Strunk, 2009a). The alternative suggestion is an output-based wage schedule, which links teacher wages to educational outcomes such as performance evaluation and student test scores. Studies on output-based salary schedule have found positive evidences in improving student achievement (Dee & Keys, 2004; Lavy, 2007) and reducing dropouts (Eberts, Hollenbeck, & Stone, 2002). However, because teacher productivity is difficult to identify, the output-based wage schedule is not widely used. Once carried out, it often results in controversy (Lavy, 2007; Loeb, Miller, & Strunk, 2009b).

Another teacher personnel policy that makes the teacher labor market different from the labor economic framework is the rule of teacher deployment and transfer. In European countries where teacher recruitments are organized by the central government or the intermediate-level government and countries where teachers are civil servants or career civil servants, teachers can be forced to transfer to other schools or resign (Carreño, 2002). Similarly, in Japan and Korea, where teachers are hired at the regional level, teachers are more likely to be assigned to schools where they are needed regardless of the teachers' personal preferences, and teachers are also rotated across schools periodically in order to reduce the gaps in the quality of education across schools (Akiba et al., 2007). As a result of different degrees of commitment to equity, sometimes allocation of qualified teachers allows disadvantaged students to have more access to qualified teachers, while sometimes allocation of qualified teachers favors more advantaged students.

In addition, the rules of teacher transfer are sometimes used as a way of guaranteeing the job security of incumbent teachers; other times these rules are used as a way of getting rid of poor-performing teachers. In the United States, many districts apply seniority-based transfer rules, which give senior teachers the priority to interview for jobs and fill the vacancies (Cohen-Vogel, Feng, & Osborne-Lampkin, 2013; Hess & West, 2006; Levin, Mulhern, & Schunck, 2005; Levin & Quinn, 2003). Under the seniority-based rules, schools often have no choice or limited choice in which teachers are hired and assigned to schools. In seniority-based systems it is also very difficult to fire teachers; rather they are often passed to other schools within a district. Studies found that the transfer rules affect the way schools and districts allocate teachers and tend to increase the difficulties of disadvantaged schools in getting more qualified and experienced teachers (Anzia & Moe, 2013; Koski & Horng, 2007; Levin et al., 2005; Moe, 2005, 2011).

2.3 National contexts

In examining teacher mobility, the influence of centralization of institutional arrangement is important. Education systems differ in the arrangement of education financing and management. An important aspect is the division of responsibilities among central, regional, and local authorities in terms of allocating resources, managing personnel, planning and structures, and organizing instruction.² For example, among countries in the Organization for Economic Co-operation and Development (OECD), decisions concerning personnel management are made by central government in majority Southern European countries, while the decisions are made by regional government in Argentina, Spain and India, and by local administrations in Chile, Finland, and the United States. The decisions are made mainly by individual schools in Czech Republic, Hungary, Ireland, the Netherlands, New Zealand, Sweden, and the

² In reviewing education development in OECD countries, Education at a Glance (1998) divides educational functions into four domains: resources, personnel management, planning and structure, and the organization of instruction. The domain of resources includes the decisions on the amount, sources and allocation of resources available to schools for expenditures in different areas. The domain of personnel management includes decisions on hiring and dismissing staff and setting salary schedules and work conditions. The planning and structure includes decisions on creating or closing schools, programs offered in schools, course content, and examinations. The organization of instruction includes decisions on the school attendance, instruction time, textbooks, teaching methods, and assessment methods.

United Kingdom. The different levels of authorities in teacher management are likely to result in different patterns of teacher mobility and allocation.

From the perspective of making public policies, centralization is often seen as a better way to achieve equity, while decentralization is often seen as a way to improve efficiency and encourage local participation and innovation. Some studies examining teacher distribution and quality across countries argue that more centralized education systems are better at providing students equal access to qualified teachers, while decentralized systems make it more difficult for disadvantaged schools to attract and retain teachers. The Educational Testing Service, when comparing the United States with higher-achieving countries in eighth-grade math and science teacher education and development, found that the majority of higher-achieving countries are relatively centralized in preparing, hiring, and allocating teachers (Wang, Coleman, Coley, & Phelps, 2003). Another cross-national study linked national levels of teacher quality to student achievement and opportunity gaps, and found that a decentralized funding system and a localized teacher labor market are likely to contribute to inequality in the distribution of school resources and qualified teachers (Akiba et al., 2007). The study also found that among the 21 countries with less than 5% difference in the percentage of high-socioeconomic-status (SES) students and low-SES students taught by qualified teachers, many have centralized education systems, which suggests that more centralized education management tends to be better at providing equal allocation of resources to schools. The study also suggests that in countries such as Japan, regional hiring and assignment of teachers with periodic rotation are effective in reducing differences in teacher quality across schools. Again, the findings support the argument for more centralized educational management systems. However, research has also found that centralized education systems are not necessarily linked to equal distribution of resources and policies favoring disadvantaged students. Studies show that in countries where the institutional arrangement of checks and balances is not well developed, the upper-level governments are not necessarily more likely to allocate school resources and teachers more equally (Luschei & Carnoy, 2010; Luschei et al., 2013)..

China is a case between highly centralized systems like that in South Korea and decentralized systems like that in the United States. The financing and managing of elementary and lower secondary education in China is more like that of the United States, where the revenues to support schools and locus of decision-making fall largely on township governments before 2001. Although the level of responsibilities of financing and managing basic education has shifted from townships to upper-level county governments since the centralization reform in rural areas in 2001, the teacher labor market remains localized, with barriers to enter. In the next section, I describe the educational management system in China with a focus on rural Gansu.

3. Background and context

3.1 The educational management system in rural China

Formal education in China includes: (1) pre-school education in kindergarten; (2) primary education for children ages 6–13 years old; (3) secondary education for adolescents ages 12–18 years old, including 3 years of middle school and 3 years of high school; (4) tertiary education. Primary and lower secondary education has been required by law for all children since the passage of the 1986 Compulsory Education Law. K-9 is compulsory education and is free after 2007, while high school, which is from grade 10-12, is not free and students have to take exams to enter. Therefore, there is larger difference between the labor market for high school teachers and labor market for primary and middle school teachers.

There are five levels of governments, including central government, provincial government, prefecture government, county (municipality in the city) government and township (district in the city) government. Village is not a formal level of government. Before the centralization reform since 2001, the responsibilities of providing public services were decentralized to the local governments — especially the county and township governments (Fock & Wong, 2005, 2008; Tsang, 1996; Wong, 1991, 1997). The principle of educational financing and administration structure is “local responsibility and administration by levels” (Tsang, 1996). According to this principal, local governments — county and township governments — are responsible for providing primary and secondary education, while provincial governments are responsible for providing higher education. In the cities, primary education is the responsibility of district governments, and secondary education is the responsibility of city governments. In the rural areas, China has had a tradition of community-run schools since the 1960s, and primary education had been the responsibility of local provincial and local governments even before 1980s. The villages also play an important part in the provision of basic education, though they are not part of the local governments (Tsang, 1996).

One consequence of decentralized way of providing basic education was increasing disparities across regions (Bray, 1996a, 1996b; Hanson, 2000). Under the decentralized education system, the quantity and quality of education was increasingly tied to local economics and social development. As a result,

geographic factors, especially urban–rural differences, have become one of the major causes of educational inequality in China, which has raised public and scholarly concern on the influence of rural and community disadvantages on educational equality. Using 1988 CHIP survey and 1992 Children Survey Hannum (1999, 2002a, 2002b) finds that rural poverty results in the rural-urban, gender, and ethnic disparities in enrollment. Connelly and Zhang’s (2007) findings confirm Hannum’s (1999, 2003) and Brown and Park’s (2002) findings that higher local income is positively associated with enrollment in primary and middle schools.

In response to the increasing inequality, a centralization reform was carried out in 2001 in rural areas. The reform shifted the responsibilities of financing basic education from the township governments to higher-level governments, especially the county-level governments. At the same time, the payroll of teachers was also shifted to county governments, followed by the transfer of decision-making regarding teacher personnel management (Han, 2013; Liu, Murphy, Tao, & An, 2009).

3.2 The educational management system in rural Gansu

After the centralization reform, the main responsibility of providing basic education falls on county governments. In Gansu province, the township governments provided about 70% funding for primary and lower secondary education at the beginning of 2000s. By 2008, the amount provided by township governments decreased to 10%, while the rest was transferred to county governments (Liu et al., 2009).

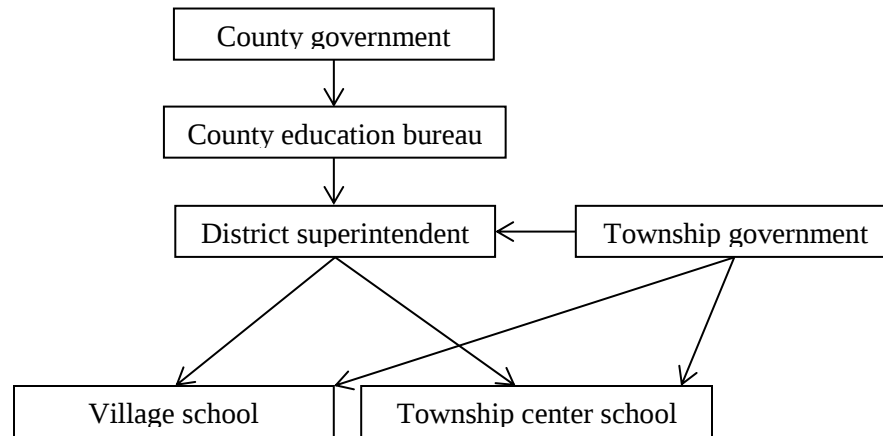


Figure 3.1: The education management in rural areas post centralization in 2001³

Figure 3.1 shows the structure of education management in rural Gansu after the centralization reform. The county government is responsible for raising the revenue to support the schools and staffs. The county education bureau is a subordinate of the county government, which is responsible for the routine management and equality control of schools. The school district, which corresponds to the area of the township, is the basic unit of the educational management in rural areas.⁴ Since early 1980s, providing primary and lower secondary education was the responsibilities of township governments. The education bureau in the township government was in charge of managing local schools, including teacher personnel. Sometimes, the township education bureau was referred to as school district office. After the centralization reform, the township education bureau or office was replaced by the district or township central school. Central school tends to be better located near or at the center of a township, and away from remote villages within the township. Therefore it can be a proxy of better location and resources available.

The school district superintendent is in charge of managing the local primary and lower secondary schools. The district superintendent can be the director of the township education bureau, head of the school district, or the principal of the township central school. Most of the time, district superintendent is appointed by the government department in charge of school personnel rather than by election. As shown

³ The introduction of education management structure is limited to primary and middle schools. The management of high schools is not discussed here.

⁴ In the following paragraphs, I refer to the unit of township in educational management as school district.

in Table 3.1, three bodies can assume the authority of appointing district superintendent: the township government, the county education bureau, and the county personnel department. The superintendent can be appointed by one of them or by the township government and county education bureau together. Because the superintendent is the primary manager of the school district, whoever appoints the superintendent has large influence over schools and teachers.

The village school principal is responsible for routine education management and work with the school district on teacher evaluation and promotion. As shown in Table 3.1, village school principal can be appointed directly by the superintendent, or the superintendent has either large or limited influence over the candidates while the township government makes the final decision. The village school principal can also be appointed by the county education bureau. Sometimes all three bodies have some influence.

The authority of hiring, assigning and transferring teachers can be assumed by different levels of governments, including district superintendent, township government, county education bureau and county government. Usually, the county government hires teachers according to the demands reported by township governments and assigned teachers to townships based on teachers' hometowns. Most of the teachers are local residents of the counties and graduated from county-level secondary normal schools (*zhongdeng shifan xuexiao*). Teacher assignment to schools can be decided by county government, township government or superintendent. When the township government makes the decisions, sometimes the superintendent can have some influence on the assignment. Schools are not allowed to hire regular teachers directly from the labor market and have to accept teachers assigned to them, because regular teachers in public schools are public employees who are on the government payroll and take up officially budgeted posts (*bianzhi*). Different from regular teachers, contract teachers are hired by schools, villages or districts and are paid by the institutes which hire them.

The county government controls teacher transfer to schools in county government seat and between districts. The county government seat is one of the townships within a county in rural area, which is often the economic and cultural center of a county. As a result, the schools located in county government seat tend to be better. In some counties, teacher transfer to schools in county government seat operates through

examinations specifically designed to recruit teachers from schools in other districts within the county. For a few counties, the transfer to schools in county government seat is prohibited to avoid bribe (Li, 2012). If a teacher wants to transfer to another school within the district, it has to be approved by the county education bureau, township government or the superintendent (see Table 3.1). Sometimes the superintendent has either strong or weak influence over the decisions when the township government makes the final decision. Sometimes teacher transfer needs to be approved by all three authorities. Therefore, the second reason to include primary and middle school teachers in the analysis is that primary and middle schools are funded and managed by the county and township government. The recruitment, assignment and transfer of primary and middle school teachers follow similar process, while high school teachers are more separated from primary and middle school teachers.

Table 3.1: The locus of decision-making regarding school personnel

Personnel policy	Description
Appointment of the superintendent	
Township government	Appointed by the township government
County education bureau	Appointed by the county education bureau, or township government had a say in the candidates
County government	Appointed by county's party personnel department
Appointment of the village school principal	
Township government	Appointed by township government, while superintendent has either strong or little scope to suggest the candidates
Superintendent	Appointed by superintendent
County education bureau	Appointed by county education bureau
Mixed	Appointment is made by superintendent, township government and county education bureau together
The deployment of teachers	
Township government	Allocated by township government, or superintendent has influence over the candidates
Superintendent	Allocated by superintendent
County education bureau	Allocated by county education bureau
The transfer of teachers within district	
Township government	Decided by township government, when superintendent has either strong or weak influence over the candidates
Superintendent	Decided by superintendent
County education bureau	Decided by county education bureau
Mixed	Decided jointly by superintendent, township government and county education bureau

Source: Liu, Murphy, Ran, & An (2009)

3.3 Contract teachers and teacher qualification

One reason of hiring contract teacher is that the governments cannot afford the regular teacher payroll. Another reason is that regular teachers are not willing to work in remote rural areas, especially when there is no additional compensation for tough working conditions. As a result, township governments and villages seek to employ contract teachers, and these teachers are often unprepared or unqualified, with a lower level of education than regular teachers but higher than average local people. The payment of a contract teacher is about one fifth to one fourth of that of regular teachers (Han, 2013; Robinson & Yi, 2008; Wang, 2002a). In this way, primary and secondary education can be extended to more students quickly and with lower costs.

Since early 1990s, the government has taken great efforts to improve teacher quality. The “Education Reform and Development in China” (1993) document required that by 2000, 95% of primary teachers should be graduates of normal schools, 80% of middle school teachers should be graduates from normal colleges, and 70% of high school teachers should be graduates from 4-year normal universities. Also in 1993, the Teacher Act was passed, followed by the Education Act, signaling the beginning of a teacher certification system. Teachers are required to pass the national teacher certification exam. At the same time, the government has attempted to gradually eliminate contract teachers. In 1985, among 5.3 million primary teachers, 2.8 million (52.8%) were contract teachers. Among 2 million middle school teachers, 413,500 (20.7%) were contract teachers. The contract teachers composed 42% of all teachers in basic education. The percentage of contract teachers in rural areas was even higher. Since then, the total number and percentage of contract teachers decreased over the years; in 2001, 705,000 rural primary and middle school teachers were contract teachers, which was only 6.6% of all the rural teachers (Robinson & Yi, 2008). As the entry requirement for teachers was tightened and contract teachers were dismissed, the quality of teachers greatly improved. Meanwhile, the expansion of higher education since late 1990s greatly increased the supply of teachers with college degrees, while the number of school-age children

started to fall, so the shortage of qualified teachers was reduced. In 2006, the Ministry of Education continued its education reform policies, announcing the goal of dismissing 448,000 additional contract teachers through 2010.⁵

While the policy of reducing contract teachers is in effect, research has found that a new generation of contract teachers has emerged to cope with the changing needs of schools. In examining the evolution of non-governmental (*daike*) teachers in Gansu province, Robison and Yi (2008) found that this new generation of contract teachers tends to be younger, with only 5.7% older than 40 years and 41.7% younger than 25 years. A survey conducted by the China Institute for Educational Finance Research in 2007 also found that the new generation of contract teachers tends to be younger than regular teachers on average (Liu, 2009). Many of these contract teachers graduated from teacher colleges or other colleges, and have teacher qualifications. They also participate in in-service training and teacher evaluation in schools related to the promotion of teacher professional rank. Liu's (2009) study also found that contract teachers are not only employed by schools in understaffed rural areas, they also exist in schools with no difficulty in staffing, and even in overstaffed schools; this suggests that besides teacher shortages in terms of regions, types of schools, and certain subject areas, there are mismatches between supply and demand under the current teacher employment and compensation system. In general, the findings show that while the policy of eliminating contract teachers and replacing them with regular teachers continues, the hiring of contract teachers is not subsiding and the dual-track system of teachers has persisted in rural as well as urban schools.

3.4 Teacher distribution in China

3.4.1 The distribution of primary and middle school teachers in China

In 2013, there were 5.58 million full-time primary teachers and 3.48 million full-time middle school teachers in China. Among all the full-time primary teachers, 26.3% taught in cities, 34.4% taught in counties and townships, and 39% taught in rural areas. Among the full-time teachers, 54.2% of primary

⁵ Ministry of Education, 2006, "Reports on the dismissal of contract teachers".

school teachers and 58.8% of middle school teachers were younger than 40 years. With regard to educational attainment, about 36.9% of primary school teachers and 73.6% of middle school teachers graduated from 4-year universities, 50.1% and 24.4% graduated from 3-year colleges, and 12.5% and 0.7% graduated from upper secondary schools. With regard to professional rank, 54.3% ranked senior and 33.7% ranked grade 1 in primary school, while 16% ranked senior and 43.2% ranked grade 1 in middle school (Educational Statistics Yearbook of China, 2013).⁶

The overall student-teacher ratio is 16.76 for primary school and 12.76 for middle school. The ratios differ among rural and urban schools. According to the regulation issued by the General Office of the State Council ([2001]74), the standard student-teacher ratio in primary school is 19 in urban schools, 21 in county schools, and 23 in rural schools. The standard student-teacher ratio in middle school is 13.5 in urban schools, 16 in county schools, and 18 in rural schools. Because the local governments set the posts of regular teachers according to the standard, the ratio of students to regular teachers tends to be larger in rural areas and where local governments have limited financial capacity.

Table 3.2 shows the compositions of teacher educational background in urban and rural schools. In general, teachers who have graduated from 4-year colleges have increase quickly over time, especially in rural schools. At the same time, the differences in the percentages of teachers with a college degree between urban and rural schools are decreasing. However, there are still significant gaps across urban schools, county and township schools, and rural schools. The pattern of teacher mobility tends to exacerbate the initial disparities in teacher distribution. Research examining teacher mobility finds that the teacher attrition rates are higher in rural schools, because teachers tend to move from rural schools to urban schools or schools located in county or township seats. Teachers in rural schools are also more likely to exit teaching by taking the exams to be civil servants (An, 2013).

⁶ Before the reform on teacher professional rank in 2011, there are four ranks in primary and middle schools respectively, including level 3, level 2, level 1 and senior. I will describe in detail in the following section.

Table 3.2: The composition of teachers' educational levels in 2004, 2007, and 2013 in China (%) ⁷

	4-year college			3-year college			High school		
	2004	2007	2013	2004	2007	2013	2004	2007	2013
Primary school									
Total	4.58	12.21	36.88	44.16	54.63	50.09	49.55	32.22	12.50
Urban	13.43	30.99	57.04	57.83	54.13	37.38	28.11	14.49	4.53
County and township	5.12	13.84	35.24	53.27	62.00	53.91	40.72	23.75	10.60
Rural	2.14	6.59	24.87	38.00	51.93	55.23	57.64	40.19	19.47
Middle school									
Total	28.97	46.95	73.57	64.66	49.92	24.41	6.08	2.75	0.69
Urban	54.56	70.93	83.03	42.70	27.07	13.55	2.20	0.94	0.26
County and township	27.91	46.62	71.16	66.93	50.71	27.51	4.96	2.44	0.77
Rural	18.94	35.86	65.65	72.31	60.02	32.76	8.50	3.92	1.15

Source: Educational Statistics Yearbook of China (2004, 2007, 2013)

⁷ The "Educational Statistics Yearbook of China, 2000" does not distinguish among full-time teachers, part-time teachers, and other school staff. It also does not show the teacher composition by region.

3.4.2 The distribution of primary and middle school teachers in Gansu

Gansu province locates in interior northwestern China with desert, mountainous and hilly landscapes. In 2000, Gansu had a population of 25.62 million. About 76% of the population lived in rural areas. The illiteracy rate was 14.34%. 2.67% of the population had university education, 9.86% had high school education, 23.92% had middle school education, and 36.91% had primary school education. The GDP per capita of Gansu ranked 30 out of 31 provinces in 2013-2014 (See Figure 3.2). Among the 86 counties in Gansu, 41 are officially designated as national poverty counties.

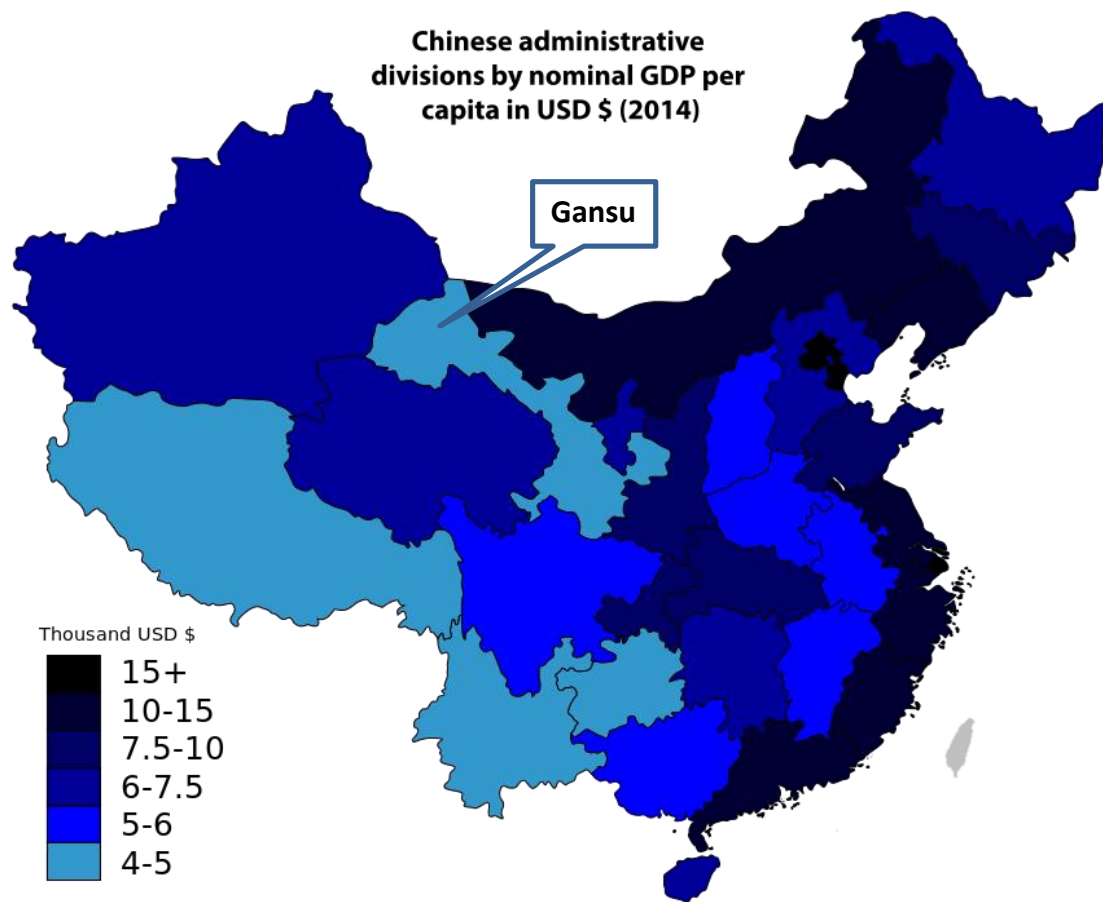


Figure 3.2: The provinces by GDP per capita in 2013-2014 (not include Hong Kong, Macau and Taiwan).

Table 3.3 shows the composition of teacher educational background in urban and rural schools. In general, teachers who have graduated from 4-year colleges have increase, especially in rural schools. At the same time, the differences in the percentages of teachers with a college degree between urban and

rural schools are decreasing. However, there are still significant gaps across urban schools, county and township schools, and rural schools.

Table 3.3: The composition of teachers' educational levels in 2004, 2007, and 2013 in Gansu province (%)

	4-year college			3-year college			High school		
	2004	2007	2013	2004	2007	2013	2004	2007	2013
Primary school									
Total	2.3	8.2	38.2	35.6	48.1	43.5	58.1	41.4	17.7
Urban	8.3	22.9	50.0	62.8	60.0	43.7	27.5	16.2	5.7
County and township	2.2	10.0	42.4	41.4	57.2	46.8	53.9	31.6	10.4
Rural	1.4	5.5	33.6	29.7	43.8	42.1	64.0	47.7	23.7
Middle school									
Total	16.8	33.5	73.3	73.4	61.5	24.9	9.5	4.8	1.1
Urban	43.5	64.4	80.9	53.5	33.5	16.7	2.8	1.6	0.3
County and township	15.9	34.8	73.5	76.6	61.4	25.2	7.3	3.6	0.9
Rural	10.8	25.3	70.2	76.8	68.2	27.9	12.0	6.4	1.7

Source: Educational Statistics Yearbook of China (2004, 2007, 2013)

Table 3.4 shows the compositions of teacher professional ranks in urban and rural schools. Before the reform on teacher professional rank in 2011, there are four ranks in primary and middle schools respectively, including level 3, level 2, level 1 and senior. I will introduce the system of teacher professional rank in detail in the following section. The distribution shows that there are higher proportions of senior primary and senior secondary teachers in the urban schools, followed by the county and township schools. The proportions of senior teachers in rural schools rank the lowest. On the other hand, the proportions of teachers with no rank are highest in rural schools, followed by the county and township schools, and the proportions are the lowest in urban schools. The majority of teachers with no rank are likely to be novice teachers and contract teachers. This suggests that novice teachers are more likely to be assigned to rural schools and contract teachers who are likely to be less-qualified are also more likely to be employed by rural schools.

Table 3.4: The composition of teachers' professional ranks in 2004, 2007, and 2013 in Gansu province (%)

	Senior			1st grade			2nd grade			3rd grade			No rank		
	2004	2007	2013	2004	2007	2013	2004	2007	2013	2004	2007	2013	2004	2007	2013
Primary school															
Total	30.4	34.7	37.4	43.8	41.7	47.7	14.4	11.8	5.6	0.4	0.3	0.2	10.9	11.2	8.2
Urban	45.3	50.1	50.7	40.1	39.1	41.4	7.1	3.9	2.4	0.5	0.3	0.1	6.8	6.2	3.9
County and township	31.1	36.2	37.4	46.7	44.3	51.4	14.1	10.8	4.5	0.4	0.3	0.1	7.5	8.1	5.6
Rural	27.8	32.1	34.1	43.7	41.4	47.7	15.6	13.2	6.9	0.4	0.3	0.2	12.5	12.8	10.4
Middle school															
Total	2.4	3.0	7.4	26.2	27.3	32.0	41.1	41.3	50.8	14.1	13.0	3.0	16.2	15.4	6.8
Urban	9.1	11.8	16.8	44.7	44.1	41.2	33.1	34.6	37.1	4.5	2.3	1.3	8.6	7.3	3.7
County and township	2.2	2.6	6.7	27.6	27.7	32.6	45.0	43.8	52.4	12.2	11.2	2.3	12.9	14.7	6.0
Rural	0.9	1.1	4.5	21.3	23.0	27.8	41.5	41.3	54.6	17.1	16.8	4.4	19.3	17.7	8.7

Source: Educational Statistics Yearbook of China (2004, 2007, 2013)

The tendency of teachers moving from rural to urban schools is found by some studies. In examining teacher mobility in Gansu, An (2013) found that during 2000 to 2010 the proportions of primary teachers transferring out of a school are the highest in rural schools, followed by township and county schools. The proportions of the teachers transferring into a school are the highest in township and county schools, followed by rural schools. Urban schools have the lowest proportions of teachers transferring out of and into a school. It suggests that there is a tendency of teachers moving from rural schools to township and county schools. The author also found that there are more teachers retire every year in urban schools as compared with rural schools, township schools, and county schools. It suggests that teachers tend to move to township and county schools after obtaining teaching experience in rural schools, and tend to move to urban schools when they become more qualified. Such pattern would put students in rural schools at disadvantage as they are always taught by younger and inexperienced teachers.

The unequal distribution of teachers between urban and rural schools, and among schools within rural areas, is not only caused by teachers' preferences toward higher wages and better working conditions, which is exacerbated by the urban–rural and regional differences, but is also caused by the way of evaluating and incentivizing teachers.

3.5 Teacher promotion, evaluation and transfer as incentives

In the educational system in China, three institutional mechanisms are used to evaluate and incentivize teachers — teacher professional rank, end-of-year teacher evaluation, and teacher transfer. All three mechanisms are applied to general teachers who are on the government payroll. Although the contract teachers are also under the supervision of the township and county education bureaus, the rules might not apply in the same way. For example, in most schools, contract teachers are excluded from the promotion of professional rank. Many contract teachers do not participated in teacher evaluation. The wages of contract teachers usually are not linked to student performance, though student performance matters with regard to extending the employment contract.

The first mechanism is the teacher professional rank. There are four ranks in primary and middle schools, including level 3, level 2, level 1, and senior.⁸ There are rules on the years of teaching experience before a teacher can apply for promotion to the next level. All the teachers start as interns. They can apply for promotion to level 3 in the next year. The years required for the eligibility of application for promotion to level 2 and level 1 differ according to the educational background of the teachers, and they also differ among regions. The basic wages are mainly determined by teachers' educational background, professional rank, and teaching experience: (1) the level of wage is based on teachers' professional rank. Teachers with a higher professional rank get higher wages regardless of educational background; (2) the difference in the amount between ranks increases with educational background; (3) based on teacher's level, the wage increases over time with experience. As a result, teachers have strong incentive to be promoted. Because the total amount for level 1 and senior ranks available within a district is limited, teachers have to compete for promotions.

The basic criteria for promotion include teachers' educational background and years of teaching experience. The end-of-year teacher evaluation results are also important. In examining teacher promotion in rural Gansu, Li, Liu, and An (2010) identified three categories as key factors considered in teacher promotion in China: (1) years of teaching experience, or years since last promotion; (2) most recent end-of-year teacher evaluation; (3) personal recommendation by the superintendent or government officials, usually a result of personal connections, and sometimes bribes. These criteria have similarities and differences as compared to systems in other countries. For example, teacher promotion in the United States and many other countries is mainly determined by years of teaching experience (Vegas, 2007). Personal connections also exist in many countries, including some parts of China where the fiscal budget is limited and there is little compensation for working in remote rural schools. In these countries or regions, there are no objective criteria like teaching experience or teacher evaluation, which leaves room for corruption (Umansky, 2005). As compared to teaching experience and personal recommendations,

⁸ Since 2011, the central government integrated the two separate tracks of primary and middle school teacher professional rank into one track. There are level 3, level 2, level 1, senior 2 (equivalent to associate professor) and senior 1 (equivalent to professor). Teachers start at level 3 as intern teachers for the first year.

teacher evaluation as a promotion criterion is likely to be more effective in monitoring teacher quality and motivating teachers. Studies in rural China find that teachers respond to promotion incentives by working harder (Karachiwalla, 2010), and teachers with higher professional rank are better at improving student achievement (Chu et al., 2014; Park & Hannum, 2001) compared to those having college degree (Chu, Loyalka, Chu, Shi, & Rozelle, 2014).

The second mechanism, the end-of-year teacher evaluation, is an important factor to consider in promotion.⁹ It is also used separately for short-term remuneration and appraisal of teaching awards. While teacher professional ranks determine the long-term wage, the results of the teacher evaluation affect the short-term rewards.¹⁰ In rural China, teachers are usually evaluated by schools and districts together. The results include fail to pass, pass, good, and excellent.¹¹ Factors taken into account in teacher evaluation include student achievement, workload, punctuality, teaching attitude, and sometimes research. The influences of schools versus districts on the evaluation results vary, so do the importance of each factor. Student academic performance is often used as the main criterion to evaluate teachers and allocate rewards. Besides teachers, superintendents are also evaluated according to student exam results (Liu, Murphy, Ran, & An, 2009).

Third, teacher transfer is also used by the local government as a way of rewarding and punishing teachers. When the wage schedule is unified within a county, and there is no compensating wage differential provided for teachers at hard-to-staff schools, teachers' overall welfare is more closely related to where and at which school they teach. Thus the decisions of assigning a teacher to a particular school affect not only the quality of education at a school, but also the teacher's quality of life and professional development. While teacher transfer contains rent-seeking opportunities, for example, a bribe to transfer a teacher to schools in better areas, it is also a way of achieving certain desired allocation of teachers. For

⁹ For example, some districts require that teachers need to have good or excellent records in end-of-year evaluations in 2 out of 5 years in order to be eligible for promotion (An, 2008; Li, 2012).

¹⁰ According to Li (2012), some districts and schools do not link short-term rewards directly to the results of teacher evaluations. Instead, they tend to link the short-term rewards directly to student test scores.

¹¹ For teachers who apply for promotion to the highest professional rank, it is required to achieve an excellent on the teacher evaluation.

example, in some districts, the township governments or superintendents tend to reward high-performing teachers by transferring them from rural schools in remote areas to central schools, and punish poor-performing teachers by transferring them to remote schools (Li, Liu, & An, 2010; Robinson & Yi, 2008). However, frequent use of teacher transfer as way of reward and punishment tends to exacerbate the gap of qualified teachers among schools and harms the disadvantaged schools. Therefore, some districts are careful in using teacher transfer as reward and punishment, and try to allocate teachers more equally based on the demands of schools within the district. For example, some districts assign all the new teachers, most of whom have a college degree, to schools in remote mountainous areas (Li, 2012).

The empirical research on teacher mobility in rural China is limited. Some studies found cases that some districts tend to transfer poor-performing teachers to schools in remote rural areas, while high-performing teachers have more chance to move to central schools and schools near county government seat and urban area (Li, Liu, & An, 2010; Li, 2012; Robinson & Yi, 2008). Some studies drew on educational statistics yearbook to give an general picture of teacher distribution and make inference about teacher mobility pattern (An, 2013). Others drew on teacher or school survey data. In examining the distribution and structure of 2008 teachers sampled in 70 schools from 6 provinces, Zhang and Yu (2008) concluded that younger teachers, teachers with more education and “backbone” teachers are more likely to switch schools, and are more likely to move to schools in county government seats, urban schools, and schools in more developed areas. However, Zhang and Yu’s study used descriptive statistics, without taking multiple factors into account at the same time. In examining the educational management system in rural China, Liu, Murphy, Tao, and An (2009) described how the decision-making of teacher transfer changed during 2000 and 2007. However, their study has not examined teacher mobility directly. Using the same set of data, Han (2013) examined the allocation of teachers in early 2000s, and found that the allocation of more qualified teachers favors schools located in or near county government seat. The problem of Han’s study is that it only used one variable, student–teacher ratio, in measuring teacher distribution and making inference about the impact of policy changes on teacher distribution.

3.6 Summary

Taken as a whole, the existing literature suggests that teacher mobility is a complex issue. Teachers have their own preference of whether and where to teach, and they respond to various pecuniary and non-pecuniary factors. Research shows that, on average, teachers prefer working in schools and districts with higher salaries and benefits, better working conditions and support network, lower enrollments and smaller classes with high-achieving students. However, it does not mean that the sorting of teachers, especially those qualified teachers, to better schools and higher-achieving students occurs universally. There is deviation from this pattern both within and across countries. Some teachers value students with similar background as themselves over students with higher achievement or more advantaged socioeconomic status. Some teachers value the familiarity of the community and closeness to the place where they grew up over schools located at wealthier areas. In addition, the effects of demographics, working conditions, and school location on teacher turnover might vary across countries, depending on the structure of the teacher labor market and the policy effort of the governments. Some countries manage to provide more equal allocation of resources to schools and are more effective in reducing differences in teacher quality across schools. There are several studies that examine the variations in the distribution of teachers across countries and try to link the different patterns to the institutional arrangement and policies regarding hiring and allocating teachers. Because the findings regarding individual teacher characteristics and institutional factors are often closely related to the context where the research was conducted, making inference would require careful consideration of country specific context.

In reviewing the educational management system in rural China, I find that the rule of allocating and transferring teachers is less clear as compared to other countries such as the United States, where the rule is negotiated and written down in contract at district level, and countries such as Korea, where assigning and transferring teachers are completely controlled by the regional government. Some research in rural China has examined the changes in educational management system including teacher personnel policies. Some research has examined the distribution and structure of teachers. However, there is no quantitative

research that focuses on teacher mobility and examines individual teacher- and school-level characteristics associated with teacher mobility in rural areas.

4. Research questions

This study examines teacher mobility with a focus on individual teacher characteristics and institutional factors. Because of limited data availability, this study cannot trace out the whole process. Instead, I take the initial matching of teachers to schools as given, focusing on teacher mobility from one school to another. First, I examine the distribution of teachers across schools to explore whether there is systematic sorting of teachers in rural Gansu. Second, I examine the relationship between teacher mobility measured at school level and school characteristics including wages, working conditions, and compositions of students and teachers. Third, I examine the relationship between teachers' individual characteristics and mobility status. If teachers in rural China are similar in their personal preferences to teachers in other countries, I would expect the same pattern of relationship between teacher mobility and individual teacher characteristics.

The questions that guide this study are:

1. School-level analysis

- 1.1 Are similarly qualified teachers distributed equally across schools?

- 1.2 How do school characteristics relate to teacher mobility?

- a. How do the wages and working conditions influence teacher mobility?

- b. How do the compositions of students and teachers influence teacher mobility?

2. Teacher-level analysis

- 2.1 How does a teacher's initial placement relate to teacher mobility?

- a. How does a teacher's initial placement affect whether that teacher switches schools?

- b. How does a teacher's initial placement affect whether that teacher switches schools early or late in the career?

- c. How does a teacher's initial placement relate to reasons to move?

- 2.2 Are better teachers more likely to switch schools?

- a. Are teachers with higher professional ranks more likely to switch schools?

b. Are teachers with higher end-of-year evaluation scores more likely to switch schools?

Question 1.1 — “Are similarly qualified teachers distributed equally across schools?” — is informed by the literature on teacher distribution. The sorting of qualified teachers toward better schools and more advantaged students are documented by a substantial body of research in both developed and developing countries. I expect that similar pattern also exists in rural China, where the teacher labor market is localized, with barrier between districts and counties. Based on research in rural China which finds large gaps in school resources between schools, I expect to find that qualified teachers tend to concentrate in certain schools.

Question 1.2 — “How do school characteristics relate to teacher mobility?” — and the sub-questions are informed by literature on the relationship between institutional factors and teacher mobility. Based on the literature I expect to find that school location, working condition, and the composition of students and teachers will affect teacher mobility measured at school level.

Question 2.1 examines the influence of teacher’s initial placement on teacher mobility at individual level. Based on the research finding the “draw of home” for teachers, I expect to find that teachers who are assigned away from their home are more likely to switch schools. There are a series of sub-questions. First, I examine whether a teacher is more likely to switch schools when the initial placement is outside the home district as a whole. Next, I focus on subsample of teachers who have switched schools, and examine whether a teacher whose initial placement is outside the home district differs in the time and reason to switch schools as compared to those assigned to schools within home district. According to the prior research, I expect to find that a teacher is more likely to switch schools and is likely to switch earlier in the career when the initial placement is outside the home district. I also expect to find difference in the reason to move for teachers who are assigned away from their home.

As for the last question — “Are better teachers more likely to move to other schools?” — the findings of prior research are mixed. Whether better teachers are more likely to leave or stay is closely related to the context where the research was conducted. There are nation- and region-specific rules of hiring, allocating and transferring teachers that make the teacher labor market different from that of private

sectors. As a result, better teachers are not always matched to schools where they are most needed or valued. Based on the prior research on institutional arrangement regarding teacher personnel in rural China, I focus on two variables, which are teacher professional rank and teacher evaluation result, and examine their relationship with the probability of teachers moving to other schools. The results would add to the understanding of how teachers are distributed across schools in rural China.

5. Data and methods

5.1 Data

The data used in this study is from Gansu Survey of Children and Families (GSCF). GSCF is a longitudinal, multilevel survey of rural children in Gansu. The survey employed random multi-stage, cluster design at each stage, which drew children from village lists of school-aged children based on the residency. The GSCF has completed three waves in 2000, 2004 and 2007. In 2000, 2,000 children from 100 villages ages 9 to 12 were sampled. Of the 2,000 children, one did not have complete information, 9 never attended school, and 19 left school before wave 1 was conducted in June 2000. The sample attrition is low. Of the 1,999 children with complete first wave information, 1,872 (93.6%) were tracked in wave 2 when they ages 13 to 16. All of the 1,872 children completed child questionnaire. 1,863 of the original 2,000 children participated in wave 3 in 2007. Of the 1,863 youths ages 17 to 21, 427 did not complete the children questionnaire themselves because they left home for work, military service or higher education.

The survey also collected detailed information of children's home background, schooling, achievement, and welfare by linking the primary sample of children to secondary samples of children's mothers, homeroom teachers, school principals, and village leaders. In addition, a teacher survey was conducted to all teachers in the schools attended by sample children. Some of the teachers were resampled, because many children remained at the same schools in the follow-up survey. There are 1,070 teachers in wave 1, 2,672 teachers in wave 2, and 2,382 teachers in wave 3. Among 2,672 teachers in wave 2, 617 have also participated in wave 1. Among 2,382 teachers in wave 3, 592 have participated in wave 1, and 1,033 has participated in wave 2. Because teachers are not the primary sample that GSCF focuses on, teachers are not assigned the same identification code. Thus it is difficult to generate a panel data of teachers by linking those who participated in all three waves together. On average, 89.7% of all teachers from each school were surveyed in wave 1, 73.9% were surveyed in wave 2, and 69.6% were surveyed in wave 3.

The drawback of many administrative data is the lack of teacher background information. One reason for using GSCF is that it contains teachers' personal and professional information. In this section, I describe in detail the dependent and independent variables that I use in analysis, and how I generate some of the variables based on survey questions.

5.2 Measurement

In this section, I describe the variables used in this study.

5.2.1 Dependent variables

Table 5.1 presents the dependent variables used in this study.

Table 5.1: Dependent variables used in school-level and teacher-level analysis

Variable	Type	Description
School-level variables from 2000, 2004 and 2007 GSCF principal survey		
Proportion of teachers who left	Continuous	Proportion of teachers who left a school in last 12 months
Proportion of teachers who came	Continuous	Proportion of teachers who came to a school in last 12 months
Teacher-level variables from 2007 GSCF teacher survey		
Whether a teacher has switched schools	Dichotomous	1= if a teacher has switched schools at least once and 0= if not
Whether a teacher has switched schools 0, once or more than once	Categorical	1= if a teacher has not switched schools, 2= if a teacher has switched school once, and 3= if a teacher has switched schools more than once.
Early career move (≤ 5)	Dichotomous	1= if a teacher switched schools the first time within the first 5 years and 0= if a teacher switched schools later than 5 years
Late career move (≥ 10)	Dichotomous	1= if a teacher switched schools the first time after teaching for 10 years or more and 0= if less than 10 years
Reasons to move (three categories)	Categorical	1= if a teacher indicates that he or she was transferred the first time by the government, 2= if he or she moved the first time for family, and 3= if he or she moved the first time for career or personal development.
Time until switch schools	Continuous	The time span of individual teacher since he or she entered teaching until the he or she moved to another school or until 2007 when the data collection ended.

The first set is school-level dependent variable based on 2000, 2004 and 2007 GSCF survey. The principal survey asked principals of the sampled schools how many teachers had left and came to the schools in the last 12 months. Based on the answers, I generate two dependent variables:

- a. The proportion of teachers who left a school in last 12 months
- b. The proportion of teachers who came to a school in the last 12 months

The second set is teacher-level dependent variables based on 2007 GSCF teacher survey:

- a. The first variable is a binary dependent variable describing teacher's mobility status, 1= if a teacher has switched schools at least once and 0= if not. In 2007 survey, Question D2, D3, and D4 asked teachers how long they had been teachers, and how long they had been teaching at the current schools, whether they had taught at other schools, and how many schools before the current schools. Based on the answers, I generated the binary variable of teacher's mobility status.
- b. The second variable is a categorical variable, 1= if a teacher has not switched schools, 2= if a teacher has switched school once, and 3= if a teacher has switched schools more than once.
- c. Using subsample of teachers who have switched schools, I generate two binary variables describing teacher's mobility status. Question D5 in 2007 survey asked teachers who ever switched schools when they left the school, and when they moved to another school. According to the answers, I generate two binary variables indicating early and late moves in one's career. One is a binary variable indicating early career move, where 1= if a teacher switched schools the first time within the first 5 years and 0= if a teacher switched schools later than 5 years. The other is a binary variable describing late career move, where 1= if a teacher switched schools the first time after teaching for 10 years or more and 0= if less than 10 years.
- d. The 2007 survey asked teachers why they left the school. It is a multiple choice question. The choices include personal reasons (for example, in order to live with one's family), better working condition, better living condition, involuntary transfer by county education bureau or by district education office and structural changes such as school consolidation. Based on the answers to the

reasons of the first move, I generate a categorical variable where 1= if a teacher indicates that he or she was transferred the first time by the government, 2= if he or she moved the first time for family, and 3= if he or she moved the first time for career or personal development.

- e. The 2007 survey asked teachers when they started teaching, when they left a school and move to another school. Based on the retrospective questions about teacher's career history, I generate a continuous variable using time span of individual teacher since he or she entered teaching until the point of time he or she moved to another school or until 2007 when the data collection ended.

5.2.2 Independent variables

a. School-level variables

Table 5.2 presents the school-level independent variables used in the study.

Table 5.2: School-level independent variables from 2000, 2004, and 2007 GSCF survey

Variable	Type	Description
School-level variables from 2000, 2004 and 2007 principal survey		
Central school	Dichotomous	1= central school and 0= otherwise
Boarding school	Dichotomous	1= boarding school and 0= otherwise
Primary school	Dichotomous	1= primary school and 0= otherwise
Number of classrooms	Continuous	
% classrooms with rainproof roofs	Continuous	
% dilapidated classrooms	Continuous	
Student enrollment	Continuous	
% minority students	Continuous	
% minority teachers	Continuous	
% regular teachers	Continuous	
% teachers with college degree	Continuous	
% teachers with ≤ 5 years of experience	Continuous	
% teachers with ≥ 20 years of experience	Continuous	
Student-to-all teacher ratio	Continuous	Used in descriptive analysis in Section 6.1
Student-to-regular teacher ratio	Continuous	Used in descriptive analysis in Section 6.1
Student-to-college-graduated teacher ratio	Continuous	Used in descriptive analysis in Section 6.1
Monthly wage of regular teachers	Continuous	
Teacher variables averaged at school level from 2000, 2004 and 2007 teacher survey		
Mean age of teachers	Continuous	
% teachers who are villagers	Continuous	
% teachers with teacher certification	Continuous	
% teachers with level 1 or senior rank	Continuous	
Average hours teaching in class per week	Continuous	
Average hours working after class per week	Continuous	

At the school level, GSCF has collected information about school type, location, facility and the composition of students and teachers.

Variables of school type and location include whether a school is a central school of the district, whether a school is boarding school, and whether school is a primary school. The former is a proxy for school locations, because central school usually locates nearer to township seat. Whether a school is a boarding school also provides information about school location, because boarding schools are more likely to be schools away from remote villages and near to township or county seat.

Variables of school facility include the number of classrooms, the percentage of classrooms with rainproof roof and the percentage of dilapidated classrooms.

Variables of student composition include the total number of students and the percentage of minority students.

Variables of teacher composition are the percentage of minority teachers, the percentage of regular teachers, the percentage of teachers with college degree, the percentages of teacher with 0–5 years and the percentages of teacher with more than 20 years of teaching experiences. All three waves asked principal about the monthly wage of regular teachers and contract teachers. This study uses the average monthly wage of regular teachers as the measure of the average wage level of a school. Based on the student enrollment and teacher composition, I generate the student-all teacher ratio, student-regular teacher ratio, and student-college graduated teacher ratio.

I also generate averages of individual teacher characteristics at school level, including mean age of teachers in a school, the percentage of teachers who are villagers of where the school locates, the percentage of teachers with teacher certification, the percentage of teachers with level 1 or senior professional rank, average hours teaching in class and working after class per week (see Table 5.3).

b. Teacher-level variables

Table 5.3 presents the teacher-level independent variables used in the study.

Table 5.3: Teacher-level independent variables from 2007 GSCF teacher survey

Variable	Type	Description
Variables of interest		
Initial placement	Dichotomous	1= if the initial placement is not the district where the teacher was born and 0= otherwise
Teacher evaluation score	Categorical	excellent, 1=excellent and 0= otherwise; good, 1= good and 0= otherwise; pass, 1= pass and 0= otherwise; fail, 1= fail and 0= otherwise (used in Cox proportional regression in Section 7.4)
Teacher professional rank	Categorical	1= a teacher is level 1 or senior rank and 0= if lower than level 1(used in Cox proportional regression in Section 7.4)
Control variables		
Age	Continuous	
Gender	Dichotomous	1= male and 0=female
Marriage status	Dichotomous	1= single and 0= otherwise
Teaching experience	Continuous	
Teacher certification	Dichotomous	1= certified and 0= otherwise
Exam score	Categorical	1= scored above 80 and 0= scored lower than 80
Education background	Categorical	1= college degree and 0= lower than college
Graduated from normal school	Dichotomous	1= graduated from normal school and 0= otherwise
Further education	Dichotomous	1= received further education and got credential after entering teaching and 0= otherwise
Employment status	Dichotomous	1= regular teacher and 0= contract teacher
Monthly wage	Continuous	
Teach middle school	Dichotomous	1= if a teacher teaches grade 7 or above and 0= if teaches grade 6 or below

The first variable of interest is a teacher's initial placement. Question D5 in wave 3 asked about the location of the first school where a teacher taught before, including whether the school was out of the province, in other counties within the province, in other districts within the current county, or within the current district, and whether the school was located at the county seats, township seats, or rural areas. Question B4 asked about the place of birth. The answers include the current village, other village in the current district, other district in the current county, other county in the province and other province. According to the career history provided by the answers, I generate the variable of the initial placement, 1= if the initial placement is not the district where the teacher was born and 0= otherwise.

The second variable of interest is the end-of-year teacher evaluation score. There are 5 categories, which equals 4 if excellent, equals 3 if good, equals 2 if pass and equals 1 if fail. In wave 3 survey, teachers were asked about their end-of-year evaluation scores from 2003 to 2006. The answers provide the opportunity of examining whether teacher transfer is used as a way of rewarding or punishing teachers. I generate four binary variables: excellent, 1=excellent and 0= otherwise; good, 1= good and 0= otherwise; pass, 1= pass and 0= otherwise; fail, 1= fail and 0= otherwise.

The third variable of interest is teacher professional rank. As mentioned in the review of prior studies, higher teacher professional rank has positive impact on student learning (Chu, et al., 2014). Compared to teacher education and credential, teacher professional rank is a more accurate way of measuring teacher quality. There are four ranks in primary schools: level 3, level 2, level 1, and senior. In middle schools, level 3, 2, 1 and senior. I generate a variable, 1= a teacher is level 1 or senior in primary or middle school and 0= if lower than level 1.

Variables of teacher characteristics include age, gender, marriage status (1= single and 0= otherwise), teaching experience, teacher certification (1= certified and 0= otherwise), results of certification exam (1= scored above 80 and 0= scored lower than 80), education background at the entry of teaching (1= college degree and 0= lower than college), normal school education (1= graduated from normal school and 0= otherwise), further education (1= received further education and got credential after entering teaching and

0= otherwise), teachers' employment status (1= regular teacher and 0= contract teacher), and teachers' self-reported monthly wage.

5.3 Methods

5.3.1 School-level analysis

In Section 6, I draw on 2000, 2004, and 2007 GSCF principal and teacher (?) survey data to exploit teacher distribution and mobility at school level. First I examine the distribution of teachers to explore whether there is systematic sorting of teachers in rural Gansu. Second, I examine the relationship between school characteristics and teacher mobility.

To answer the first question in school-level analysis, I apply similar method used by Lankford, Loeb, and Wyckoff (2002). The school-level teacher characteristics are ordered from the lowest percentile to the highest percentile to examine how the schools that at the 10th, 50th, and 90th percentile of the distribution differ. If, for example, schools at the 10th percentile look similar to schools at the 50th or 90th percentile, it suggests that the distribution of these characteristics is relatively uniform among schools. If the distribution of these characteristics spread out among percentiles, it suggests that certain kind of teachers are not distributed uniformly and there might be systematic sorting of teachers among schools. I also look at the correlations among the school-level teacher characteristics to see how different dimensions of teacher characteristics relate to each other, for example, whether schools with less experienced teachers are more likely to have fewer teachers with college degree.

To answer the second question in school-level analysis, I apply OLS regression to examine the relationship between school-level factors and teacher mobility.¹² The dependent variables in this analysis are the proportion of teachers who left the school and the proportion of teachers who came to the school in last 12 month.

Empirical model

¹² I also conducted Tobit regression, because the dependent variables are non-negative and stack at 0. Tobit model is used to estimate the linear relationship between variables when there is either left- or right-censoring in the dependent variables. There are no large differences in the coefficients of variables of main interest.

Models without fixed effects:

$$Y_{it} = \alpha + \beta S_{it} + \epsilon_{it} \quad (5.1)$$

Models with district fixed effects and wave dummies:

$$Y_{it} = \alpha + \beta S_{it} + D_j + \eta_t + \epsilon_{it} \quad (5.2)$$

Models with District-by-wave fixed effects:

$$Y_{it} = \alpha + \beta S_{it} + I_{jt} + \epsilon_{it} \quad (5.3)$$

Y_{it} are the proportion of teachers who left and proportion of teachers who came to school i in wave t .

The school-level variables include whether a school was a central school of the district, whether the school was boarding school, number of classrooms, the percentage of classroom with rainproof roof, the percentage of dilapidated classrooms, the total number of students, the percentage of minority students, the percentage of minority teachers, the percentage of regular teachers, the percentage of teachers with college degree, the percentage of teacher with 0-5 years and more than 20 years of teaching experiences respectively, and monthly wage for regular teachers. I also include school-level averages of teacher attributes (see Table 5.2). My primary interests are the coefficients of school location, teacher composition, wage and average workload.

Schools in three waves are pooled together in the analysis. For each outcome I fit three models. Model 5.1 treats each school in three waves as an observation. Model 5.2 includes district fixed effects D_j and wave dummy η_t . Because the township is the main unit of educational management in rural areas, including D_j captures the unobserved factors related to the living conditions and the average unobserved school characteristics. Because the outcomes and variables of interest may be correlated, for example, the dependent and independent variables may change in the same direction over time, including wave fixed effects η_t can eliminate bias due to such pattern. Including both township and wave fixed effects eliminate bias due to district characteristics that are stable over time and due to temporal trends that are common to all the districts. Model 5.3 includes district-by-wave fixed effects, because if the secular trends differ by districts, it might lead to bias in estimation even both district and wave fixed effects are

taken into account. School fixed effects are not used because the variables of interest in this analysis include school location which seldom changes for a school during a short period of time, including school fixed effects would eliminate time-invariant variables. All the standard errors are clustered at school level.

5.3.2 Teacher-level analysis

In Section 7, I draw on 2007 GSCF teacher survey data to examine the relationship between teachers' individual characteristics and mobility status.

a. Binomial and multinomial logit regression models

To answer the first question in Question 2.1, I use binomial and multinomial logit models to examine how the individual teacher characteristics relate to mobility. The dependent variable used in binomial logit model is a binary variable which equals 1 if a teacher switched schools at least once and equals 0 if not. The dependent variable used in multinomial logit model is a categorical variable which equals 1 if a teacher did not switched schools, equals 2 if a teacher switched once, and equals 3 if a teacher switched more than once.

To answer the second question in Question 2.1, I use binomial logit model and generate two binary variables using subsample of teachers who switched school at least once. One variable indicates early career move. The other indicates late career move (see Table 5.1). My primary interests are the coefficients on teacher's initial placement. The models control for other teacher characteristics including gender, marriage status, teaching experience, teacher certification, teacher certification exam result, education background at the entry of teaching, whether graduated from normal school, whether received further education, teachers' employment status, and teachers' self-reported monthly wage (see Table 5.3). The models also take a set of school variables and school means of variables from teacher survey into account (see Table 5.2).

To answer the third question in Question 2.1, I use multinomial logit model to examine the relationship between teacher's initial placement and reasons to move. The dependent variable used in the analysis is a categorical variable which equals 1 if a teacher was transferred by the government, equals 2 if a teacher chose to move for family, and equals 3 if a teacher chose to move for personal development. My primary

interests are the coefficients on teacher's initial placement. The models control for other teacher characteristics including gender, marriage status, teaching experience, teacher certification, teacher certification exam result, education background at the entry of teaching, whether graduated from normal school, whether received further education, teachers' employment status, and teachers' self-reported monthly wage.

Empirical model

$$\text{logit}(Y_{ij}) = \alpha + \beta T_{ij} + \gamma S_j + D_k + \epsilon_{ij} \quad (5.4)$$

T_{ij} is a set of teacher characteristics. My primary interests are the coefficients on the initial placement. The first model only control for individual teacher characteristics including gender, marriage status (1= single and 0= otherwise), teaching experience, teacher certification (1= certified and 0= otherwise), results of certification exam (1= scored above 80 and 0= scored lower than 80), education background at the entry of teaching (1= college degree and 0= lower than college), normal school education (1= graduated from normal school and 0= otherwise), further education (1= received further education and got credential after entering teaching and 0= otherwise), teachers' employment status (1= regular teacher and 0= contract teacher), and teachers' self-reported monthly wage (see Table 5.3). The second model includes school variables and the third model also take school means of variables from 2007 teacher survey into account (see Table 5.2). District fixed effects are used and standard errors are clustered within schools.

As for the empirical model to answer the third question, my primary interests are the coefficients on the initial placement. The model also control for other teacher characteristics including gender, marriage status (1= single and 0= otherwise), teaching experience, teacher certification (1= certified and 0= otherwise), results of certification exam (1= scored above 80 and 0= scored lower than 80), education background at the entry of teaching (1= college degree and 0= lower than college), normal school education (1= graduated from normal school and 0= otherwise), further education (1= received further education and got credential after entering teaching and 0= otherwise), teachers' employment status (1=

regular teacher and 0= contract teacher), and teachers' self-reported monthly wage. The model is first fitted without district fixed effects. Then district fixed effects are taken into account.

b. Cox proportional model

To answer the third question, I use survival analysis, or referred as event history analysis. Survival analysis is a set of methods for analyzing data using the time until the occurrence of an event, such as mortality, illness and fertility, as outcome variables. The approach is widely used in the fields of public health, biology and sociology. Several studies on teacher labor market have applied this approach to examine teacher mobility (Adams, 1996; Cowen, Butler, Fowles, Streams, & Toma, 2012; Dolton & van der Klaauw, 1995; Stinebrickner, 1999).

The first reason for choosing survival analysis to model teacher mobility is that the method treats the teachers as right-censored given they were still teaching at school when the data collection ended. The second reason is that the method can take time-variant covariates into account, which allows for estimation of relationship between time-variant covariates and the probability of teachers moving to other schools. When there are censoring observations, several approaches are often used. One way is to use censored-normal regression. Thus censoring is not a big problem for OLS regression. The real problem with OLS regression in analyzing survival data is the assumed normality of distribution for time to an event. Many distributions of survival data are non-symmetric, or even bimodal. Linear regression is not robust to these violations (Cleves, Gould, Gutierrez, & Marchenko, 2010). Another way to address the censoring problem is to create a binary variable which groups teachers into two categories: those teachers who stayed at the same school and those who moved. Next, the variable is regressed on the variables of interests and other covariates. The problem of the logit model is that it only considers current status and it cannot take time-variant variables into account. As a result, it leaves out a large amount of information. For example, teachers who switched school in the first year and in the last year of the data are in the same group. In the teacher-level analyses above, I addressed the problem first by fitting the data with binomial and multinomial logit models. Then I used the subsample of teachers who switched schools at least once to generate two variables which indicate early and late career move as the outcomes. However, it may

still underestimate the true survival period. The survival analysis can make use of the timing when an event occurs, for example, when a teacher moves to another school, thus it can take the variables that change over time, such as years of teaching experience and teacher professional ranks, into account.

In this part of analysis, I choose Cox regression model to examine the career paths of teachers. For the discussion that follow, I mainly draw from Cleves et al.'s (2010) "An Introduction to Survival Analysis Using Stata" and Stata's survival analysis manual.

The hazard function and Cox proportional model

Let T be a positive random variable representing the waiting time until a teacher moved to another school (often called survival time). Given the event occurs at time t , the probability density function is:

$$f(t) = \Pr(T = t) = \lim_{dt \rightarrow 0} \frac{1}{dt} \Pr(t \leq T \leq t + dt)$$

The cumulative distribution function is:

$$F(t) = \Pr(T < t).$$

The survival function given the probability of a teacher had not switched school before duration t is:

$$S(t) = \Pr\{T \geq t\} = 1 - F(t) = \int_t^{\infty} f(x)dx$$

The hazard rate function is the rate of change in the survivor function when the event occurs. The numerator is the conditional probability that teacher moved to another school in the time span $[t, t + dt)$ given it has not occurred before. dt is the width of the time span. The result is the rate of the occurrence of the event in a time unit. It can be understood as the division of the number of teachers who changed schools at the points of analysis by the number of teachers at risk of changing schools. It represents the probability that a teacher had worked at school j until the point of time changing school.

$$h(t) = \lim_{dt \rightarrow 0} \frac{\Pr[t \leq T < t + dt | T \geq t]}{dt}$$

Cox model estimates the relationship between hazard rate and explanatory variables without assumption about the distribution of baseline hazard function, allowing more flexibility (Cox, 1972). The basic Cox model is as follows:

$$h(t, X_i) = h_0(t) \exp(\beta X_i) = h_0(t)h_i$$

t is the time from the beginning until a teacher left a school. The outcome is hazard rate, the probability that a teacher worked at a school until the point of time leaving the school. $h_0(t)$ is the baseline hazard function. It is completely unspecified, and β are estimated independently of the hazard function. The advantage of unspecified based line function is that there is no need to make assumptions about the distribution of the waiting time t . The Cox model assumes that the underlying hazard functions for different individuals are the same, and the individual hazard functions are proportional to one another. The model can examine the effects of X_i on the risk of switching schools. When applying the Cox model to the data, it is necessary to examine whether the covariates meet the assumption.

In section 7.4, a dataset is constructed from retrospective questions about career history for teachers who participated in 2007 GSCF survey. Teachers entered the data the year they began teaching, and exited the data when the survey was conducted in 2007. The outcome variable is the time for teachers since the beginning until they move to other schools. Two variables, teacher professional rank and teacher evaluation result, are examined to determine their relationship with the probability of teachers moving to other schools. The models also control for other teacher characteristics including gender, educational background when entering teaching, teacher's initial placement, employment status, teaching experience, and whether received further education.

Empirical model

To answer the first question — “Are teacher with higher professional rank more likely to move to other schools” — I generate the dummy variable *Rank* which equals 1 if a teacher is level 1 or senior rank and

equals 0 if lower than level 1. α_1 tells us whether a teacher with higher professional rank is less likely or more likely to move to another school

$$h(t, x) = h_0(t)\exp(\alpha_1 Rank + \alpha_2 Z) \quad (5.5)$$

To answer the second question — “Are teacher with higher end-of-year evaluation scores more likely to move to other schools” — I generate four dummy variables measuring the results of teacher evaluation: excellent, where 1= excellent in the 2003, 2004, 2005 or 2006 teacher evaluation and 0=otherwise; good, where 1= good and 0= otherwise; pass, where 1= pass the evaluation and 0= otherwise; fail, where 1= fail and 0= otherwise. β_1 tells us how the results of evaluation are associated with the probability to move. The teacher evaluation results are available from 2003 to 2006 in the 2007 GSCF survey. Thus when the variable of teacher evaluation is included, the sample is limited to data after 2003.

$$h(t, x) = h_0(t)\exp(\beta_1 Evaluation + \beta_2 Z) \quad (5.6)$$

$h(t)$ is the hazard rate using the time span of a teacher entering teaching until he or she move to another school as time t . The outcome can be interpreted as the probability that a teacher worked at a school until the point of time leaving the school. Z is a vector of control variables, which include teacher-level time-invariant and time-variant covariates. The time-invariant covariates include initial placement, gender, education background when entering teaching and whether employed as contract teachers.¹³ Time-variant covariates are experience, whether received further education and upgraded the degree at the time when moving to another school. Because age is highly correlated with years of teaching experience, it is excluded from the analysis. District fixed effects are used in all the models. In addition, in multiple failure data, failures are correlated within the same subject (individual or group), which violates the independence assumption. There are several ways to deal with the problem. I choose to adjust the

¹³ The reason why working as contract teacher is time-invariant is that contract teachers can convert to general teachers after teaching for certain years according to the policies of local school districts. On the other hand, once teachers are employed as general teachers, they remain as general teachers.

covariance matrix of the estimators to account for the correlation. In Stata it is done by cluster standard error within each teacher (Cleves et al., 2010).

Table 5.4 provides a summary of the research questions in this study, the methods and variables used to answer the questions, and the result tables for each question.

Table 5.4: Summary of research questions, methods, variables and the results

Research question	Method used	Dependent variable	Independent variable	Result	Data Source
1.1 Are similarly qualified teachers distributed equally across schools?	Description	a. % regular teachers, % contract teachers, % college-graduated teachers, % teachers with less than 5 years of experience, % teachers with more than 20 years of experience, student-to-teacher ratio, student-to-regular teacher ratio, and student-to-college-graduated teacher ratio; b. mean age of teachers, % certified teachers, and % teachers with level 1 or senior rank within a school		Table 6.2; Table 6.3	2000, 2004 and 2007 GSCF principal and teacher survey
1.2 How does teacher mobility relate to school characteristics?					
a. How do the wages and working conditions influence teacher mobility?	OLS regression model	a. Proportion of teachers who left a school in last 12 months;	School-level independent variables and teacher-level variables averaged at school level (see Table 5.2); Table 6.5 presents the descriptive statistics	Table 6.6; Table 6.7	2000, 2004 and 2007 GSCF principal and teacher survey
b. How do the compositions of students and teachers influence teacher mobility?		b. Proportion of teachers who came to a school in last 12 months			
2.1 Is there any “hometown” effect?					
a. How does a teacher’s initial placement affect whether that teacher switches schools?	Binomial and multinomial logit regression model	a. Whether a teacher has switched schools; b. Whether a teacher has switched schools 0, once or more than once	Teacher-level independent variables (see Table 5.3) and school-level independent variables (see Table 5.2); Table 7.3 presents the descriptive statistics of teacher-level independent variables	Table 7.9	2007 GSCF principal and teacher survey
b. How does a teacher’s initial placement affect whether that teacher switches schools early or late in his or her career?	Binomial logit regression model	a. Early career move (≤ 5); b. Late career move (≥ 10)	Same as above	Table 7.10	2007 GSCF principal and teacher survey
c. How does a teacher’s initial placement relate to reasons to move?	Multinomial logit regression model	Reasons to move (three categories)	Teacher-level independent variables (see Table 5.3)	Table 7.11	2007 GSCF teacher survey

Table 5.4 (cont'd)

2.3 Are better teachers more likely to move to other schools?					
a. Are teachers with a higher professional rank more likely to move to another school?	Cox proportional model	Time until switch schools	a. Time-invariant: teacher's initial placement, gender, education background when entering teaching, and whether employed as contract teachers;	Table 7.16; Table 7.17	2007 GSCF teacher survey
b. Are teachers with higher end-of-year evaluation score more likely to move to another school?			b. Time-variant: experience, whether received further education and upgraded the degree at the time when moving to another school		

6 School-level Analysis

In this section, I draw on 2000, 2004, and 2007 GSCF survey data to exploit teacher distribution and mobility at school level. In Section 6.1, I use descriptive statistics and methods similar to Lankford, Loeb, and Wyckoff (2002) to answer the first questions question — “Are similarly qualified teachers distributed equally across schools?”. In Section 6.2, I use regression models to answer the second question — “How is teacher mobility related to school characteristics?”.

6.1 Are similarly qualified teachers distributed equally across schools?

6.1.1 Analytic sample

In this section, I draw on 2000, 2004, and 2007 GSCF survey data to examine the distribution of teachers with characteristics identified by prior research on teacher quality to see whether there is systematic sorting of teachers and how the distribution changed from 2000 to 2007 in rural Gansu. In the original data, there are 148 schools in 42 districts in 20 counties in 2000 survey, 232 schools in 51 districts in 20 counties in 2004 survey, and 196 schools in 45 districts in 20 counties in 2007 survey. Among these schools, 92 schools appeared in all three waves (See Table 6.1). In order to examine how the distribution changed over time, I limit the sample to 92 schools which were sampled in all three waves.

Table 6.1: The distribution of sample schools in 2000, 2004, and 2007 surveys

	School	County	Township	Schools per county	Schools per township
2000	148	20	42	7.4	3.5
2004	232	20	51	11.6	4.5
2007	196	20	45	9.8	4.3
Sampled in three waves	92	20	42	4.6	2.2

According to the methods used in Lankford, Loeb, and Wyckoff (2002), the school-level teacher characteristics are ordered from the lowest percentile to the highest percentile to examine how the schools

that at the 10th, 50th, and 90th percentile of the distribution differ. The school-level variables include (see Table 5.2):

School principal survey: variables describing teacher include the percentage of regular teachers, the percentage of contract teachers, the percentage of teachers with college or above degree, the percentage of teacher with 0–5 years of experience, the percentage of teachers with more than 20 years of experiences, the student-to-teacher ratio, student-to-regular teacher ratio, and student-to-college-graduated teacher ratio.

Teacher survey: school averages of mean age, the percentage of certified teachers, and the percentage of teachers with level 1 or senior professional rank.

First, school-level teacher characteristics are ordered from the lowest percentile to the highest percentile. Then I examine how the schools that at the 10th, 50th, and 90th percentile of the distribution differ. Next, I look at the correlations among the school-level teacher characteristics to see how different dimensions of teacher characteristics relate to each other.

6.1.2 Results

Table 6.2 shows the 10th, 50th, 90th percentiles and the difference between 90th and 10th percentiles for measures of teacher qualifications across schools in 2000, 2004 and 2007. In general, the results show that teachers are not distributed equally. There are substantial differences between 10th and 90th percentiles.

Overall the percentage of contract teachers has been decreasing. Schools at 10th percentile or below have no contract teachers in 2000 and remain the same over the years, while schools at 90th percentile or above have a substantial proportion of teachers who are contract teachers (61.2%) in 2000. The percentage deceased to 44% in 2004 and 34.7% in 2007. As a result, the gap between schools at 10th and 90th percentiles in the percentage of contract teachers has been narrowing. On the other hand, the distribution of regular has not changed much compared to the distribution of contract teachers. There is a slight increase in the percentage of regular teachers on average, while the gap between schools at 10th and 90th percentiles remains around 55% from 2000 to 2007.

As for the distribution of college graduated teachers, although more teachers graduated from college, there is a substantial increase in the gap between schools at 10th and 90th percentiles. Schools at 10th percentile or below have no teachers with a college degree in 2000 and remain the same in 2004 and 2007. Schools at 90th percentile or above have 31.2% teachers graduated from college in 2000, 66.1% in 2004, and 82.8% in 2007.

Compared to the distribution of teachers with a college degree, the distribution of teachers regarding teaching experience has not changed much. Some schools (10th percentile or below) have no teachers with 0–5 years of teaching experience in 2000 and remain the same in 2004 and 2007. Others (90th percentile or above) have 44.1% teachers who are novice teachers in 2000, 31.4% in 2004 and 35.3% in 2007. As a result, the gap decreased, but not much. On the other hand, some schools (10th percentile or below) have few teachers with more than 20 years of teaching experience, while others (90th percentile or above) have 71.1% teachers with more than 20 years of experience in 2000, and increased to 78.2% in 2007.

Overall, the percentage of certified teachers has increased substantially as a result of the initiation of teacher certification system in late 1990s and early 2000s. Schools at 10th percentile or below have 31.8% teachers who are certified in 2000 and increased to 56.7% in 2007, while all the teachers from schools at 50th percentile are certified in 2007. At the same time, the gap between schools at different percentiles has not changed much.

The percentages of teachers with level 1 or senior professional rank spread out even larger. Some schools (10th percentile or lower) have 16.2% teachers with level 1 or senior professional rank in 2000, 14.6% in 2004 and 19% in 2007, while others (90th percentile or above) have 76.2% teachers with level 1 or senior professional rank in 2000, 98.8% in 2004 and 97.3% in 2007. As a result, the gap between schools at 10th and 90th percentiles has increased from 60% in 2000 to 78.3% in 2007.

The ratios of students to all the teachers, regular teachers and teachers with a college degree can indicate the quality of education at a school. The central government requires that the highest student-teacher ratio in primary school to be 19 in urban schools, 21 in county schools, and 23 in rural schools.

Over the years, schools at 90th percentile or above managed to bring the ratio from more than 32.5 in 2000 to 23.1 in 2007. Meanwhile, the gap between the schools at 10th and 90th percentiles has decreased from 20.4 in 2000 to 12.1 in 2007. The gap in student-regular teacher ratio is also narrowing over the years, though still quite significant. The student-regular teacher ratio of schools at 10th percentile or below is 9.9 in 2000 and 8.9 in 2007, while the ratio of schools at 90th percentile or above is 45.9 in 2000 and 33 in 2007. As a result of the uneven distribution of teachers with a college degree, the gap in the ratio of students to college graduated teachers is the largest, though the gap has also been narrowing. The ratio for schools at 10th percentile or below is 0 and remains the same over the years, while the ratio for schools at 90th percentile or above is 167.8 in 2000, 151.2 in 2004 and 94.4 in 2007.

Table 6.3 shows that the school-level teacher attributes are highly correlated. Schools that have higher percentage of level 1 or senior rank teachers are more likely to have higher percentage of regular teachers (correlations of approximately 0.67), higher percentage of teachers with more than 20 years of experience (0.38), higher percentage of certified teachers (0.43), lower percentage of contract teachers (-0.57), lower percentage of teachers with less than 5 years of experience (-0.58). These schools also tend to have smaller student-teacher ratio (-0.27). Schools that have higher percentage of certified teachers are more likely to have more regular teachers (0.55), more college-graduated teachers (0.34), and smaller student-teacher ratio (-0.61). Schools with higher percentage of older teachers are more likely to have lower percentage of college-graduated teachers (-0.44), at the same time, these schools tend to have more experienced teachers (0.79). As for student-teacher ratio, schools with larger ratios measured in three ways tend to have lower percentage of regular teachers, higher percentage of contract teachers, and lower percentage of college-graduated teachers.

Table 6.2: Average teacher characteristics at school level by percentile in 2000, 2004, and 2007 ¹⁴

Variable	2000				2004				2007			
	10th	Median	90th	90th-10th	10th	Median	90th	90th-10th	10th	Median	90th	90th-10th
% regular	27.4%	78.4%	.	.	25.9%	85.1%	.	.	33.9%	87.1%	.	.
% contract	0.0%	17.0%	61.2%	61.2%	0.0%	10.6%	44.0%	44.0%	0.0%	6.5%	34.7%	34.7%
% college graduated	0.0%	.	31.2%	31.2%	0.0%	21.1%	66.1%	66.1%	0.0%	40.9%	82.8%	82.8%
% with <5 experience	0.0%	15.2%	44.1%	44.1%	0.0%	8.3%	31.4%	31.4%	0.0%	12.8%	35.3%	35.3%
% with >20 experience	0.6%	32.2%	71.1%	70.5%	7.0%	46.9%	96.8%	89.7%	1.1%	47.6%	79.4%	78.2%
ST ratio	12.1	22.1	32.5	20.4	12.9	22.4	33.2	20.3	11.0	17.7	23.1	12.1
ST ratio (regular)	9.9	28.3	45.9	36.0	9.2	25.9	39.6	30.4	8.9	19.8	33.0	24.0
ST ratio (college)	0.0	.	167.8	167.8	0.0	35.0	151.2	151.2	0.0	26.7	94.4	94.4
Mean age	27.7	35.0	42.3	14.6	27.1	36.6	43.2	16.2	29.9	39.1	46.0	16.1
% certified	31.8%	76.2%	.	.	35.7%	85.5%	.	.	56.7%	100.0%	.	.
% level 1 or senior	16.2%	54.4%	76.2%	60.0%	14.6%	65.3%	98.8%	84.2%	19.0%	66.3%	97.3%	78.3%

¹⁴ There are 92 schools for each wave in this analysis. The number is larger than 30 but it is still a small sample compared to large sample with normal distribution. The nearest rank method is often used in small-sample. When the value of some variables is not evenly distributed, there may be no observation in some percentile, especially the highest percentile.

Table 6.3: The correlation between school-level averages of teacher characteristics in 2007

	1	2	3	4	5	6	7	8	9	10	11
1. % regular	1										
2. % contract	-0.8331*	1									
3. % college graduated	0.3279*	-0.2733*	1								
4. % with <5 experience	-0.3898*	0.3987*	0.0727	1							
5. % with >20 experience	0.1326	-0.2634	-0.3351*	-0.5225*	1						
6. ST ratio	-0.4800*	0.2647	-0.3371*	0.1799	-0.0146	1					
7. ST ratio (general)	-0.4606*	0.5595*	-0.0758	0.3017*	-0.1625	0.1376	1				
8. ST ratio (college)	-0.2802*	0.3531*	-0.3626*	-0.1188	0.0336	-0.0117	0.2032	1			
9. Mean age	0.169	-0.2321	-0.4369*	-0.5966*	0.7783*	-0.0048	-0.1426	0.1406	1		
10. % certified	0.5540*	-0.3434*	0.3372*	-0.219	-0.0558	-0.6062*	0.1256	-0.1402	0.0336	1	
11. % level 1 or senior	0.6724*	-0.5745*	0.1451	-0.5833*	0.3813*	-0.2684*	-0.2956*	-0.1781	0.5646*	0.4304*	1

* correlation coefficients significant at the 1% level

6.2 How does the teacher mobility relate to school characteristics?

6.2.1 Analytic sample

In this section, I examine the relationship between school characteristics and teacher mobility use an analytic sample of 382 schools. I generate this sample by pooling schools in 2000, 2004, and 2007 GSCF survey together. Schools with missing values are excluded. The resulted sample contains 137 schools in 2000, 221 schools in 2004, and 186 schools in 2007 (see Table 6.4). The descriptive statistics of variables used in are presented in Table 6.5.

Table 6.4: The distribution of sample schools

	School	County	Township	Schools per county	Schools per township
2000	137	20	42	6.9	3.3
2004	221	20	50	11.1	4.4
2007	186	20	44	9.3	4.2
Total	544	60	136	9.1	4.0

6.2.2 Results

a. Descriptive statistics

Table 6.5 provides the descriptive statistics of variables used in the analysis. About 16% schools in 2000, 17% in 2004, and 20% in 2007 are township central schools. The percentage of boarding schools has increased from 10% in 2000 to 24% in 2004 and 27% in 2007. The student enrollment increase from 335 on average in 2000 to 702 in 2007. The percentage of minority students is relatively small, which is 3.6% in 2000, 3.3% in 2004, and 3.2% in 2007. About 80% classrooms have rainproof roofs, while the percentage of dilapidated classrooms varies from 20% in 2000 to 23% in 2004, and to 14% in 2007.

On average, about 15.2% teachers in a school left the school in last 12 months in 2000, 12.3% did it in 2004, and 8.7% did it in 2007. On average, about 17% teachers in a school came to the school in last 12 months in 2000, 14.6% did it in 2004, and 13.2% did it in 2007. Among all the teachers in a school, about 21% teachers have less than 5 years of teaching experience in 2000, 18% in 2004, and 20% in 2007. About 40% teachers have more than 20 years of teaching experience in 2000, 41% in 2004, and 39% in

2007. The percentage of the minority teachers is 3.9% in 2000, 2.2% in 2004, and 2.4% in 2007. The percentage of teachers with college degree has increased from 21% in 2000 to 58% in 2004 and 61% in 2007. The percentage of regular teachers increased from 81% in 2000 to 89% in 2004 and 2007, while the percentage of certified teachers increased from 78% in 2000 to 89% in 2004 and 95% in 2007. The percentage of level 1 and senior teacher is relatively stable over time, with 57% in 2000, 54% in 2004, and 57% in 2007. Among the teachers, 37% were born in the villages where the schools located in 2000. The percentage decreased to 26% in 2004 and 25% in 2007. The average age of teachers is 35 years in 2000, 35 years in 2004, and 37 years in 2007. The monthly wages for regular teachers increased from 587 yuan in 2000 to 963 yuan in 2004 and 1287 yuan in 2007. The hours spent teaching in class per week ranges from 14.9 hours in 2000 to 12.6 hours in 2004 and 12.5 hours in 2007. The workload after class including lesson preparation, grading, tutoring and home visiting ranges from 44.8 hours per week in 2000 to 39.1 hours in 2004 and 39.6 hours in 2007.

Table 6.5: The descriptive statistics for schools in 2000, 2004, and 2007 GSCF survey

Variable	2000		2004		2007	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
No. of teachers left	1.88	2.04	2.52	5.35	1.84	3.50
No. of teachers came	2.26	2.48	3.96	6.13	3.88	6.98
% teachers left	0.15	0.16	0.12	0.21	0.09	0.15
% teachers came	0.17	0.17	0.15	0.24	0.13	0.16
Central school	0.16	0.37	0.17	0.37	0.20	0.40
Boarding school	0.10	0.30	0.24	0.43	0.27	0.44
Primary	0.12	0.32	0.41	0.49	0.35	0.48
Enrollment	335.35	320.34	775.19	844.82	702.12	859.68
% of minority students	0.04	0.15	0.03	0.13	0.03	0.13
No. of classrooms	18.90	15.08	17.85	21.36	16.28	14.55
% of rainproof	0.77	0.36	0.80	0.34	0.79	0.36
% of dilapidated	0.20	0.31	0.23	0.36	0.14	0.24
≤ 5 years of experience	0.21	0.19	0.18	0.16	0.20	0.18
≥ 20 years of experience	0.40	0.27	0.41	0.29	0.39	0.24
% of minority teachers	0.04	0.14	0.02	0.09	0.02	0.10
% of regular teachers	0.81	0.22	0.89	0.16	0.89	0.17
% of college-educated teachers	0.21	0.26	0.58	0.36	0.61	0.33
Wage for regular teachers	587.30	138.31	962.68	172.31	1286.58	224.52
% of villager	0.37	0.31	0.26	0.27	0.25	0.25
Mean age	35.23	5.80	35.10	5.43	36.76	6.25
% of certified teachers	0.78	0.25	0.89	0.17	0.95	0.11
% of level 1 and senior teachers	0.57	0.28	0.54	0.34	0.57	0.31
Mean hours in class	14.95	5.00	12.56	3.92	12.53	3.54
Mean hour after class	44.75	9.61	39.14	11.01	39.56	11.64
N	137	137	221	221	186	186

b. Regression results

Table 6.6 shows the results of OLS regression on proportion of teachers who left schools in last 12 months across three waves. Column 1, 3 and 5 are the results with school characteristics from principal survey. Column 2, 4 and 6 include variables from teacher survey averaged at school level. The first and second models are fitted without fixed effects. The third and fourth models are fitted with district fixed effects and wave dummies. The fifth and sixth models are fitted with District-by-wave fixed effects.

The results show that the monthly wages of regular teachers in a school is significant associated with the proportion of teachers who left a school in last 12 months when the fixed effects are not included. Higher wages are likely to associate with lower proportion of teachers leaving a school. However, when either the township and wave fixed effects or District-by-wave fixed effects are used, the wage effect becomes insignificant. This suggests that once the township contexts are accounted for, wages do not affect the tendency of teachers leaving the schools.

According to the prior research, when there is no compensating wage differential provided for teachers working at hard-to-staff schools within a district, the factors that drive teachers away from a school is more likely to be school working conditions such as school location, student body, and school environment. The results show that school location matters. Being the central school is associated with about 6% lower proportion of teachers leaving the school. The coefficient of boarding school is negative but not significant. While the conditions of school buildings do not matter, except for that higher percentage of dilapidated classrooms are marginally correlated with higher proportion of teachers leaving a school when the fixed effects are not used. When the fixed effects are not included, larger student enrollment and percentage of minority students are significant associated with lower proportion of teacher leaving a school. When the fixed effects are applied, the effect of student composition becomes insignificant. This suggests that when comparing schools across districts, larger schools and schools located in minority concentrated areas tend to experience lower teacher turnover.

As for the teacher composition, when the fixed effects are not used, the results show that higher percentage of general teachers and certified teachers are associated with lower percentage of teachers

leaving a school, while higher percentage of college-graduated teachers are associated with higher percentage of teachers leaving a school. However, when the fixed effects are taken into account, the effects of teacher composition become insignificant. Working hours in class and after class do not matter.. In addition, the results also show that primary schools tend to have more teachers leaving in each year. Whether the fixed effects are included or not, the proportion of teachers leaving a primary school is 12 times that of a middle school.

Table 6.6: Estimation results of OLS regression on proportion of teachers who left the schools

Variable	1	2	3	4	5	6
Central school	-6.381** (2.298)	-6.508** (2.359)	-5.593* (2.345)	-5.909* (2.416)	-6.268* (2.627)	-6.504* (2.727)
Boarding school	-1.689 (1.527)	-2.007 (1.571)	-2.057 (1.774)	-2.658 (1.746)	-1.607 (2.142)	-2.139 (2.156)
Primary	11.534*** (3.083)	11.705*** (3.074)	11.567** (3.481)	12.725*** (3.504)	12.159** (4.216)	11.705** (4.120)
Enrollment	-0.003** (0.001)	-0.002* (0.001)	-0.002+ (0.001)	-0.002 (0.001)	-0.001 (0.001)	-0.001 (0.001)
% of minority students	-0.074+ (0.039)	-0.081* (0.041)	-0.067 (0.054)	-0.054 (0.062)	-0.024 (0.056)	-0.004 (0.066)
No. of classrooms	0.01 (0.035)	0.011 (0.036)	-0.008 (0.034)	0.001 (0.034)	-0.026 (0.049)	-0.026 (0.049)
% of rainproof	0.029 (0.019)	0.032+ (0.019)	0.006 (0.017)	0.01 (0.018)	0.019 (0.021)	0.023 (0.021)
% of dilapidated	0.019 (0.027)	0.011 (0.027)	0.021 (0.027)	0.014 (0.027)	0.027 (0.032)	0.02 (0.031)
≤ 5 years of experience	0.028 (0.043)	0.007 (0.046)	-0.002 (0.053)	-0.017 (0.055)	0.009 (0.063)	-0.007 (0.066)
≥ 20 years of experience	-0.019 (0.036)	-0.001 (0.034)	-0.022 (0.040)	-0.012 (0.038)	-0.009 (0.046)	0.001 (0.043)
% of minority teachers	-0.021 (0.051)	-0.033 (0.054)	0.049 (0.070)	0.034 (0.074)	0.019 (0.082)	-0.016 (0.084)
% of general teachers	-0.113* (0.053)	-0.055 (0.059)	-0.07 (0.055)	-0.022 (0.066)	-0.083 (0.069)	-0.036 (0.081)
% of college-educated teachers	0.103+ (0.052)	0.101+ (0.058)	0.091 (0.058)	0.084 (0.066)	0.095 (0.065)	0.084 (0.072)

Table 6.6 (cont'd)

Variable	1	2	3	4	5	6
Log wage	-7.040** (2.351)	-4.601+ (2.701)	-3.613 (3.686)	-2.842 (3.833)	-3.125 (5.033)	-2.167 (4.894)
% of villager		-0.01 (0.035)		-0.02 (0.039)		-0.042 (0.043)
Mean age		-0.219 (0.186)		-0.092 (0.220)		-0.167 (0.239)
% of certified teachers		-0.116+ (0.064)		-0.1 (0.065)		-0.144+ (0.077)
% of level 1 and senior teachers		0.003 (0.027)		-0.022 (0.028)		0.013 (0.032)
Mean hours in class		0.181 (0.235)		-0.01 (0.234)		0.143 (0.286)
Mean hour after class		0.063 (0.064)		0.106 (0.068)		0.089 (0.074)
District fixed effects	No	No	Yes	Yes	No	No
Wave dummies	No	No	Yes	Yes	No	No
District-by-wave fixed effects	No	No	No	No	Yes	Yes
N	544	544	544	544	544	544

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Columns 1, 3 and 5 control for school characteristics from principal survey;

Columns 2, 4 and 6 also take school means of teacher-level variables from teacher survey;

Columns 1 and 2 do not include any fixed effects;

Columns 3 and 4 include district fixed effects and wave dummies;

Columns 5 and 6 include district-by-wave fixed effects.

Table 6.7 shows the results of OLS regression on proportion of teachers who came to the schools in last 12 months across three waves. The models are fitted in the same way as estimations in Table 6.6. The results show that school location matters. Being the central school in a township is associated with about 6% lower proportion of teachers coming to the school. Being a boarding school is also associated with lower proportion of teachers coming to the school, with about 5% lower when the fixed effects are not used and about 8% when the fixed effects are used. Being a primary school is associated higher proportion of teacher coming to the school only when the fixed effects are not used.

Neither the composition of students nor the conditions of school buildings matter. The results also show that the teacher composition matters. Higher percentage of teachers with less than 5 years of experience is associated with higher proportion of teachers coming to a school. About 1% increase of the percentage of teachers with less than 5 years of experience in a school is associated with about 0.2% increase of the proportion of teachers coming to a school, and the results are consistent without and with fixed effects. On the other hand, higher percentage of certified teachers is associated with lower proportion of teachers coming to a school. Working hours in class and after class do not matter. Additionally, the results show that when school mean variables and the fixed effects of township and wave are taken into account, the monthly wages of regular teachers in a school is associated with lower proportion of teachers who came to the school, but it is only marginally significant. It might be possible that within a township, better school location is likely to be more attractive than wages. It is also possible that teachers are more likely to stay at a school with higher wage. As a result, there are fewer vacancies in the school.

Table 6.7: Estimation results of OLS regression on proportion of teachers who came to the schools

Variable	1	2	3	4	5	6
Central school	-6.645** (2.353)	-6.456** (2.450)	-5.957** (2.148)	-5.748* (2.365)	-6.749** (2.362)	-6.603* (2.570)
Boarding school	-4.782** (1.812)	-5.140** (1.838)	-7.440*** (2.230)	-8.173*** (2.179)	-7.768** (2.651)	-8.362** (2.702)
Primary	5.759* (2.921)	6.215* (2.977)	4.135 (3.107)	5.217 (3.257)	3.593 (3.584)	3.572 (3.607)
Enrollment	-0.001 (0.001)	0 (0.001)	0.001 (0.002)	0.001 (0.002)	0.002 (0.002)	0.002 (0.002)
% of minority students	-0.028 (0.049)	-0.028 (0.053)	0.034 (0.062)	0.043 (0.067)	0.064 (0.065)	0.081 (0.068)
No. of classrooms	-0.003 (0.045)	0.002 (0.047)	-0.044 (0.039)	-0.035 (0.041)	-0.075 (0.053)	-0.077 (0.055)
% of rainproof	0.004 (0.025)	0.007 (0.025)	-0.01 (0.025)	-0.007 (0.026)	-0.003 (0.026)	0 (0.027)
% of dilapidated	-0.021 (0.027)	-0.03 (0.028)	-0.028 (0.031)	-0.039 (0.031)	-0.026 (0.034)	-0.033 (0.034)
≤ 5 years of experience	0.233*** (0.067)	0.224** (0.069)	0.189* (0.073)	0.193** (0.070)	0.175* (0.078)	0.172* (0.076)
≥ 20 years of experience	0.014 (0.038)	0.023 (0.039)	0.014 (0.043)	0.017 (0.044)	0.019 (0.045)	0.024 (0.044)
% of minority teachers	-0.1 (0.071)	-0.108 (0.075)	-0.008 (0.080)	-0.014 (0.081)	-0.037 (0.089)	-0.06 (0.089)
% of general teachers	-0.017 (0.050)	0.047 (0.049)	0.044 (0.054)	0.103+ (0.059)	0.043 (0.066)	0.092 (0.068)
% of college-educated teachers	0.019 (0.044)	0.028 (0.044)	-0.001 (0.049)	0.001 (0.054)	-0.003 (0.053)	-0.003 (0.057)

Table 6.7 (cont'd)

Variable	1	2	3	4	5	6
Log wage	-3.876 (2.545)	-1.943 (2.553)	-9.356* (4.432)	-8.462+ (4.692)	-11.219 (9.687)	-10.563 (9.391)
% of villager		-0.027 (0.036)		-0.054 (0.044)		-0.057 (0.049)
Mean age		0.065 (0.212)		0.204 (0.250)		0.106 (0.243)
% of certified teachers		-0.154** (0.055)		-0.182** (0.061)		-0.193** (0.070)
% of level 1 and senior teachers		-0.015 (0.029)		-0.023 (0.030)		-0.001 (0.038)
Mean hours in class		0.057 (0.260)		-0.16 (0.264)		-0.058 (0.305)
Mean hour after class		0.072 (0.076)		0.098 (0.075)		0.065 (0.087)
District fixed effects	No	No	Yes	Yes	No	No
Wave dummies	No	No	Yes	Yes	No	No
District-by-wave fixed effects	No	No	No	No	Yes	Yes
N	544	544	544	544	544	544

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Columns 1, 3 and 5 control for school characteristics from principal survey;

Columns 2, 4 and 6 also take school means of teacher-level variables from teacher survey;

Columns 1 and 2 do not include any fixed effects;

Columns 3 and 4 include district fixed effects and wave dummies;

Columns 5 and 6 include district-by-wave fixed effects.

6.3 Summary

Regarding the first question — “Are similarly qualified teachers distributed equally across schools?” — the results show that teachers are not distributed equally. On one hand, the teacher quality in terms of college education and certification has improved a lot. There are more teachers graduated from college, and the percentage of certified teachers has also increased substantially. The overall student-teacher ratios have decreased over the years and met the standards. The gaps in the ratio of students to regular teachers and students to college-graduate teachers have been narrowing. At the same time, the percentage of contract teachers has been decreasing, and the gap between schools has been narrowing. However, there are still substantial differences among schools in terms of a variety of measures of teacher qualification. The gap between schools in the percentage of teachers with a college degree has increased substantially. As a result, the gap in the ratio of student to college-graduated teachers between schools remains quite large. The gap in the percentage of level 1 or senior rank teachers also remains large and has increased from 60% in 2000 to 78.3% in 2007. Though the percentage of certified teachers has increased, the gap remains around 45% between schools at 10th and 90th percentiles. In addition, the gap in the percentage of teachers with more than 20 years of experience between schools at 10th and 90th percentiles remains around 80%. Because the teacher quality measures at the school level are highly correlated, schools that have less-qualified teachers as measured by one attribute are also likely to have less-qualified teachers based on other measures. As a result, there are still large gaps among schools in the chances of students’ access to more qualified teachers.

Regarding the first part of the second question — “How do the wages and working conditions influence teacher mobility?” — the findings show that the conditions of school buildings and the workload do not matter, while the school location matters. Being a central school is related to lower proportion of teachers leaving a school and lower proportion of teachers coming to a school. The results are consistent without and with fixed effects. The explanation of negative relationship between being a central school and lower proportion of teachers leaving a school is that central schools usually have better location and better

working conditions. As a result, teachers tend to stay at the school and the proportion of teachers leaving the school tends to be lower. The findings also show that higher wages are likely to reduce the proportion of teachers leaving a school; however, the wage effects disappear when fixed effects are added. The possible explanation is that when there is no compensating wage differential within a district, teachers tend to look for better working conditions. In addition, the results also show that primary schools tend to have more teachers leaving in each year, while the proportion of teachers coming in is not significant larger than that of middle school once fixed effects are used.

Regarding the second part of the question — “How do the compositions of students and teachers influence teacher mobility?” — the findings show that student composition does not matter for either the proportion of teachers leaving a school or the proportion of teachers coming to a school. On the other hand, teacher composition matters. Higher percentage of teachers with less than 5 years of experience is associated with higher proportion of teachers coming to a school. Schools that have higher percentage of certified teachers tend to have lower proportion of teachers leaving and coming to the school in last 12 months. Why do schools with higher percentage of teachers with less than 5 years of teaching experience tend to have higher proportion of teachers coming to the schools? One explanation is the way of allocating new teachers. Regardless of which level of government assumes the authority, new teachers tend to be assigned to rural schools and schools in remote areas. At the same time, younger and inexperienced teachers are more likely to have college degree, because of the college expansion and the rising threshold of being a teacher. Once these teachers gain experience, they tend to move away from rural schools. As a result, those schools that have more inexperienced teachers constantly got novice teachers assigned to them.

7 Teacher-level analysis

7.1 Analytic sample

To examine how the individual teacher characteristics relate to teacher mobility, I draw on teacher survey in 2007 GSCF. There are 2,382 teachers who participated in the survey. Among these teachers, 2,335 from 194 schools in 45 districts across 20 counties have complete data on the variables used in analyses. The numbers of teachers per school range from 1 to 64, with mean of 12 and standard deviation of 11. There are 13 schools with only 1 teacher, 13 school with 2 teachers, and 13 schools with 3 teachers. Given the survey was conducted in rural Gansu, it is reasonable for some schools in remote rural areas to have 1 or 2 teachers. However, there are not enough teachers per school to use school fixed effects to eliminate school-level variation and compare teachers within a school. Thus I use district fixed effects to eliminate cross-district variation and compare teachers within a district. For district fixed effects model, I also control for school covariates and cluster standard errors at school level.

According to the question in 2007 teacher survey — “Do you have other non-teaching jobs before?” — teaching is the first job for most of the teachers in the sample. Among 2,382 teachers, 3% had other jobs before being a teacher. 98.8% teachers were younger than 30 years when entering teaching. 28.9% teachers entering teaching between the age 23 and 26. Because teachers’ age is highly correlated to years of teaching experience, I choose to include only teaching experience in the analysis. Table 7.1 describes the status of teacher mobility. On average, about 55.4% teachers participated in 2007 survey had switched schools at least once. 54.5% of those who switched schools did so within the first 5 years, and 28.2% after 10 years, 14.9% after 15 years, and 7.6% after 20 years of staying at their first schools.

Table 7.2 shows the number of times a teacher has switched schools and the number of years he or she spent teaching in each school. The table includes teachers who have taught at 5 or fewer schools. There are fewer than 10 teachers who have taught at more than 5 schools. The following analysis also does not include teachers who have taught at more than 5 schools. The majority teachers teach in only 1 or 2 schools. About 23.2% teachers teach in 3 or more schools. A teacher who teaches in 1 school until the time he or she was surveyed spends 9.8 years on average at the school. A teacher who teaches in 2

schools spends 7.7 years on average at each school. A teacher who teaches in 3 schools spends 7.1 years in the first school, 5.4 years in the second school, and 6.7 years in the third school. The more schools a teacher teaches, the shorter the time span in each school, but the time span in the last school tends to become longer, indicating that the teacher may find the one they want to stay, or it is difficult for he or she to transfer any more.

Table 7.3 provides the descriptive statistics of teacher variables. The first placements of 56.4% teachers were not the districts where the teachers were born. 60.5% teachers are male. 15.8% teachers are single. The average teaching experience is about 14.4 years. 37.4% teachers graduated from college. 61% teachers graduated from normal college or normal secondary school. 57.9% teachers have received further education and upgraded their education credential after entering teaching. 89.5% are regular teachers. 95.4% are certified teachers. In the teacher certification exam, 69.7% scored above 80 out of 100 in pedagogy. 89.5% teachers are regular teachers. 51.1% teachers are level 1 or senior teachers. The average monthly wage was 1,220.1.

Table 7.1: Description of teacher mobility status

	Total	Percentage
Whether or not have switched schools		
Switched at least once	2380	55.4%
Whether or not have switched schools		
0	2380	44.6%
1	2380	31.8%
≥ 2	2380	23.6%
Years until first move		
≤ 5	1320	54.5%
≥ 10	1320	28.2%
≥ 15	1320	14.9%
≥ 20	1320	7.6%

Table 7.2: The number of schools a teacher teaches and the average number of years in each school

Total number of schools	% Teachers	School 1	School 2	School 3	School 4	School 5
1	44.9%	9.8(9.1) ^a				
2	32.0%	7.7(7.0)	7.7(6.4)			
3	13.0%	7.1(6.8)	5.4(4.5)	6.7(5.8)		
4	7.6%	6.5(5.6)	4.8(4.0)	5.1(4.2)	5.9(5.7)	
5	2.6%	5.9(6.3)	4.7(4.0)	5.1(3.7)	3.9(2.9)	5.6(5.1)
Total	2366	2366	1304	548	241	62

a. Standard deviation

Table 7.3: The descriptive statistics of teacher level variables

Variable	Mean	Std. Dev.
Assignment	0.56	0.50
Male	0.61	0.49
Single	0.16	0.36
Experience	14.40	10.20
Teach middle school	0.48	0.50
College degree	0.37	0.48
Normal school	0.61	0.49
Further education	0.58	0.49
Certified	0.95	0.21
General teachers	0.90	0.31
Level 1 or senior	0.51	0.50
Monthly wage	1220.07	396.11
Exam score	0.70	0.46

7.2 Descriptive statistics

7.2.1 Characteristics of teachers who moved versus who stayed

Columns 1, 2 and 3 in Table 7.4 show the results of comparing teachers who have switched schools at least once to teachers who have remained at the same school. The results show that compared to teachers who have not moved until 2007 when the survey was conducted, teachers who have switched schools were more likely to be assigned the first time to districts outside their home districts. They were more likely to be male, married and had more years of teaching experience. These teachers were also more likely to be general, certified and level 1 or senior teachers, and their monthly wages tended to be higher. On the other hand, they were less likely to have college education and less like to be graduates from normal colleges or normal secondary schools. Columns 4, 5 and 6 compare teachers who have switched more than once to teachers who have switched once. The pattern is similar except for that those teachers moved more than once tend to be assigned to their home districts for the first time compared to teachers who moved only once. In general, the differences are closely related the age and teaching experience. Teachers who had switched schools, on average, were older, thus tended to have less education, while have more teaching experience, got higher professional ranks, and earned more than younger teachers. In addition, primary school teachers are more likely to switch schools, while secondary school teachers are less likely to switch schools.

Table 7.4: Comparing teacher attributes by mobility status

Variables	Stayer	Mover	Mean Diff	Move once	Move ≥ 1	Mean Diff
Assignment	0.51	0.607	-0.097***	0.629	0.577	0.052*
Male	0.555	0.646	-0.090***	0.59	0.721	-0.131***
Single	0.259	0.076	0.183***	0.116	0.022	0.094***
Experience	10.307	17.702	-7.395***	15.549	20.597	-5.048***
Teach middle school	0.59	0.396	0.194***	0.49	0.269	0.221***
College degree	0.535	0.245	0.290***	0.323	0.14	0.183***
Normal school	0.631	0.594	0.037*	0.622	0.555	0.067**
Further education	0.476	0.663	-0.187***	0.645	0.686	-0.041
Certified	0.935	0.97	-0.035***	0.961	0.982	-0.021**
Regular teachers	0.866	0.919	-0.053***	0.906	0.936	-0.031**
Level 1 or senior	0.321	0.664	-0.343***	0.567	0.795	-0.228***
Monthly wage	1096.427	1319.876	-223.450***	1281.134	1371.978	-90.845***
Exam score	0.687	0.705	-0.018	0.714	0.693	0.021
N	1043	1292		741	551	

7.2.2 Characteristics of teachers who moved earlier versus who move later

Columns 1, 2 and 3 in Table 7.5 compare teachers who moved within the first 5 years to teachers who moved after 10 years since entering teaching. Teachers who moved earlier are more likely to be assigned to districts which are not their home districts, and they are also less likely to be villager where the current schools located. These teachers tend to be younger, female and single with less teaching experience. They are more likely to be graduated from normal college, while less likely to have high professional rank. More of them work as contract teachers. They also earn less. These differences are likely to be related to teaching experience. The results also show that primary school teachers are less likely to move early in their career, while secondary school teachers are more likely to move early. Columns 4, 5 and 6 compare teachers who moved after 10 years versus earlier. The first assignment of late movers is more likely to be districts where they were born. They tended to be older, male and married with less education but more teaching experience. They are more likely to be regular teachers with higher professional ranks, thus earn more, which is also highly related to years of teaching experience. Primary school teachers are more likely to move later, while secondary teachers are less likely to do so.

Besides comparing the timing of moves, I also examine the difference between teachers who moved from rural to town or county schools (move up) versus other teachers, including teachers who move from county or town to rural schools (move down) and teachers who move between schools of the same level. I also compare characteristics of teachers who moved down versus other teachers. There is not much difference between teachers move downward and the other teachers, except for that these teachers are more likely to be assigned the first time to schools outside their home districts. Teachers whose first move is upward are also more likely to be assigned to schools outside the home districts. In addition, these teachers tend to be younger, female teachers with college education (see Table 7.6).

Table 7.5: Comparing teacher attributes by timing of move

Variables	Other	Early move	Mean Diff	Other	Late move	Mean Diff
Assignment	0.527	0.672	-0.145***	0.663	0.466	0.197***
Male	0.724	0.581	0.144***	0.59	0.784	-0.195***
Single	0.007	0.133	-0.126***	0.103	0.008	0.095***
Experience	23.39	13.01	10.381***	14.368	25.978	-11.610***
Teach middle school	0.349	0.434	-0.084***	0.436	0.294	0.143***
College degree	0.147	0.325	-0.178***	0.311	0.081	0.230***
Normal school	0.521	0.654	-0.133***	0.635	0.491	0.145***
Further education	0.658	0.667	-0.009	0.67	0.644	0.026
Certified	0.973	0.968	0.005	0.969	0.973	-0.005
Regular teachers	0.94	0.901	0.039**	0.906	0.951	-0.046***
Level 1 or senior	0.786	0.564	0.222***	0.59	0.849	-0.259***
Monthly wage	1429.25	1229.658	199.592***	1265.08	1455.906	-190.825***
Exam score	0.69	0.718	-0.027	0.72	0.668	0.051*
N	584	708		921	371	

Table 7.6: Comparing teacher attributes by direction of mobility

Variables	Other	Upward	Mean Diff	Other	Downward	Mean Diff
Assignment	0.565	0.775	-0.210***	0.571	0.818	-0.247**
Male	0.727	0.6	0.127*	0.719	0.682	0.037
Single	0.019	0.075	-0.056**	0.024	0	0.024
Experience	20.511	18.05	2.461*	20.327	20.227	0.1
Teach middle school	0.257	0.4	-0.143**	0.273	0.136	0.137
College degree	0.137	0.25	-0.113*	0.148	0.091	0.057
Normal school	0.569	0.625	-0.056	0.573	0.591	-0.018
Further education	0.689	0.65	0.039	0.685	0.727	-0.043
Certified	0.983	0.975	0.008	0.982	1	-0.018
Regular teachers	0.936	0.95	-0.014	0.934	1	-0.066
Level 1 or senior	0.801	0.725	0.076	0.79	0.909	-0.119
Monthly wage	1367.843	1424.4	-56.557	1365.493	1524.182	-158.689**
Exam score	0.7	0.775	-0.075	0.699	0.864	-0.165*
N	483	40		501	22	

7.2.3 Characteristics of teachers by reason to move

Table 7.7 describes the reason why teacher switched schools. The table shows that more teachers move for their families the first time. About 25% teachers among 1268 indicate that they moved for families. About 18% teachers indicate that they moved for better working and living conditions. Over time, the percentage of teachers move for families decreased, while the percentage of teachers move for personal development stayed the same. On the other hand, about half of the teachers indicate they are transferred by the governments the first time. Over time, the percentage of teachers transferred by the governments increased from 48% to 70%.

Table 7.7: Reasons why moving to other schools in 1st, 2nd, 3rd, and 4th moves (%)

Reason	1st move	2nd move	3rd move	4th move
Personal/family reason	24.53	15.91	9.91	10.61
Better working condition	14.12	13.36	6.9	15.15
Better living condition	3.55	4.32	3.45	1.52
Transfer by county education bureau	5.91	4.32	4.31	3.03
Transfer by district education office	42.51	53.44	68.53	66.67
School consolidation	3.79	3.93	3.02	.
Others	5.6	4.72	3.88	3.03
Total	1268	509	232	66

I generated a binary variable which equals 1 if a teacher chooses to move for family or personal development, and equals 0 if a teacher is reallocated by the school district or county government or because of structural changes due to school consolidation. Table 7.8 compares teachers who indicate that they move for personal reasons (voluntary transfer) to teachers who were transferred by the government (involuntary transfer). In general, teachers who claim that they choose to move for personal reasons are more likely to be assigned the first time outside their home districts. More female teachers indicate that they choose to move for personal reasons, while more male teachers indicate that they are transferred by the government. Younger teachers and teachers with college degree are more likely to choose to move for personal reasons, while more experienced teachers are more likely to be reallocated by the governments.

Table 7.8: Comparing teacher attributes by reason to move

Variables	1st move			2nd move		
	Involun -tary	Volun -tary	Mean Diff	Involun -tary	Volun -tary	Mean Diff
Assignment	0.478	0.754	-0.276***	0.514	0.709	-0.195***
Male	0.742	0.542	0.200***	0.784	0.616	0.168***
Single	0.087	0.048	0.039***	0.016	0.017	-0.002
Experience	18.21	17.291	0.919*	20.978	19.634	1.344
Teach middle school	0.377	0.41	-0.033	0.241	0.291	-0.049
College degree	0.21	0.276	-0.066***	0.117	0.18	-0.063*
Normal school	0.564	0.616	-0.052*	0.552	0.599	-0.046
Further education	0.661	0.669	-0.008	0.702	0.669	0.033
Certified	0.968	0.972	-0.004	0.987	0.988	-0.001
Regular teachers	0.911	0.927	-0.016	0.94	0.942	-0.002
Level 1 or senior	0.685	0.652	0.033	0.825	0.773	0.052
Monthly wage	1335.548	1306.968	28.579	1390.997	1362.919	28.078
Exam score	0.688	0.723	-0.035	0.702	0.703	-0.002
N	663	537		315	172	

Table 7.8 (cont'd)

Variables	3rd move		Mean Diff	4th move		Mean Diff
	Involun -tary	Volun -tary		Involun -tary	Volun -tary	
Assignment	0.435	0.681	-0.246***	0.391	0.778	-0.386***
Male	0.87	0.681	0.189***	0.935	0.833	0.101
Single	0.006	0.021	-0.016	0	0	0
Experience	23.22	18.83	4.391***	25.935	19.333	6.601***
Teach middle school	0.186	0.191	-0.005	0.065	0.5	-0.435***
College degree	0.079	0.128	-0.049	0.022	0.278	-0.256***
Normal school	0.537	0.532	0.005	0.5	0.5	0
Further education	0.655	0.681	-0.025	0.652	0.667	-0.014
Certified	0.989	0.979	0.01	1	1	0
Regular teachers	0.949	0.915	0.034	1	1	0
Level 1 or senior	0.887	0.809	0.078	1	0.833	0.167***
Monthly wage	1442.073	1308.766	133.307**	1595.696	1448.111	147.585**
Exam score	0.655	0.596	0.06	0.587	0.556	0.031
N	177	47		46	18	

7.3 Is there any “hometown” effect?

7.3.1 How does a teacher’s initial placement affect teacher mobility

Table 7.9 shows the estimation results. For each set of regression, the first model only includes teacher-level variables. The second model takes school-level variables into account. The third model also includes school-level averages of teacher attributes. All six models use district fixed effects with standard errors clustered within schools.

Columns 1, 2, and 3 present the results of binomial logit regression in odds ratios. The coefficient on the initial placement shows that a teacher who is assigned to a school outside the district where he or she was born is 2.74 times more likely to switch schools compared to teachers who are assigned to schools located within the home districts. Overall, male teachers are more likely to switch schools, which is consistent with some previous report on teacher mobility. When controlling for teaching experience, receiving further education, being level 1 or senior rank teachers and earning higher wages are associated with higher probability to switch schools, while working as regular teachers and having college degree when entering teaching are related to lower probability of switching schools, which is different from the previous beliefs that teachers with higher level of educational background tend to have higher turnover rates, and that regular teachers are more likely to move around compared to contract teachers.

Columns 4 to 9 present the results of multinomial logit regression in relative risk ratios using teachers who had switched schools once as the reference category. The outcomes in columns 4, 6 and 8 are the probability of staying at the same school. The outcomes in columns 5, 7 and 9 are the probability of switching schools more than once. Columns 4 and 5 present the results of the first model which only includes teacher-level variables. Columns 6 and 7 present the results of the second model which takes school-level variables into account. Columns 8 and 9 present the results of the third model which also includes school-level averages of teacher attributes. All six models use district fixed effects with standard errors clustered within schools. The pattern of teachers who moved more than once compared to teachers who moved once is similar to that of teachers who moved compared to who stayed. The results show that a teacher whose initial placement is outside the home district is 1.5 times more likely to switch schools

more than once. Male teachers, experienced teachers and level 1 or senior teachers are more likely to move more than once. The only difference is that single teachers are less likely to move more than once when years of teaching experience is controlled for. Additionally, the coefficient on central school in the set of school variables show that the probability of ever moving to other schools might be higher for teachers currently teaching at central schools, however it does not differ significantly from teachers currently teaching at non-central schools.

The results using the current status of teachers also show that, when the survey was conducted in 2007, teachers with level 1 or senior professional ranks are more likely to have switched schools once or more than once in their career. The unclear issue is whether a teacher is more likely to switch schools after getting promoted, or a teacher is more likely to get promoted after moving to another school? One of the reasons of asking this question is that the total amount of the posts for level 1 and senior ranks available within a district is limited. The number of teachers eligible for promotion always exceeds the number of available posts. As a result, teachers have to compete for promotion. Moreover, the posts are assigned to districts then allocated to schools. The quotas across schools within a district might differ. As a result, it is possible that teachers with higher professional ranks have more choices and are more likely to move. It is also possible that teachers tend to move to schools where they have better chances of getting promoted.

Table 7.9: Estimation results of binomial and multinomial logit regression on teacher mobility status

Variable	Binomial logit models ^a			Multinomial logit models ^b					
	Move	Move	Move	Stay	Move>1	Stay	Move>1	Stay	Move>1
Initial placement not home	2.552*** (0.354)	2.723*** (0.367)	2.741*** (0.365)	0.427*** (0.066)	1.329+ (0.209)	0.411*** (0.061)	1.485* (0.243)	0.404*** (0.060)	1.453* (0.239)
Male	1.277* (0.154)	1.322* (0.162)	1.321* (0.163)	0.921 (0.124)	1.682** (0.287)	0.884 (0.120)	1.674** (0.294)	0.88 (0.122)	1.681** (0.303)
Single	0.743 (0.147)	0.772 (0.154)	0.784 (0.159)	1.087 (0.208)	0.296*** (0.099)	1.053 (0.205)	0.292*** (0.101)	1.048 (0.210)	0.294*** (0.104)
Experience	1.047*** (0.011)	1.045*** (0.012)	1.045*** (0.012)	0.967** (0.010)	1.029** (0.009)	0.967** (0.011)	1.026** (0.010)	0.967** (0.012)	1.026** (0.010)
Teach middle school	0.523*** (0.091)	0.639 (0.189)	0.655 (0.196)	1.417+ (0.260)	1.335 (0.398)	1.356 (0.418)	0.428*** (0.078)	0.716 (0.237)	0.689 (0.232)
College	0.641** (0.104)	0.637** (0.103)	0.652* (0.108)	1.466* (0.242)	0.755 (0.148)	1.474* (0.251)	0.791 (0.169)	1.436* (0.251)	0.771 (0.164)
Normal school	1.01 (0.121)	1.007 (0.122)	0.991 (0.119)	0.977 (0.126)	0.961 (0.132)	0.984 (0.128)	0.963 (0.139)	0.994 (0.128)	0.945 (0.136)
Further education	1.638*** (0.221)	1.654*** (0.234)	1.674*** (0.241)	0.655** (0.099)	1.282+ (0.189)	0.658** (0.104)	1.361+ (0.228)	0.648** (0.103)	1.353+ (0.226)
Certified	1.246 (0.334)	1.2 (0.330)	1.09 (0.322)	0.859 (0.240)	1.367 (0.734)	0.902 (0.262)	1.412 (0.742)	0.943 (0.298)	1.298 (0.722)
Regular teacher	0.371* (0.153)	0.419* (0.180)	0.439+ (0.190)	2.435* (1.054)	0.757 (0.311)	2.221+ (1.002)	0.79 (0.341)	2.117+ (0.963)	0.789 (0.355)
Level 1 or senior	1.473* (0.243)	1.425* (0.242)	1.475* (0.261)	0.781 (0.130)	1.621* (0.348)	0.825 (0.142)	1.677* (0.356)	0.789 (0.144)	1.680* (0.360)
Monthly wage	1.934* (0.559)	2.030* (0.611)	1.876* (0.577)	0.538* (0.170)	1.053 (0.325)	0.530+ (0.172)	1.153 (0.373)	0.583 (0.195)	1.195 (0.405)
Test score 80	1.086 (0.117)	1.135 (0.123)	1.161 (0.128)	0.946 (0.111)	1.1 (0.152)	0.913 (0.107)	1.14 (0.162)	0.889 (0.105)	1.138 (0.161)

Table 7.9 (cont'd)

Variable	Move	Move	Move	Stay	Move>1	Stay	Move>1	Stay	Move>1
School variables	No	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Central school		1.17 (0.281)	1.248 (0.333)			1.043 (0.252)	1.534+ (0.361)	0.952 (0.268)	1.429 (0.339)
School means	No	No	Yes	No	No	No	No	Yes	Yes
N	2335	2335	2335	2335	2335	2335	2335	2335	2335

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

a. Teachers who stay at the same school as reference category

b. Teachers who switched school once as reference category

Columns 1, 4 and 5 do not take school-level variables and school means of teacher-level variables into account;

Columns 2, 6 and 7 control for school-level variables;

Columns 3, 8 and 9 control for school-level variables and school means of teacher-level variables.

Table 7.10 shows the estimation results of binomial logit regression on early career move and late career move. The two sets of models are fitted in the same way as models in Table 7.9. The coefficient on the initial placement shows that the probability of moving early in one's career for a teacher whose initial placement is outside the home district is slightly higher compared to teachers who are assigned to schools within the home districts. However it is only marginally significant. On the other hand, being assigned to schools outside home district tends to reduce the probability of late career move. Controlling for teaching experience, teachers not married (3.4 times) and certified teachers (3.5 times) are more likely to have early career move. While the marriage status do not matter in late career move after entering teaching for more than ten years, and having teacher certification is likely to reduce the probability of late career move.

Table 7.10: Estimation results of binomial logit regression on early and late career moves

Variable	Early move			Late move		
	1	2	3	4	5	6
Initial placement not home	1.175 (0.188)	1.273 (0.217)	1.387+ (0.238)	0.73 (0.150)	0.695+ (0.148)	0.636* (0.138)
Male	1.076 (0.205)	1.108 (0.215)	1.141 (0.226)	1.3 (0.267)	1.236 (0.271)	1.203 (0.278)
Single	3.523* (1.842)	3.700* (1.978)	3.428* (1.782)	1.008 (0.504)	0.943 (0.476)	0.973 (0.484)
Experience	0.857*** (0.011)	0.854*** (0.012)	0.857*** (0.012)	1.203*** (0.015)	1.206*** (0.016)	1.205*** (0.016)
Teach middle school	0.933 (0.171)	0.604 (0.204)	0.789 (0.284)	0.981 (0.241)	0.763 (0.396)	0.546 (0.366)
College	0.886 (0.268)	0.852 (0.246)	0.934 (0.272)	0.808 (0.233)	0.906 (0.259)	0.834 (0.254)
Normal school	1.136 (0.171)	1.082 (0.167)	1.089 (0.170)	1.163 (0.207)	1.284 (0.229)	1.376+ (0.260)
Further education	0.833 (0.152)	0.821 (0.152)	0.893 (0.172)	1.424 (0.375)	1.535 (0.408)	1.379 (0.384)
Certified	2.821+ (1.619)	3.186* (1.832)	3.455* (2.031)	0.207* (0.149)	0.201* (0.148)	0.210* (0.160)
Regular teacher	1.39 (0.881)	1.604 (1.109)	1.706 (1.201)	1.558 (0.870)	1.404 (0.799)	1.289 (0.730)
Level 1 or senior	1.344 (0.344)	1.418 (0.394)	1.305 (0.377)	0.876 (0.195)	0.799 (0.188)	0.859 (0.210)
Monthly wage	0.701 (0.292)	0.633 (0.290)	0.6 (0.281)	1.156 (0.495)	1.261 (0.573)	1.269 (0.557)
Test score ≥ 80	0.99 (0.163)	0.956 (0.163)	0.896 (0.157)	0.981 (0.201)	0.96 (0.201)	1.06 (0.225)
School variables	No	Yes	Yes	No	Yes	Yes
Central school		1.379 (0.339)	1.317 (0.300)		0.966 (0.290)	1.011 (0.296)
School means	No	No	Yes	No	No	Yes
N	1287	1287	1287	1261	1261	1261

+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Columns 1 and 4 do not take school-level variables and school means of teacher-level variables into account;

Columns 2 and 5 control for school-level variables;

Columns 3 and 6 control for school-level variables and school means of teacher-level variables.

How to explain why those teachers whose initial placement is not home districts are more likely to switch schools? One explanation is that teachers who are assigned outside home districts want to move nearer or back to their hometown. Another explanation is that these teachers have their own preferences and are more aggressive in planning their career paths. The comparison between voluntary and involuntary transfer in Table 7.8 indicates that teachers whose initial placement is outside their home districts are more likely to move for personal reasons instead of transferred by the governments. The next step is to distinguish between moving for one's family or personal development.

7.3.2 How does a teacher's initial placement relate to reasons to move?

Table 7.11 shows the estimation results in relative risk ratios using family reason as reference category. The outcome in columns 1 and 3 are the probability of moving to other schools the first time as a result of deployment by government. The outcome in columns 2 and 4 are the probability of moving to other schools for personal reason. Columns 1 and 2 present the results of the first model which only includes teacher-level variables without district fixed effects. Columns 3 and 4 present the results of the second model which takes district fixed effects into account. The coefficient on the initial placement shows that that teachers whose initial placement is not home district are more likely to move in order to live with family than move in pursuit of personal development (odds ratio 47.5% lower), or transferred by the governments (odds ratio 71% lower).

Table 7.11: Estimation results of multinomial logit regression on reasons to move ^a

Variable	Transfer by Government (without FE)	Personal Reason (without FE)	Transfer by Government (with FE)	Personal Reason (with FE)
Assignment	0.241*** (0.054)	0.607+ (0.155)	0.292*** (0.069)	0.525* (0.133)
Male	2.610*** (0.398)	1.472 (0.360)	2.117*** (0.388)	1.489+ (0.336)
Single	3.442** (1.450)	2.392* (1.028)	3.321** (1.522)	2.184 (1.057)
Experience	0.970* (0.012)	0.977 (0.016)	0.982 (0.014)	0.983 (0.016)
Teach middle school	1.008 (0.216)	1.239 (0.272)	1.011 (0.202)	1.236 (0.285)
College	1.005 (0.245)	1.484 (0.411)	0.982 (0.266)	1.468 (0.420)
Normal school	1.063 (0.175)	1.204 (0.214)	1.019 (0.180)	1.159 (0.231)
Further education	0.867 (0.152)	1.02 (0.230)	0.799 (0.145)	0.986 (0.231)
Certified	0.653 (0.411)	0.376 (0.258)	1.261 (0.783)	0.493 (0.328)
Regular teacher	0.422+ (0.209)	0.701 (0.439)	0.739 (0.439)	0.764 (0.567)
Level 1 or senior	1.34 (0.305)	1.489 (0.416)	1.32 (0.288)	1.465 (0.399)
Monthly wage	2.578** (0.852)	2.246* (0.863)	2.018 (0.872)	1.644 (0.736)
Test score ≥ 80	1.113 (0.183)	0.978 (0.166)	1.099 (0.196)	1.007 (0.202)
District fixed effects	No	No	Yes	Yes
N	1200	1200	1200	1200

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

a. family reason as reference category

7.4 Are better teachers more likely to switch schools?

The results of logit regression in the second part find correlation between higher ranks and higher probability of ever switched schools. Next, I want to examine whether a teacher tend to move after get promoted to level 1 or senior rank and the influence of the end-of-year evaluation results on the probability of switching schools the next year.

7.4.1 Analytic sample

In preparing the data, I mainly draw from Cleves et al.'s (2010) "An Introduction to Survival Analysis Using Stata", Cleves' (2000) "Analysis of Multiple Failure-time Data with Stata", and Stata's survival analysis manual.

I construct a retrospective person-period dataset using 2007 GSCF teacher survey data. For each individual, the record starts when he or she enters teaching, which contains individual's age, gender, educational background, initial placement, whether got teacher certification, and whether worked as a contract teacher. Table 7.12 provides an example. In this sample, individual 1 is female, and was 19 years old when entering teaching as a regular teacher. At that time she did not have college education, nor did she graduated from normal college or secondary normal school. She has got teacher certification. Her initial placement was in the district where she was born. The data for the others can be interpreted in the same way.

Table 7.12: Sample of the formation of original data

Subject ID	DOB	Age	Male	College graduated	Normal school	Initial placement	Certified teacher	Contract teacher
1	1981	19	0	0	0	0	1	0
2	1972	20	0	0	1	1	1	0
3	1974	20	0	0	1	0	1	0
4	1965	20	1	0	0	0	1	0
5	1953	21	1	0	0	0	1	0
6	1974	21	0	0	1	0	1	0
7	1957	22	0	0	0	0	1	0

The outcome variable in survival analysis is the time until the occurrence of an event, such as mortality, illness, and fertility. The survival analysis estimates the probability of waiting time to the occurrence of an event of interest, given an individual has survived up to the event. The structure of the data is a certain span of time divided into mutually exclusive states. As time goes, individuals either change or do not change states. The observations are defined as censored when the event has not occurred at the time points of analysis. Table 7.13 provides an example. $_t0$ is the analysis time when record begins. $_t$ is the outcome variable, which is the analysis time when record ends. $_d$ equals 1 if an individual switch schools, 0 if censored. Individual 1 switched schools at age 22. She had 3 years of teaching experience and received further education at that time. Individual 2 switched schools twice. The first time was when she taught for 1 year. The second time was when she taught for 3 years. The Individual 7 stayed at the same school when the surveyed was conducted in 2007. At that time she was 50 years old, did not get further education, and had 28 years of teaching experience. The data for the others can be interpreted in the same way.

Table 7.13: Sample of the formation of the data used in survival analysis

Subject ID	Age when moved	Further education	Experience	$_t0$	$_t$	$_d$
1	22	1	3	0	3	1
2	21	1	1	0	1	1
2	23	1	3	1	3	1
3	23	1	3	1	3	1
4	36	1	16	0	16	1
5	48	1	27	0	27	1
6	24	0	3	0	3	1
6	27	0	6	3	6	1
7	50	0	28	0	28	0

The estimation of Cox model is based on forming the risk set at each failure time, and then maximizing the conditional probability of failure. Therefore, the waiting time when failures occur are not used in the analysis. What is used is the ordering of the failures. When subjects failed at the same time, the ordering of failures is not clear. There are several approaches to deal with the problem. This study applies Efron

approximation. According to Cleves et al. (2010), this approximation is more accurate than Breslow's approximation in Stata. In addition, the data used in this analysis is multiple-failure data, where sometimes two or more events occur for one individual.¹⁵ In analyzing multiple-failure data using Cox regression model, the records for each individual need to be split at all observed failures (Cleves, 2000). The way to form the multiple-failure data and generate time-variant covariates is described in detail in "stset" and "stsplit" sections in Stata manual for survival analysis. Table 7.14 displays an example of the data for Cox regression model. The maximum time of school transfer for a teacher is 3. The record for each teacher is divided into three observations. The time duration for each observation is one year, which means that there are teachers moving to other schools each year. For the first teacher, she entered teaching when she was 20, and moved to another school when she was 22. For the second teacher, she entered teaching at 21, and moved to another school the first year and the third year. For the third teacher, she entered teaching at 21, and moved to another school in the third year.

¹⁵ The occurrence of an event is referred as failure using terminology in survival analysis.

Table 7.14: Sample of the formation of data used in Cox proportional model

Subject ID	DOB	Age	Male	Experience	College graduated	Normal school	Further education	Initial placement	Certified teacher	Contract teacher	_t0	_t	_d
1	1981	20	0	1	0	0	1	0	1	0	0	1	0
1	1981	21	0	2	0	0	1	0	1	0	1	2	0
1	1981	22	0	3	0	0	1	0	1	0	2	3	1
2	1972	21	0	1	0	1	1	1	1	0	0	1	1
2	1972	22	0	2	0	1	1	1	1	0	1	2	0
2	1972	23	0	3	0	1	1	1	1	0	2	3	1
3	1974	21	0	1	0	1	1	0	1	0	0	1	0
3	1974	22	0	2	0	1	1	0	1	0	1	2	0
3	1974	23	0	3	0	1	1	0	1	0	2	3	1

Table 7.15 displays the structure of the data used in the analysis. There are 2,382 subjects in the data with 24,065 records. The average number of records per subject is over 10, with 39 being the maximum number of records for any one subject, and 1 being the minimum number. In line 3 and 4, the table reports that everyone entered at time 0. The average exit time was 10.3 years, with a minimum of 1 and a maximum of 43. This is just the average of the follow-up time, not the average survival time because some of the subjects are censored. In line 5 and 6, the table reports that there are no gaps between each time span. Line 7 shows that subjects were at risk of failure for a total of 24,072 years. This is calculated by summing the length of the interval $(_t0, _t]$ of all records. Line 8 reports that there were 2,074 failures in the data. It should be noted that this data has been split at all observed failure times.

Table 7.15: The structure of the data used in the analysis

```

failure _d: move == 1
analysis time _t: (move_end-origin)
              origin: time move_begin
exit on or before: time .
id: tid

```

Category	total	per subject			
		mean	min	median	max
no. of subjects	2328				
no. of records	24065	10.3372	1	7	39
(first) entry time		0	0	0	0
(final) exit time		10.34021	1	7	43
subjects with gap	0				
time on gap if gap	0	.	.	.	.
time at risk	24072	10.34021	1	7	43
failures	2074	.8908935	0	1	4

7.4.2 Results

Table 7.16 shows the results of the influence of higher professional rank on the probability of teachers switching schools. The coefficients on the level 1 or senior professional rank shows that the odds of switching schools for level 1 or senior teachers are 49% higher compared to teachers with lower professional ranks. The finding suggests that a teacher with middle or senior professional rank, who is seen as better teachers, is more likely to leave a school and move to another school.

Table 7.16: The influence of professional rank on the risk to switch schools

Variable	
Level 1 or senior	1.489*** (0.118)
Initial placement	1.599*** (0.120)
Male teacher	1.012 (0.078)
Contract teacher	0.762 (0.228)
College degree	0.658*** (0.057)
Experience	0.981 (0.017)
Further education	1.300*** (0.087)
District fixed effects	Yes
N	12576
+ p<0.10, * p<0.05, ** p<0.01, *** p<0.001	

In order to examine the effects of teacher evaluation result in the previous year on the probability of teachers switching schools in the following year, I generate a sample which includes the teachers who switched schools in 2004, 2005, 2006 and 2007 with only the evaluation scores of the previous year. For example, for teachers who moved in 2004, only the evaluation score in 2003 is kept. In this way, I can examine the immediate influence of the teacher evaluation results. Table 7.17 shows the estimation results. Only the coefficients on the variable of evaluation score are presented in the tables. The results show that

achieving an excellent on previous year's evaluation does not affect the mobility status the next year, while failing to pass previous year's evaluation significantly increases the odds of moving to other schools in the following year, while teachers who got "good" or "pass" are more likely to remain at their current schools.

Table 7.17: The influence of teacher evaluation result on the risk to switch schools

Coefficient on evaluation results	
Excellent	1.047 (0.127)
Good	0.984 (0.092)
Pass	0.894 (0.079)
Fail	3.699** (1.806)
N	4550

7.5 Summary

In the teacher-level analysis, I first use binomial and multinomial logit models to answer three questions:

- How does a teacher's initial placement affect whether that teacher switches schools?
- How does a teacher's initial placement affect whether that teacher switches schools early or late in the career?
- How does a teacher's initial placement relate to reasons to move?

Regarding the first question, I find that teachers who are assigned to a school outside the district where they were born are more likely to switch schools compared to teachers who are assigned to a school located within their hometown district. Regarding the second question, I find that being assigned to a school outside one's home district is only marginally associated with the timing of a move. Being assigned to a school in an outside district tends to increase the probability of a move within the first 5 years and reduce the probability of a move later in one's career. However, this is only marginally

significant, and thus should be interpreted with caution. Why those teachers assigned to schools outside their home districts more likely to switch schools? One explanation is that teachers who are assigned away from home districts want to move nearer to their hometown, which is how the “draw of home” works. Another explanation is that teachers who work at schools in other districts have their own preferences and are more aggressive in planning their career path. When assigning teachers to school districts, the county education bureaus tend to allocate teachers to their hometown; therefore it is likely that these teachers have a preference for certain schools and locations and indicate an intention to work there.

Regarding the second question, the results show that the probability of moving early in one’s career for a teacher whose initial placement is outside the home district is slightly higher compared to teachers who are assigned to schools within the home districts. However it is only marginally significant. On the other hand, being assigned to schools outside home district tends to reduce the probability of late career move.

Regarding the third question, I examine the relationship between teachers’ initial placement and their reasons for switching schools, and find that teachers who work at schools outside their home districts are more likely to leave their initial school for family reasons. Although it remains a challenge to further identify the underlying mechanisms that drive such moves, what is conclusive is that the turnover rate is higher for teachers who are assigned to schools outside their home district compared to teachers who are assigned to work in their home district.

Next, I use survival analysis to find out whether better teachers are more likely to switch schools:

- a. Are teachers with higher professional ranks more likely to switch schools?
- b. Are teachers with higher end-of-year evaluation scores more likely to switch schools?

Regarding the first question, I find that teachers with middle- or senior-level professional ranks are more likely to move to another school. The available data cannot identify where and what kind of schools these teachers move to. According to the prior studies in other countries and in China, teachers prefer to work in schools with better student performance and better working conditions. If this is the case, then schools in rural Gansu are losing these teachers. It is also possible that, except for teachers’ own

preference, the local government officials tend to draw better teachers from schools within the district to the central schools and urban schools for their own benefit.

Regarding the second question, I find that failing to pass the end-of-year evaluation increases the probability of a teacher moving to another school in the following year, while achieving the best score on the evaluation has no effect on a teacher's mobility immediately after the evaluation. Teachers who got "good" or "pass" on the evaluation are more likely to stay at their current schools. These results confirm previous findings in case studies that local governments use teacher transfer as a way of punishing lower-performing teachers by assigning them away from current schools. One possible explanation of the frequent use of teacher transfer as punishment is that regular teachers are government employees, and in these cases there are no rules for getting rid of low-performing teachers unless they make serious mistakes.

8 Conclusion

8.1 Summary of the findings

This study investigates an understudied but crucial dimension of education in China: teacher mobility. The primary goal of this study is to provide a basic understanding of teacher mobility in rural schools in China. The topic has been extensively studied in many developed countries, especially in the United States. However, there is little research in China, partly because of the lack of individual-level longitudinal data on teachers. As a result, little is known about how teachers move around schools. Even less is known about how teacher personnel policies affect teacher mobility and distribution. This study employs longitudinal data from Gansu province from 2000 to 2007 to understand how school characteristics, teacher attributes, and district personnel policies affect the mobility and distribution of teachers among schools in rural areas.

First, I examine the distribution of teacher attributes across schools to find whether there is systematic sorting in terms of teacher quality in rural Gansu. The findings show that there are substantial differences among schools with regard to teacher quality. Because the educational policies since the 1990s have focused on improving teacher quality, the overall numbers of teachers with a college degree and the percentage of regular teachers are increasing. The student–teacher ratios have met the national requirement, and the gaps between schools are narrowing. However, there is a substantial increase in the gaps between schools in terms of the percentage of teachers with a college degree, and the ratios of student to college-graduate teachers. Because the teacher quality measures at the school level are highly correlated, schools that have less-qualified teachers as measured by one attribute are also likely to have less-qualified teachers based on other measures. As a result, there are still large gaps among schools in the chances of students’ access to more qualified teachers.

In terms of how school characteristics relate to teacher mobility, the findings show that higher wages are likely to reduce the proportion of teachers leaving a school, but only when district fixed effects are not added. According to prior research, if the wage schedule is the same within a district, teachers tend to look for schools with better working conditions. The findings show that the conditions of school buildings

and the workload do not matter, while the school location matters. Being a central school is related to lower proportion of teachers leaving the school and lower proportion of teachers coming to a school as well. The findings also show that student composition does not matter for either the proportion of teachers leaving a school or the proportion of teachers coming to a school. On the other hand, teacher composition matters. Higher percentage of teachers with less than 5 years of experience is associated with higher proportion of teachers coming to a school. One explanation is the way of assigning novice teachers to rural schools and schools in remote areas. As a result, those schools that have more inexperienced teachers constantly got novice teachers assigned to them.

In the teacher-level analysis, first I examine the effects of initial placement on teacher mobility. This study approaches the “draw of home” effect differently from prior research in the U.S. context, in which teachers tend to find jobs near the high school or college where they graduated or district where they grew up (Boyd, Lankford, Loeb, & Wyckoff, 2005b). In the case of rural Gansu, most of the teacher candidates are local residents of the counties and graduated from county-level secondary normal schools (*zhongdeng shifan xuexiao*); on the other hand, the county governments recruit teachers according to the demands of schools districts and then assign teachers to districts with consideration of where teachers came from. The localized teacher preparation system and the localized teacher recruitment and deployment would work in the same direction as teachers’ preference of working close to home, if there is any, thus sending teachers back to their home district. Therefore, it is difficult to isolate one influence from another when looking at the initial matching of teachers to jobs. Instead, by focusing on the decisions to move from one school to another and comparing the difference between teachers who move and those who do not, I identify the motivation of those teachers who are assigned to schools outside their home district and verify that the “draw of home” does exist and affects the decision to move after the initial placement. The results show that a teacher whose initial placement is not his or her home district is more likely to switch schools, while being assigned to other districts does not necessarily lead to an early move in one’s career. Next, using reasons to move as outcomes, I test two possible explanations: these teachers want to move back to their home district, or these teachers are more aggressive in planning their career path and therefore

constantly look for better schools. I find that teachers who work at schools outside their home district are more likely to leave the initial school for family reasons. Together, the findings suggest that the draw of home also exists in rural China, even though the final decisions on teacher transfer are made by educational bureaus or officials.

So are better teachers more likely to switch schools? The findings show that teachers with middle- or senior-level professional ranks are more likely to move to another school. Although the available data cannot identify where and what kind of schools these teachers move to, previous studies suggest that teachers tend to move away from schools in remote rural areas to schools located near township and county seats, and to schools in urban areas. Teacher professional rank is a cumulative measure of teacher quality that is not only determined by the effectiveness of a teacher in improving student achievement, but also by the years of teaching experience and educational background. With regard to evaluation scores, I use the teacher evaluation scores at end of each academic year to examine whether teachers with better evaluation results in the previous year are more likely to switch schools immediately after the evaluation. The results show that failing the end-of-year evaluation increases the probability of moving to another school the following year, while teachers in the middle tend to stay at their current schools. Taken together, the findings suggest that both high-performing teachers and low-performing teachers have higher probability of switching schools. The differences are that low-performing teachers tend to move to another school the year after the evaluation, while high-performing teachers are more likely to move in the long run. Together the findings suggest that the local governments tend to use involuntary teacher transfer more as a way of punishing teachers with the lowest evaluations by assigning them away from their current schools.

8.2 Policy Implication

As the universal free compulsory education has been achieved around 2007, the educational quality, including access to qualified teachers, has become the focus in China. Policies addressing the shortage of teachers in rural areas have been issued. For example, the central and provincial government launched the special-post teacher project in 2006, which is similar to Teach for America, aiming to increase the supply

of teachers in remote rural schools through alternative ways of recruitment. During the same period, some provincial and local governments carried out teacher-transfer policies, encouraging or requiring public school teachers and principals from high-performing schools to transfer to hard-to-staff or low-performing schools. Since then, the strategy of transferring and rotating teachers to improve distribution has been frequently brought up by the Ministry of Education and the State Council in educational documents. In 2015, the State Council issued the “Plan to support the teachers in rural schools (2015–2020).” The document highlights the strategies to improve teacher distribution through teacher rotation, alternative ways of recruitment and teacher compensation in hard-to-staff areas. There are several implications from this study that could enlighten the policies designed to improve the equal distribution of teachers.

One of the most consistent findings in this study is the effects of the draw of home, which is that teachers whose initial placements are not in their home district are more likely to switch schools and are more likely to do so for reasons concerning their families rather than career development or involuntary transfer. This is consistent with previous research findings that teachers who teach in schools in their home village are likely to have stronger community ties (Sargent & Hannum, 2005) and are more likely to stay regardless of the location and working conditions of the school (Li, 2012). The findings suggest that localized recruitment and deployment of teachers have value in retaining teachers and improving student learning. The policies of teacher rotation should be carried out with consideration of the effects of draw of home. Policies that centralize the recruitment and deployment of teachers to the upper-level governments, such as the “special-post” teachers and “free-tuition college-trained teachers”, should also be examined with care. Because the teachers recruited this way tend to have graduated from colleges without teacher preparation programs, and the college they attended tends to be far from the schools where they are assigned, it is likely that these teachers lack ties with local communities and students. As a result, the schools might experience frequent teacher turnover.

Besides the draw of home, the use of teacher transfer as a way of punishment also tends to work to the opposite effect of the teacher rotation policies. A growing body of research in the United States context

argues that teacher turnover can improve the match between teachers and schools and enables schools and districts to get rid of low-performing teachers. Some of these studies find that teachers who remain at the same school tend to outperform those who leave with regard to improving student performance (Goldhaber et al., 2007; Hanushek & Rivkin, 2010; Jackson, 2013). However, this study finds that in the context of rural China the teachers who are more likely to stay are the teachers in the middle. Although teachers who are better at improving student achievement also tend to move to other schools, they tend to do so in the long term; on the other hand, teachers who fail their evaluation are more likely to move to another school in the following year. According to the previous case studies in rural Gansu that some districts tend to transfer low-performing teachers to hard-to-staff schools or low-performing schools as punishment, this study confirms the findings from case study that low-performing teachers tend to be transferred away from initial schools. Therefore, rotating teachers to improve the teacher quality in those schools might be affected by the negative image among teachers, though the underlying reasons differ.

In order to alter the negative image of teacher transfer as punishment, both pecuniary and non-pecuniary incentives should be provided for working at schools in remote rural areas. Specially, additional compensation for teachers who are assigned to hard-to-staff schools also matters for the implementation of policies such as teacher rotation. The current standard of wage compensation for government employees working in remote areas is determined at the county level.¹⁶ There is no difference in compensation for teachers working within the same county. This study finds that when the wage schedule is the same within a district, teachers tend to look for better working conditions. The findings show that schools in remote rural areas and schools with a higher percentage of inexperienced teachers tend to drive teachers away, while schools with more certified teachers tend to have lower teacher turnover. If the distribution of school resources differs substantially with a district or county, and if teachers can choose where they teach or refuse to be assigned to a certain schools, the distribution of teachers would be related to the uneven distribution of school resources and skew toward better schools.

¹⁶ Ministry of Finance, Ministry of Human Resources and Social Security, "The guidance of implementing subsidies for government employees working in remote areas" (2006, no.61).

In general, the successful implementation of the policies which attempt to improve the equal distribution of teachers is closely related to prior institutional arrangement including the use of teacher transfer as reward and punishment, and other educational policies regarding the equal distribution of school resources and additional compensation for teachers working in hard-to-staff schools.

8.3 Limitations and future work

8.3.1 The limitations of school-level analysis

The dataset used in this study, the Gansu Survey of Children and Families (GSCF), is a longitudinal multi-level survey of children ages 9 to 12 from 100 villages in 20 counties in Gansu province. The 2,000 children were randomly drawn from village lists of school-age children according to their birth registry. The main data source of this study is secondary samples of school principals and teachers in schools attended by the sample children. The first limitation of the study is that it is not a representative sample of all the schools in Gansu province or in China. It would be problematic to generalize the findings to schools and teachers across the country. Second, the teacher questionnaires were supposed to be distributed to all the teachers in the schools attended by the sample children; however, not all the teachers participated in the survey. The average sampling rate of teachers in the schools was 89.7% in wave 1, 73.9% in wave 2, and 69.6% in wave 3. The school-level averages of teacher attributes are generated based on the sampled teachers only. Although I have compared mean between school-level averages based on teachers at all the sampled schools, and teachers at schools with sampling rates higher than 20% and higher than 50%, respectively, and find no significant difference in school means, we still need to be careful when interpreting the estimation on the aggregated teacher characteristics.

8.3.2 The limitations of teacher-level analysis

Teachers' mobility status is constructed from retrospective questions about one's career history. Teachers entered the data the year they began teaching, and exited the data when the survey was conducted in 2007. Therefore, the record is right-censored at 2007. This would cause biased in the first part of the analysis using whether a teacher has switched schools as outcome. It is possible that some teachers had not switched schools at the time of the survey, not because they were less likely to move but

because the time period was not long enough to observe the moves. In the second part, I address the problem using survival analysis. Another problem of the teacher career history data is that I only have information from teachers who were sampled in the 2007 survey. What I cannot observe are teachers who left teaching completely. If a substantial body of teachers left teaching, the estimates would be biased. The results rely on the assumption that most of the teachers remained teachers.

In rural China, the teacher labor market is quite localized. Once a teacher is assigned to a school in a certain district, the opportunity of moving to another school outside the county or to a school in a county seat is quite limited. The alternative opportunities outside teaching also need to be taken into account. Gansu is one of the most impoverished provinces in China. Among the 20 counties in this study, 9 counties are poverty counties as designated by the central government. While poverty counties are the most hard-to-staff areas across the country, they receive more support in terms of block transfer from central government. A large part of the appropriation is spent on personnel expenditures in government and public sectors. Thus the average wage level is not necessarily lower in these counties. On one hand, the payments of teachers are higher and more secure. On the other hand, there are limited job opportunities outside teaching. Thus it is reasonable to make the inference that the number of teachers leaving teaching would not lead to serious bias in the estimates. If the schools were located in developed coastal areas, the assumption would not be reliable.

Regarding the limitation of the current study, in the future, I plan to examine teacher mobility using administrative data that are linked to schools and cover all the teacher records within a county to account for teachers who leave teaching. I also want to include the alternative job opportunities within teaching and outside teaching to give a more complete picture of the teacher labor market in China.

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