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The determinants of teacher mobility in Sweden

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The determinants of teacher mobility in Sweden[1]

by

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Abstract

This paper examines the determinants of teacher turnover using matched employee-employer panel data from Swedish lower and upper secondary schools in a market-oriented institutional environment with a growing private sector and individually negotiated wages. I find statistically significant and robust negative correlations between mobility and monetary compensations. Unlike previous research, I do not find robust evidence that the share of minorities correlates positively with turnover. The positive association exists; however, in the case of private and upper secondary institutions. Finally, private institutions experience higher turnover.

Keywords: Teacher turnover, non-pecuniary factors, pecuniary factors
JEL-codes: I21, J44

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1 Introduction

The effectiveness of schools is fundamentally important for future labour productivity and economic growth. It has been established 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, 2013), and teachers may leave schools when the match quality is low. It is not clear a priori whether policy makers would want to minimize the teacher turnover. On the one hand, they may want to reduce turnover if high rates lead to lower student achievement. On the other hand, they may want to increase teacher turnover in order to improve teacher-school-student match quality. The few empirical studies do not help to resolve this issue (Guin, 2004). Correlational (Boyd et al., 2005) and more recent causal (Ronfeldt et al., 2013) studies reveal a negative relationship between teacher turnover and student achievement. At the same time, however, the organizational management literature suggests a positive relationship between personnel rotation and infusion of new ideas into organizations (Abelson and Baysinger, 1994). Finally, there is the evidence that more effective teachers are at least as likely and sometimes even more likely to stay in schools than their less effective peers (Hanushek and Rivkin, 2010; Boyd et al., 2011).

Given the importance of schooling, teacher turnover has attracted much attention in the last decade. This is likely related to many recent educational policies, such as alterations in teacher compensations, introduction of free schools, or broadening school choice, that affect both students and the labor market for teachers.[3] Furthermore, out-of-teaching mobility has been seen as a potential explanation of declining teacher quality (Fredriksson and Öckert, 2007; Grönqvist and Vlachos, 2008). Most of the articles studying the determinants of teacher mobility have been correlational, but some are causal. Studies show that teachers are generally discouraged by high fractions of poor, minority, and low-achieving students (Hanushek et al., 2004; Falch and Strøm, 2005; Scafidi et al., 2007; Jackson, 2009; Barbieri et al., 2011; Bonhomme et al., 2011). Furthermore, teachers are responsive to even small variation in wages (Figlio, 1997; Figlio, 2002; Feng 2011; Falch, 2011); however, this relationship failed to be robustly

[3] Free schools and school choice is studied by Cullen et al. (2005; 2006), Hsieh and Urquiola (2006), Jackson (2012) and Hensvik (2012) among others. Teacher compensations are studied by Figlio (1997), Figlio (2002), Lavy (2009), Falch (2011) and Fryer (2011) among others.

confirmed in a large cross-sectional data (Hanushek et al., 2004). The competition between publicly and privately run schools also affects teacher turnover (Jackson, 2012; Hensvik, 2012). Finally, it is important to understand the differences between the wages offered to teachers in education and in other sectors of the economy (Dolton and van der Klaauw, 1995, 1999; Brewer, 1996; Dolton and Marcenaro-Gutierrez, 2011).

In this paper, I make use of the Swedish institutional setup and high quality administrative data to shed more light on the aforementioned associations. I present evidence on the relationship between teacher turnover and teacher compensations, employment in privately owned school, exposure to minorities, and employment in upper secondary school in a large repeated cross-section of lower and upper secondary schools for years 1996/1997 to 2006/2007. The correlations for compensation and private ownership could help in understanding teachers' decisions in an environment with much higher variation in compensations than in previous studies and with rapidly growing private sector. The relationship to educational system level should be of interest as vast majority of the aforesaid studies focus on relatively younger kids attending primary or middle school and not on teenagers whose school behavior might be more troublesome for teachers.

I find that teacher turnover correlates negatively with teacher monetary compensations but it does not correlate significantly with the fraction of minorities at the school on average. More importantly, I document substantial heterogeneity in this association and I show that it exists only for upper secondary and private schools. Furthermore, I demonstrate that privately owned schools experience higher teacher turnover rates and that this correlation is weaker for upper secondary schools. Finally, the relationship between earnings and teacher turnover becomes weaker when I add control variables, and thus, a somewhat speculative interpretation of this negative result could be that it may be possible to influence teacher's mobility decisions through changes in their monetary compensations.

The paper is organized as follows: section two briefly presents the institutional background, section three presents econometric modeling and data sources, section four presents descriptive evidence, section five contains the main results, section six includes heterogeneity analyses, and section seven concludes.

2 Swedish schooling system and institutions

The Swedish schooling system starts with preschool and continues with nine years of comprehensive school. Lower secondary school covers the grades 7 to 9. The academic grades in 9th grade determine student's chances to advance to upper secondary school. Swedish municipalities are obliged by law to provide upper secondary schooling to all students who successfully complete compulsory education. Upper secondary school consists of different programs (subject oriented tracks), lasts for three years, and provides eligibility to post-secondary education.

Private schooling is growing in Sweden and is encouraged by the government. In 1992, Sweden introduced a school voucher reform that allowed both non-profit and for-profit independent schools. The municipality is obliged to pay the independent schools for each student they can attract, with an amount corresponding roughly to the average per student cost in the public schools.[4] Since the reform the fraction of private schools has risen, in particular at the upper secondary level. In the 2005/2006 school year there were 220 private upper secondary schools, which constituted 33.1 % of all upper secondary schools in Sweden, a rise from 8.1 % in 1996/1997. At the same time, the number of private lower secondary schools constituted only 15.8 % of all schools at this level starting from 3.2 % in 1996/1997.[5]

The teaching profession in Sweden is regulated with different required qualifications depending on the subject taught and the type of school. Teaching at the secondary school level requires completing special coursework beyond what is required from a compulsory school teacher. Individuals from other professions who want to become teachers need to supplement their professional degrees with a minimum of 1.5 years of preparation in pedagogy, didactics, and teaching practice.

Municipalities are the primary employers of teachers in Sweden, and thus, handle the responsibility of recruiting them.[6] In practice, however, the decisions regarding recruitment, selection, and employment of a teacher are made at the school level by a

[4] An independent school receives around 85-95% of the average per student cost in public schools though amounts vary year to year. Some municipalities also have a socioeconomic gradient for the school voucher. The private schooling was effectively introduced at lower secondary level in 1992, and at upper secondary level in 1994 (Böhlmark and Lindahl, 2007, 2008).

[5] This information is based on registry data.

[6] For more information on the reform that shifted responsibility for schooling from the central government to municipalities see: Fredriksson and Öckert (2008). There is still a small fraction of schools run by county or state, however, those employ around 1% of all the teachers between 1996/1997 and 2005/2006. Those schools are excluded from the analysis since they have different sources of funding and their role is diminishing.

principal. Finally, teacher wages are determined at the local level through individual bargaining between teacher and principal given the collective bargaining outcome set at the national level.[7]

One can distinguish several important underlying decisions related to job mobility in this summary of the institutional setting. Every year an 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 occupation. In the former case they negotiate a new contract with a new school principal. In both the case of re-employment and at a new hire the teacher and school determine salary in an individual bargaining. The decision to re-employ teachers seems to be important given that 21 % of teachers are in temporary positions. Typically, teachers in temporary positions are employed under fixed-term contracts and are exposed to higher probabilities of job separation. In the analysis I consider three types of separations: total turnover, within-teaching turnover, and out-of-teaching turnover.

3 Data sources and econometric modeling

This paper utilizes multiple Swedish population-wide registries. The main data source is the teacher registry that covers all teachers employed in Swedish schools in years 1996/1997 to 2006/2007. It contains information on teachers' education, specialization, experience, certification, place of work, type of contract (permanent vs. temporary), and workload. To these data I have matched background information on age, gender, immigration histories, education, employment, and income for all teachers in the registries. I use pupil registries for lower and upper secondary schools to obtain information on students in a given school. These allow linking of children to their parents to schools, as well as obtaining the average percentiled GPA of the students. Administrative records on earnings and wages provide information on teachers' monetary compensations.[8] The details of the sample construction are discussed in the appendix.

[7] Individualized pay was introduced in 1996 and is discussed in detail by Hensvik (2012) and in survey by Lindholm (2006).
[8] Monthly wages are available for all public school teachers, and a sample of private school teachers.

This paper focuses on the relationship between pecuniary and non-pecuniary characteristics of jobs and teachers' decisions to stay at 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' job preferences with respect to how they value particular characteristics of the working environment. The paper is only descriptive, so I am not able to identify teacher's preferences in an econometric sense. Nonetheless, it should be intuitive that leaving employment j in favor of an alternative opportunity k is related to how teacher values employment j in comparison to k. Thus, I specify the following linear model. The dependent variable equals unity if a teacher leaves their current employment year to year, and such a decision is regressed on teacher's working environment and their own characteristics. These binary models show whether teachers who remain in their appointments have, on average, different characteristics than those who leave their jobs.

From a policy perspective, one should also investigate whether the factors associated with mobility differ by type of school. The uniqueness of the Swedish system and the completeness of the data allow me to study differences by level of schooling (lower secondary vs. upper secondary) and type of ownership (private vs. public). Using the main specification, I also run separate regressions depending on the teacher's destination. In particular, I specify two distinct variables for transition: switching schools within the teaching profession and leaving teaching in favor of a different occupation.[9] This analysis could be of interest to policy makers, as loosing pedagogues in favor of other sectors of the economy may lead to worsening productivity of the educational system as a whole.

In order to simplify the interpretation of the results, the estimation strategy is based on the least squares using linear probability model.[10] The following econometric model is estimated:

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

[9] Switching to primary education or adult education is treated as a school-to-school mobility. Switching to kindergarten, pre-K, or university education is treated as leaving the profession. The results are robust to various definitions of school-to-school mobility and quits, and are available upon request.

[10] This method yields very similar estimates to the non–linear models. The regressions using logit and multinomial logit models with marginal effects evaluated at means are available upon request. The majority of correlations between explanatory variables are below 0.1 and the correlogram is available upon request.

where y_{ijt} is equal to unity if teacher i leaves the current employer j at the period following t, W_{ijt} is the earnings or wages of teacher i at school j and time t, X_{jt} is a vector of observable school characteristics at school j at time t (share of minorities, student quality, mean parental income, student's gender composition, school resources, and 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 clustered at school level. The clustering follows the idea that in a perfect experiment teachers would be randomly assigned to different schools and their mobility decisions would be observed conditional on school characteristics. Since the turnover variation occurs at the school level and I have an unbalanced panel of all lower and upper secondary schools in Sweden the errors should be clustered at the school level. The vector of δs captures county-by-year fixed effects.

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 relationship between a variety of characteristics of jobs and teachers' decisions whether to stay at their current appointment or not. Given the nature of the study, I am interested in the coefficients on earnings, school types and fraction of minorities; however, we can consider them jointly conditional on all the other control variables or separately. The analysis provides evidence about the univariate correlations of the characteristics and mobility as well as multivariate correlations conditional on all other variables. The latter modeling is the preferred specification. The results survive in the univariate regressions.[11]

4 Descriptive evidence

The total turnover is split into turnover within teaching (school-to-school transitions) and quits (leaving teaching for a different occupation). Figure 1, Figure 2 and Figure 3 provide descriptive evidence of turnover patterns by several characteristics of interest. The school-to-school turnover rate increases over the years from 4.3 % to 4.9 % (Figure

[11] The univariate regressions can be found in Table A 1 in the appendix.

1). The quit rate increases from 6.3 % in 1996 to 7.9 % in 2005. This adds up to a total turnover increasing from 10.6 % in 1996 to 12.8 % in 2005. Over the same period of time the number of teachers increases by 33 %.

Figure 1. Turnover and number of teachers over time

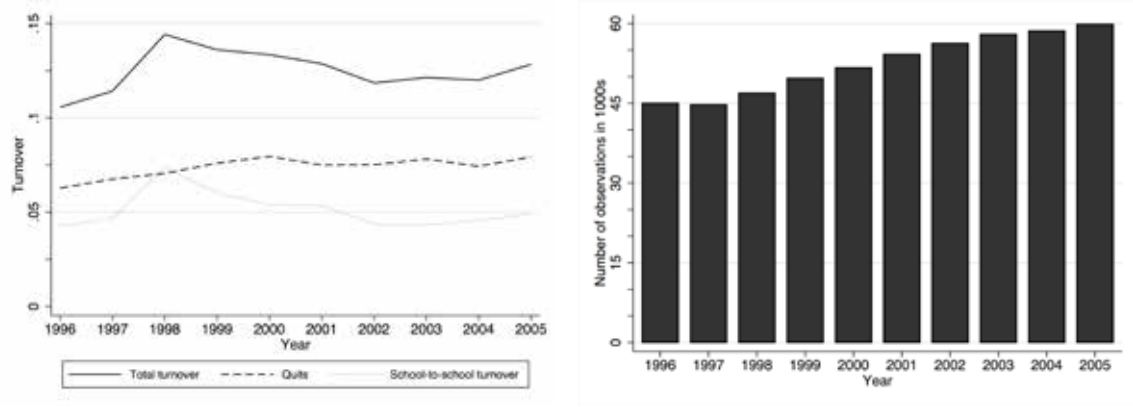

Figure 2 depicts the relationship between teacher turnover and share of minorities in the left panel (Falch and Strøm, 2005) as well as monetary compensations in the right panel (Falch, 2011). The school-to-school transitions are largely stable across schools with a different number of minority students; however, the share of teachers leaving teaching in favor of other occupations is the largest in schools with zero minority enrolment. This initial decrease in the quit rate is in opposition to findings in Falch and Strøm (2005). Moreover, there is a negative relationship between earnings and turnover – the more teachers earn the lower the turnover due to both the school-to-school transitions and to quits. In fact, the two lines converge at about 230 000 SEK yearly. It is worth noting, that teachers who earn less than 125 000 SEK a year are likely to be temporarily employed, and thus I control for the type of employment in the regressions.

Figure 2. Turnover by minority enrollment and earnings

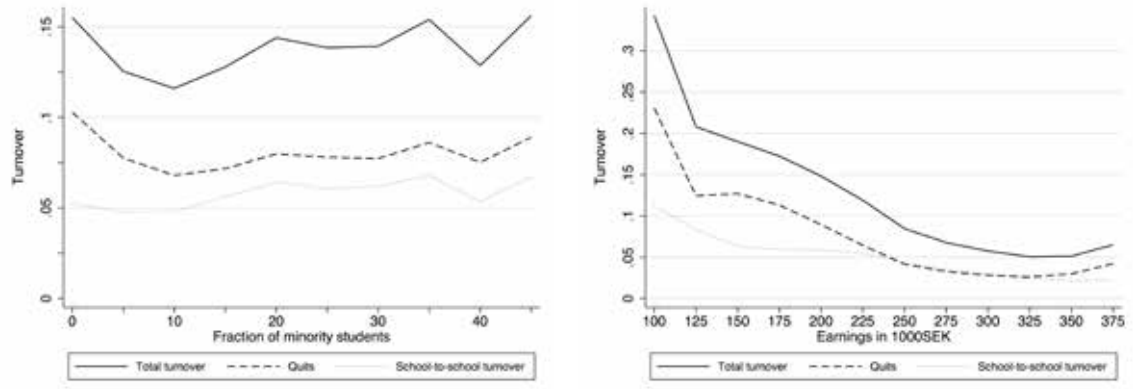

Figure 3 depicts the turnover rates separately for lower, upper, public and private institutions. There is a large jump in upper secondary school within-teaching turnover in 1998.[12] Lower and upper secondary schools teachers behave differently across years. In the upper secondary schools both school-to-school mobility and quits seem to be relatively flat whereas in lower secondary schools the quits increase over time from 5.8 % in 1996 to 8.6 % in 2005, while the school-to-school mobility is flat. Turnover levels are also generally higher for privately owned institutions than for public schools.

Figure 3. Turnover by school type

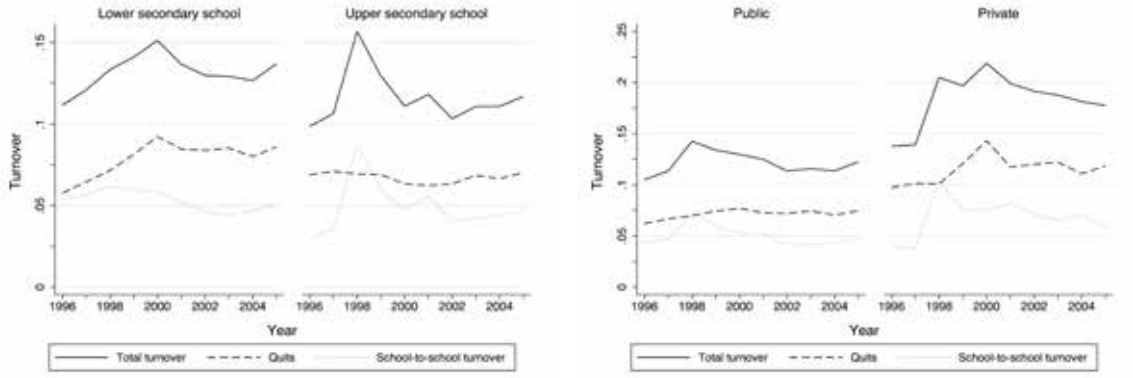

Table 1 presents descriptive statistics of variables used in the econometric analysis. Panel A presents three turnover measures, panel B presents pecuniary and personal characteristics, and panel C presents average school-level characteristics. Total turnover rate, is at 12.5 %, which is lower than the overall turnover rate across all the occupations in Sweden (Edin et al., 2009). While studies based on the US registry data have higher school-to-school mobility than quit rates, Sweden has higher percentage of turnover due to leaving the profession than switching between schools. In Swedish schools 56 % of teachers are women, 6.8 % come from non-Nordic countries, 20.8 % are employed on temporary contracts. There is 15.6 % science, 13.8 % vocational and 6.6 % remedial education teachers and 67 % of teachers are university graduates.[13] The

[12] The jump is due to the adult education expansion reform proposed in the mid-1990s. If job-to-job mobility is of interest then this variation should be kept as teachers indeed change their jobs voluntarily. They simply prefer moving to adult education over staying in their current employment when such an opportunity occurs. If I exclude these transitions to adult education then the jump vanishes. This graph is available upon request.

[13] 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 mathematics. A university graduate is defined as an individual graduating three, four, or five year long 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.

fraction of teachers employed in private schools during the study period rose from around 2 % in 1996 to 10.5 % in 2005. Panel C shows that student-teacher ratio in full-time equivalence, which is a proxy for school resources, is 11.5 % and the average number of pupils is 574.[14] There is on average 8.3 % non-Nordic immigrants in Swedish schools. This number is larger than the one reported for Norway (Falch and Strøm, 2005).

Table 1. Descriptive statistics

Variable	Mean	Standard deviation
Panel A: Teacher turnover		
Total mobility	0.125	(0.331)
Within profession mobility	0.051	(0.220)
Out of profession mobility	0.074	(0.262)
Panel B: Personal and pecuniary characteristics		
Log yearly earnings (1000SEK)	5.290	(0.586)
Log monthly wages*	9.952	(0.161)
Upper secondary	0.437	(0.496)
Private	0.056	(0.230)
Age	44.115	(9.668)
Female	0.562	(0.496)
Foreign	0.068	(0.251)
Married	0.572	(0.495)
University diploma	0.674	(0.469)
Science	0.156	(0.363)
Vocational	0.138	(0.345)
Remedial	0.066	(0.249)
Temporary	0.208	(0.406)
Workload	86.488	(23.273)
Panel C: School characteristics		
Share of foreign students	0.083	(0.086)
Student's percentiled GPA	48.175	(6.708)
Students' parents income in 1000SEK	380.201	(96.397)
Share of girls	0.482	(0.100)
Student-teacher ratio in full time equivalence	11.511	(3.241)
Number of students/100	5.739	(4.574)
N	525076	

Note: mean values, standard errors in parentheses.
*N = 475 505.

5 Main results

The estimates presented in this section correspond to the model outlined in section 3. I estimate a binary linear regression model with county-by-year fixed effects and the

[14] 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 schools.

dependent variable equals to unity if the teacher leaves a particular school between year t and year t+1, and zero otherwise.[15] Table 2 present the baseline results. Column (1) shows estimates on types of schools controlling only for personal characteristics. Column (2) adds average school-level characteristics to the estimates from column (1) and additionally displays coefficients on fraction of immigrants and student GPA. Column (3) adds annual earnings to the specification from column (2). This allows me to understand if the differences in mobility by type of school and school characteristics are driven by differences in earnings. 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 the log monthly salary. This exercise is performed to investigate how covariates in the model from column (3) change when the sample is restricted to public school teachers for whom the monthly wage data are available. Column (3) which includes all personal, pecuniary, and school-level characteristics is the preferred specification. In addition to the main coefficients of interest in this paper the tables also report some other coefficients that might be of interest to the readers (gender, temporary employment, foreign and science teacher indicators, and average school-level student GPA).

[15] Specifications with only year, or only county, or only year and county, or using municipality instead of county fixed effects have also been estimated and yield similar results. Including school fixed effects removes some of the variation that is of interest in the heterogeneity analyses in this paper.

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)			-0.064***	-0.069***	
			(0.002)	(0.002)	
Log monthly salary					-0.153***
					(0.008)
Upper-secondary school	-0.009***	-0.003	0.002	0.003	0.007**
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Private school	0.019***	0.026***	0.015**		
	(0.005)	(0.006)	(0.006)		
Share of immigrant students		0.009	0.015	-0.004	-0.005
		(0.016)	(0.016)	(0.016)	(0.016)
GPA		-0.001***	-0.001***	-0.001**	-0.001**
		(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.005***	-0.004***	-0.009***	-0.008***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Foreign born	0.013***	0.012***	0.005	0.004	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Science	0.009***	0.010***	0.011***	0.009***	0.011***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Temporarily employed	0.224***	0.224***	0.195***	0.197***	0.211***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
R-squared	0.129	0.130	0.138	0.136	0.130
Observations	525,076	525,076	525,076	475,505	475,505

Note: Standard errors clustered at school level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include county-by-year fixed effects. In addition to the displayed variables in column (1) I control for teacher's age, marital status, university education, vocational and special education indicator variables and workload. In column (2) on top of column (1) I control for student-teacher ratio in full time equivalence, share of female students, mean parental income, second order polynomial in school size and indicator for schools with less than 100 students. Columns (4) and (5) only cover public school teachers. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

The results in columns (1), (2) and (3) suggest that private schools experience higher teacher turnover. Working in a private school is associated with 1.5 to 2.6 percentage points (pp) higher turnover depending on the specification. Teaching at upper secondary school has a negative association with turnover when I do not control for school characteristics, but a positive association in the sample of public schools with all of the controls.

Column (3), where log earnings are added, suggests a negative relationship between monetary compensations and the probability that a teacher is going to leave their employment in the following year. The significant and negative estimate of 6.4 pp indicates that principals may have a scope for changing the turnover through manipulation of monetary compensations; however, the limitations of descriptive methods mean that there well might be other explanations to the observed pattern. The results on earnings combined with the Swedish institutional flexibility in pay negotiations are in line with the causal findings from Falch (2011) that even small

changes in teacher wages can result in lower turnover rates. My estimates are smaller than those in Hanushek et al. (2004) – another correlational study looking at teachers' compensations. However, their measure of monetary compensation is different than mine. In Hanushek et al. (2004) virtually all the salary associations vanish when school district fixed effects are applied, whereas, here the coefficients on both log earnings and log monthly salaries are stable qualitatively and quantitatively across various fixed effects specifications.

The coefficients on log yearly earnings in columns (3) and (4) range from -6.9 to -6.4 pp, and the coefficient on log monthly wages in column (5) among public school teachers is -15.3 pp. This difference in the size of earnings vs. wage coefficients in columns (4) and (5) can be attributed to different definitions of both monetary compensation measures. At the same time, since they give the same results qualitatively and monthly wages are not available for all teachers, all further analyses are conducted on the full sample using log yearly earnings.[16]

The additional covariates displayed in Table 2 are: gender, immigrant status, science teacher, and temporary employment indicators. The gender indicator suggests that female teachers experience lower turnover rates. Specializing in science and being employed on temporary contract are associated with higher turnover rates. There is a positive relationship between being foreign born and mobility when I do not control for monetary compensations. Finally, student quality is negatively associated with teacher turnover.

The results in Table 2 show no relationship between the share of minorities and teacher turnover, and this is in contrast to other research from the US (Hanushek et al., 2004), Norway (Falch and Strøm, 2005), Italy (Barbieri et al., 2011) or Netherlands (Bonhomme et al., 2011). All of the coefficients in columns (2) to (5) are statistically insignificant and substantively small. I further explore this relationship in Table 3 by grouping minorities into students coming from European and non-European countries (panel A) and interacting the share of minority students with an immigrant teacher dummy variable (panel B). In panel A there is no indication for any heterogeneity in the association depending on the geographical and cultural origin of the immigrants. In panel B there is suggestive evidence that immigrant teachers cluster with immigrant

[16] Estimates for public school teachers and monthly wages are available upon request. The main findings remain unchanged.

students, which is in line with prior research (Hanushek et al., 2004; Jackson, 2009). Table 3 also suggests a positive correlation between an indicator for a foreign born teacher and their mobility, which may reflect either lower quality of matches between immigrant teachers and schools or generally higher occupational mobility among immigrants (Green, 1999). At the same time, the coefficient on the level of minority students at school is consistently small and insignificant.

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

Variables	(1) **Mobility** **Full sample**
Panel A: Split analysis	
Share of European students (2.6 %)	0.045
	(0.036)
Share of other immigrant students (5.7 %)	-0.000
	(0.022)
R-squared	0.138
Panel B: Interaction analysis	
Immigrant teacher	0.012***
	(0.004)
Share of immigrant students	0.024
	(0.016)
Share of immigrant students*Immigrant teacher	-0.070**
	(0.028)
R-squared	0.138
Observations	525,076

Note: Standard errors clustered at school level (*** p<0.01, ** p<0.05, * p<0.1). Estimates based on specification from column (3) in Table 2. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

Univariate regressions (Table A 1 in the appendix) shed more light on the relative contributions of included covariates. Type of contract is the factor that explains the most of the variation in teacher turnover and monetary compensation (earnings or wages) is the second.[17] Considering the variables grouped into personal, pecuniary, and school-level characteristics the amount of explained variation in total turnover is the following: personal (R^2=0.13), pecuniary (R^2=0.08) and school-level (R^2=0.01). When comparing just the monetary vs. school-level characteristics conditional on personal observables, the former one (R^2=0.14) explains slightly more variation in the total turnover than the latter one (R^2=0.13). Thus, it is not trivial to quantitatively gauge the relative importance of either of these groups for teacher turnover. However, it seems

[17] When all control variables are analyzed then a factor that explains the most of the variation is the type of employment, followed by pecuniary characteristics and workload. The univariate regressions for all covariates used in the analysis are available upon request.

that teachers in Sweden are less sensitive to school characteristics than teachers in other countries.

Finally, I can only observe mobility if teachers leave their school between one year and the next, but I do not know if this mobility is voluntary or not. In particular, there can be reshuffling of teachers between schools in municipalities due to the fact that employment protection is based on an employment in municipality and not at the school (this does not apply to privately owned institutions). It could also 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 teacher stock by more than 5 % over the studied period.

Table A 2 in the appendix replicates Table 2 using this restricted sample. The sample size is reduced to a quarter of the full sample size, however the coefficients on earnings and wages remain negative and significant, and are roughly of the same magnitude, and the estimates on the minority enrollment remain insignificant and cannot be statistically distinguished from the ones presented in Table 2. The associations between school ownership and teacher turnover are now insignificant and smaller than in Table 2 though they remain positive. Overall, these estimates indicate that the differences in mobility should not be driven by selective lay-offs when schools are down-sizing.

A final question is whether it is reasonable to pool 11 years of data in one equation (Falch and Strøm, 2005). 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 the more experienced teachers. As a further robustness check I estimate columns (1) to (3) from Table 2 using only teachers that were present in the sample in the first year of the study. The results are reported in Table A 3 in the appendix. The sample size is reduced by approximately 48 %, however the results do not change substantively. The coefficient on earnings decreases while the ones on school ownership increase. Furthermore, the coefficients on upper secondary school become insignificant in column (1) and turn positive and significant in columns (2) and (3). Similarly to all previous results, I do not find a statistically significant relationship between minority enrollment and teacher turnover.

6 Heterogeneity analyses

The results presented so far suggest that schools in Sweden experience higher teacher turnover rates in privately owned institutions, have a negative relationship between teacher compensations and turnover, and do not have an association between minority enrolment and teacher mobility decisions. In Table 4, I investigate how these relations differ by level of school and by school ownership. In Table 5, I further document how the estimates differ depending on whether a teacher transfers to another school or transitions out-of-teaching.

Table 4. Heterogeneity analysis by school types. 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)	-0.073***	-0.056***	-0.051***	-0.067***
	(0.003)	(0.003)	(0.005)	(0.002)
Upper-secondary school			-0.026**	0.002
			(0.012)	(0.003)
Private school	0.022***	0.014		
	(0.008)	(0.009)		
Share of immigrant students	-0.013	0.110***	0.131***	-0.008
	(0.017)	(0.039)	(0.049)	(0.017)
GPA	-0.001**	-0.001***	-0.001**	-0.001**
	(0.000)	(0.000)	(0.001)	(0.000)
Female	-0.014***	-0.003	-0.010*	-0.009***
	(0.001)	(0.002)	(0.005)	(0.001)
Foreign born	-0.003	0.013***	0.013	0.002
	(0.004)	(0.004)	(0.010)	(0.003)
Science	0.007***	0.013***	0.025***	0.010***
	(0.002)	(0.002)	(0.006)	(0.001)
Temporarily employed	0.219***	0.164***	0.139***	0.199***
	(0.004)	(0.004)	(0.009)	(0.003)
R-squared	0.149	0.132	0.100	0.142
Observations	295,454	229,622	29,520	495,556

Note: Standard errors clustered at school level (*** p<0.01, ** p<0.05, * p<0.1). Estimates based on specification from column (3) in Table 2. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

Columns (1) and (2) in Table 4 present estimates for lower and upper secondary schools, respectively. The association between monetary compensation and turnover is significantly larger (p-value: 0.000) in lower secondary schools which suggests that the cost of retaining a teacher through changes in earnings could be lower in these schools. There is also a positive and significant correlation between school ownership and turnover at the lower level of schooling. Although this relationship is not significant in upper secondary schools, I cannot rule out the equality of the coefficients in both schools (p-value: 0.483). Finally, column (2) points towards a strong correlation

between the share of minorities and teacher turnover in upper secondary schools in Sweden. Prior research has focused mostly on relatively younger kids, enrolled in elementary or lower secondary education, and found significant results for minority enrollment (Hanushek et al., 2004; Falch and Strøm, 2005; Scafidi et al., 2007; Bonhomme et al., 2011). This is not evident in the lower-secondary school in Sweden (column (1)), however, the 11.0 pp estimate for upper secondary schools is similar in size to Hanushek et al. (2004) elementary schools' results. Given that upper secondary school covers ages when pupils go through adolescence, which is often strongly connected to increased disruptive behavior, then the positive correlations found for younger children in Netherlands, Norway, and the US may be even larger in the upper secondary schools in these countries. Interestingly, Barbieri et al. (2011) find similar coefficients on fraction of minorities for primary, lower secondary and upper secondary school teachers using Italian data from the mid-2000s. However, instead of turnover rates they use applications for transfers.

There is a positive relationship between the share of minorities and teacher turnover in privately owned institutions, though not in public schools (columns (3) and (4); p-value: 0.007). At the same time, however, there is a negative association between teaching in upper secondary private school and individual mobility, which can explain why the coefficient on minority enrollment is larger in private schools given the findings from columns (1) and (2) that point towards a relationship between minorities and turnover only in upper-secondary schools. Finally, the estimate on earnings is significantly larger (p-value: 0.005) for public schools. This suggests that the cost of retaining a teacher by increasing earnings could be lower in public schools than in private schools.

The models used so far pool all destinations of teachers leaving the school together, however, there is research indicating that the correlations with teacher characteristics differ depending on the destination (Lankford et al., 2002). To investigate whether the relationship between teacher quality and teacher turnover depends on destination, in Table 5, I estimate the baseline specification from column (3) in Table 2 for mobility within teaching profession and mobility out-of-teaching.

Table 5. Heterogeneity analysis by different destinations

Variables	(1) Within teaching mobility	(2) Out-of-teaching mobility
Log yearly earnings (1000SEK)	-0.009***	-0.055***
	(0.001)	(0.002)
Upper-secondary school	0.005**	-0.003*
	(0.002)	(0.002)
Private school	0.003	0.012***
	(0.004)	(0.004)
Share of immigrant students	0.008	0.006
	(0.011)	(0.009)
GPA	-0.001***	-0.000*
	(0.000)	(0.000)
Female	-0.002***	-0.006***
	(0.001)	(0.001)
Foreign born	0.009***	-0.004
	(0.003)	(0.003)
Science	0.007***	0.003***
	(0.001)	(0.001)
Temporarily employed	0.057***	0.138***
	(0.001)	(0.002)
R-squared	0.032	0.115
Observations	525,076	525,076

Note: Standard errors clustered at school level (*** p<0.01, ** p<0.05, * p<0.1). Estimates based on specification from column (3) in Table 2. All regressions corrected for school mergers and dissolutions as well as for mobility in grades below 7th that teachers work with.

The estimates on earnings are negative for both school-to-school and out-of-teaching mobility, however, the latter one is significantly more negative. This suggests that if indeed principals can retain teachers by increasing their compensations, then it is relatively cheaper to encourage teachers to stay in the profession rather than to stay with their current school. Furthermore, the estimated relationship between upper secondary school indicator and school-to-school transitions is positive while it is negative in the case of out-of-teaching transitions. This indicates that upper secondary school teachers are more mobile within teaching but they are less likely to leave the profession for an alternative occupation. I also find positive and significant association between school ownership and leaving teaching. This suggest that private schools are more likely than public schools to lose teachers in favor of alternative jobs. Finally, in neither the case of within teaching nor out-of-teaching transitions I find statistically significant relationship between minority enrollment and turnover. This is in stark contrast to Hanushek et al. (2004) and Falch and Strøm (2005), whose results point towards quitting the profession rather than changing schools within the same geographical unit or occupation.

7 Conclusions

The contemporary literature on teacher mobility lacked a detailed study using high quality data in an environment for which the economists usually argue for i.e., with individual-level variation in wages and relatively large and growing private sector (Björklund et al., 2006). Furthermore, most of the aforementioned studies focus on rather younger children attending primary and middle school and we know relatively little about the teacher turnover in high schools. This paper attempts to fill in these gaps in the literature on teacher turnover using unusually rich data on teachers from Swedish lower and upper secondary schools covering years 1996/1997 to 2006/2007.

The results indicate that, in Sweden unlike in US, Italy, the Netherlands, and Norway, schools with higher shares of minorities on average do not seem to experience higher turnover rates. At the same time, I document substantial heterogeneity in this association. In particular, I show that this relationship exists for upper secondary and private schools and is roughly of the same magnitude as the one documented for lower levels of schooling in Hanushek et al. (2004). If share of minorities at school is associated with the disruptive behavior or not-fitting-in and these behavioral problems grow in a teenagehood, then my results suggest that the turnover estimates in US high schools might actually be even higher. I also find support for the hypothesis that privately owned institutions experience higher teacher turnover and that this correlation is smaller for private upper secondary schools. On the other hand, I do not find any general support for the fact that turnover differs by level of schooling. The average differences in turnover in lower vs. upper secondary schools are small and insignificant. Finally, a somewhat speculative interpretation of the negative results found for earnings and wages is that it may be possible to influence teacher's mobility decision through changes in their monetary compensations.

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Appendix

A1. Tables

Table A 1. Estimation results from univariate OLS models

	(1)		(2)		(3)	
Variables	**Mobility**	**R^2**	**Within teaching mobility**	**R^2**	**Out-of-teaching mobility**	**R^2**
Log-earnings	-0.154*** (0.002)	0.079	-0.038*** (0.001)	0.018	-0.115*** (0.002)	0.068
Log-wages	-0.559*** (0.008)	0.060	-0.152*** (0.005)	0.017	-0.407*** (0.006)	0.050
Upper secondary	-0.015*** (0.002)	0.006	-0.003* (0.002)	0.008	-0.012*** (0.001)	0.003
Private	0.058*** (0.006)	0.008	0.015*** (0.003)	0.008	0.043*** (0.004)	0.004
Share of immigrant students	0.030** (0.014)	0.006	0.014 (0.009)	0.008	0.015* (0.009)	0.002
GPA	-0.001*** (0.000)	0.007	-0.001*** (0.000)	0.008	-0.001*** (0.000)	0.002
Female	0.002 (0.001)	0.006	0.002** (0.001)	0.008	-0.000 (0.001)	0.002
Foreign born	0.072*** (0.004)	0.009	0.024*** (0.003)	0.009	0.048*** (0.002)	0.004
Science	0.002 (0.002)	0.006	0.008*** (0.001)	0.008	-0.005*** (0.001)	0.002
Temporarily employed	0.266*** (0.003)	0.112	0.072*** (0.001)	0.026	0.193*** (0.002)	0.091

Note: Standard errors clustered at school level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include only county-by-year fixed 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 525 076 observations. Regressions for wages are based on 475 505 observations.

Table A 2. 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)			-0.070***	-0.070***	
			(0.004)	(0.006)	
Log monthly salary					-0.174***
					(0.017)
Upper-secondary school	-0.021***	-0.009	-0.007	-0.000	0.005
	(0.004)	(0.008)	(0.008)	(0.009)	(0.009)
Private school	0.013	0.017	0.007		
	(0.009)	(0.011)	(0.010)		
Share of immigrant students		0.034	0.040	0.017	0.008
		(0.028)	(0.028)	(0.027)	(0.028)
GPA		-0.002***	-0.001***	-0.001**	-0.001*
		(0.000)	(0.000)	(0.000)	(0.000)
Female	-0.007***	-0.007***	-0.011***	-0.010***	-0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Foreign born	0.020***	0.019***	0.012*	0.011	0.009
	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)
Science	0.006**	0.007**	0.008***	0.008***	0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Temporarily employed	0.234***	0.234***	0.204***	0.213***	0.226***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
R-squared	0.134	0.135	0.144	0.144	0.138
Observations	129,275	129,275	129,275	114,874	114,874

Note: Standard errors clustered at school level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include county-by-year fixed effects. In addition to the displayed variables in column (1) I control for teacher's age, marital status, university education, vocational and special education indicator variables and workload. In column (2) on top of column (1) I control for student-teacher ratio in full time equivalence, share of female students, mean parental income, second order polynomial in school size and indicator for schools with less than 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% over the studied period.

Table A 3. 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)			-0.040***
			(0.003)
Upper-secondary school	-0.000	0.007*	0.010***
	(0.002)	(0.004)	(0.004)
Private school	0.020***	0.030***	0.024***
	(0.007)	(0.007)	(0.007)
Share of immigrant students		0.011	0.016
		(0.016)	(0.016)
GPA		-0.001***	-0.001***
		(0.000)	(0.000)
Female	-0.007***	-0.007***	-0.009***
	(0.001)	(0.001)	(0.001)
Foreign born	0.009***	0.008**	0.005
	(0.003)	(0.003)	(0.003)
Science	0.008***	0.009***	0.009***
	(0.002)	(0.002)	(0.002)
Temporarily employed	0.177***	0.176***	0.161***
	(0.004)	(0.004)	(0.004)
R-squared	0.074	0.076	0.079
Observations	275,723	275,723	275,723

Note: Standard errors clustered at school level (*** p<0.01, ** p<0.05, * p<0.1). All regressions include county-by-year fixed effects. In addition to the displayed variables in column (1) I control for teacher's age, marital status, university education, vocational and special education indicator variables and workload. In column (2) on top of column (1) I control for student-teacher ratio in full time equivalence, share of female students, mean parental income, second order polynomial in school size and indicator for schools with less than 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 teachers observed in the first year of data.

A2. 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) of secondary education. The reason for restricting the analysis to these grade levels, is that I lack information on student characteristics for lower levels. Teachers who are on unpaid leave of absence or whose workloads are 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 a teacher has multiple entries in the registry, the observation with the highest workload is selected irrespectively whether it is at the same or at different schools.[18] The teacher registry is a high quality data set, that allows recovering

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

information on school location (unique identifier), school ownership and type, teacher certification, workload, employment type (temporary vs. permanent), 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, the share of miscoded teachers is likely low. Nonetheless, each included school serves grades 7-9 and only turnover between such schools is considered at lower secondary level.

Teachers are then linked (using unique identifier) to population registry, which covers all individuals living in Sweden. The population registry is a 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. The analysis is restricted to teachers aged 25-58 years, to abstract from mobility driven by educational attainment and retirement decisions.

The earnings registry often contains multiple entries per individual, which reflect different sources of labor compensations but are uniquely identifiable based on establishment identifier. This poses linking problem for individuals with multiple entries as I may miss-assign earnings from different establishment to a particular school code. Since there is no direct link between unique school code and establishment identifiers, I create such a link using a mode rule. In particular, based on the individuals with only one record I define most often occurring establishment identifier for each school code. I then use this data to resolve matching of individuals with multiple earnings entries.

The students' characteristics are based on "school in" and "school out" pupil registries. The lower secondary school composition is based on outgoing students. 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 years t+1, t+2 and t+3.

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. The main advantage of using lower secondary school grades as a measure of upper secondary school quality is that it is largely exogenous to upper secondary school teachers. I match these students to their parents using unique family identifier and obtain the family level socioeconomic indicator i.e. mean parental income.

Finally, having data 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 136 100 teachers and 622 453 person–year observations. I exclude the following observations from the sample: very small schools with number of teachers in full time equivalence less than 3 (5 170 observations), teachers that are below 25 years old (8 370 observations), teachers that are above 58 years old (82 298 observations), and schools with the number of students less than 15 (1 539 observations). The final sample consists of 121 580 teachers, 2703 unique schools and 525 076 person-years. Applying the monthly wages sample restriction further reduces the sample to 109 541 teachers, 2172 unique schools and 475 505 teacher-years.

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