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The determinants of teacher mobility in Sweden

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The determinants of teacher mobility in Sweden[1]

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April 26th 2012

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Keywords: Teacher mobility, Non-pecuniary factors, Pecuniary factors, Student composition
JEL-codes: I21, J44

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1. Introduction

Sweden is often thought of as the quintessential social welfare economy with highly compressed wages and even more compressed after–tax income. Despite the notion that there is equality versus efficiency tradeoff, it has also one of the highest average incomes in the world and a relatively low unemployment rate. Given these features, the common perception is that Swedish labor market performs well in terms of matching firms to potential employees (Holmlund and Storrie, 2002; Carling and Richardson, 2004). Since economists view labor mobility as the mechanism through which labor markets improve the allocation of workers to firms, it seems important to understand its determinants in the Swedish institutional set up. Both Edin et al. (2009) and Oyer (2009) show that there is a substantial amount of job mobility in Sweden. They demonstrate that the average yearly turnover rate in the 1990s was at the level of around 20% with the peaks at the beginning and at the end of this period.

Public policy makers and governments are often focused on the educational issues, since the quality of the current education directly affects the future productivity of the country. It is a common perception that teachers are one of the most important factors in the education production function (Rivkin et al., 2005), however, their effectiveness depends on the quality of the match between a school and a teacher (Jackson, 2011a), and teachers may leave schools when the match quality is low. Thus, since teachers matter for students and teacher job mobility is related to school characteristics, then one way of affecting students' outcomes is through changing their teachers, which – at the school level – can be seen as job turnover[2]. In fact, if we see teacher turnover as a mechanism to improve the allocation of teachers to schools, then reshuffling of teachers can either alleviate or deepen the quality gap across schools[3].

Unlike in most countries, the Swedish labor market for teachers does not differ much from other white-collar job markets. It is deregulated, with relatively large and growing private sector at both lower and upper secondary school levels[4], competition between schools

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[2] Job mobility and job turnover although related define the same phenomenon from a different perspective. While individual decisions and covariates can be seen as job mobility from the perspective of the teacher, the school level covariates can be seen as job turnover from the perspective of a management. Throughout the paper I use job mobility when referring to individual's perspective, while job turnover when referring to institution's perspective.

[3] There is a view in macroeconomics, dating back at least to Schumpeter (1939), which emphasizes the continuous reallocation of resources across heterogeneous production units as the mode of aggregate business fluctuations and economic growth. Furthermore, theoretical (Jovanovic, 1979) and empirical (Farber, 1999) evidence suggest that job mobility plays an important role in determining labor market equilibrium. Thus, the fact that teachers will change schools may have an impact on their student's performance. In particular, if a school loses a number of effective teachers then the quality of the education will decrease in this school, however, at the same time it will increase in schools, which acquire the searching teachers. Note that losing teachers in favor of other sectors affects adversely the teaching profession given the declining quality of more recently educated teachers (Fredriksson and Öckert, 2007; Grönqvist and Vlachos, 2008).

[4] For details regarding the growth in private institutions see footnote 14 and table A1 in section 2 of the appendix.

and individually negotiated wages. Thus, it can be seen as institutional setup with a liberal labor market for teachers i.e. what economists typically argue for. Furthermore, given the shortages of teachers and reduced interest in becoming a teacher[5], one of the most important challenges for Swedish education policy makers is how to attract and retain teachers.

Given the Swedish context, and using population-wide registries on lower and upper secondary institutions for school years 1996/1997 to 2006/2007, this paper contributes to understanding of teacher mobility in a unique labor market environment, which was to my knowledge never studied before. In particular, pecuniary determinants of job mobility and non-pecuniary aspects of job turnover are investigated. For example, I study whether increase in share of minorities positively correlates with a decision to leave a school and if by the means of raising the monetary compensations this coefficient can be decreased. I also describe the differences in the behavior of lower versus upper and private versus public school teachers. Furthermore, personal characteristics such as gender and origin along with their interactions with the respective school level student gender and origin characteristics are examined[6]. Finally, I attempt to determine what teachers switch schools, and why some other teachers leave the profession.

The labor markets for teachers in most European countries, depart from the Swedish institutional setup, and exhibit very little variation in pecuniary characteristics or private schooling, while teacher's salary is mostly determined by the amount of formal education and job tenure (Falch and Strøm, 2005). The US market for teachers is more competitive and in certain states, like Florida, teacher's turnover is partially determined by their student performance (Feng et al., 2010)[7]. Economic studies from different states and countries show that teachers are responsive to even small variation in wages within the profession (Baugh and Stone, 1982; Feng, 2009; Falch, 2011) and over time (Murnane and Olsen, 1990), however, this relationship is not so obvious in cross–sectional analysis (Hanushek et al., 2004). Another factor affecting teacher turnover and composition at school is the competition between the institutions, in particular, between these that are publicly and privately run (Jackson, 2011b;

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[5] See for instance Björklund et al. (2006) or National Agency for Education (2003) for details about teacher shortages in the 1990s in Sweden. Fredriksson and Öckert (2007) and Grönqvist and Vlachos (2008) provide overview of the selection into the teaching profession.

[6] Throughout the paper I use the terms personal and individual characteristics interchangeably. These are gender, marital status, employment type or education among others. As pecuniary factors I understand wages and earnings, while as non-pecuniary factors I understand school characteristics i.e. share of minorities, student-teacher ratio etc. For the details regarding variables used in the analysis see section 3.

[7] The effect is not direct since the accountability system affects primarily school resources, which in turn may influence teacher employment or wages. Furthermore, there is substantial variation in compensation schemes and employment policies across the US states. Nonetheless, even the most liberal US schemes cannot be compared in the amount of freedom and choice to Sweden.

Hensvik, 2012)[8]. It is also important to understand the differences between the wages offered to teachers in education and other sectors of economy (Dolton and van der Klaauw, 1995, 1999; Ballou, 1996; Brewer, 1996; Dolton and Marcenaro-Gutierrez, 2011).

The non–pecuniary characteristics play an important role alike and sometimes they may even dominate in the mobility decisions (Hanushek et al., 2004). The factor that is most often emphasized in cross–sectional analysis as the one that discourages teachers the most from particular school seems to be the proportion of minority students, which is also highly correlated with the fraction of poor and low achieving students (Falch and Strøm 2005; Scafidi et al., 2007; Barbieri et al., 2008). This pattern is confirmed in causal studies from North Carolina (Jackson, 2009) and Netherlands (Bonhomme et al., 2011)[9]. There is also evidence that low skilled teachers tend to allocate themselves into disadvantaged schools, which are unable to attract highly qualified staff due to limited financial resources and high wage premiums that are required by good teachers (Lankford et al., 2002; Boyd et al., 2005).

The majority of research on teacher mobility and teaching profession in general comes from the US. Most of these studies, however, have two limitations. Firstly, most of the wages are set at the school district or higher level, which makes them problematic to interpret – i.e. they exert the same rigidity as the majority of European regulations, the only difference being that they are limited in scope to a school district rather than a country[10]. Secondly, the US research is often limited to a single state only, and sometimes even to a sample of teachers within a state. Therefore, it is impossible to determine what happens to teachers when they leave the state – i.e. whether they leave to a different job or just to a school in a different state. It means that the results might be geographically inaccurate, especially in the counties that are close to the state borders and in the states that are net exporters of teachers. This paper similarly to Falch and Strøm (2005) overcomes the second problem by using population-wide

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[8] On the supply side, schools facing increased competition may experience difficulties attracting and retaining good teachers. On the demand side, since funding is tied to student enrolment, schools facing competition for students have an increased incentive to hire and keep teachers, who attract students. Thus, the supply-demand game reflected in job mobility does not offer clear theoretical predictions. Jackson (2011b) finds small overall effects on turnover, however, difficult to staff schools (low-income, high-minority share) hire fewer new teachers and experience declines in teacher quality. He also finds that schools increase teacher compensations to better retain quality teachers. Hensvik (2012) finds that increased competition between schools translates into higher wages, also for teachers in public schools. Furthermore, she documents that high ability teachers from areas where the competition is most fierce experience highest growth in the compensations.
[9] By cross-sectional studies I understand least squares regressions, fixed effects models and survival analyses. By causal studies I understand quasi-experimental methods and instrumental variables estimates.
[10] As noted in footnote 7, the pay policies in schooling vary across states, however, even in the state of Texas, which is perceived as the one with the most deregulated monetary compensation system, the pay scale is present within the school district. In many other states the pay scale is much more rigid and in a sense closer to the "European" model, in which the wage depends mostly on the amount of formal education and experience. In fact Jackson (2011a) notes in the abstract that "…Because teacher wages are essentially unrelated to productivity, this is compelling evidence that workers may seek high quality matches for reasons other than higher pay…" and further at the bottom of page 9 that "…Teacher labor markets are an interesting context to study the relationship between match effect and worker mobility because teacher salary is, for the most part, based on teacher's years of experience and level of education…".

data, and additionally contributes to the literature as the first study thus far, which examines teacher mobility in liberal labor market setup that economists usually argue for.

The paper is organized as follows: section two presents the institutional background of Swedish educational system, section three provides information on econometric modeling and data sources, section four presents descriptive evidence, section five contains the main results, section six includes various robustness analyses, while section seven concludes.

2. Swedish schooling system and institutions

The Swedish schooling system starts with pre-school and continues with nine years of comprehensive school. Since 1994 the compulsory education is divided into three stages that cover grades 1-3, 4-6 and 7-9 respectively. In each of those levels students usually have different sets of teachers and sometimes even the schools are located in different establishments. The 9th grade is the first time when one can observe student's performance in terms of high stake grades[11]. The score from the 9th grade determines student's ability to apply to upper secondary school. Swedish municipalities are obliged by law to offer upper secondary schooling to all students that successfully completed compulsory education and are interested in continuing schooling. Upper secondary education consists of different programs, lasts three years and provides eligibility for post-secondary education.

Private schooling in Sweden is common and is encouraged by the government. In 1992 Sweden introduced educational vouchers reform that allowed anyone to establish a for-profit school. Private schools were effectively introduced at the lower secondary level in 1992, while at the upper secondary level in 1994. Moreover, the municipality is obliged to pay the private school equivalent to the average per-pupil expenditure in the public school[12]. To be eligible for public funding, private schools have to be approved by the National Agency for Education and follow the national curriculum. These schools are neither allowed to select pupils by ability, socio-economic or ethnic characteristics, nor to charge any fees. At the same time, however, there are no restrictions on the ownership of private schools and thus the regulations generally do not constitute a great obstacle for new schools to enter the market and receive public funding[13]. Since the reform was implemented the fraction of private schools has risen to a substantial share, and private schools seem to be relatively more popular at the upper secondary level. In the school year 2006/2007 there were 234 private upper secondary schools, constituting 34.5% of all upper secondary schools in Sweden, a rise from 8.2% in 1996/1997. At the same time, the number of private lower secondary schools in 2006/2007 constituted 17.8% of all schools at this level, an increase from 3.4% in 1996/1997.

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[11] It is also the first time the students are observed in any aspect related to schooling. Countrywide tests were introduced but not collected in the fifth grade in1998 and in the third grade in 2009. Grades have been also given for some time in the eighth grade, however, they do not count into the academic records. Starting in 2012 the grades will be given in grades 6-9. Furthermore, written feedback to students in grades 1-9 has been given since 2008.

[12] In reality due to the 1992 reform a private school gets around 85% of the amount of money per student given to a public schools. The minimum required funding percentage generally changes over years and is below 100% mainly because of the extra costs involved for public schools regarding special education. Some municipalities also have a socioeconomic gradient for the voucher, however, these differences should be accounted for by fixed effects.

[13] For in depth discussion of the reform, its history and consequences see Böhlmark and Lindahl (2007, 2008).

Further details on the number of teachers, students and schools over time split by type of ownership can be found in table A1 in section 2 of the appendix[14].

Teaching profession in Sweden is a regulated occupation and different qualifications are required depending on the subject taught and on the type of school[15]. The certification is obtained by attending and completing a teacher education program or by receiving a minor or major in the teaching subject and supplementing it with minimum of 1.5 years of preparation in pedagogy, didactics and teaching practice. The latter route to teaching profession makes it possible for people from other professions to switch to teaching and, thus, gives non-certified teachers with a subject degree a chance to obtain certification[16]. Furthermore, due to the decentralization reforms introduced at the beginning of the 1990s, the local authorities became the employer of the majority of the school staff and, thus, handle the responsibility of recruiting them. Since January 1st 1993, the money previously used for education was incorporated into overall equalization grant to the local government. From this year and onwards, the municipalities could freely allocate resources over their different responsibilities. As showed by Fredriksson and Öckert (2008), this caused a big change in terms of the allocation of school resources over municipalities[17].

Although the municipalities are the formal employers of teachers in public schools, the decision regarding recruitment, selection and employment of teacher is made by principal at the school level. This implies that in Sweden teacher wages are determined at the local level, typically through negotiations between teacher and principal[18]. The individualized pay regime came in place in 1996 through an agreement between the employer's organization and the teacher labor unions with the intention to give employers more discretion over wages in order

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[14] This table is constructed based on the data used in the analyses. It confirms that Sweden experienced a rapid growth in the number of private schools over the 11-year period. In total, the number of schools grew by 64%, which can be plausibly associated with skyrocketing growth in the private sector. The number of students grew by 30% and the number of teachers by 38%. It is worth noting that the full time equivalence student-teacher ratio decreased over 11 years by 9%, while the non-adjusted student-teacher ratio decreased by 12%. Thus, it may indicate that schools employ more temporary faculty as a result of such a rapid expansion in private schooling and limited supply of new teachers into the profession.

[15] Teaching at the secondary school level or a vocational course requires completing special coursework beyond what is required from compulsory school teachers.

[16] The transition probabilities suggest that during the investigated period of time 76% of teachers who were either uncertified or uncertified in a given subject obtained the certification.

[17] There is still a small fraction of schools run by county or state, however, these constitute around 1% of all the teachers between 1996/1997 and 2006/2007. Those schools are excluded from the analysis since they have different sources of funding and their role is diminishing. In school year 1996/1997 the teachers from these schools constituted less than 2.5% of all teachers, while in school year 2006/2007 only 0.39% of the total number of teachers.

[18] The principal autonomy can be circumvented if there are teacher surpluses in other parts of the municipalities' schools. Given the teacher shortages described in Björklund et al. (2006) and National Agency for Education (2003) this should not be very common, however, it may vary greatly geographically. The survey conducted in 2006 by Lärarförbundet revealed that around 40% of salaries were determined in individual negotiations. Additionally, around 50% of teachers believe that salaries should be set via individual negotiations. Two-thirds of Swedish teachers have their salary reviewed every year, while only 13% have never had their salary reviewed. Finally, more then three-fourths of teachers discuss their working conditions, compensations and work satisfaction with principals on regular basis. For more details see: Lindholm (2006).

to reward teacher quality and effort (Hensvik, 2012). The behavior of principals supports the idea that local wage setting enables schools to differentiate teacher pay (Böhlmark et al., 2012), however, the quantitative evidence suggests that the individualized pay had limited impact on the overall wage dispersion (Söderström, 2005). This phenomenon might be explained by either the fact that there were already deviations from the fixed pay scale prior to 1996 or because schools have low incentives to enforce individualized pay in a non-competitive environment[19]. Teachers may be employed on three different contracts: indefinite term contracts, probationary period employment, and fixed-term contracts[20]. Moreover, schools are obliged to give priority in hiring to certified teachers, yet in the case they are unable to find a suitable candidate, they can hire an uncertified teacher, offering them a fixed-term contract.

Summarizing the Swedish institutional setup, one can distinguish several important underlying decisions in the light of job mobility. At every point in time the individual teacher considers whether to leave their current school appointment or not. Then, a school principal can either let the teacher leave or re-employ them under the new conditions. If the teacher leaves, they can either seek employment at a different school or find a job in a different profession. In the former case they negotiate a new contract with the new school principal. In either the case of re-employment or new hire the teacher and school determine the salary in an individual bargaining. The decision to re-employ teachers seems to be important in the light that 21% of teachers are in temporary positions and 23% do not work in the area of their certification. Typically, these teachers are employed under fixed-term contracts and are exposed to higher probabilities of job separation[21]. In fact the correlation coefficient between being uncertified and in temporary position is 0.51[22]. Thus, since schools are forced to hire

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[19] Prior to the introduction of individualized wages, salaries were largely determined by fixed credential based on type of work and years of experience, although local deviations were already common, mainly to overcome teacher shortages. The pay agreements generally still exist, however, they only specify a minimum wage level after one year of employment, while the actual levels are determined through individual bargaining. The involvement of a local union is still possible to endorse the proposed salary, and the unions are involved in around 60% of wage negotiations (Lindholm, 2006)

[20] Individuals employed under indefinite term contract may only be dismissed on one of the grounds mentioned in the Employment Protection Act, such as for example lack of work. Probationary period employment contracts are mainly intended for newly certified teachers and normally lead to indefinite term employment. Teachers who do not have a teaching degree are employed on fixed-term contracts of maximum 1 year. The information on the type of contract is not available in the data, however, the probability of obtaining full time employment at least once in the studied period conditional on being temporarily employed is 79%.

[21] Positions filled with non-certified teachers on fixed term contracts should be advertised every year, however, in practice this may not always be the case.

[22] Furthermore, there is 0.55 correlation between certification and university degree. Due to these correlations the indicator for working outside of certification area is dropped from the regression analysis. Furthermore, polynomial in experience is dropped from the analysis due to 0.72 correlation coefficient with teacher's age. Among all the variables used in the analyses the following pairs exert correlations higher than 0.4: earnings with temporary employment; number of students with upper secondary school indicator; parental income with share of immigrant students; parental income with GPA. Majority of correlations are below 0.1 and the correlogram is available from the author upon request.

certified teachers, the principals will more actively look for replacements for this type of teachers. In the analysis I consider three types of separations: total mobility, within-teaching mobility and out-of-teaching mobility.

3. Data sources and econometric modeling

This paper utilizes multiple Swedish population-wide registries, covering school years 1996/1997 to 2006/2007. The baseline data source is the teacher registry that covers all teaches employed in Swedish schools. It contains information on their education, specialization, experience, workload, certification, place of work and type of employment (permanent vs. temporary). Additionally, I use the population enlistment registry, which covers all individuals living in Sweden that are older than 15. I extract information on age, gender, immigration histories, education, employment and income from this database. As far as minority enrollment is concerned, it is defined based on the first generation non-Nordic immigrants i.e. those born outside of Sweden, who are not Fins, Danes, Norwegians or Icelanders. The pupil registries for lower and upper secondary schools are used to obtain information on students in a given school. These allow linking children and parents to teachers at the school level, as well as obtaining the average percentiled GPA[23]. The population-wide earnings and wage registries provide information on teachers' monetary compensations[24]. The details of the sample construction are discussed in section 1 of the appendix.

This paper focuses on the influence of personal, pecuniary and non-pecuniary characteristics of jobs on teachers' decisions to stay in or leave their current employment. The main analysis is done using a series of binary choice models that attempt to capture the manifestation of teachers' preferences with respect to how they value particular characteristics of the working environment. The dependent variable equals unity if a teacher leaves their current employment form year to year. Additionally, for the sake of comparison with the literature, using the main specification, I run separate regressions depending on teacher's destination. In particular, I specify two distinct destinations' variables: new school within lower and upper secondary schools and quitting lower or upper secondary schooling. The reference category is always continuing employment at the same establishment.

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[23] Unlike Rivkin et al. (2005), Grönqvist and Vlachos (2008) or Lavy (2009), I can only link teachers to students at the school level. Swedish registry data does not allow matching students and teachers at the class or grade level. The percentiled GPA at lower secondary school level is constructed by percentile ranking of students in every class for the given cohort of graduation and then obtaining mean percentiled score for every student based on all the classes. The percentiled GPA at upper secondary school level is defined based on student's placement in the distribution of lower secondary school graduates in a given cohort.

[24] I use two types of monetary compensation data in this paper. The main source of data comes from the nationwide earnings registry that contains information on annual earnings split by all jobs that individual undertook. It covers all the individuals that earned money in a given year. As a robustness check, I also use a secondary source of information on monthly wages, which is available for majority of public school teachers.

In order to maintain simplicity of the interpretation of the results, the estimation strategy is based on the least squares using linear probability model[25]. The following econometric model is estimated:

$$y_{ijt} = \alpha_0 + \alpha_1 W_{ijt} + \alpha_2 X_{jt} + \alpha_3 P_{ijt} + \delta t \cdot c + \varepsilon_{ijt} \qquad (1)$$

where y_{ijt} is equal to unity if teacher i leaves the current employer j at the period following t, W_{ijt} is teacher i pecuniary characteristics at school j and time t (earnings or wages), X_{ijt} is a vector of observable school characteristics of an institution j at time t (share of minorities, student quality, mean parental income, student's gender composition, school resources, school size polynomial), P_{ijt} is a vector of personal characteristics of teacher i at school j and time t (age polynomial, gender, origin, marital status, education, specialization, type of employment, type of school and workload) and ε_{ijt} is an error term that represents unobserved characteristics, which is heteroskedasticity robust and clustered at school level (Bertrand et al., 2004). The clustering follows the idea that in a perfect experiment one would randomly assign teachers to different schools and observe their mobility decisions conditional on school characteristics. Thus, since the turnover variation occurs at the school level and I have an unbalanced panel of all lower and upper secondary schools in Sweden, it is intuitive that the errors should be clustered at the school level. Vector of δs captures time-times-count fixed effects[26].

Ideally, an analysis of teacher sorting between schools should be based on a complete characterization of the individual decision of occupational choice, the initial matching process with school, and the transition of teachers between schools and out of teaching. In this paper I focus on the influence of variety of characteristics of jobs on teachers' decisions whether to stay at their current appointment or not, which should uncover the manifestation of teacher preferences. In particular, the binary model shows whether teachers who remain in their appointments (comparison group) have, on average, different pecuniary, school and personal characteristics than these who leave their jobs (treated group). Since this is a descriptive study, we shall be interested in all coefficients included in vectors α_1-α_3, however, we can consider them jointly or separately. This being said, the analysis provides evidence about the univariate correlations of the characteristics and mobility as well as multivariate correlations

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[25] This method yields very similar estimates to the non–linear models. The appropriate regressions using logit and multinomial logit models with marginal effects evaluated at means are available from the author upon request.

[26] For detailed discussion about the variety of fixed effects specifications tested see footnote 40. Often local labor markets are broader than municipality boundaries and thus estimating time-times-municipality fixed effects may remove too much variation of interest.

conditional on all other variables. The latter modeling is the preferred specification, yet majority of the results survive in the univariate regressions[27].

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[27] The details regarding univariate regressions can be found in table A3 in section 2 of the appendix. Each column represents one of the three dependent variables used in the analysis. Each row represents the independent variable that is regressed on the studied dependent variable while controlling for the time-times-county specific effects. Standard errors are clustered at school level. Variables that are qualitatively identical in multivariate and univariate regressions include: log-earnings, log-wages, temporarily employed, workload, share of immigrant students, GPA, age, marital indicator. Variables that change qualitatively in main analysis (columns (3) and (5) in table 2) include: upper secondary indicator, mean parental income, share of girls, student-teacher ratio in full time equivalence, female indicator, specialization indicators. Variables that change qualitatively in the multiple destinations analysis (table 6) include: private school indicator, mean parental income, share of girls, student-teacher ratio in full time equivalence, female indicator, immigrant indicator, education and specialization indicators.

4. Descriptive evidence

The total mobility is split into mobility within teaching (at lower and upper secondary school level) and quits (leaving studied types of schools)[28]. Figures 1-3 provide descriptive evidence of turnover patterns over time in general and split by school type and teacher's gender respectively. The turnover within lower and upper secondary schools increases over 11 years from 4.1% to 4.9%. The quit rate increases from 6.0% in 1996 to 7.5% in 2005. In figure 2 there is a large jump in upper secondary school quits in 1998[29]. In both lower and upper secondary schools, even when ignoring the jump, teachers behave differently, however, the turnover patterns look similar for male and female teachers. Both the number of teachers in lower secondary school and the number of female teachers increases, and the latter number grew over 11 years by 45% while the number of males grew at the same time by only 20%[30].
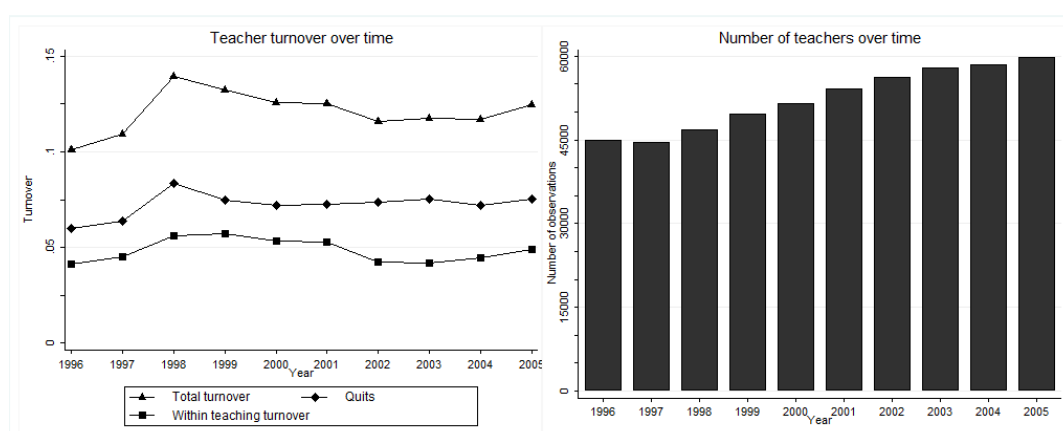

Figure 1. Turnover over time and the number of teachers each year.

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[28] An alternative would be to consider quits as leaving teaching for other occupations, however, the two quit measures are similar quantitatively - correlation coefficient is 0.94. From here on the within teaching mobility is referred to as mobility within lower or upper secondary schools, while quit is understood as leaving either of these school types in favor of other employment. As it can be seen in panel A of table 1 there are statistically significant differences among the "quitting" definitions regarding heterogeneous groups of teachers. Nonetheless, to be able to compare my estimates with the literature I decided to use the former definition. For further discussion regarding the alternative quit measure see footnote 33.

[29] This large jump is due to adult education expansion reform proposed in the mid 1990s. If one is interested in studying job-to-job mobility then this variation should be kept as the teachers indeed change their jobs voluntarily. In that sense nobody forced these teachers to relocate to adult education, and they simply preferred moving to adult education to staying in their current employment. If I consider quits as leaving teacher occupation in general then this jump vanishes. Graph is available from the author upon request.

[30] The gender differences studies have a long tradition in economics (Loprest, 1992; Croson and Gneezy, 2009), however, given that teaching in some countries is highly female dominated (Bonhomme et al., 2011) it is of interest how male and female teachers behave in a market for teachers, where gender distribution is much more even (see panel B in table 1 for descriptive statistics).
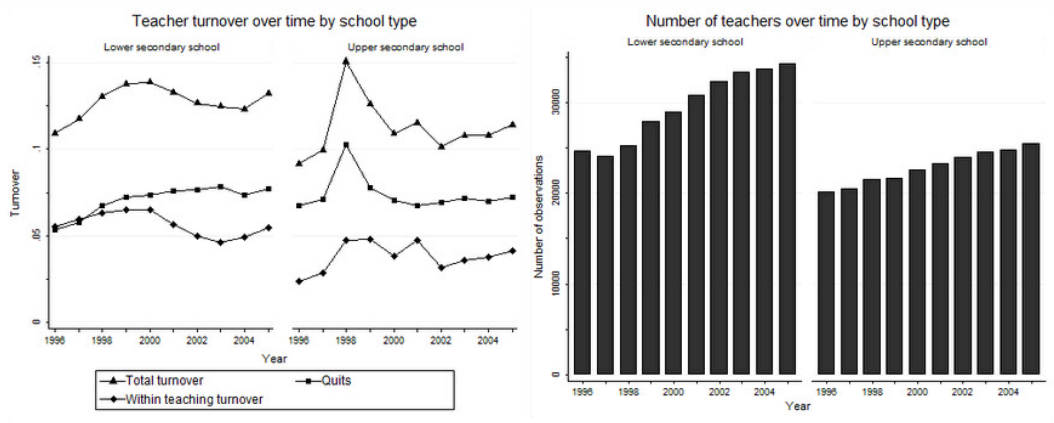
Figure 2. Turnover over time by type of school and the number of teachers in lower and upper secondary schools each year.
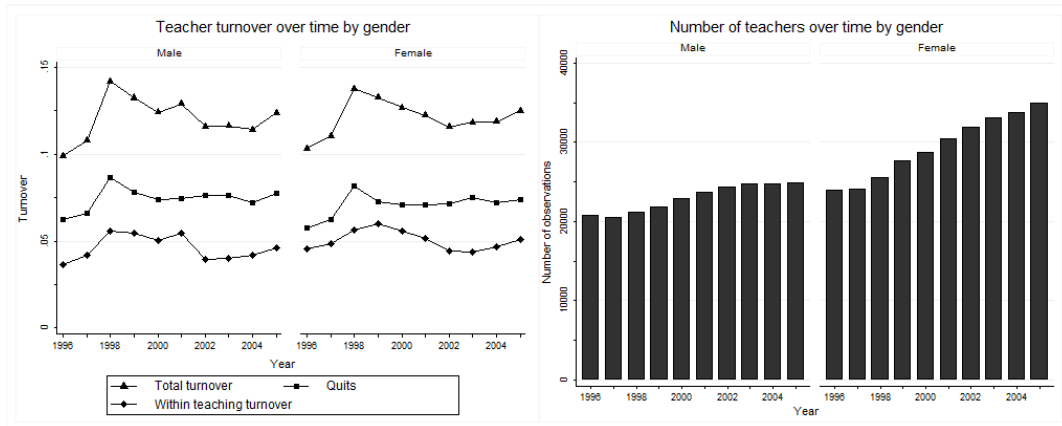
Figure 3. Turnover over time by gender and the number of teachers by gender.

Figures 4-6 provide the description of teacher turnover in relation to teacher's age, school size and minority enrollment. The total turnover and quits are higher for very small schools and all of the measures decrease with age. The within teaching turnover is at 5% at schools with small shares of minorities, while it goes up to over 6% at schools with more than 25% of minorities, however, in comparison to Falch and Strøm (2005) there is actually initial decrease in quits. The quit rate at schools with zero minority enrolment is 10%, while at schools with for instance 10% of minority enrollment it is 6.8%. There are also much fewer schools with no minorities in Sweden than in Norway.

Figures 7 and 8 present teacher turnover related to the economic status of pupils and teachers' own earnings respectively. The total turnover is at 14.6% at schools with the poorest parents and at 13.7% at schools with the richest parents. At the same time, it is at around 12% for the median group suggesting a u-shaped pattern in family income. There is also a negative relationship between turnover and earnings increase[31] and the more the teachers earn the less likely they are to either quit or in smaller magnitude move to a different school. It is worth

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[31] Similar pattern is observed for monthly wages. See figure A1 in section 2 of the appendix.

noting, that teachers who earn less than 125 000 SEK a year are with higher probability temporarily employed[32].

Figure 4. Turnover as a function of age and the number of teachers at each age group.
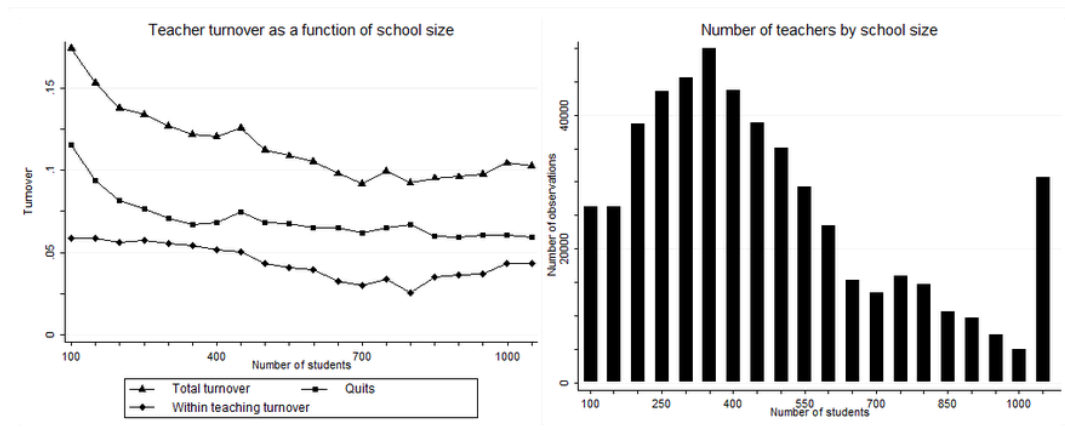
Figure 5. Turnover mobility as a function of school size and number of teachers employed by schools of each size.
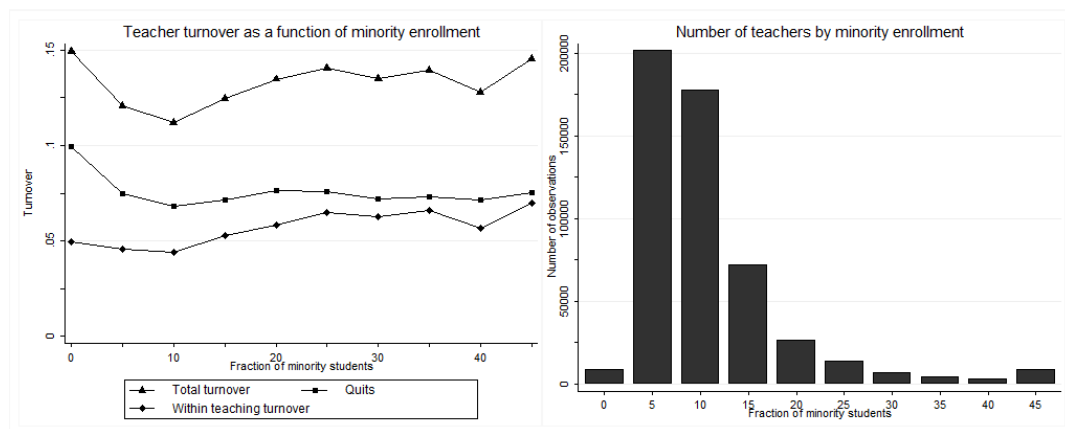
Figure 6. Turnover as a function of minority enrollment and the number of teachers in each group.

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[32] There is 6% more temporarily employed individuals in a group that earns below 125 000 SEK a year.
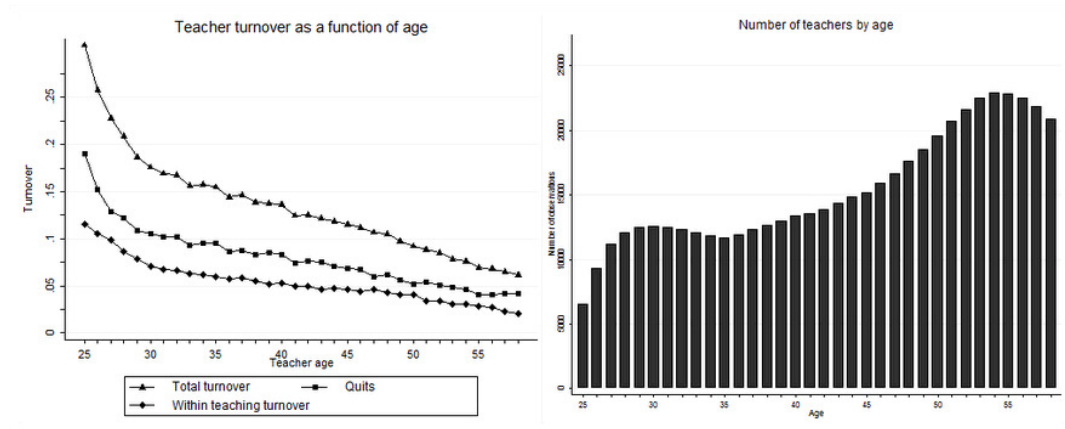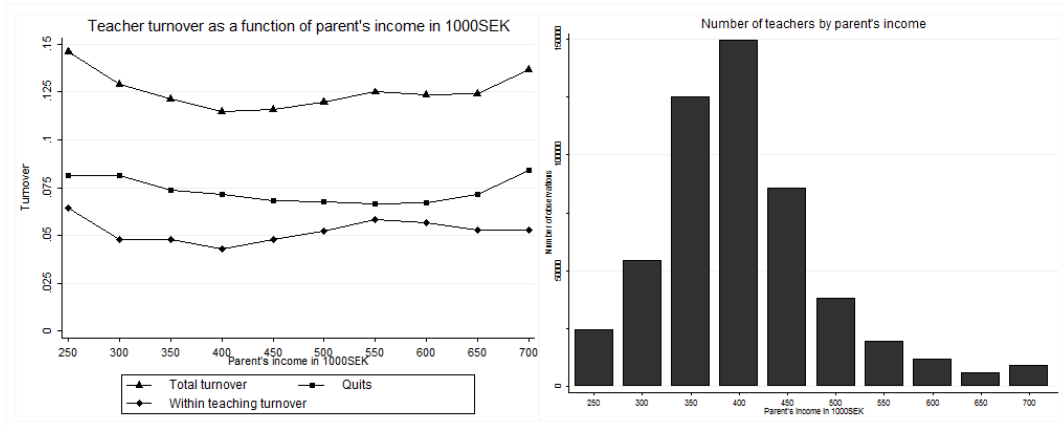
Figure 7. Turnover as a function of pupils' parents income and the number of teachers in each group.
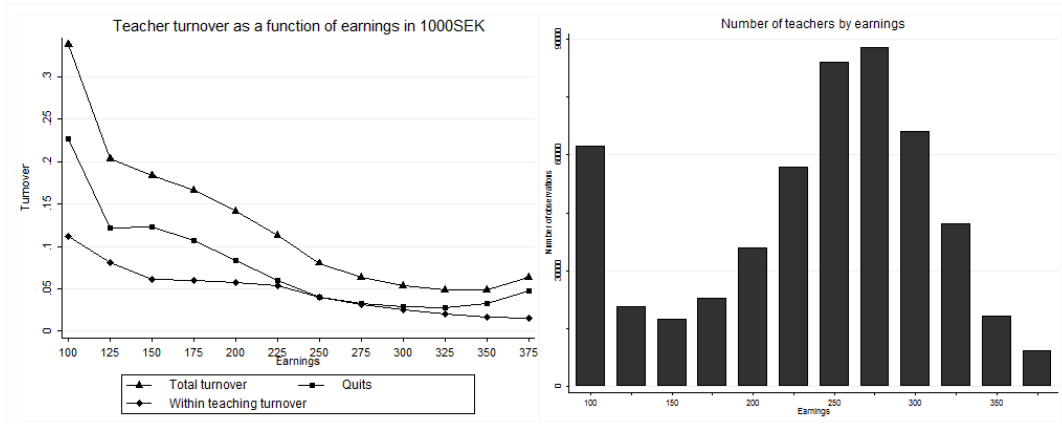
Figure 8. Turnover as a function of teacher's yearly earnings in 1000 SEK.

Table 1 presents the descriptive statistics of variables used in the econometric analysis. Panel A presents 4 mobility measures for different groups of teachers, which relate to heterogeneity analyses discussed in section 6. The difference between quit defined as leaving lower or upper secondary schooling and quit defined as leaving teacher occupation is statistically different in all groups, and the former measure is systematically larger[33]. The total turnover rate, when using the former definition, is at 12.1%, which is much lower than the overall turnover rate in all the occupations in Sweden. This may be driven by the fact that people who invest heavily in occupation-specific human capital (teaching) may have lower turnover rates in general. Furthermore, it is only the gender dimension where I do not observe statistically significant differences in turnover measures between studied groups. Although, the quit rate in Sweden is larger than in Norway, these two countries share a common feature

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[33] Although the fourth measure is not used in the econometric analyses, it may be of interest for researchers as the difference in mobility out of studied schools and out of teacher occupation have never been compared before due to data limitations. The significant difference potentially casts doubt regarding the reliability of the results reported in previous research. To my knowledge, this is the first paper that touches upon the difference between quitting particular type of school and teaching occupation in general. From the perspective of public policy makers these two transitions clearly yield different costs. Nonetheless, in the remaining of the paper I provide the estimates based on the former definition that was used so far in the literature.

that the outflow from teaching (irrespectively of the definition) is larger than the turnover within the profession. In the US registry data from Texas, Hanushek et al. (2004) find the opposite pattern – i.e. there is higher turnover within teaching than out of the profession.

Panel B reveals that the average teacher is 44 years old and over 6.8% of teachers come from non-Nordic countries. Around 56% of teachers are women and slightly larger fraction is married. There is 15.6% science, 13.9% vocational and 6.6% remedial education teachers[34]. At the same time 67.4% of teachers completed university education[35]. Furthermore, 21% of teachers are employed on temporary contracts and the average workload in the sample is about 87%. Upper secondary schools employ 43.6% of all teachers and 5.6% of teachers work for private institutions.

Panel C gives details regarding monetary compensations. The average yearly earnings for the period 1996-2005 equaled 221 887 SEK which is lower than the countrywide average wage for the whole economy for the same period, which was 234 000 SEK[36]. This amount is not very large because the sample contains 21% of temporarily employed teachers, who earn only a portion of permanently employed wage. If I limit the sample to permanently and full time employed teachers then the yearly earnings increase to 253 683 SEK. At the same time the average monthly salary in public schools is 22 016 SEK. Furthermore, there is substantial variation in compensation levels between schools and dispersion within schools. In particular, the bottom 10% of schools in terms of earnings pay on average 123 189 SEK yearly, while at the same time the top 10% of schools pay 251 493 SEK[37]. The dispersion value at the 10% most compressed schools is 13%, while it is 27% at the 10% least compressed schools. Finally, the average turnover rates differ between the schools at the top and bottom of both earnings and dispersion distributions, and they are higher in low paying and high dispersion schools.

Panel D provides information about the average characteristics of Swedish schools. The student-teacher ratio in full time equivalence, which can be seen as proxy for school

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[34] Remedial education teacher (Speciallarare) works with students in need of special assistance concerning learning and development. Special teacher training is a postgraduate education in the regular teacher training and includes 90 credits. Special education teachers focus on either language or math.

[35] A university graduate is defined as an individual graduating three, four or five yearlong university (hogskoleutbildning) education or individual with a research degree. Note that other forms of post-secondary education (eftergymnasial) education are not treated as university graduates.

[36] Further information about the salaries in Sweden http://www.scb.se/Pages/TableAndChart____149088.aspx. The earnings and wages reported in table 1 are in the form of logarithms.

[37] These calculations are available from the author upon request. The earnings used in these calculations are adjusted by workload and type of employment i.e. I use the predicted earnings from the regression of real earnings on type of employment and workload. The dispersion is calculated through dividing standard deviation of earnings in given school and year by the appropriate mean.

resources, is 9.9% and the average number of pupils is 454[38]. The unadjusted student-teacher ratio is 8.1%, which confirms that Swedish schools employ a fair number of part-time faculty. There is also on average 8.4% non-Nordic immigrants in Swedish schools. This number is much larger than the one reported for Norway (Falch and Strøm, 2005). The average income of pupils' parents is around 380 000 SEK yearly.

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[38] Number of students in lower-secondary school is measured as the sum of pupils attending grades 7 to 9 and it is provided in compulsory school registry by Statistics Sweden. Number of students in upper secondary school is measured based on the registry of students enrolled in grades 1 to 3 in upper secondary school.

Table 1. Descriptive statistics.

Panel A: Mobility variables					
Group of teachers	N	Within studied schools	Out of studies schools	Total mobility	Out of teacher occupation
All teachers	523835	0.0483 (0.2145)	0.0726 (0.2595)	0.1210 (0.3261)	0.0651 (0.2468)
Men	229647	0.04606 (0.2096)	0.0745 (0.2625)	0.1205 (0.3256)	0.0670 (0.2501)
Women	294188	0.0501 (0.2182)	0.0712 (0.2572)	0.1213 (0.3265)	0.0636 (0.2441)
Temporarily employed	109177	0.1067 (0.3088)	0.2244 (0.4172)	0.3311 (0.4706)	0.2119 (0.4086)
Permanently employed	414658	0.0330 (0.1785)	0.0327 (0.1778)	0.0656 (0.2477)	0.0265 (0.1606)
Foreign	35404	0.0756 (0.2644)	0.1200 (0.3250)	0.1957 (0.3967)	0.1143 (0.3182)
Nordic	488431	0.0464 (0.2103)	0.0692 (0.2538)	0.1156 (0.3197)	0.0616 (0.2404)
Lower secondary	295453	0.0560 (0.2299)	0.0716 (0.2578)	0.1276 (0.3336)	0.0687 (0.2530)
Upper secondary	228382	0.0384 (0.1922)	0.0740 (0.2617)	0.1124 (0.3159)	0.0605 (0.2384)
Private	29269	0.0667 (0.2494)	0.1143 (0.3181)	0.1809 (0.3850)	0.1062 (0.3081)
Public	494566	0.0475 (0.2122)	0.0702 (0.2554)	0.1174 (0.3219)	0.0627 (0.2424)
Panel B: Personal characteristics					
Age		44.111 (9.6703)	Vocational		0.1387 (0.3457)
Women		0.5616 (0.4962)	Remedial		0.0666 (0.2493)
Foreign		0.0676 (0.2510)	Temporary		0.2084 (0.4062)
Married		0.5724 (0.4947)	Workload		86.514 (23.244)
University graduate		0.6741 (0.4687)	Upper secondary		0.4360 (0.4959)
Science		0.1564 (0.3632)	Private		0.0559 (0.2297)
Panel C: Pecuniary characteristics					
Log yearly earnings (1000SEK)		5.2898 (0.5861)	Log monthly salary[39]		9.9532 (0.1613)
Panel D: School characteristics					
Share of girls		0.4812 (0.0992)	Number of students/100		4.5389 (2.9887)
Share of foreign students		0.0842 (0.0868)	Students' parents income (1000SEK)		379.22 (97.1868)
Student-teacher ratio full time equivalence		9.91 (2.93)	Student's percentiled GPA		47.87 (6.7731)

Note: Mean values. Standard errors in parentheses.

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[39] Mean log monthly salary among the individuals working in public schools for whom the data is available.

5. Main results

The estimates presented in this section correspond to the model outlined in section 3 and are based on the sample described in detail in section 1 of the appendix. Using a linear regression I estimate a binary model with county-times-time fixed effects[40] and the dependent variable equal to unity if the teacher leaves a particular school from year t to year t+1, and zero otherwise. The results are presented in table 2. Column (1) shows the raw correlation between the total mobility and teacher's individual characteristics. Column (2) adds school level characteristics to estimates from column (1). Column (3) adds yearly earnings to specification from column (2). Column (4) estimates column (3) on the sample of public school teachers, which is then used in column (5), where I substitute the log yearly earnings with log monthly salary. This exercise is performed to investigate, how covariates in model from column (3) change when the sample is reduced to public school teachers for whom the monthly wage data are available. The preferred specification is the one in column (3), which is chosen because it includes all teachers and all controls that might be of interest.

All regressions yield qualitatively stable results regarding individual characteristics. In fact, the results do not change much quantitatively if I add school characteristics. Thus, the personal characteristics seem to be orthogonal to the other covariates used in the analysis. The signs of the individual characteristics are mostly as expected. Teacher's age is convex in mobility and women are less likely to change jobs. The probability of changing jobs is only around 0.64 to 1.1 percentage points lower for women than for men, which points towards

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[40] The results are valid conditional on the assumption that controlling for county-times-time effects is an appropriate specification. In particular, one might consider specifications with only time, or only county, or only time and county, or using municipality instead of county fixed effects. While considering the main specification (column (3)) and: time and county effects – upper secondary school indicator becomes negative and barely significant; time effects only – share of immigrants is positive and significant (which points towards the fact that minorities are unevenly distributed geographically in Sweden: see Edin et al. (2003)), parental income is positive and significant, student-teacher ration in full time equivalence is negative and barely significant; county effects only – upper secondary school indicator is negative and barely significant and parental income is negative and significant; municipality effects only – upper secondary school indicator is negative and barely significant; time and municipality effects – upper secondary school indicator is negative and barely significant; time-times-municipality effects – nothing changes. Thus, all these specifications yield very similar results and I conclude that the results are not driven by misspecification of fixed effects included. Including school or teacher fixed effects removes some of the variation that is of interest in this paper (i.e. school level covariates or teacher gender differences), and thus these results are not presented in the paper. When I include school specific effects and estimate regression with individual covariates only, then the results do not change qualitatively. When I include individual specific effects and estimate regression with school covariates only: share of immigrants becomes positive and significant, GPA becomes insignificant, parental income becomes negative and significant and share of girls becomes positive and significant. It is worth noting, however, that these two models depart from the idea laid out beyond model presented in equation (1). As far as linearity assumption is concerned, logit models with marginal effects evaluated at mean yield similar results. In the main analysis (table 2) when using logit models: in column (2) – student's parents income becomes insignificant and vocational indicator becomes significant; column (3) – upper secondary school indicator and vocational indicator become significant; column (4) – vocational indicator becomes significant; column (5) – upper secondary school indicator becomes significant while minority and university education indicators become insignificant. All these regressions are available from the author upon request.

relatively high gender equality in the labor market for teachers[41]. Married individuals are less likely to move, which is a widely recognized fact in family economics (Felmlee, 1982). As expected, temporarily employed teachers are more likely to move and the mobility is decreasing in workload[42]. Science and remedial education teachers are more likely to change employers, which is perhaps due to high demand for these professionals[43]. This result is relevant from the policy point of view since literature points towards effective science learning as one of the most important predictors of future labor market success (Altonji, 1995; Edmark and Nordström Skans, 2010). Moreover, teachers with university education are less likely to move, which is supported by the literature (Börsch-Supan, 1990).

The type of employer correlates significantly with the mobility. Upper secondary school teachers are between 0.7 and 0.9 percentage points less mobile than their lower secondary school counterparts. If one focuses on either the whole sample (column (3)) or public schools with log monthly wages control (column (5)), then the coefficient on upper secondary school indicator is no longer significant. There is also a difference in mobility patterns between private and public schools, which is relevant from the policy point of view, given the large expansion of private schooling in Sweden. In particular, private school teachers experience between 1.5 and 2.6 percentage points higher mobility, which is one of the key results of the paper given the Swedish institutions.

The coefficients on both log yearly earnings and log monthly salary for publicly employed individuals are highly significant and negative in all the specifications, which suggests that Swedish principals may have means to retain teachers by offering them higher monetary compensations. As far as the size of the monetary coefficients is concerned, they are relatively small in comparison to these from table 7 in Hanushek et al. (2004). It worth noting, however, that their measure of monetary compensation is somewhat different than mine. Furthermore, in the case of Texas virtually all the salary effects vanish when the school district fixed effects are implemented, whereas, in the case of Sweden the coefficients on both log earnings and log monthly salaries are stable qualitatively and quantitatively across various fixed effects specifications[44].

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[41] Falch and Strøm (2005) find a negative 6 percentage points estimate, whereas Stinebrickner (1998) finds positive coefficient on female indicator variable. Furthermore, this equality in mobility is important when one has in mind the increase in the number of female teachers during the studied period.
[42] Workload is defined as the fraction of full time position that teacher covers in their main post.
[43] The Swedish system of teacher employment is demand driven and school can compete for teachers by changes in salaries. Thus, in specializations, which are highly demanded we should see more competition for teachers and as a result more mobility (Hensvik, 2012).
[44] Time, county, municipality, time and county, time and municipality, time-times-county, time-times-municipality, school as well as school and time fixed effects were applied. These are available from the author upon request.

Table 2. Baseline estimation results. The dependent variable is equal to unity if the teacher changes job.

VARIABLES	(1) Mobility	(2) Mobility	(3) Mobility	(4) Mobility	(5) Mobility
Log yearly earnings (1000SEK)			-0.06409***	-0.06793***	
			(0.002)	(0.002)	
Log monthly salary					-0.13282***
					(0.008)
Temporarily employed	0.22240***	0.22218***	0.19399***	0.19546***	0.21060***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Workload	-0.00162***	-0.00163***	-0.00113***	-0.00104***	-0.00149***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Upper-secondary school	-0.00893***	-0.00870***	-0.00453	-0.00712**	-0.00437
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Private school	0.01744***	0.02633***	0.01527***		
	(0.005)	(0.006)	(0.006)		
Share of immigrant students		0.00698	0.01284	-0.00561	-0.00684
		(0.016)	(0.016)	(0.017)	(0.017)
GPA		-0.00089***	-0.00084***	-0.00058**	-0.00050**
		(0.000)	(0.000)	(0.000)	(0.000)
Student's parents income		-0.00003*	-0.00002	-0.00005***	-0.00005**
		(0.000)	(0.000)	(0.000)	(0.000)
Share of girls		-0.02438**	-0.02986***	-0.01915*	-0.01656
		(0.010)	(0.010)	(0.012)	(0.011)
Student-teacher ratio FTE		-0.00043	-0.00032	-0.00130***	-0.00147***
		(0.000)	(0.000)	(0.000)	(0.000)
Age	-0.00920***	-0.00925***	-0.00670***	-0.00663***	-0.00835***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age^2	0.00008***	0.00009***	0.00007***	0.00007***	0.00009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.00690***	-0.00640***	-0.01089***	-0.01070***	-0.00820***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Immigrant	0.01629***	0.01585***	0.00801**	0.00804**	0.00884***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Married	-0.01765***	-0.01734***	-0.01716***	-0.01661***	-0.01541***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
University graduate	-0.01268***	-0.01131***	-0.00789***	-0.00466***	-0.00289**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Science	0.00813***	0.00868***	0.00976***	0.00842***	0.00941***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Vocational	0.00427**	0.00089	0.00174	0.00143	0.00007
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Remedial education	0.03410***	0.03170***	0.03327***	0.03149***	0.03245***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	523,835	523,835	523,835	474,538	474,538
R-squared	0.133	0.133	0.142	0.140	0.133

Note: School level clustered standard errors (*** p<0.01, ** p<0.05, * p<0.1). Regressions include time*county specific effects as well as (except for column (1)) number of students, number of students^2 and indicator for schools below 100 students. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

Table 2 shows that ten percent increase in teacher earnings decreases the probability of changing jobs by 0.6-0.7 percent. At the same time, if we focus on monthly wage among public school teachers then the coefficient suggests 1.3 percent decrease. The difference in the size of earnings/wage coefficients in columns (4) and (5) shall be attributed to different definitions of both monetary compensations. Nonetheless, since they give the same results qualitatively and monthly wages are available only for a sample of public school teachers, then from here on the heterogeneity analysis (section 6) is conducted on the full sample using log yearly earnings[45]. Considering the rigid wage distribution in Sweden, the correlation is likely to be stronger in countries where in addition to deregulated market the wages are less compressed and the employment protection laws less strict. In fact, a one standard deviation

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[45] Estimates for public school teachers and monthly wages are available from the author upon request. Main findings remain unchanged.

in log yearly earnings decreases the mobility by 3.8 percentage point, while a one standard deviation in log monthly wage yields 0.5 percentage points decrease in mobility. Given the size of the coefficients, the policies aimed at reducing mobility in Sweden through increased pay can be seen as rather expensive ones, however, the negative and significant correlation in the cross-sectional analysis is the second key finding of this paper.

In fact, it is not clear a prior whether policy makers would want to decrease the turnover. On the one hand, they may want to lower turnover if it leads to lower student achievement, especially when turnover is higher in some schools that others. On the other hand, they may want to increase teacher mobility in order to improve the teacher-school-student matches. Furthermore, increased turnover may encourage bad teachers to leave the profession if they will be forced to change their jobs often enough. Finally, if the objective function of a principal in school, which does not face competition, is to reduce their own work intensity as much as possible, then they may want to reduce the turnover, as it is costly for them to search for teacher replacements. The few empirical studies do not help in resolving this issue (Guin, 2004). For instance, Ronfeldt et al. (2011) suggest a negative effect of turnover on students' outcomes, while Abelson and Baysinger (1984) show that turnover results in better person-job matches and infusion of new ideas into organizations.

I also re-estimated column (3) including interaction terms between earnings and gender, type of employment and education. In this regression the main earnings coefficient remains negative and significant, and the interactions indicate that there is no gender specific correlation in earnings, however, the interaction with type of employment comes out negative and significant, while the correlation with university indicator is positive and significant. Finally, I analyzed specification from column (3) in schools with below and above median earnings dispersion. The results in each case are similar, however, the earnings coefficient is significantly more negative in the former case[46].

Unlike most other researchers I do not find support for the hypothesis that high share of minorities correlates with higher job turnover, which is the third key result of this paper. The coefficients are not only insignificant but they are also close to zero. In order to further explore this novel finding[47], in table 3, I split the students into these coming from European and non-European countries (panel A). I also interact the share of immigrant children with an

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[46] The estimation results are available from the author upon request.
[47] Jackson (2009) in his causal study finds that a sudden inflow of minority students (blacks) is associated with systematic changes in the makeup of teachers at the affected schools. These schools generally loose high quality teachers, however, the white teachers were no more likely to leave the affected schools than the non-affected ones, whereas black teachers preferred staying in schools with increasing proportion of black students.

immigrant teacher dummy (panel B). First of all, there is no indication for any heterogeneous impact of minorities coming from different geographical and cultural regions. Secondly, the bottom panel points towards immigrant teachers clustering with immigrant students, which is in line with Hanushek et al. (2004) and Jackson (2009) findings. The results for public schools are identical to these for the full sample. Furthermore, in both tables 2 and 3, there is indication that immigrant teachers are more likely to change jobs, which may either reflect lower quality of matches between immigrant teachers and schools or generally increased occupational mobility among immigrants (Green, 1999).

Table 3. Minorities at school. The dependent variable is equal to unity if the teacher changes job.

VARIABLES	(1) Mobility Full sample	(2) Mobility Public school sample
Panel A: Split analysis		
Share of European students	0.03750	0.02713
	(0.036)	(0.037)
Share of other immigrant students	0.00073	-0.02457
	(0.021)	(0.024)
R-squared	0.142	0.133
Panel B: Interaction analysis		
Immigrant teacher	0.01599***	0.01668***
	(0.004)	(0.005)
Share of immigrant students	0.02286	0.00142
	(0.016)	(0.016)
Share of immigrant students*Immigrant teacher	-0.07300***	-0.07139**
	(0.027)	(0.028)
Observations	523,835	474,538
R-squared	0.142	0.133

Note: School level clustered standard errors. (*** p<0.01, ** p<0.05, * p<0.1). All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with. Column (1) is based on the specification from column (3) in table 2, while column (2) is based on specification from column (5) in table 2.

As far as socioeconomic is concerned, I find only weak and close to zero negative correlation between parents' income and teacher mobility. The US studies are not conclusive about the effect of students' test scores on teacher mobility. Scafidi et al. (2007) find that teachers are more likely to leave schools with low achieving students, while Hanushek et al. (2004) do not find any significant effects for Texas. Swedish teachers tend to behave like these researched in the former paper since there is a significant and negative correlation between student's GPA and teacher mobility. This result may indicate that teachers desire working with high quality pupils, as they perceive such a job as an easier one.

The negative correlation between share of girls and mobility can be either interpreted as overrepresentation of girls in particular type of schools or as the fact that perhaps girls are less disruptive in their behavior. To further elaborate on this issue, I estimated the regression from column (3) with additional interaction terms between share of girls and upper secondary as well as private school indicators. The results (available upon request) indicate that coefficients on both interaction terms become negative and significant, while at the same time share of girls becomes insignificant. It indeed, suggests that initial negative correlation might be driven by overrepresentation of girls in particular types of schools.

As far as importance of particular factors is concerned, univariate regressions (table A3 in section 2 of the appendix) shed more light on the relative contributions of included covariates. It seems that a single factor that explains the most of the variation in teacher mobility is the type of employment, followed by pecuniary characteristics and workload. Considering the variables grouped in personal, pecuniary and non-pecuniary characteristics the amount of explained variation in total turnover is the following: personal (R^2=0.13), pecuniary (R^2=0.08) and non-pecuniary (R^2=0.01). When comparing just the pecuniary vs. the non-pecuniary conditional on personal characteristics, the former one (R^2=0.14) explain slightly more variation in total turnover than the latter one (R^2=0.13). Thus, it is not trivial to gouge quantitatively the relative importance of either of the groups, yet it seems that in Sweden teachers are less sensitive to school characteristics that in the other studied countries.

Finally, I can only observe mobility if teachers have different establishment numbers, however, it may be problematic whether this mobility is voluntary or not. In particular, there can be reshuffling of teachers between schools in municipality due to the fact that employment protection is based on employment in municipality and not at the school. Furthermore, it may be the case that if one school has an opening for a teacher and there are other schools in the same municipality laying off teachers, there might be bargaining and reshuffling of teachers within the municipality. To address this issue I restrict the analysis to the sample of municipalities that never experienced reductions in the teacher stock by more than 5% in the studies period. Note that this is a very restrictive assumption in the sense that it excludes municipalities that experienced only temporary reductions and it also imposes small room for reductions[48].

Table A4 in the appendix presents the estimation results using the sample described above and specifications from table 2. The sample size is reduced four fold, however, majority of the results remain unchanged both qualitatively and quantitatively. The changes in the significance are mostly related to school characteristics. In particular, parental income, gender ratio at school and school resources are no longer significant in any of the specifications. Moreover, private school indicator although still positive is no longer significant in columns (1) and (3) and upper secondary indicator becomes significant in columns (3) and (5). Importantly for the aim of this paper the coefficients on earnings, wages, type of employment, minorities and student quality remain virtually unchanged. Thus, these

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[48] Some of the municipalities experiences as much as over 80% reductions in teacher stock from year to year over the studied period.

estimates should reassure the readers that involuntary mobility and reshuffling of teachers within municipalities do not pose a threat to the validity of the main results.

6. Heterogeneity analyses

Table 4 presents the first part of the heterogeneity analysis, and regressions in this section are based on the specification presented in column (3) in table 2. Columns (1) and (2) present differences between female and male teachers. As far as personal characteristics are concerned, both genders behave differently. In particular, only highly educated women are more likely to stay with their current employment and immigration history does not seem to correlate with female turnover whereas it has positive influence on males' decisions. Unlike women, men display preferences towards working in upper secondary education[49]. Finally, males are significantly more responsive to increases in earnings, which is consistent with the literature (Blanchflower and Oswald, 1995). Thus, even though in general female teachers are no more mobile than males, there is actually heterogeneity in what influences their decisions to change jobs.

Given the institutional details discussed in section 2, temporarily and permanently employed teachers may differ in terms of the determinants of their mobility. Columns (3) and (4) shed light on these differences. In table 2 when the earnings control was added the coefficient on temporary employment dropped by more than 12%, which suggests that correlation between monetary compensation and the type of employment matters. In fact, temporarily employed teachers are more than three times as responsive to increased earnings as permanently employed. This difference might be associated with having multiple positions in different schools. In the dataset I restrict myself to the main employment (largest workload), however, each teacher might have multiple positions[50]. Such a teacher has broader possibilities of changing the job because they can move to a different school where they hold minor position easier than a teacher with only one major employment[51]. At the same time, however, if the school where they hold main position is satisfied with the teacher then they can simply offer a new contract with higher monetary compensation. This way teachers are retained at the current school and their earnings are necessarily higher. The temporary teachers are also easier to be retained at upper secondary school level and when they are highly educated. The temporarily employed science teachers are more than five times as mobile as the permanently employed, which might be related to large shortages in science

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[49] The negative and significant coefficients for males only may also indicate that there is a gender-dependent underlying selection process into upper and lower secondary teaching professions.

[50] In fact when one considers the whole sample then the temporarily employed have on average 0.07 positions more than permanently employed, which is significant at 1% level.

[51] A principal in such a school has more information about the teacher because of the minor position and thus they may be more willing to employ them rather than a completely new teacher. In the latter case the asymmetry of information should be larger than in the former.

teachers[52]. Finally, there is no significant correlation for temporarily employed immigrant teachers, which might be due to the fact that nearly 40% of all the minority teachers are employed on temporary contracts.

Table 4. Heterogeneity analysis by individual characteristics. The dependent variable is equal to unity if the teacher moves.

VARIABLES	(1) Women	(2) Men	(3) Temporary	(4) Permanent	(5) Foreign	(6) Nordic
Log yearly earnings (1000SEK)	-0.05978***	-0.07044***	-0.09948***	-0.02834***	-0.06410***	-0.06481***
	(0.002)	(0.003)	(0.003)	(0.002)	(0.006)	(0.002)
Temporarily employed	0.20221***	0.18215***			0.18662***	0.19488***
	(0.003)	(0.003)			(0.012)	(0.003)
Workload	-0.00108***	-0.00121***	-0.00126***	-0.00116***	-0.00084***	-0.00116***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Upper-secondary school	0.00099	-0.01294***	-0.04062***	0.00228	0.00000	-0.00658**
	(0.003)	(0.003)	(0.006)	(0.003)	(0.008)	(0.003)
Private school	0.01327**	0.01847***	-0.05782***	0.04131***	-0.00049	0.01673***
	(0.006)	(0.007)	(0.011)	(0.006)	(0.015)	(0.006)
Share of immigrant students	0.00928	0.01977	0.05733*	-0.00577	0.03101	0.01722
	(0.016)	(0.021)	(0.034)	(0.014)	(0.054)	(0.016)
GPA	-0.00098***	-0.00067**	-0.00101**	-0.00089***	-0.00096	-0.00083***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Student's parents income	-0.00002	-0.00002	-0.00003	-0.00003	0.00009	-0.00003*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Share of girls	-0.03476***	-0.03181***	-0.02280	-0.03094***	0.00329	-0.03245***
	(0.012)	(0.012)	(0.024)	(0.009)	(0.031)	(0.010)
Student-teacher ratio FTE	-0.00018	-0.00063	0.00149	-0.00070	0.00317***	-0.00077*
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Age	-0.00698***	-0.00607***	-0.01384***	-0.00416***	-0.01277***	-0.00623***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)
Age^2	0.00007***	0.00006***	0.00016***	0.00003***	0.00012***	0.00006***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female			-0.00626*	-0.00994***	-0.02039***	-0.01016***
			(0.003)	(0.001)	(0.005)	(0.001)
Immigrant	0.00287	0.01293***	-0.01109	0.01632***		
	(0.004)	(0.004)	(0.007)	(0.005)		
Married	-0.01887***	-0.01433***	-0.04174***	-0.01031***	-0.03949***	-0.01548***
	(0.001)	(0.001)	(0.003)	(0.001)	(0.005)	(0.001)
University graduate	-0.01447***	-0.00012	-0.00520	-0.00522***	-0.00484	-0.00833***
	(0.002)	(0.002)	(0.003)	(0.001)	(0.005)	(0.001)
Science	0.00475**	0.01352***	0.02627***	0.00567***	0.02753***	0.00848***
	(0.002)	(0.002)	(0.004)	(0.001)	(0.006)	(0.001)
Vocational	0.00120	0.00923***	-0.00520	0.00478***	0.01185	0.00056
	(0.002)	(0.003)	(0.005)	(0.002)	(0.011)	(0.002)
Remedial education	0.03635***	0.02690***	0.02235***	0.03613***	0.07866***	0.03112***
	(0.003)	(0.004)	(0.008)	(0.002)	(0.020)	(0.002)
Observations	294,188	229,647	109,177	414,658	35,404	488,431
R-squared	0.145	0.140	0.058	0.032	0.151	0.139

Note: School level clustered standard errors (*** p<0.01, ** p<0.05, * p<0.1). Regressions include time*county specific effects, number of students, number of students² and indicator for schools below 100 students. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

Columns (5) and (6) further explore the differences between native and minority teachers. Even though, table 3 suggested clustering of immigrant teachers in schools with immigrant students, the heterogeneity analysis does not point towards any differences in turnover between natives and immigrants with changes in share of minorities at school. Non-Nordic teachers prefer working in well-endowed schools, however, the exact type of school does not seem to matter. Both types of teachers are equally responsive to changes in monetary compensations, even though foreign teachers earn on average 16% less.

In table 5, I present heterogeneity analysis related to different types of schools. Columns (1) and (2) present differences between lower and upper secondary school teachers. The

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[52] For example, there is 2% more uncertified teachers in science subjects than in all other subjects, yet this difference is likely not big enough to drive the fivefold difference in the estimated coefficients.

monetary compensation correlation is larger in lower secondary schools and thus it is relatively cheaper to keep desired teachers who work with younger kids. It may be crucial as remedial education teachers have higher probability of leaving lower secondary schools and they in turn matter for disadvantaged students. In other words, if it is relatively cheaper to retain desired teachers (university graduate indicator is also negative and significant but science teachers are more likely to leave these schools) who work with younger students then policy makers may have a tool to reduce the inequalities in future outcomes, since the literature shows that the early interventions yield better results (Borman et al. 2005; Heckman, 2006; Dobbie and Fryer, 2010). Importantly from a policy point of view, minorities increase teacher turnover in upper secondary schools. Hanushek et al. (2004), Falch and Strøm (2005), Scafidi et al. (2007) as well as Bonhomme et al. (2011) all focus on relatively younger kids, enrolled in elementary or lower secondary education, and find significant results for minorities. In the case of Sweden this is not true, however, the 9.5 percentage points estimate for upper secondary schools is somewhat of the size of Hanushek et al. (2004) elementary schools' results. Given that upper secondary school covers age when pupils go through adolescence period, which is often strongly connected to increased disruptive behavior, then the positive correlations found in Netherlands, Norway and the US may be even larger in upper secondary schools there.

There is also positive correlation between minorities and turnover in private schools (columns (3) and (4)), and the size of the earnings coefficient is smaller in these schools. Thus, private schools are not only less likely to retain teachers (table 2), but it is also relatively more expensive for them to do so through increased pay. At the same time, they are losing teachers due to increased shares of minorities and limited resources as well as discourage full-time employed and science teachers. Thus, it seems that among teachers, who change jobs, those that are choosing to work in private sector favor rather a well-endowed, high achieving institutions with small share of minorities. Therefore, even given large private schooling expansion and increased competition, the private schools do not seem to have advantage in the labor market for teachers and in some instances, it is more challenging for them to retain teachers[53].

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[53] It may well be the fact, that the ownership per se does not matter, however, the private schools are managed in a way so as to push teachers away if they are not appropriately compensated.

Table 5. Heterogeneity analysis by school type. The dependent variable is equal to unity if the teacher moves.

VARIABLES	(1) Lower secondary school	(2) Upper secondary school	(3) Private school	(4) Public school
Log yearly earnings (1000SEK)	-0.07239***	-0.05552***	-0.05100***	-0.06682***
	(0.003)	(0.003)	(0.005)	(0.002)
Temporarily employed	0.21547***	0.16520***	0.14115***	0.19765***
	(0.004)	(0.004)	(0.009)	(0.003)
Workload	-0.00098***	-0.00138***	-0.00098***	-0.00115***
	(0.000)	(0.000)	(0.000)	(0.000)
Upper-secondary school			-0.00555	-0.00776**
			(0.010)	(0.003)
Private school	0.01971***	0.01745*		
	(0.007)	(0.009)		
Share of immigrant students	-0.01603	0.09517***	0.12267***	-0.00871
	(0.017)	(0.037)	(0.042)	(0.017)
GPA	-0.00084**	-0.00099***	-0.00132**	-0.00060**
	(0.000)	(0.000)	(0.001)	(0.000)
Student's parents income	-0.00004**	0.00001	0.00005	-0.00005***
	(0.000)	(0.000)	(0.000)	(0.000)
Share of girls	0.01468	-0.04450***	-0.04501*	-0.01949*
	(0.023)	(0.011)	(0.023)	(0.012)
Student-teacher ratio FTE	-0.00068	0.00003	0.00448***	-0.00139***
	(0.001)	(0.001)	(0.001)	(0.000)
Age	-0.00561***	-0.00729***	-0.00593**	-0.00665***
	(0.001)	(0.001)	(0.003)	(0.001)
Age^2	0.00005***	0.00007***	0.00006*	0.00007***
	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.01584***	-0.00532***	-0.01319**	-0.01104***
	(0.001)	(0.002)	(0.005)	(0.001)
Immigrant	0.00033	0.01544***	0.01366	0.00575*
	(0.004)	(0.004)	(0.009)	(0.003)
Married	-0.01914***	-0.01410***	-0.01403***	-0.01727***
	(0.001)	(0.001)	(0.005)	(0.001)
University graduate	-0.00889***	-0.00240	0.00013	-0.00745***
	(0.002)	(0.002)	(0.006)	(0.001)
Science	0.00518***	0.01417***	0.02370***	0.00875***
	(0.002)	(0.002)	(0.006)	(0.001)
Vocational	-0.00164	0.00621**	0.01045	0.00196
	(0.003)	(0.002)	(0.010)	(0.002)
Remedial education	0.03749***	0.02403***	0.00888	0.03355***
	(0.002)	(0.005)	(0.013)	(0.002)
Observations	295,453	228,382	29,269	494,566
R-squared	0.152	0.137	0.103	0.145

Note: School level clustered standard errors (*** p<0.01, ** p<0.05, * p<0.1). Regressions include time*county specific effects, number of students, number of students^2 and indicator for schools below 100 students. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

The models used so far force the relationship between the explanatory variables and the probability to exit school to be independent of destination, however, there is research indicating that the impact of teacher characteristics differs depending on the destination (Lankford et al., 2002). To investigate whether the relationship between these characteristics and teacher turnover depends on the destination, I estimate the baseline specification from table 2 (column (3)) separately for mobility within lower and upper secondary school as well as out of these types of school (i.e. either to kindergarten or adult education or completely out of teaching profession). The estimation method is OLS, which is a linearization of multinomial logit approach used in Hanushek et al. (2004) and Falch and Strøm (2005). The results are similar to the ones obtained using non-linear methods with marginal effects evaluated at means.

Table 6. Heterogeneity analysis by different destinations.

VARIABLES	(1) Within teaching mobility	(2) Out-of-teaching mobility
Log yearly earnings (1000SEK)	-0.01361***	-0.05048***
	(0.001)	(0.002)
Temporarily employed	0.05739***	0.13660***
	(0.002)	(0.002)
Workload	-0.00019***	-0.00093***
	(0.000)	(0.000)
Upper-secondary school	-0.01091***	0.00638***
	(0.002)	(0.002)
Private school	0.00378	0.01149***
	(0.004)	(0.004)
Share of immigrant students	0.02101*	-0.00818
	(0.011)	(0.009)
GPA	-0.00036***	-0.00048***
	(0.000)	(0.000)
Student's parents income	-0.00000	-0.00002
	(0.000)	(0.000)
Share of girls	-0.01964***	-0.01021
	(0.007)	(0.006)
Student-teacher ratio FTE	0.00045	-0.00078**
	(0.000)	(0.000)
Age	-0.00292***	-0.00378***
	(0.000)	(0.000)
Age^2	0.00002***	0.00004***
	(0.000)	(0.000)
Female	-0.00241***	-0.00847***
	(0.001)	(0.001)
Immigrant	0.00985***	-0.00184
	(0.003)	(0.003)
Married	-0.00715***	-0.01001***
	(0.001)	(0.001)
University graduate	0.00974***	-0.01763***
	(0.001)	(0.001)
Science	0.00581***	0.00396***
	(0.001)	(0.001)
Vocational	-0.00031	0.00205
	(0.001)	(0.001)
Remedial education	0.00960***	0.02367***
	(0.001)	(0.002)
Observations	523,835	523,835
R-squared	0.035	0.117

Note: School level clustered standard errors (*** p<0.01, ** p<0.05, * p<0.1). Regressions include time*county specific effects, number of students, number of students^2 and indicator for schools below 100 students. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

The earnings coefficient is larger in a quit decision, so it is relatively cheaper to encourage teachers to staying in the profession rather than to staying in the current school. This may be driven by the fact that individuals who choose teaching usually exert high motivation to working with pupils, and therefore they may experience large negative shock to their utilities if they decide to quit the profession. Additionally, when introducing the reforms, policy makers usually worry that the best teachers may leave the profession. The descriptive evidence presented here indicates that in fact university educated teachers are less likely to quit and more likely to move within the profession. Furthermore, the estimates on science teacher's indicator suggest that although more of the mobility occurs within teaching, however, there is still a large fraction of individuals who quit teaching in lower or upper secondary schools. Given the large expansion in private schooling in Sweden it is of interest what happens to teachers employed in private sector. Estimates suggest that these individuals are no more, than public school teachers, likely to change jobs within profession, however,

they are 1.2 percentage points more likely to leave the profession for outside opportunities. The decomposition of minorities' correlations suggests that, if anything, teachers are rather changing jobs within the profession than quitting teaching. It is in contrast with findings in Hanushek et al. (2004) and Falch and Strøm (2005), whose results point towards quitting the profession rather than changing school within the same geographical unit (or occupation).

A question, asked also by Falch and Strøm (2005) that can be applied to all the regressions presented above is whether it is reasonable to pool 11 years of data in one equation. It might be questionable, as teachers who come into the sample in the later years have a smaller window in which they can make mobility decisions than more experienced teachers. As a further robustness check I re-estimated columns (1) to (3) from table 2 using only teachers that were present in the sample in the first year of study. The results are reported in table A2 in the appendix. The sample size is reduced by approximately 250 000 observations, however, the results stay virtually unchanged qualitatively. The coefficients on upper secondary school loose significance, while these on vocational specialization gain significance. Additionally in column (2) mean parental income is no longer significant, while student-teacher ratio in full time equivalence gains significance in columns (2) and (3). The signs of all these coefficients are consistent with results from table 2.

7. Conclusions

The contemporary literature on teacher mobility lacked the detailed analysis of this phenomenon in an institutional environment for which the economists usually argue for i.e. with individual-level variation in wages and relatively large and growing private sector. This paper attempts to fill in this gap using unusually rich dataset on Swedish lower and upper secondary schools teachers covering years 1996/1997 to 2006/2007.

The results indicate that in terms of job turnover the Swedish market for teachers behaves differently than labor market as a whole described in Edin et al. (2009). Moreover, unlike in many previous descriptive studies, I find a retaining effect of the increased earnings and wages, which is robust to various fixed effects specifications and sample compositions. Nevertheless, the coefficients on the monetary compensations vary across these subsamples and in some cases such raises might be viewed as expensive policies in offsetting the discouraging non-pecuniary factors.

Another important difference between Sweden and other countries is the finding, that share of minorities does not generally increase turnover. The correlation coefficients come out significant only in upper secondary and private schools. In that sense previously estimated positive and significant coefficients for the compulsory education in Netherlands, Norway and the US might be even larger in the case of secondary education in these countries[54]. Furthermore, teachers discouraged by the minorities choose rather to move within the profession than to quit teaching, however, immigrant teachers tend to cluster with immigrant students.

Finally, other counties may be interested in the impact of privatization and competition on teacher turnover. Although the coefficients presented in this paper should not be interpreted as causal, it is evident that the turnover rate in the private sector is systematically higher than in the public sector, and private schools do not seem to have advantage in the job turnover process. For example, I find that private schools have particular problems with retaining science teachers, employing more permanent faculty and preventing teacher from leaving the profession.

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[54] Alternatively the mechanism of selection of teachers may differ across countries. Moreover, I am unable to determine if the lack of correlation between share of minorities and teacher mobility in Sweden is due to an egalitarian culture of the Swedish society, less disruptive behavior of immigrants or perhaps schooling system institutions.

References

Abelson, M.A., and D.B. Baysinger (1984), "Optimal and dysfunctional turnover: Toward an organizational level model", *Academy of Management Review*, 9:2, 331-341.

Altonji, G.J. (1995), "The effects of high school curriculum on education and labor market outcomes", *Journal of Human Resources*, 30:3, 409-438.

Ballou, D. (1996), "Do public schools hire the best applicants?", *Quarterly Journal of Economics*, 111:1, 97-133.

Barbieri, G., C. Rossetti, and P. Sestito (2008), "The determinants of teachers' mobility. Evidence from a panel of Italian teachers", mimeo University of Milan.

Baugh, H.W. and J.A. Stone (1982), "Mobility and wage equilibrium in the educator labor market", *Economics of Education Review*, 2:3, 253–274.

Bertrand, M., E. Duflo, and S. Mullainathan (2004), "How much should we trust differences-in-differences estimates?", *Quarterly Journal of Economics*, 119:1, 249-275.

Björklund, A., M.A. Clark, P-A. Edin, P. Fredriksson, and A. Krueger (2006), "The market comes to education in Sweden: An Evaluation of Sweden's surprising school reforms", Russel Sage Foundation, New York.

Blanchflower, G.D. and A.J. Oswald (1995), "The wage curve", MIT Press.

Bonhomme, S., G. Jolivet, and E. Leuven (2011), "Estimation of preferences for job attributes using job–to–job mobility: teacher turnover and school characteristics", mimeo CREST.

Borman, D.G., R.E. Salvin, A. Cheung, A. Chamberlain, N. Madden, and B. Chambers (2005), "The national randomized field trial success for all: Second year outcomes", *American Educational Research Journal*, 42:4, 673-696.

Boyd, D., H. Lankford, S. Loeb, and J. Wyckoff (2005), "Explaining the short careers of high – achieving teachers in school with low performing students", *American Economic Review*, 95:2, 166–171.

Böhlmark, A. and M. Lindahl (2007), "The impact of school choice on pupil achievement, segregation and costs: Swedish evidence", IZA Working Paper 2786.

Böhlmark, A. and M. Lindahl (2008), "Does school privatization improve educational achievement? Evidence from Sweden's voucher reform", IZA Working Paper 3691.

Böhlmark, A., E. Grönqvist, and J. Vlachos (2012), Mimeo

Börsch-Supan, A. (1990), "Education and its double-edged impact on mobility", *Economics of Education Review*, 9:1, 39–53.

Brewer, J.D. (1996), "Career paths and quit decisions: evidence from teaching", *Journal of Labor Economics*, 14:2, 313–339.

Carling, K. and K. Richardson (2004), "The relative efficiency of labor market programs: Swedish experience from the 1990s", *Labour Economics*, 11:3, 335-354.

Croson, R. and U. Gneezy (2009), "Gender differences in preferences", *Journal of Economic Literature*, 47:2, 448-474.

Dobbie, W. and R.G. Fryer (2011), „Are high quality schools enough to increase achievement among the poor? Evidence from the Harlem children's zone", *American Economic Journal: Applied Economics*, 3:3, 158-187.

Dolton, P. and W. van der Klaauw (1995), "Leaving teaching in the UK: a duration analysis", *Economic Journal*, 105:429, 431–444.

Dolton, P. and W. van der Klaauw (1999), "The turnover of teachers: a competing risk explanation", *Review of Economics and Statistics*, 81:3, 543–552.

Dolton, P. and O.D. Marcenaro-Gutierrez (2011), "If you pay peanuts do you get monkeys? A cross-country analysis of teacher pay and pupil performance", *Economic Policy*, 26:65, 5-55.

Edin, P-A., P. Fredriksson, and O. Aslund (2003), "Ethnic enclaves and the economic success of immigrants – evidence from a natural experiment", *Quarterly Journal of Economics*, 118:1, 329-357.

Edin, P-A., B. Holmlund, and O. Nordström Skans (2009), "Wage Dispersion Between and Within Plants: Sweden 1985-2000", in E. Lazear and K. Shaw (eds.) *The Structure of Wages: an International Comparison*, University of Chicago Press.

Edmark, K. and O. Nordström Skans (2010), "Science of success: the causal effect of high school math and science on labor market outcomes", mimeo IFAU.

Falch, T. and B. Strøm (2005), "Teacher turnover and non–pecuniary factors", *Economics of Education Review*, 24:6, 611–631.

Falch, T. (2011), "Teacher mobility responses to wage changes: Evidence from a quasi – natural experiment", *American Economic Review*, 101:3, 460-465.

Farber, S.H. (1999), "Mobility and stability: The dynamics of job change in labor markets", in O. Ashenfelter and D. Card (eds.) *Handbook of Labor Economics*, 3:B, 2439-2483.

Felmlee, H.D. (1982), "Women's job mobility processes within and between employers", *American Sociological Review*, 47:1, 142-151.

Feng, L. (2009), "Opportunity wages, classroom characteristics, and teacher mobility", *Southern Economic Journal*, 75:4, 1165-1190.

Feng, L., D. Figlio, and T. Sass (2010), "School accountability and teacher mobility", NBER Working Paper 16 070.

Fredriksson, P. and B. Öckert (2007), "The supply of skills to the teacher profession", Mimeo Uppsala University.

Fredriksson, P. and B. Öckert (2008), "Resources and student achievement – evidence from a Swedish policy reform", *Scandinavian Journal of Economics*, 110:2, 277-296.

Green, A.D. (1999), "Immigrant occupational attainment: Assimilation and mobility over time", *Journal of Labor Economics*, 17:1, 49-79.

Grönqvist, E. and J. Vlachos (2008), "One size fits all? The effects of teacher cognitive and non-cognitive abilities on student achievement", IFAU Working Paper 25.

Guin, K. (2004), "Chronic teacher turnover in urban elementary schools", *Educational Evaluation and Policy Analysis*, 12:42, 1-25.

Hanushek, E.A., F.J. Kain, and G.S. Rivkin (2004), "Why public schools loose teachers?", *Journal of Human Resources*, 39:2, 326–354.

Heckman, J.J. (2006), "Skill formation and the economics of investing in disadvantaged children", *Science*, 312:5782, 1900-1902.

Hensvik, L. (2012), "Competition, wages and teacher sorting: four lessons from a voucher reform", *Economic Journal*, forthcoming.

Holmlund, B. and D. Storrie (2002), "Temporary work in turbulent times: the Swedish experience", *Economic Journal*, 112:480, F245-F269.

Jackson, C.K. (2009), "Student demographics, teacher sorting, and teacher quality: Evidence from the end of school desegregation", *Journal of Labor Economics*, 27:2, 213-256.

Jackson, C.K. (2011a), "Match quality, worker productivity and worker mobility: Direct evidence from teachers", NBER Working Paper 15990.

Jackson, C.K. (2011b), "School competition and teacher labor markets: Evidence from charter school entry in North Carolina", NBER Working Paper 17225.

Jovanovic, B. (1979), "Job matching and the theory of turnover", *Journal of Political Economy*, 87:5, 972-990.

Lankford, H., S. Loeb, and J. Wyckoff (2002), "Teacher sorting and the plight of urban schools: the importance of alternative labor market opportunities and non – pecuniary variation", *Educational Evaluation and Policy Analysis*, 24:1, 37-62.

Lavy, V. (2009), "Performance pay and teachers' effort, productivity and grading ethics", *American Economic Review*, 99:5, 1979-2011.

Lindholm, A. (2006), "Lärarförbundet och lärarnas riksförbund medlemsundersökning om lön och arbetstid".

Loprest, J.P. (1992), "Gender differences in wage growth and job mobility", *American Economic Review*, 82:2, 526-532.

Oyer, P. (2009), "Wage Structure and Labor Mobility in Sweden, 1970-1990", in E. Lazear and K. Shaw (eds.) *The Structure of Wages: an International Comparison*, University of Chicago Press.

Murnane, J.R. and R.J. Olsen (1990), "The effects of salaries and opportunity costs on length of stay in teaching: evidence from North Carolina", *Journal of Human Resources*, 25:1, 106–124.

National Agency for Education, (2003), "Behov av och tillgång på pedagogisk personal – Skolverkets bedömning 2003".

Rivkin, S.G., E.A. Hanushek, and J.F. Kain (2005), "Teachers, schools, and academic achievement", *Econometrica*, 73:2, 417–458.

Ronfeldt, M., H. Lankford, S. Loeb, and J. Wyckoff (2011), "How teacher turnover harms student achievement", NBER Working Paper 17176.

Scafidi, B., D.L. Sjoquist, and T.R. Stinebrickner (2007), "Race, poverty, and teacher mobility", *Economics of Education Review*, 26:2, 145–159.

Schumpeter, J. (1939), "Business cycles: A theoretical, historical and statistical analysis of the capitalist process", McGraw-Hill, New York.

Stinebrickner, T. (1998), "An empirical investigation of teacher attrition", *Economics of Education Review*, 17:2, 127-136.

Söderström, M. (2005), "Evaluating institutional changes in education and wage policy", *Economic Studies*, 95, Uppsala University Doctoral Dissertation.

Söderström, M. and R. Uusitalo (2010), "School Choice and Segregation: Evidence from an Admission Reform", *Scandinavian Journal of Economics*, 112:1, 55-76.

Appendix

Section 1. Details of sample construction.

I construct the sample of lower and upper secondary school teachers for the school years 1996/1997 to 2006/2007. The information about teachers comes from the teacher registry and the analysis focuses on teachers working in grades 7-9 (lower secondary school) of compulsory education and in grades 1-3 (upper secondary school) in secondary education. Teachers who are on unpaid leave of absence or whose workload is zero hours (i.e. they do not perform any pedagogical duties) are excluded from the analysis. Such teachers are treated neutrally in terms of mobility if they come back after the absence period to the same school. Similarly, I exclude teachers who are employed as principals, study counselors etc. In each year if teacher has multiple entries in the registry, the one with the highest workload is selected irrespectively of whether it is at the same or at different schools[55]. Teacher registry is a high quality data set, that allows recovering information on school location (unique identifier), school ownership and type, teacher certification, workload, employment type, education and position.

Teachers are grouped into either lower or upper secondary education and teachers working in grades 7-9 are recovered by merging the teacher registry to the pupil registry via unique school identifier. There exist schools with more grades covered under the same school identifier (i.e. 1-9 or 4-9) and one possible source of bias would be for instance relating teachers who work with students in grades 1-3 to school characteristics measured for students in grades 7-9. Since I have information about the grades in which teachers work I address this issue by excluding teachers coded as primary (grades 1-3) and middle (grades 4-6) school teachers. Such a procedure does not solve the problem completely as some teachers (arts or music) are not necessarily coded by grades. Thus, I may still include some miscoded teachers, however, to this end it is the best matching I can perform. Nonetheless, each included school serves grades 7-9 and only mobility between such schools is considered at lower secondary level. Such a bias will not be present in upper secondary schools, as these teachers are directly linked to their students covering grades 1-3.

Teacher experience is not available for all years, and thus I use the predicted experience in the analysis. In particular, since the teacher registries date back to 1979 I explore this feature to construct the "in teaching predicted experience" variable. I create a panel of all teachers between 1979 and 2006 and link it to population enlistment data between 1985-2006

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[55] The workload of teachers having multiple positions at the same school is not summed and the highest workload position is selected.

in order to obtain teacher's birth date. I then use all this information and tenure data provided in the later registries (since 1999 and onwards) to construct the predicted measure of experience[56].

Teachers are then linked (using unique identifier) to population enlistment registry, which covers all individuals living in Sweden who are older than 15. The population registry is high quality data set that allows recovering information on gender, marital status, age, family composition (using unique family identifier), immigration history, education and income. Income is measured as a gross salary plus income from business and self-employment plus any work-related allowances. Investment losses are not included, and thus, income is lower-bounded at zero. Teachers are restricted to be younger than 59 years due to changes in retirement policies. According to the new pension system, that applies only to those born in 1938 and onwards, employees in Sweden can collect pension at the age of 61 at the earliest, however, this amount will be significantly lower than the guaranteed pension, which is available after turning 65. Note that people who were born in 1937 or earlier do not fall into the new pension system. In the first year studied in this paper they are 59 and that is why I restrict the teachers to be younger than 59 years old. The older teachers can retire under different rules and indeed you can see a sharp increase in separations for teachers above 58. Thus, for the sake of logical consistency I present results for the sample of teachers aged 25-58 that all fall into the new pension system. The bottom cutoff is due to university education and possible onsite job training during the last year of college.

The earnings registry covers all individuals while the wage registry covers all individuals employed in the public sector and the sample of individuals employed in the private sector[57]. In the latter dataset the information is collected once a year and reflects the employment status and monthly salary as of November 1st each year. In the case of teachers this data is useful as schools are in operation when the data is collected and therefore one can observe how much school pays an individual teacher that is not reflecting part-time or full-time leaves, out of the labor market periods or unemployment. Thus, in that sense the wage data are, unlike the earnings data, not subject to the labor supply decisions critique. The main disadvantage of using monthly wages is that they cover only a sample of private schools and typically different schools over time. Furthermore, the private institution's sampling probability depends on the size of the establishment, so it is likely that the smaller and newly

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[56] Detailed Stata code for tenure variable can be obtained from the author upon request.
[57] The wage data is a secondary source of information because of its quality. Even though it is supposed to cover all the individuals working in public schools over the course of this study some 6 925 (or 6.1%) of public school teaches have missing wage data.

founded private institutions would be underrepresented. It may thus yield a selection problem, however, when I estimate the regression with yearly earnings on the sample of individuals for whom the monthly wages are available the coefficient on the yearly earnings does not depart much from the one obtained for the full sample.

Both earnings and wages registries often contain multiple entries per individual, which characterizes different sources of labor compensations. In the former case the data are restricted to individuals whose employment started no later and ended no earlier than in October. Individuals with a single record per year are matched based on their unique identifiers. Furthermore, I construct the median rule that matches school codes with establishment identifier i.e. among these individuals who have single records for each school identifier I match most often occurring establishment identifier in earnings registry. The remaining teachers' earnings are matched with individuals based on their unique identifier and mode rule match[58]. As far as monthly wages are concerned individuals coded as teachers are selected and then the maximum workload is chosen. Teacher and wage registries are then merged using unique personal identifier.

The students' characteristics are based on "school in" and "school out" pupil registries. The lower secondary school composition is based on outgoing students, which should not pose a selection problem as majority of students graduate the lower secondary education. Söderström and Uusitalo (2010) report that about 90% of student population complete the ninth grade and is eligible for upper secondary schooling, and of those 98% continue. The quality of students in lower secondary school is measured based on their 9th grade outgoing grades. The measure is calculated for year t as a mean percentiled GPA from cohorts graduating in year t+1, t+2 and t+3. It reflects the fact that teacher characteristics are measured in the fall of the school year while the examination takes place in the spring of the school year. For example, the lower secondary school quality in the school year 2006/2007 is measured using grades from exams administered in years 2007, 2008 and 2009.

The upper secondary school composition is based on all the students that are in a given school in a particular year. The quality of students in upper secondary school is measured based on their 9th grade grades, due to a large selection in graduation rates. Even allowing 4 years for graduation between 25 and 30% of students do not finish upper secondary schools. Additionally, the advantage of using lower secondary school grades as a measure of upper secondary school quality is the fact that it is largely exogenous to upper secondary school

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[58] Detailed Stata code of the mode rule can be obtained from the author upon request.

teachers. I connect these students to their parents using unique family identifier and obtain the family level socioeconomic indicator i.e. mean parental income[59].

Finally, having a dataset with teachers and students I match the two using a unique school identifier. Naturally since the mobility itself is a lagged variable school year 2006/2007 is dropped from the analysis. The final sample includes 135 895 teachers and 621 430 person–year observations. I exclude the following observations from the main sample: very small schools with number of teachers in full time equivalence less than 3 (5 232 observations), teachers that are below 25 years old (8 363 observations), teachers that are above 58 years old (82 211 observations), and schools with the number of students less than 15 (1 789 observations). The final sample consists of 121 331 teachers and 523 835 person–years. Adding the data on monthly wages for the public school teachers decreases the sample size to 106 669 individuals and 474 538 teacher–years.

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[59] The description of how income is calculated is given in previous paragraphs.

Section 2: Graphs and tables.

Figure A1. Turnover and number of teachers as function of teacher's monthly wage. Public school teachers with available data.

Table A1. Description of evolution of Swedish schools

| | Public Schools | | | | | | | | | Private Schools | | | | | | | | |
| | Lower secondary | | | Upper secondary | | | Total | | | Lower secondary | | | Upper secondary | | | Total | | |
Year	Teachers	Students	Schools	Teachers	Students	Schools	Teachers	Students	Schools	Teachers	Students	Schools	Teachers	Students	Schools	Teachers	Students	Schools
1996	24217	268381	914	19778	187030	338	43995	455411	1252	466	3313	30	381	3030	30	847	6343	60
1997	23545	264237	921	20022	187833	355	43567	452070	1276	578	3990	40	428	3397	35	1006	7387	75
1998	24594	276030	972	20967	184348	362	45561	460378	1334	665	4395	44	543	5041	42	1208	9436	86
1999	27106	297940	1095	20832	188209	397	47938	486149	1492	812	6600	75	837	7271	56	1649	13871	131
2000	27846	301363	1120	21621	189129	431	49467	490492	1551	1112	8975	103	965	8935	69	2077	17910	172
2001	29413	311153	1161	21944	191407	422	51357	502560	1583	1438	13060	133	1314	12296	97	2752	25356	230
2002	30532	320602	1191	22136	192268	436	52668	512870	1627	1757	15976	154	1792	16629	132	3549	32605	286
2003	31130	330967	1192	22228	193781	437	53358	524748	1629	2199	20702	186	2292	22281	170	4491	42983	356
2004	31241	338912	1209	21901	197802	438	53142	536714	1647	2494	24092	207	2898	28136	204	5392	52228	411
2005	31419	339792	1217	22094	203633	445	53513	543425	1662	2889	27499	228	3409	32104	219	6298	59603	447
∑	281043	3049377	10992	213523	1915440	4061	494566	4964817	15053	14410	128602	1200	14859	139120	1054	29269	267722	2254

Note: Number of teaches, number of students and number of schools by school type and ownership across years.

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Table A2. Baseline estimates restricted to the sample of teachers present in the first year of the analysis. The dependent variable is equal to unity if the teacher changes job.

VARIABLES	(1) Mobility	(2) Mobility	(3) Mobility
Log yearly earnings (1000SEK)			-0.03792***
			(0.003)
Temporarily employed	0.17418***	0.17391***	0.15971***
	(0.004)	(0.004)	(0.004)
Workload	-0.00133***	-0.00133***	-0.00108***
	(0.000)	(0.000)	(0.000)
Upper-secondary school	-0.00135	-0.00439	-0.00144
	(0.002)	(0.003)	(0.003)
Private school	0.01794***	0.03060***	0.02512***
	(0.007)	(0.007)	(0.007)
Share of immigrant students		0.00863	0.01354
		(0.017)	(0.017)
GPA		-0.00093***	-0.00090***
		(0.000)	(0.000)
Student's parents income		-0.00002	-0.00001
		(0.000)	(0.000)
Share of girls		-0.01774*	-0.02114**
		(0.011)	(0.011)
Student-teacher ratio FTE		-0.00137***	-0.00124***
		(0.000)	(0.000)
Age	-0.00721***	-0.00724***	-0.00521***
	(0.001)	(0.001)	(0.001)
Age^2	0.00006***	0.00006***	0.00004***
	(0.000)	(0.000)	(0.000)
Female	-0.00889***	-0.00855***	-0.01081***
	(0.001)	(0.001)	(0.001)
Immigrant	0.01158***	0.01035***	0.00743**
	(0.003)	(0.003)	(0.003)
Married	-0.00872***	-0.00841***	-0.00806***
	(0.001)	(0.001)	(0.001)
University graduate	-0.00531***	-0.00367**	-0.00253*
	(0.002)	(0.002)	(0.002)
Science	0.00807***	0.00851***	0.00945***
	(0.002)	(0.002)	(0.002)
Vocational	0.00947***	0.00634***	0.00604***
	(0.002)	(0.002)	(0.002)
Remedial education	0.02733***	0.02511***	0.02587***
	(0.003)	(0.003)	(0.003)
Observations	274,902	274,902	274,902
R-squared	0.077	0.078	0.081

Note: School level clustered standard errors (*** p<0.01, ** p<0.05, * p<0.1). Regressions include time*county specific effects as well as (except for column (1)) number of students, number of students^2 and indicator for schools below 100 students. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

Table A3. Estimation results from univariate OLS models.

VARIABLES	(1) Mobility	(A1) R²	(2) Within teaching mobility	(A2) R²	(3) Out-of-teaching mobility	(A3) R²
Log-earnings	-0.15325*** (0.002)	0.081	-0.04049*** (0.001)	0.020	-0.11275*** (0.002)	0.067
Log-wages	-0.54911*** (0.008)	0.061	-0.17774*** (0.005)	0.021	-0.37137*** (0.006)	0.043
Temporary	0.26516*** (0.003)	0.115	0.07376*** (0.001)	0.028	0.19140*** (0.002)	0.092
Workload	-0.00253*** (0.000)	0.039	-0.00053*** (0.000)	0.011	-0.00200*** (0.000)	0.034
Upper secondary	-0.01360*** (0.002)	0.007	-0.01667*** (0.002)	0.010	0.00307** (0.002)	0.003
Private	0.05610*** (0.006)	0.008	0.01380*** (0.003)	0.008	0.04230*** (0.004)	0.004
Share of non-Nordic students	0.02077 (0.014)	0.006	0.02110** (0.009)	0.008	-0.00033 (0.008)	0.003
GPA	-0.00097*** (0.000)	0.007	-0.00033*** (0.000)	0.008	-0.00064*** (0.000)	0.003
Mean parental income	-0.00010*** (0.000)	0.007	-0.00002*** (0.000)	0.008	-0.00007*** (0.000)	0.003
Share of girls	-0.02003 (0.013)	0.006	-0.01289 (0.008)	0.008	-0.00714 (0.008)	0.003
Student-teacher ratio in full time equivalence	-0.00087** (0.000)	0.006	0.00101*** (0.000)	0.008	-0.00188*** (0.000)	0.003
Age	-0.00487*** (0.000)	0.027	-0.00201*** (0.000)	0.016	-0.00286*** (0.000)	0.014
Female	-0.00077 (0.001)	0.006	0.00297*** (0.001)	0.008	-0.00375*** (0.001)	0.003
Immigrant	0.07347*** (0.004)	0.009	0.02461*** (0.003)	0.009	0.04886*** (0.002)	0.005
Married	-0.04949*** (0.001)	0.012	-0.01940*** (0.001)	0.010	-0.03009*** (0.001)	0.006
University	-0.08392*** (0.002)	0.021	-0.01219*** (0.001)	0.009	-0.07173*** (0.001)	0.019
Science	0.00185 (0.001)	0.006	0.00873*** (0.001)	0.008	-0.00688*** (0.001)	0.003
Vocational	-0.01438*** (0.002)	0.007	-0.01556*** (0.001)	0.009	0.00118 (0.001)	0.003
Remedial education	-0.00348 (0.002)	0.006	0.00177 (0.002)	0.008	-0.00525*** (0.002)	0.003

Note: School level clustered standard errors (*** p<0.01, ** p<0.05, * p<0.1). Regressions include time*county specific effects. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with. All models except for wages regressions are based on 523,835 observations. Regressions for wages are based on 474,538 observations. Columns A1, A2, A3 include R² from the univariate regression models for a given dependent variable.

Table A4. Estimation results on a sample of municipalities with limited reductions in teacher stock. The dependent variable is equal to unity if the teacher changes job.

VARIABLES	(1) Mobility	(2) Mobility	(3) Mobility	(4) Mobility	(5) Mobility
Log yearly earnings (1000SEK)			-0.07026***	-0.07099***	
			(0.004)	(0.006)	
Log monthly salary					-0.16866***
					(0.017)
Temporarily employed	0.23286***	0.23276***	0.20242***	0.21097***	0.22455***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Workload	-0.00148***	-0.00150***	-0.00089***	-0.00077***	-0.00128***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Upper-secondary school	-0.02001***	-0.01714***	-0.01400**	-0.01601**	-0.01147*
	(0.004)	(0.006)	(0.006)	(0.007)	(0.007)
Private school	0.01341	0.02362**	0.01389		
	(0.009)	(0.010)	(0.010)		
Share of immigrant students		0.02393	0.03009	-0.00060	-0.00928
		(0.026)	(0.026)	(0.026)	(0.026)
GPA		-0.00158***	-0.00145***	-0.00095**	-0.00083*
		(0.000)	(0.000)	(0.000)	(0.000)
Student's parents income		0.00001	0.00001	-0.00004	-0.00005
		(0.000)	(0.000)	(0.000)	(0.000)
Share of girls		0.01475	0.01103	0.00622	0.00749
		(0.016)	(0.016)	(0.018)	(0.018)
Student-teacher ratio FTE		0.00019	0.00034	-0.00078	-0.00115
		(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.00971***	-0.00985***	-0.00708***	-0.00682***	-0.00817***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age^2	0.00009***	0.00009***	0.00007***	0.00007***	0.00009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.00874***	-0.00911***	-0.01360***	-0.01251***	-0.01023***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Immigrant	0.02203***	0.02134***	0.01347**	0.01267*	0.01144*
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)
Married	-0.01490***	-0.01437***	-0.01405***	-0.01272***	-0.01103***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
University graduate	-0.01867***	-0.01715***	-0.01294***	-0.00922***	-0.00688**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Science	0.00507*	0.00587**	0.00714***	0.00703***	0.00864***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Vocational	-0.00292	-0.00651	-0.00506	-0.00555	-0.00783*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Remedial education	0.03737***	0.03430***	0.03631***	0.03381***	0.03552***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	131,283	131,283	131,283	116,748	116,748
R-squared	0.137	0.139	0.148	0.148	0.141

Note: School level clustered standard errors (*** p<0.01, ** p<0.05, * p<0.1). Regressions include time*county specific effects as well as (except for column (1)) number of students, number of students^2 and indicator for schools below 100 students. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with. Sample reduced to municipalities, which do not experience reductions in teacher stock of more than 5% in any of the studied years.