

Teacher turnover and non-pecuniary factors^{*}

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Abstract

This paper studies teacher mobility using matched employee-employer panel data from Norwegian primary and lower secondary schools. The Norwegian institutional set-up with completely centralized wage setting for teachers is ideal to analyze the effect of non-pecuniary job attributes on quit decisions. We find that teachers tend to leave schools with high share of minority students and high share of students with special needs. In addition, the composition of teachers and the school size affect the propensity to quit. These results are robust across different econometric specifications and sub-samples.

JEL classification: I29; J44; J45; J63

Keywords: Teacher turnover; non-pecuniary factors; centralized wage setting; student composition

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1. Introduction.

This paper studies the effect of non-pecuniary job attributes on individual teacher quit behavior. While sociologists, psychologists and industrial researchers all stress the importance of non-pecuniary job characteristics for worker turnover, economists have paid more attention to pay as the main motivation for worker quit decisions.¹ According to search models, workers quit a job when the discounted utility stream in the current job falls short of the discounted utility stream associated with alternative job offers (Burdett, 1978). Empirical models analyzing individual quit behavior in this tradition typically assume that the wage is the key variable describing utility levels in different jobs. However, in several countries with centralized pay bargaining, important segments of the labor market exhibit little or no variation at all in wages across jobs. In such environments, only a limited part of worker job to job mobility would be motivated by wage differences, while non-wage job attributes should be important determinants of individual turnover. Further, recent work by Clark (2001) demonstrates that job satisfaction measures are important predictors of worker quits even after controlling for wages.

The labor market for teachers in most European countries is a prominent example of such an environment, with teacher pay almost exclusively determined by the amount of formal education and teaching experience. While wage differences between teaching and non-teaching is clearly relevant to understand why teachers move from teaching to non-teaching jobs, the national teacher wage system suggests that teachers also search across schools in order to find a match which satisfies their preferences with regard to non-wage job characteristics. If non-pecuniary attributes differ between schools, it is likely that the extent and existence of teacher shortages can differ substantially between schools even within areas with similar costs of living. For example, if teachers tend to leave schools with many minority students, serious problems with teacher shortages may arise in these schools. Further, cost of living varies across geographical areas. Hence, equal teacher pay across areas suggests that teacher shortages tend to arise in areas where living costs are high and thereby the *real* teacher wage is low.

The extreme wage rigidity described above has been one of the cornerstones in teacher union wage policy in many European countries and the unions have claimed that teacher pay equality prevent large regional differences in teacher quality. However, the arguments presented above suggest that equality in teacher quality across schools is implausible in a rigid teacher wage system. Taken together with the strong evidence for teacher quality as the most important factor

¹ Clark (2001) provides a short overview of the literature on job quits and job satisfaction in psychology, sociology and management.

in education production [Rivkin et al. (2001)], this suggests that teacher mobility is an important research issue. As a first step towards an assessment of the costs of a rigid pay system, the purpose of this paper is to quantify empirically the effect of non-pecuniary school and district variables on teacher exit decisions. To our knowledge, the present paper appears to be the first study of this kind in Europe.²

Most existing evidence on teacher moves across schools and school districts is based on US data. However, the US system with wage setting at the school district level makes studies of the relationship between teacher quit behavior and non-pecuniary school attributes complicated by the fact that school district wages themselves can easily respond to such factors. Thus, identification of the causal effect of non-pecuniary factors on teacher moves requires additional assumptions compared to the European institutional setting. Nevertheless, non-pecuniary factors and opportunity costs have been found to be important determinants of teacher supply and hence the quality of teachers [Loeb and Page (2000), Hanushek et al. (2001)].

A further limitation with the US research on teacher mobility is that most studies have used data for specific states. This implies that teachers moving to schools in other states are implicitly treated equal to teachers leaving the education sector completely, which may be a too restrictive assumption. Further, recent evidence suggests that much of teacher sorting and teacher moves takes place within school districts rather than between, which may imply that recent studies focusing on inter-district teacher moves may only reveal a quite limited part of actual teacher mobility [Betts, Reuben and Danenberg (2001) and Loeb (2000)].³

The present study contributes to the research on teacher mobility by analyzing teacher transitions between schools and out of the school system using a complete matched individual teacher-school data set for all Norwegian primary and lower secondary public school teachers combined with detailed information of the schools during the period covering the school years 1992/93 to 1999/2000. Ironically, the completely centralized teacher wage setting system may be ideal for studies of non-wage determinants of mobility since identification problems due to compensating wage differentials do not arise. A possible objection to this argument is that non-pecuniary attributes of teacher positions are not fixed, but adjust endogenously in the absence of wage

² UK teachers decision to quit teaching has been studied by Dolton and Mavromaras (1990) and Dolton and van der Klaauw (1995), but these studies does not consider the effect of school specific factors such as student composition and school size on the decision to quit.

³ An exception on inter-district-mobility is the study by Greenberg and McCall (1974).

flexibility. As an example, schools may have incentives to decrease teacher workloads in areas with teacher shortages to compensate for the inflexibility of wages. However, such behavior is severely restricted in Norway by national regulations. The teacher workload, for instance, is completely determined in collective bargaining between the teacher union and the central government. In addition, the data enable us to distinguish completely between teachers leaving the education sector and teachers moving between schools within and between school districts. Bonesrønning et al. (2001) shows that the supply of certified teachers varies a lot between Norwegian schools even within school districts, and that certified teachers seem to prefer large schools with few minority students.⁴

The paper is organized as follows: Section 2 reviews the existing literature on the association between teacher turnover and non-pecuniary school factors. In section 3 we present the theoretical and institutional background of the empirical analysis, section 4 contains a description of the data, while section 5 presents the empirical results. Section 6 concludes the paper.

1. Previous studies.

A number of studies suggests that higher wages reduce teacher quit propensity [Baugh and Stone (1982), Murnane and Olsen (1989), Theobald (1990), Theobald and Gritz (1996), Dolton and van der Klaauw (1995, 1999), Brewer (1996), Mont and Reese (1996) and Stinebrickner (1998, 2001)]. However, only a few studies provide systematic evidence on the role of non-pecuniary factors in teacher quit decisions. The investigations on this issue have used two types of data: Administrative data on teachers from certain US states or school districts, and national US survey data. An early study by Greenberg and McCall (1974) on the mobility of teachers in the San Diego school district show that experienced teachers tend to move from schools with high share of minority students and low average achievement. Hanushek et al. (2001), using a large administrative Texas data base, corroborate this finding by demonstrating that teachers currently working in schools with high minority share and low achievement students have a higher propensity to move from a school district. Their results also imply that non-pecuniary differences between schools related to student composition and quality is more important than wage differences for quit decisions.

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⁴ While the effective supply of certified teachers to a school analyzed by Bonesrønning et al. (2001) is determined by both the entry and exit decisions of teachers, the present study focuses solely on the exit decision.

Authors studying the effect of working conditions on teacher wages and teacher turnover have included measures of class size or resource use per student as explanatory variables. The underlying argument is that required teacher effort per teaching hour is higher in large than in small classes, and hence teachers favor schools with small classes and large resource use per student, usually approximated by the student-teacher ratio measured at the school level or district level. If wage flexibility is limited, schools may reduce class size in an attempt to improve working conditions and hence reduce teacher turnover. A detailed investigation of this issue can be found in Mont and Rees (1996). Using administrative data from New York state, they find that lower class size has a significant positive, but numerically small effect on length of stay in teaching. Recent studies by Stinebrickner (1998, 1999) using national US survey data find no statistically significant association between class size and duration of teaching jobs.⁵

A final set of variables suggested to affect teacher turnover is spending on non-teacher items by the schools. The evidence in Gritz and Theobald (1996) using administrative data from the state of Washington, suggests that higher school spending on central administration and instructional assistants decrease length of stay in teaching. Thus, their findings show that moving resources away from teachers to other school personnel increases teacher turnover.

The main advantages of studies using administrative data is large sample sizes and detailed information on school and student body characteristics. Their main weakness is that they rely on data from a specific US state, which implies that teachers moving between states while continuing teaching is treated equal to those exiting the teaching profession. Studies using national surveys on US teachers are obviously more suited to give a complete picture of teacher mobility since they can make a distinction between those exiting the teaching profession and those migrating between states while continuing teaching. On the other hand, these studies use small samples of teachers and have to rely on self-reported data on school characteristics.

2. Theoretical and institutional considerations

We base our analysis on the conventional view that teachers make rational decisions on whether to continue to act as teachers without changing school. Consider a teacher currently holding a teacher position and continuously evaluating the current workplace compared to alternative

⁵ Other analyses of the relationship between teacher wages and school resource use are Kenny and Denslow (1980), Eberts and Stone (1985) and Levinson (1988).

choices. Broadly speaking, he prefers to stay on at the same school if the utility by doing so is greater than all alternatives.

We follow the framework suggested by Gritz and Theobald (1996) and let the pecuniary rewards available to a teacher in his current school, in another school in the same school district, in a school in a different school district and outside the education sector be represented by W^S , W^{SS} , W^{SD} , W^{SU} respectively. Let Q^S , Q^{SS} , Q^{SD} and Q^{SU} denote the corresponding non-pecuniary rewards associated with these alternatives. The utility levels associated with these four alternatives can then be written as $U(W^S, Q^S)$, $U(W^{SS}, Q^{SS})$, $U(W^{SD}, Q^{SD})$ and $U(W^{SU}, Q^{SU})$.

Based on this conceptual framework the teacher prefers to move to another school in the same school district if $U(W^{SS}, Q^{SS}) > U(W^S, Q^S)$, $U(W^{SS}, Q^{SS}) > U(W^{SD}, Q^{SD})$ and $U(W^{SS}, Q^{SS}) > U(W^{SU}, Q^{SU})$. He will move to a school in another district if $U(W^{SD}, Q^{SD}) > U(W^S, Q^S)$, $U(W^{SD}, Q^{SD}) > U(W^{SS}, Q^{SS})$ and $U(W^{SD}, Q^{SD}) > U(W^{SU}, Q^{SU})$. Finally, he will leave the education sector if $U(W^{SU}, Q^{SU}) > U(W^S, Q^S)$, $U(W^{SU}, Q^{SU}) > U(W^{SS}, Q^{SS})$ and $U(W^{SU}, Q^{SU}) > U(W^{SD}, Q^{SD})$.

This clearly suggests that district-level and school-level factors affect the decision to quit in addition to individual-specific characteristics. To give a more comprehensive discussion of the mechanisms at work, it may be useful to take the following general quit equation as a starting point

$$(1) \quad P(Move_{isdt} = 1) = F[a_0 + a_1 I_{isdt} + a_2 S_{sdt} + a_3 D_{dt}]$$

where $Move$ is equal to one if teacher i at school s in school district d at time t leave the school between the school years t and $t+1$, and I , S and D are vectors of individual, school and school district characteristics, respectively. The left hand side variable should be interpreted as the probability to quit and F is the corresponding distribution function.

Pecuniary rewards

Consider first the pecuniary rewards associated with the different alternatives. First, according to the Norwegian teacher pay system in the period considered, the wage level for a teacher was solely determined by his experience and education, and did not vary between schools. Assuming that consumer prices vary only between school districts (implicitly saying that teachers can travel to job at relative low costs within districts), the real pecuniary rewards associated with teaching

in schools within a school district is equal, while real pecuniary rewards associated with schools in different districts varies to the extent that costs of living varies between school districts. In contrast, expected pecuniary rewards related to the non-education alternative is equal to the highest expected real wage level the teacher can attain in the private sector. The upshot of this discussion is that teachers have higher propensity to quit the higher the local consumer price level and the higher the expected real wage level in alternative occupations. We have no data on consumer prices disaggregated to the local level, but we believe that inclusion of time dummies and district and regional fixed effects will capture most of the development in consumer prices through time and differences in cost of living between areas. As to the alternative pay outside teaching, we would ideally like to include a variable describing the amount of money a person with teacher education and given individual characteristics would earn in a non-teaching job as done in Dolton and van der Klaauw (1995). The only outside earnings measure we have is private income per capita in the municipality. Since this variable includes both labor and non-labor earnings it is obviously a very crude proxy for outside pay opportunities for teachers. However, we include a number of measured individual characteristics of the teachers as the number of years of education above high school level, sex and age. While these characteristics may have a direct effect on teacher exit decisions, they may also proxy for the individuals' pecuniary rewards in jobs outside teaching. Further, we include the local unemployment level (UN) as a proxy for the probability of getting an alternative job outside teaching.

Non-pecuniary rewards

Norwegian schools are highly regulated and similar with respect to curriculum taught, teaching methods and the number of hours the teacher has to spend in the classroom. Yet, the schools may differ in other respects, such as physical environments and working conditions. Our hypothesis is that the composition of students and teachers at the school is an important determinant of the working conditions. First, some student groups are likely to require more effort to teach than other groups. In particular, we will consider the share of the students belonging to ethnic and language minorities (MINO/P) and the share of the students with special needs (SPESU/P). Ideally, one would like to include a range of variables characterizing the student body composition at the schools in analysis of quit behavior. But due to data limitations, we focus on these two variables that hopefully will capture the most relevant aspects of the student body composition. Note however that a finding that schools with high SPESU/P and MINO/P have higher quit rate should not be taken as evidence that teachers discriminate students with minority background or special needs. It is quite possible that these variables are correlated with other

unmeasured conditions in the schools due to the fact that schools with a large number of such students often lies in areas with social problems.

While the student body composition is likely to be an important determinant of the working conditions in a school, the quality and characteristics of the other teachers within the school may also influence an individual teacher's decision to quit. The argument that employees prefer to work near similar individuals, with worker segregation as a result, can be dated back to the seminal work on discrimination by Becker (1971). While certified teachers has a very similar background, schools with recruitment problems are forced to use non-certified teachers. Certified teachers may find it less attractive to work together with non-certified teachers. This argument suggests that the propensity to quit for tenured certified teachers is higher in schools that hire non-certified teachers than teachers in schools not hiring non-certified teachers. In the empirical model we therefore include a dummy variable (NQT) that equals unity if the school employs at least one non-certified teacher at the time when the teacher makes his decision to quit or not.

As noted above, several authors have included measures of class size and resource use per student as explanatory variables in teacher turnover studies. The measure of resource use per student used in our model is the number of teaching hours per student (U/P). Finally, we include school size, measured by the number of students ($PUPIL$) in our model. An issue of particular interest is whether school size increases or decreases teacher quit probability. On the one hand, quits may be seen as a result of mismatch between teacher and school. However, as the school size increases, the possibility of moving teachers among classes and subjects within a school will increase and the probability of obtaining a satisfactory match between teacher and school should increase. In addition, schools below a certain threshold size may be viewed as unattractive because they leave few opportunities for specializing and contact with other teachers. This line of reasoning leads to the hypothesis that a teacher's propensity to quit is decreasing in school size. On the other hand, schools above a certain threshold may be viewed as less unattractive due to crowding and more bureaucracy. Thus, we will include both $PUPIL$ squared and dummy variables for the smallest schools in the model to capture the possibility of such non-linearities in the school size effects.

4. Teacher turnover in Norwegian primary and lower secondary schools: Descriptive evidence.

The present paper uses data on teachers in primary and lower secondary Norwegian schools during the school years 1992-93 to 1999-2000. The data covers the whole country, which means that we avoid the problem of distinguishing between teachers migrating between states and districts and those leaving teaching that has plagued US studies using administrative data. In addition, since the extent of private schools in Norway is negligible, the exit to such schools is not a realistic option for the teachers.⁶

In order to restrict the study to true voluntary quits, we include only teachers with permanent appointment in the analysis. Thus, temporary teachers and teachers on short-term contracts are excluded. In addition, teachers above 60 years of age are excluded in order to avoid including retirement decisions. The data reduction is more closely described in Appendix A.

As to the extent of teacher turnover in Norway, on average, 9.5 percent of the teachers used in the present analysis leave their current school from one year to another. In order to get some further feeling with the main features of the mobility, Figures 1-5 describe how teacher transitions are related to certain school and individual characteristics. The figures present the overall quit rate, and decompose this rate into inter-district-mobility (Move_m), intra-district-mobility (Move_s), and mobility out of the school sector (Move_o).

Figure 1 shows the development over time in the average turnover rate. While being relatively constant at 8% in the first three years, the rate started to increase in 1996 and was close to 12 % in 1997 and 1998. The sharp increase in the average turnover rate from 1995 occurs when the average unemployment rate in Norway declined sharply. One hypothesis is that as the unemployment rate declined, more teachers took advantage of the improved possibilities for work and higher pay in other occupations to leave teaching. In accordance with this hypothesis, Figure 1 shows that the increased turnover after 1995 is due to higher propensity to leave the school sector. The transition rates to other schools were relatively constant during the period. These changes in turnover rates over time points to the importance of including variables capturing the labor market situation in the econometric model for teacher turnover.

Figure 2 plots the teacher turnover rate against school size measured by the number of students (SIZE). The turnover rate seems to be highest for the smallest and largest schools, and indicates

⁶ In the school year 1995/96, 1.5 percent of the students were enrolled in private schools.

that non-linear terms should be included in the econometric model in order to capture the full effect of school size on turnover.

Figure 3 shows that the turnover rate is declining in age. The average turnover rate for teachers at age 24 is 25 percent, while the average turnover rate for those at age 50 is around 7 percent.⁷

Figure 4 shows a positive relationship between the teacher turnover rate and the share of students at the school belonging to ethnic and language minorities. This picture seems robust across different teacher destinations (out of education, new school in same district, new school in new district). While the average turnover rate among teachers at schools without minority students is around 9 percent, the average turnover rate at schools with at least 55 percent minority students is about 16 percent. As regards to the relationship between teacher turnover and the share of students with special needs (SPESU/P), Figure 5 shows that the teacher turnover rate is somewhat higher in schools where SPESU/P is high, but the relationship seems less clear in this case compared to that found for minority students. Taken together, Figures 4 and 5 suggest that teacher turnover is related to student composition, although strong conclusions on the causal effect of student composition on teacher mobility behavior cannot be drawn on the basis of these figures. The third variable measuring the working conditions at the school, the dummy variable for whether the school employ non-certified teachers (NQT), also seems to be important for quits. The average quit rate is 10.4 percent and 8.7 percent for schools with NQT=1 and NQT=0, respectively.

Table A1 includes descriptive statistics of all variables used in the empirical model. 65 percent of the teachers are female, 28 percent are working part time, and 2 percent are on leave. The average (weighted) school size is 240 students, and almost half of the schools are pure primary schools with separate classes on each grade. Almost half of the teachers work at schools employing both certified and non-certified teachers.

5. Teacher turnover: Econometric evidence.

In this section we present the results from estimating reduced form quit equations as suggested by (1) above. To facilitate comparison with other studies in the area, our baseline model is a binary model where the teacher's only choice considered is whether or not to leave his current

⁷ The skewed distribution of observations with respect to age is in large part due to previous changes in teacher demand related to the rapid growth in the number of students during the 1960s and 1970s and a subsequent fall in the 1980s.

school appointment. In section 4.3 we estimate a less restrictive version where we allow the effect of the right hand side variables to differ between quit for three different destinations.

5.1. Baseline model

We estimate a probit version of the model where the left hand side variable is the probability of leaving a particular school from year t to year $t+1$. The explanatory variables are measured at the individual level, school level and the school district level as discussed in relation to equation (1) above. In addition we include the following individual characteristics. A dummy variable for whether the teacher has a leader position, a dummy variable for part time work, and a dummy variable indicating whether the teacher is on leave with full or partly pay. The following school specific variables are included in addition to those described above. A dummy variable for whether the school has a library and dummy variables for school type (see Appendix A for definitions). The reference school type is a pure primary school with separate classes at each grade. Finally, the model also includes school district size measured by population.

The baseline results are presented in Table 1. Column (1) shows the preferred model, which includes region specific effects (90 regions) and time specific effects (7 years).⁸ For the probit model, we only present the estimated mean probability derivatives throughout the paper. Columns (2) and (3) show that the results do not change much when interaction between the time specific and region specific effects (630 variables) are included, or when the region specific effects are replaced by school district specific effects (432 local government specific effects).

The following results seems to be robust across the specifications in Table 2:

- i) Young teachers have a higher propensity to quit than old teachers.
- ii) Teachers with more education have higher propensity to quit than teachers with basic 3-year education college.
- iii) The probability of quitting is lower for female teachers than for male teachers.
- iv) Teachers working at schools with high share of minority students and students with special needs have higher propensity to quit.
- v) Teachers working at schools using individuals without teacher certification in teaching positions have a higher quit probability.

⁸ The regions used are the labor market regions constructed by Statistics Norway on the basis on commuting data.

- vi) The propensity to quit is non-linear in school size, with small and large schools having high quit propensities. The model predicts that the quit probability reaches its minimum at school size of about 370 students.
- vii) High local unemployment reduces teacher quit.

Result i) confirm what is found elsewhere in the literature, i.e. people are more mobile early in their working careers than late in their careers. The numerical results show that the marginal effect of increased age on the probability of quitting at mean values of quit is about -0.60 and -0.15 percentage points when the initial age is 25 and 60, respectively.

The results also clearly suggest that schools tend to lose teachers with higher education to a larger degree than teachers with the shortest possible education to be certified as a teacher. Increasing the education level from 3 years of higher education (28.8 percent of the observations) to the longest possible educational level (which is six years of higher education and account for 2.6 percent of the observations), the quit probability at mean increases by 3.6 percentage points.⁹

Although the US evidence on the effect of teacher qualifications is somewhat mixed, the results generally supports the hypothesis that the quit rate is increasing in qualification level. A reasonable interpretation is that teachers with higher education have better outside opportunities and therefore has a higher propensity to quit. This is also consistent with the evidence in Dolton and van der Klaauw (1995). Taken literally, the finding suggests that the wage premium for teachers with higher education is too low, which might be reasonable given the highly compressed wage distribution for teachers. However, such a conclusion is based on the assumption that the mobility in general is independent of educational level and that highly educated teachers perform better than less educated teachers, measured by their contribution to student achievement. While we have not been able to analyze the effect of teacher education on student achievement in Norway, existing US evidence gives very weak support for the hypothesis that more highly educated teachers generate higher student achievement [Rivkin et al.(2001)].

⁹ Estimations based on a dummy variable approach, using dummy variables for each educational level, showed that the effect was extremely close to linear. According to the raw data, the share of the teachers who quit is 8.1, 9.7, 10.3 and 11.9 percent for teachers with three, four, five and six years of higher education, respectively.

Result iii) above, female teachers are less reluctant to quit than their male colleagues, deserves some comments.¹⁰ Several studies from the US have found the opposite result. Using a longitudinal national US sample, Stinebrickner (1998) found that female teachers are more reluctant than males to leave teaching for family reasons. At first sight our result seems surprising given the US evidence. However, if we take into account the very generous Scandinavian rules for leave due to birth (approximately one year paid leave financed by the national government), the fact that teachers on paid leave are not defined as quitters in the present analysis, the flexibility in working time, and the large amount of subsidized publicly provided child care, this result is less surprising. Actually, the higher quitting propensity for male teachers seems perfectly consistent with the reasonable hypothesis that males opportunity cost in terms of expected wage in other occupations is higher than for women.

Regarding the other variables measured at the individual level, the results are as expected. School leaders, teachers working part time, and teachers on leave are more reluctant to quit than others.

The composition of the students seems to have an impact on the quit decision. Comparing a school with no minority students with a school with 20 percent minority students, the propensity to quit is about 0.8 percentage points larger in the latter case. For the share of students with special needs, the corresponding figure is 1.1 percentages points higher propensity to quit. These effects are quite large if one compares schools where nearly all students belong to a minority or have special needs with schools without such students.

The model formulation so far implies a linear association between the probability to quit and our variables describing student body composition. However, it is possible that this formulation implies a misspecification of the true effects. To investigate whether the linear specification is reasonable, the effect of student composition on the quit probability was estimated using a dummy variable approach. The model allows the effect of schools with a minority share of, say, $[15, 20)$, to differ freely from schools with a minority share outside this range, but restrict the effect of student composition to be equal within each group. For the minority share, schools with a minority share of at least 50 percent are grouped together because they are too few to split into several groups, and the same is the case for schools where at least 20 percent of the students have

¹⁰ The result implies that the quit probability is 0.6 percentage points higher for women than for men, evaluated at the sample mean.

special needs. The result from this model is shown in Figure 6. Both the effects of MINO/P and SPESU/P are reasonable linear. According to the results, the quit probability on schools where MINO/P is in the range $[15, 20)$ is 1.6 percentage points higher than in schools without minority students. The corresponding result for students with special needs is 1.9 percentage points. Thus, it seems fair to conclude that the effects of student composition are not driven by outliers.

According to result v), the propensity to quit also seems to depend on teacher composition at the school. The mean propensity to quit is about 0.7 percentage points higher at schools that have to utilize individuals without teacher certification in teaching positions than in schools that only employ certified teachers.¹¹

Even though the results clearly suggest that student and teacher composition are important determinants of teacher quit behavior, these effects cannot be interpreted as pure discrimination effects. Both MINO/P and SPESU/P may to some extent pick up unmeasured background factors such as low parental income, high share of lone parents and so on, which may be the true variables that affect teacher behavior. In addition, we cannot rule out the possibility that teacher composition may proxy for other factors that makes the school unattractive from a teacher's point of view.

The relation between the probability to quit and school size turns out to be highly nonlinear. The model includes the number of students (PUPIL), PUPIL squared, and dummy variables for schools with less than 20 pupils and for schools with $[20, 60)$ pupils. The model implies that there is an "optimal" school size in terms of quit of about 370 pupils. The quit probability is equal for schools with about 70 and 670 pupils, which is about 1.4 percentage points above the quit probability for schools with 370 pupils. For the smallest schools, the quit probability is even higher than implied by the quadratic specification because the dummy variables for the small schools have negative effects.¹²

¹¹ We have also calculated a variable measuring to what extent a school has to rely on non-certified teachers. Using this variable instead of the dummy variable for utilization of non-certified teachers gave the same fit to the data and none of the effects of the other variable in the model changed. This result indicated that an increase from zero to 20 percent of non-certified teachers at a school increases the propensity to quit for certified teachers by 1.3 percentage points.

¹² The model implies that the mean quit probability for schools with 10 and 50 pupils are 3.5 and 2.6 percentage points larger than for a school with 370 pupils.

Above, we argued that small class size and high resource use at the school may lead to lower teacher quit rate. However, contrary to prior expectations, the variable measuring resource use, U/P, has a positive and significant effect at 5 percent level. Increasing the resource use by 2 standard deviations increases, according to the model, the quit probability by 0.4 percentage points. It is possible that the positive effect is due to an omitted variable bias. There may be some compensating elements in U/P with regard to factors not captured by the model. For example, while the model includes the share of the students with special needs as a separate variable, the variation in ability within this student group is likely to be large. Because we have defined students with special needs as students for which there are allocated extra resources, students with large needs will increase the resource use at school more than students with minor extra needs. Thus, high resource use may in part capture unmeasured student composition effects. The model includes one other variable that should partly capture resource use not related to student composition, namely a dummy variable indicating whether the school has a library. This variable has the expected negative effect.

In addition to the individual and school factors discussed above, school district factors also influence the decision on whether to quit or not. The quit rate is higher in large local governments than in small local governments measured by the log of the population, probably due to more school choice alternatives in such communities as discussed below. In addition, the quit decision seems to be influenced by the unemployment rate. The results suggest that a doubling of the local unemployment rate reduces the probability that a teacher quits by about 0.8 percentage points. The effect of the income level of the inhabitants in the local government is positive as expected, but not statistically significant. The absence of any significant effect of this variable is not surprising, since it is only a crude proxy for the alternative wage outside teaching. A fair conclusion is that outside wages are better proxied by the teacher's level of education that was found to be an important predictor of the quit probability.

5.2. Sensitivity analyses

While the results so far seems to be quite robust across specifications, it is important to undertake further sensitivity analyses to check whether the model is robust in different dimensions. In this section we estimate the model on different sub-samples mainly based on individual characteristics. First, quit behavior may differ between women and men because of family reasons, and the fact that our model does not included variables describing the family

situation may in particular bias the results for women. But as the first two columns of Table 2 show, the behavior of men and women are surprisingly similar. However, there is a tendency that the quit decision for female teachers is more responsive to both student composition and teacher composition than is the case for men. Both the effects of SPESU/P and NQT are largest for women and are not statistically significant at 10 percent level for men. More surprisingly, the effect of local unemployment is also larger for women than for men.

Second, the relationship between individual quit behavior and non-pecuniary job attributes may differ between young and mature teachers as first suggested by Bartel (1982) who found that young men were more likely to quit repetitive jobs than mature men. Hanushek et al. (2001) using Texas data, find that the positive quit effect of high minority share of students is highest among the least experienced teachers. In order to investigate whether the quit behavior depends on the teacher's age, we estimated the model on three sub-samples; teachers below 30 years of age, between 30-50 years of age and above 50 years of age. Due to the skewed age-distribution in the total sample of teachers as seen in Figure 3, the sub-sample of the youngest teachers is relatively small. The results from this exercise are presented in columns (3) –(5) in Table 2. The negative effect on the quit probability of being a female teacher, is lower in absolute value for older than for younger teachers. MINO/P has strongest effects for the youngest and oldest teachers, while SPESU/P only has an impact on teachers below 50 years of age. But taken together, while some differences exist between different age groups, the results do not seem to vary dramatically between teachers of different age.

As a further check on the robustness of our results, we split the sample with respect to working time and estimate separate models for those working full-time and those working part-time. According to the results presented in columns (5)-(6) in Table 2, teachers working part time seem to respond somewhat stronger to the composition of students and teachers at the school than teachers working full time, but all effects of these three variables are significantly positive at 5 percent level. On the other hand, only teachers working full time seem to respond to the local labor market conditions measured by the local unemployment rate.

So far, the effect of school size in the different sub-samples is remarkably similar. One objection may be that this result, and possibly also the effects of other variables in the model, is driven by special circumstances at the small schools with pupils at different grades in the same class. Restricting the sample to schools above 200 students, for which the results are presented in

column (8) in table 2, we find that schools with 390 pupils have the lowest quit probability. Thus, we conclude that the result for the “optimal” school size is not driven by the inclusion of small schools in the sample. In addition there are only minor changes in the effect of most other variables. The major exceptions are that the negative effect of being a female teacher disappears, and that the effect of resource use and local unemployment is no longer significantly different from zero. To further check the robustness with respect to school types, we report results for subsamples using primary schools only [column (9)], and secondary schools only [column (10)] with separate classes at each grade. The most dramatic difference between school types is the effect of being a female teacher. In primary schools the quit probability for female teacher is clearly lower than for men, while the opposite is the case in secondary schools. Thus, it seems like women to a greater extent than men prefer teaching in primary schools. Regarding the variables measuring student and teacher composition at the school, the effect of MINO/P is large at secondary schools in which teacher composition seems to have no effect, while SPESU/P and NQT have strong effects in the primary schools. School size has a smaller effect in these subsamples than for the whole sample, and while the “optimal” primary school size seems to be about 360 pupils, the corresponding estimate for secondary schools seems to be about 580 pupils. The latter result is, however, very uncertain due to large standard errors of the estimated coefficients.

5.3. Multinomial model.

The model above restricts the effects of the explanatory variables on the probability to exit a school to be independent of destination. Thus, the model implies that the effect of student composition on exit probability is independent of whether the teacher moves to a school in the same school district, changes school district or leaves the education sector. As noted above, most studies of the relationship between non-pecuniary school factors and teacher quits restrict the analysis to cover between district moves within certain US states. However, recent evidence provided by Betts, Rueben and Danenberg (2000) from California and Loeb (2000) from New York State, suggests that teacher characteristics differ considerably within school districts. To investigate whether the effect of non-pecuniary school characteristics on teacher quit probability depends on destination, we estimate a multinomial logit model with three possible destinations: new school in same school district, new school in another school district, and out of teaching.

Staying at the current school is chosen as the reference state.¹³ The results are presented in Table 3.

Our working hypothesis is that teachers search for the “best” school mainly within the school district, which implies that school characteristics should be most important for within-school-districts mobility. The results from the multinomial model give some evidence that this is indeed the case. The estimated coefficients for the student composition variables are larger for the probability to move to another school within the same school district than for the other destinations. However, student composition also significantly affects moves out of the school sector. The results imply that, evaluated at mean values and using the formula in Greene (1997, p. 916), increased MINO/P from zero to 0.2 increases the probability to move to another school in the same school district, to a school in another school district and out of the education sector by 0.4, 0.1 and 0.3 percentage points, respectively. The importance of school size is also strongest for moves within the school district.

On the other hand, teacher composition measured by NQT is less important for within-district-mobility than for other types of quits. One may speculate that this result partly reflects that this variable may capture some other unfavorable aspects of the school district not included in the model. Ideally, this could be investigated by including fixed school districts effects in the model, but such a large model has not been possible to estimate with the available software.

Regarding the included variables at the school district level, the effects of population size is as expected. The large positive effect of school district size on within-school-district mobility and the negative effect on the mobility to other school districts is consistent with the hypothesis that large districts contain more choice opportunities for teachers. The small but significant effect on the mobility out of the school sector may be a result of a larger alternative labor market. Regional unemployment have the expected negative sign on the mobility out of the school sector, but has also an significant impact on within school district mobility.

Consider next the effect of private income on quit probability. This variable is a crude proxy for teachers alternative wage in the external labor market and may affect the quit probability through two main mechanisms. To illustrate; consider a local government with high private income. This

¹³ A multinomial model can be theoretically justified by using a random utility model combined with the assumption that choices are independent of irrelevant alternatives. This means that the relative choice probabilities between two alternatives are independent on the other alternatives [Green (1997)].

will partly reflect high wages in the private sector, which in turn also yields high housing prices. Because the teacher wage is equal in each local government, the real teacher wage is likely to be low in such a community. Thus, if high private income mainly reflects high housing prices, we would expect teacher mobility to other local governments to be relatively high. On the other hand, if private income mainly captures high wages in the alternative labor market for teachers, we would expect the effect on mobility out of the school sector to be high. The results in Table 3 shows that private income has a significantly positive effect only on the decision to move out of the school sector, which may indicate that the second effect dominates.

6. Concluding remarks.

Industrial researchers, sociologists and psychologists all stress the idea that non-pecuniary job attributes are important determinants of an employee's decision to quit a job or not. Yet, economists are used to view differences in pecuniary rewards measured by wages as main arguments in the quit decision since wages themselves should adjust endogenously to match differences across jobs in such attributes. However, the assumption that wages are flexible does not fit well with the actual functioning of many labor markets. Thus, the relation between non-pecuniary job attributes and quit behavior should be a concern also for economists. However, the empirical identification of the effect of such factors is surely difficult when wages themselves to some extent responds to these attributes.

A novel feature of teacher labor markets in Europe is that teacher wages are more or less equal within a country and depends almost exclusively on education and experience. In such an environment, non-pecuniary job characteristics could be very important determinants of teacher mobility. Taken together with recent evidence indicating that teachers are the most important input in education production, this points to the importance of understanding teachers quit decisions. This paper presents some new econometric evidence from Norway consistent with the hypothesis that non-pecuniary job attributes in schools are important determinants of teachers probability to quit. We find that the teachers propensity to quit is especially high in schools with high share of minority students and students with special needs. Moreover, our model results suggest that the teachers leaving these schools tend to move to other schools within the same school district. At the same time, evidence from US studies on student achievement consistently shows that minority students have lower achievement than other students. Thus, the rigid pay system that exists in Norway and other European countries may hurt this group of students. We

also find that the quit propensity is particularly high in small and large schools, and we calculate that minimum quit rate arises at a school size of about 370 students.

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Appendix A. The data

The register data consist of all teachers in primary and lower secondary public schools, 1–10th grade, covering students 6 to 16 years old. The total sample includes 84,417 teachers and 383,894 person-year observations. The following observations are excluded from the analysis: Teachers without tenure (68,191 observations), the school is closed in year $t + 1$ (1,422 observations), the school has paid the teachers a wage premium due to an experiment evaluated in Falch (2001) at least once during the empirical period (5,144 observations), teachers above 60 years of age (15,397 observations), teachers below 23 years of age (125 observations), and missing data at the school level (5,467 observations). The final sample consists of 60,444 teachers and 288,151 person years.

Table A1. Descriptive statistics

	Mean	Standard deviation	Minimum	Maximum
Move	0.095	0.29	0	1
Move_m	0.023	0.15	0	1
Move_s	0.016	0.12	0	1
Move_o	0.056	0.23	0	1
Age	44.87	8.57	23	60
Years of higher education	3.97	0.78	2	6
Leader	0.101	0.30	0	1
Working part time	0.284	0.45	0	1
On leave with full or partly pay	0.021	0.15	0	1
Women	0.653	0.48	0	1
SPESU/P	0.050	0.09	0	1
MINO/P	0.064	0.04	0	1
NQT	0.452	0.50	0	1
The school has a library	0.311	0.46	0	1
U/P	88.07	26.33	41.0	15.6
Pupil	237.4	130.0	1	783
Below 20 pupils	0.012	0.11	0	1
Between 20 and 60 pupils	0.068	0.25	0	1
Combined school	0.160	0.37	0	1
Secondary school	0.250	0.43	0	1
Primary school	0.421	0.49	0	1
Mixed school	0.169	0.37	0	1
Population in the middle of the school year	63,057	123,714	212	502,867
Unemployment at the end of the school year	0.038	0.02	0.003	0.183
Mean private income (NOK)	104,621	23,576	57,258	194,513

Figure 1: Mobility over time, and the number of observations each year

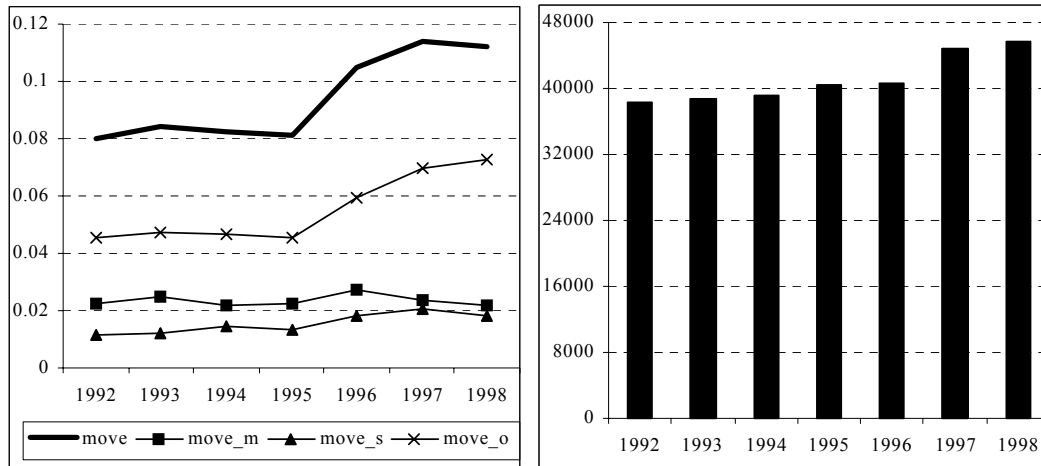


Figure 2: Mobility as a function of school size, and the number of observations in each group.

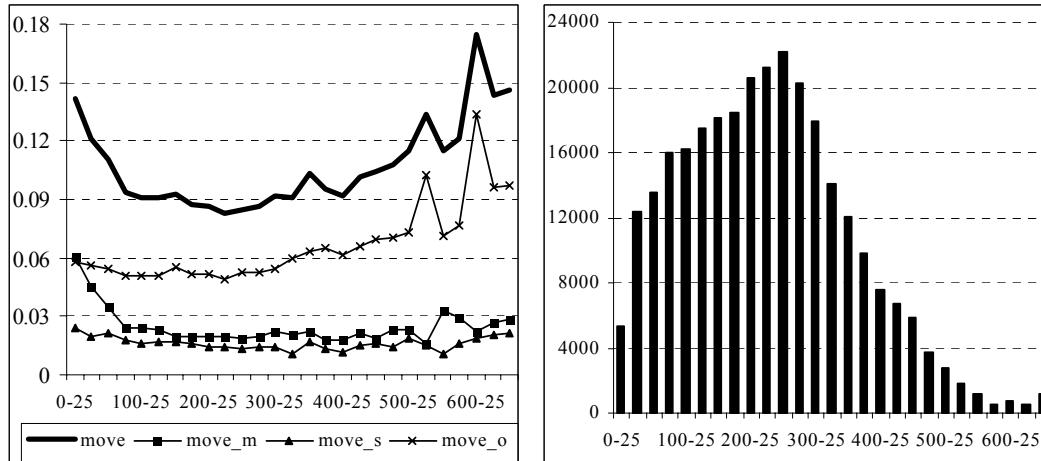


Figure 3: Mobility as a function of age, and the number of observations at each age.

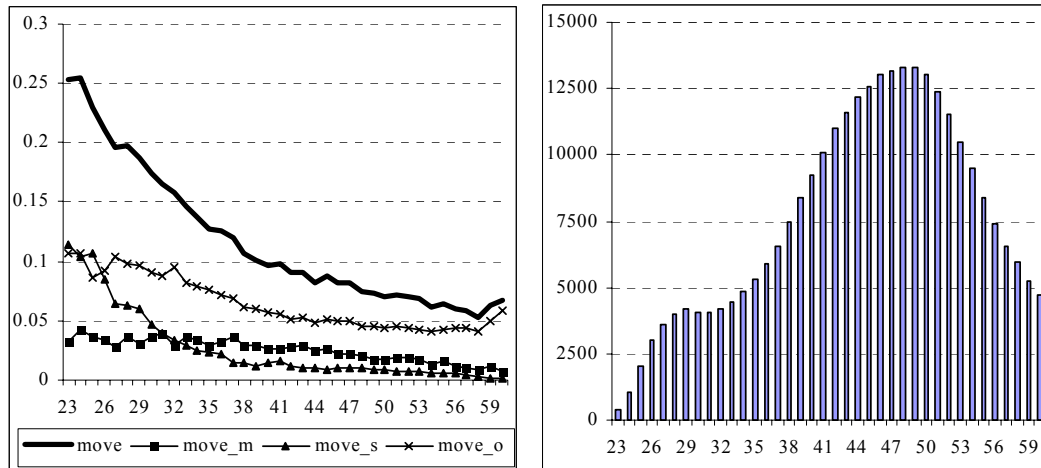


Figure 4: Mobility as a function of MINO/P, and the number of observations in each group.

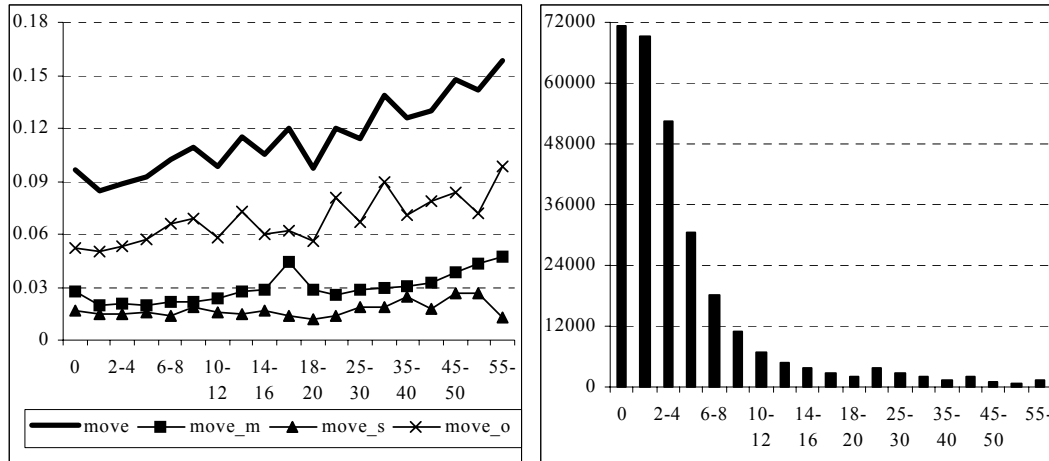


Figure 5: Mobility as a function of SPESU/P, and the number of observations in each group.

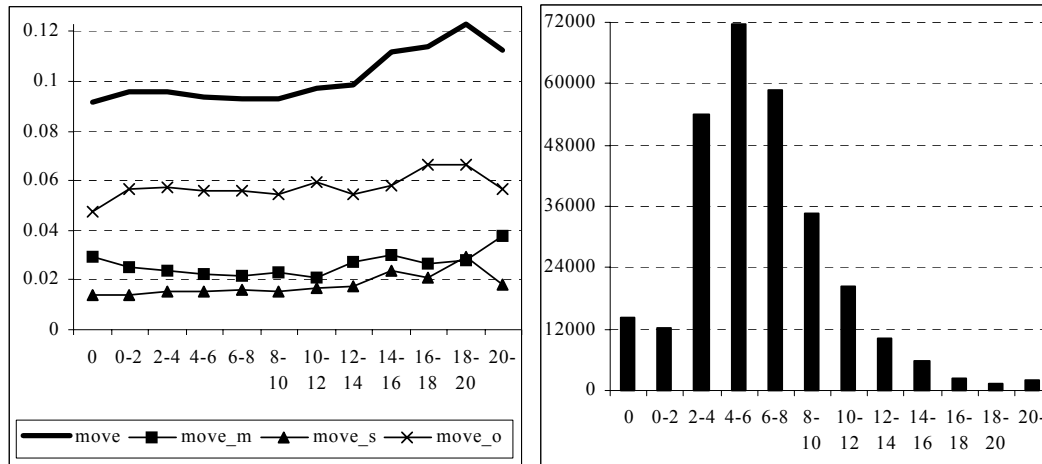


Figure 6: The effect of MINO/P and SPESU/P ± 2 standard errors using a dummy variable approach

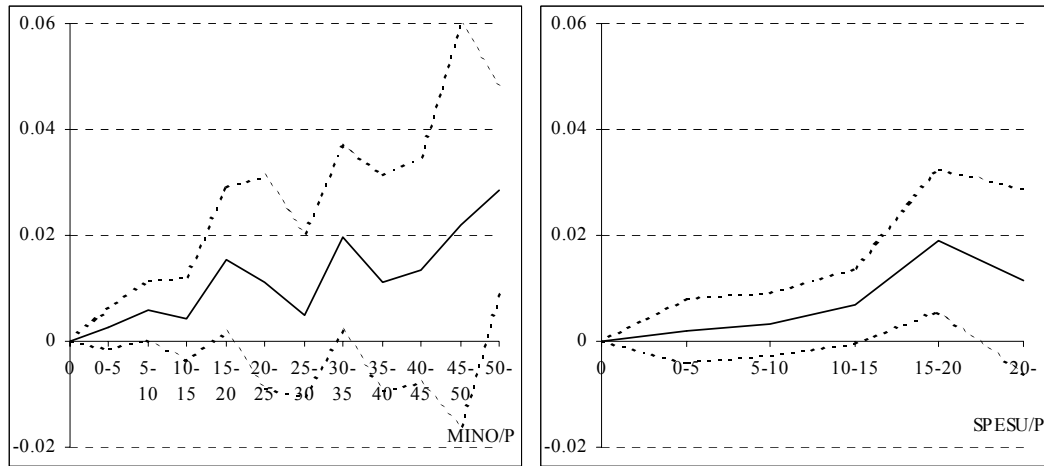


Table 1. Estimation results. Dependent variable is Move

	(1)	(2)	(3)
Age / 100	-0.947 (16.3)	-0.946 (16.5)	-0.901 (15.6)
(Age / 100) squared	0.007 (10.6)	0.007 (10.7)	0.007 (9.90)
Years of higher education	0.012 (15.6)	0.012 (15.7)	0.012 (15.8)
Leader	0.024 (11.6)	0.024 (11.7)	0.023 (11.5)
Working part time	0.032 (21.9)	0.032 (22.2)	0.032 (22.0)
On leave with full or partly pay	0.094 (22.4)	0.095 (22.4)	0.096 (22.7)
Women	-0.006 (4.72)	-0.006 (4.80)	-0.007 (4.91)
MINO/P	0.038 (3.35)	0.038 (3.47)	0.041 (3.51)
SPESU/P	0.057 (3.32)	0.059 (3.37)	0.050 (2.91)
Non-certified teachers employed at school	0.007 (5.03)	0.008 (5.64)	0.006 (4.26)
The school has a library	-0.004 (2.32)	-0.004 (2.28)	-0.003 (1.62)
(U/P) / 1000	0.071 (2.15)	0.077 (2.34)	0.085 (2.62)
Pupil / 1000	-0.161 (4.33)	-0.167 (4.73)	-0.149 (3.91)
(Pupil / 1000) squared	0.022 (3.40)	0.022 (3.73)	0.021 (3.17)
Below 20 students	0.020 (2.93)	0.019 (2.76)	0.023 (3.40)
Between 20 and 60 students	0.012 (3.30)	0.011 (3.13)	0.012 (3.27)
Combined school	-0.001 (0.51)	-0.001 (0.57)	0.001 (0.25)
Secondary school	-0.010 (5.09)	-0.010 (5.06)	-0.011 (5.54)
Mixed school	-0.001 (0.29)	-0.001 (0.27)	-0.001 (0.29)
ln Population	0.008 (5.75)	0.008 (5.76)	0.052 (1.40)
ln Unemployment	-0.008 (2.81)	-0.008 (2.35)	-0.004 (1.05)
ln (Mean private income)	0.014 (0.99)	0.013 (0.91)	0.037 (1.27)
Year specific effects	Yes	Yes	Yes
Region specific effects	Yes	Yes	Yes
Region – year specific effects	No	No	No
Municipality specific effects	No	No	No
Observations (person-years)	288,151	288,151	288,151
Log likelihood	-86,224	-85,692	-85,785
Mean of predicted probability	0.0949	0.0949	0.0949

Note: Estimated by the probit-model. Mean probability derivatives presented. Asymptotic t-values in parenthesis, calculated based on standard errors corrected to account for within-school clustering of errors.

Table 2. Estimation results for sub-samples. Dependent variable is Move

Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Women	Men	Below 30 years of age	[30,50] years of age	Above 50 years of age	Working full time	Working part time	More than 200 pupils	Primary schools	Secondary schools
Women	-	-	-0.032 (4.25)	-0.006 (3.48)	-0.003 (1.53)	0.002 (1.37)	-0.052 (13.9)	-0.001 (0.72)	-0.015 (7.17)	0.007 (3.00)
MINO/P	0.037 (3.04)	0.038 (2.32)	0.106 (2.26)	0.032 (2.50)	0.036 (2.46)	0.028 (2.32)	0.074 (3.38)	0.030 (2.27)	0.032 (2.36)	0.051 (2.55)
SPESU/P	0.064 (3.22)	0.044 (1.87)	0.129 (1.71)	0.063 (3.05)	0.020 (0.85)	0.048 (2.57)	0.082 (2.80)	0.064 (1.95)	0.079 (2.56)	0.041 (1.27)
Non-certified teachers employed at school (NQ) (U/P) / 100	0.009 (5.32)	0.004 (1.71)	0.006 (0.82)	0.009 (5.26)	0.004 (2.09)	0.005 (3.15)	0.013 (4.91)	0.008 (3.71)	0.010 (3.95)	0.001 (0.32)
	0.045 (1.18)	0.099 (1.97)	0.041 (2.39)	0.053 (1.34)	0.053 (1.03)	0.091 (2.55)	0.008 (0.13)	0.122 (1.28)	0.087 (0.90)	0.071 (0.58)
Pupil / 100	-0.149 (3.98)	-0.178 (3.41)	-0.362 (3.99)	-0.150 (3.48)	-0.139 (3.47)	-0.162 (4.26)	-0.174 (3.39)	-0.186 (2.22)	-0.080 (1.88)	-0.111 (1.51)
(Pupil / 100) squared	0.022 (3.51)	0.020 (2.23)	0.047 (2.58)	0.020 (2.71)	0.020 (3.21)	0.021 (3.33)	0.025 (3.07)	0.024 (2.15)	0.012 (1.70)	0.009 (0.76)
ln Population	0.009 (5.87)	0.006 (3.22)	0.004 (0.66)	0.010 (6.39)	0.004 (2.27)	0.008 (5.33)	0.009 (3.86)	0.011 (4.47)	0.008 (3.12)	0.004 (1.56)
ln Unemployment	-0.012 (3.28)	-0.003 (0.72)	-0.016 (1.26)	-0.010 (2.84)	-0.003 (0.81)	-0.009 (2.94)	-0.005 (1.00)	-0.007 (1.35)	-0.010 (1.61)	-0.005 (0.94)
ln (Mean private income)	0.009 (0.55)	0.021 (1.16)	0.044 (0.76)	0.006 (0.35)	0.025 (1.36)	0.014 (0.97)	0.010 (0.41)	-0.020 (0.87)	0.029 (1.18)	0.008 (0.33)
Year specific effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region specific effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations (person-years)	188,043	100,108	18,239	187,884	82,021	206,439	81,712	169,715	121,318	72,014
Log likelihood	-57,760	-28,174	-8,947	-57,884	-19,119	-57,459	-28,511	-49,831	-36,732	-19,409
Mean of predicted probability	0.0990	0.0872	0.2050	0.0974	0.0647	0.0846	0.1209	0.0924	0.0971	0.0813

Note: Estimated by the probit-model. Mean probability derivatives presented. Asymptotic t-values in parentheses, calculated based on standard errors corrected to account for within-school clustering of errors.

Table 3. Estimation results. Multinomial logit model.

Moving decision	Moving to another school in the same local government	Moving to another school in another local government	Moving out of the schooling sector
Women	-0.106 (3.44)	0.010 (0.26)	-0.104 (4.81)
MINO/P	0.860 (3.54)	0.330 (1.32)	0.329 (1.99)
SPESU/P	0.951 (2.88)	0.040 (0.10)	0.732 (2.69)
Non-certified teachers employed at school	0.050 (1.40)	0.099 (2.74)	0.111 (4.84)
(U/P) / 100	-0.054 (0.66)	0.174 (2.90)	0.114 (2.65)
Pupil / 100	-0.400 (5.93)	-0.079 (1.23)	-0.124 (2.19)
(Pupil / 100) squared	0.039 (3.73)	0.008 (0.80)	0.022 (2.35)
ln Population	0.366 (10.6)	-0.211 (7.12)	0.076 (3.54)
ln Unemployment	-0.144 (2.04)	-0.050 (0.72)	-0.108 (2.44)
ln (Mean private income)	-0.580 (1.71)	0.237 (0.77)	0.402 (1.90)
Year specific effects		Yes	
Region specific effects		Yes	
Municipality specific effects		No	
Observations (person-years)		288,151	
Log likelihood		-110,118	
Mean of predicted probability	0.0233	0.0157	0.0559

Note: Estimated by the multinomial logit-model. t-values in parentheses, calculated based on standard errors corrected to account for within-school clustering of errors