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ABSTRACT

This paper investigates the early working careers of graduates from teacher education using Norwegian register data. The longitudinal data follows the individuals up to 12 years after graduation. The analysis is on net attrition since mobility both out of and into teacher positions is taken into account. The findings reveal a gradual net attrition from teacher positions of about 1.3 percentage points yearly, starting 1–3 years after graduation. Some of the attrition is to leadership positions in education, but the main attrition is to jobs outside education. The attrition is mainly among males and graduates with relatively high measured academic ability, and it differs greatly across teacher education types. The differences in the probability of teaching related to gender and academic ability are low shortly after graduation, but increase over time. Teacher education graduates for secondary schooling work as teachers to the lowest degree. These systematic patterns are related to both the demand and supply side of the teacher labour market.

1. Introduction

Recruiting and retaining high-quality teachers is vital for student performance (Hanushek, 2011). Teacher attrition is an increasing concern in many countries because it reinforces teacher shortages. Teacher shortages are prevalent in several countries, including the US (e.g., Goldhaber et al., 2020; Sutcher et al., 2019), the UK (e.g., Sibieta, 2020; Sims, 2020) and other countries (e.g., Cheryl, 2017; Falch et al., 2009). In addition, teacher attrition of novice teachers questions the effectiveness of teacher education programmes. When teacher graduates, and early career teachers, end up in non-teaching jobs, it might have been more effective for the educational system if they had chosen another higher education study.

This paper investigates the working career of graduates from teacher education. I use Norwegian register data that include all graduates from teacher education in Norway in the period 2001–2013 and their working careers in the period 2004–2013. I ask whether the propensity to work as a teacher is related to individual characteristics such as gender, parental education, measured academic ability and the type of teacher education. Further, I investigate the dynamics of these factors in the early years after graduation.

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There is an extensive literature on teacher attrition. One strand of the literature studies the relationship between various observable teacher characteristics and teacher attrition. Early survey articles, mainly based on studies from the US, conclude that attrition is significantly related to several factors (Borman & Dowling, 2008; Guarino et al., 2006). For example, female teachers, non-minority teachers and teachers with high measured academic ability have higher attrition. The relationship with age and experience is more complex, but the studies indicate the highest attrition for young and inexperienced teachers and old teachers close to the retirement age. Later survey articles (Nguyen et al., 2020; Nguyen & Springer, 2021) mainly confirm these findings, but conclude that the more recent studies do not find any relationship with gender. In a recent paper, Goldhaber et al. (2022) show that the transition from studies to teacher positions varies markedly over the business cycle.

Another strand of the literature investigates teachers' intentions to leave teaching based on questionnaires. There are consistent findings that supportive leadership, social connections, and other aspects of the job environment increase job satisfaction and reduce the intention to leave (Ladd, 2011; Sims, 2020). A third strand of the literature is based on qualitative interviews with a limited number of teachers. This literature is to a large extent concerned about teacher burnout and resilience (Amitai & Houtte, 2022; Hong, 2012).

The literature on career motivation is also relevant for the present study. The studies in this literature use different approaches, but questionnaire data is most commonly used. The survey of Heinz (2015) on student teachers' career motivation highlights intrinsic, extrinsic and altruistic factors. The intervention study of Ajzenman et al. (2021) finds that intrinsic motivation, such as influencing children's development, is vital for high-performing students, while extrinsic motivation, such as working conditions and monetary benefits, is vital for low-performing students.

The contribution of the present paper is on the quantitative relationship between teacher attrition and teacher characteristics. Few such studies exist outside the US.[1] The baseline findings are mainly in accordance with findings from the US. In addition, the analysis shows that attrition increases with experience, which implies that a declining share of the teacher graduates works as teachers. They move to leadership positions within education and leave for jobs outside the educational sector. There are systematic patterns on characteristics of leaving teachers. While male graduates work as a teacher to a larger degree than females early in their career, the opposite is the case when the time since graduation exceeds four years. Teacher attrition is also positively related to measured academic ability. Teacher attrition is heterogenous, which implies that the composition of experienced teachers differs from the composition of novice teachers.

Section 2 presents relevant Norwegian institutions and Section 3 presents the data. Descriptions of the teacher education graduates are in Section 4, while Section 5 includes the empirical analyses. The relationships between individual characteristics and teacher attrition are unfolded in different ways, including dynamic relationships and alternatives to teaching positions. Finally, section 6 provides a discussion of the results and concluding comments.

2. Teacher education in Norway

Teacher education in Norway is provided in numerous higher education institutions across the whole country. The classification of teacher education programmes is based on which part of the educational system they are geared towards. The description below is organised accordingly and is restricted to education programmes that qualify for permanent teacher positions during the empirical period 2001–2013.

2.1. Early Childhood Education and Care

Public sector pre-schools, the institutions for early childhood education and care (ECEC), gradually expanded from the 1970s. The institutions are staffed with assistants, who often have specialisation from upper secondary education, and teachers. The ECEC teacher education programme is a three-year bachelor's.

The demand for ECEC places increased gradually faster than the supply. Towards the end of the previous century, there was a significant excess supply. Consequently, it was widespread with unformal care, particularly for the youngest children. For the parents, this was expensive because the ECEC places were and still are, highly subsidised by the government.

In 2003, a national reform gave the right to a place in either a public or private ECEC institution from 2009. As a result, in the period after 2003, the capacity in ECEC increased, with a sharp increase in the demand for ECEC teachers.

Figure 1 shows a reduction in the number of graduates from 2001 to 2002. After a period with a stable number of graduates of about 1,300, a positive trend started in 2009.[2] An immediate response to the reform in 2003 should be visible in 2007 (increased enrolment in 2004 into the three-year bachelor programme). It seems to have been a delay in educational choice decisions.
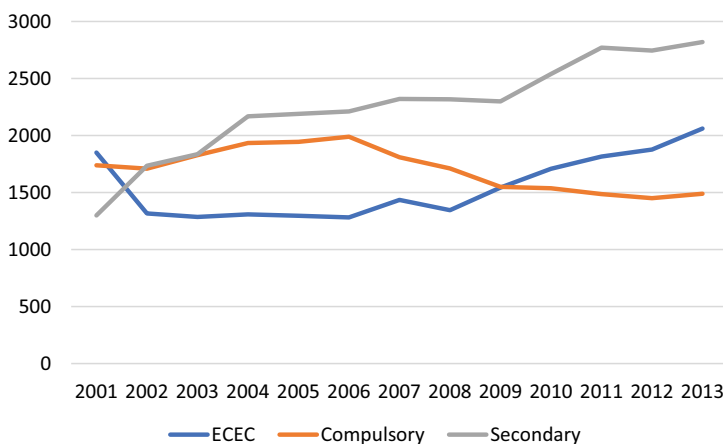

Figure 1. Number of teacher education graduates.

2.2. Compulsory schooling

Compulsory education starts the year the child turns 6 years of age and ends the year the child turns 16 years of age, denoted grades 1–10. A reform in 1997 expanded compulsory education from 9 to 10 years by lowering the starting age from 7 to 6.

Historically, there has been one major study programme for teachers in compulsory education. This teacher education programme used to certify teachers for all subjects in compulsory schooling. In 1992, the study programme expanded from a three-year bachelor's programme to a four-year bachelor's programme. A reform in 2010 introduced more specialisation. The programme was split into two different programsme, one for grades 1–7 (primary schooling) and the other for grades 5–10, and each programme includes a limited number of school subjects. A new reform in 2017 changed the study programmes to five-year integrated master's programmes.

Figure 1 shows a negative trend in the number of candidates for compulsory schooling starting in 2007. This caused a major concern for future teacher shortages and was a motivation for the reform in 2010.

2.3. Secondary schooling

Secondary education consists of compulsory lower secondary schooling (grades 8–10) and non-compulsory upper secondary schooling (grades 11–13) in high schools. High schools consist of several different study tracks, generally classified as either academic or vocational study tracks. The latter typically involves apprenticeship training in firms.

A reform in 1994 gave all adolescents the right to enrol in high school and complete high school within 5 years. However, already before the reform, more than 95% of the cohorts enrolled high school.

Several different study programmes qualify for teaching in secondary education (grades 8–13). The main programme is a one-year study in educational theory and practice. It builds on a bachelor's or a master's degree in disciplinary studies relevant to schools. There are two main tracks of this programme: one for general subjects such as Mathematics and languages, and the other for vocational studies such as electrician and health work. In addition, there are specific bachelor programmes qualifying for teaching in specific practical and aesthetic subjects, such as Physical education, music and electrician. Further, five-year integrated master's programmes were developed in the empirical period, combining disciplinary studies with pedagogy and practice studies. In the empirical period, about 2/3 of the candidates have the one-year practicum for general subjects, about 1/3 of the candidates are qualified for vocational, practical and aesthetic subjects, while only about 1% have the new five-year integrated programme.

Figure 1 shows a clear positive trend in the number of candidates for secondary schooling.

3. The data

This paper is based on two register data sets in Statistic Norway: one register of educational careers and one register of working careers. The data are matched by Statistic Norway using an individual identifier.

The register on educational careers includes the population of students in the period 2001–2014. I restrict the sample to graduates from teacher education programmes. Further, I limit the sample to individuals below 63 years of age because some formal types of retirement decisions are possible from this age. Figure 2 presents the age profile at graduation for the three different teacher education types presented in Chapter 2, a total of 50,771 graduates. The typical progress in the Norwegian educational system is to finish high school the year one turns 19, take one year off formal education (military service, Folk high school, travelling, working, etc.), and enrol in higher education the year one turns 20. Thus, it is most common to graduate from the three-year ECEC teacher education programme at age 23 and the four-year teacher education programme for compulsory schooling at age 24.

Several individuals graduate at a high age. In particular, the teacher education programmes for secondary schooling have a relatively flat age profile. These graduates typically have another prior degree and some labour market experience before they enrol in the one-year study programme in educational theory and practice.

The second register includes the working careers of the population with higher education for the period 2004–2013. The register includes the type of work in the main position, measured in October.[3] I classify the candidates in three different relevant positions for their education; (i) teacher in schools or ECEC, (ii) leader in schools, ECEC or a related activity, and (iii) another position in schools, ECEC or a related activity. Relevant activities outside ECEC and schools include positions responsible for apprenticeship training (which is a part of upper secondary education) and related training activities.

The information on the type of work is unfortunately not complete in the register. Some observations are registered with working time, but without classification of the type of job. I exclude these observations from the empirical analyses. The share of missing observations decreases from 16.9% in 2004 to 3.4% in 2013. The analytical sample consists of 420,581 observations. The data do not include information on permanent or temporary positions, which implies that I cannot distinguish between ordinary teachers and substitute teachers, in contrast to Goldhaber et al. (2022).
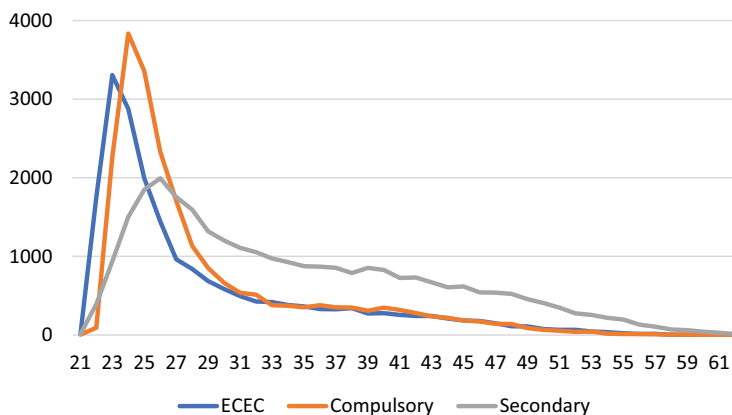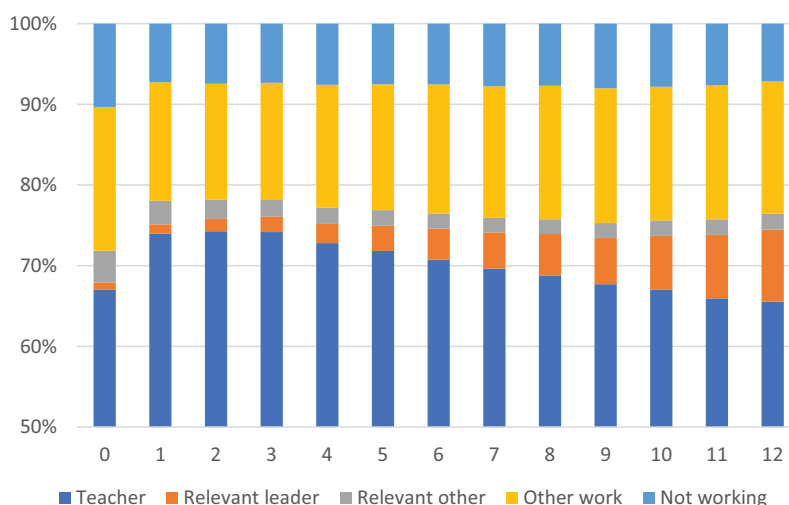

Figure 2. Age at graduation.

Figure 3. Employment categories related to years since graduation.

Figure 3 presents the share of graduates in different positions, related to years since graduation. At the year of graduation, the share working as teachers is relatively low. One year after graduation, the share working as a teacher increases by 7.0 percentage points (pp), from 67% to 74%. On the other hand, the share working outside the education sector declines by 3.1 pp, the share not working declines by 3.0 pp and the share in other relevant positions declines by 1.0 pp. It takes some time to find a teaching position. The figure also shows that few teacher graduates are in 'other relevant' positions a couple of years after graduation and onwards.

From four years after graduation and onwards, there is close to a linear reduction in the share working as teachers by slightly above 1 pp per year. Experienced teachers leave teacher positions.[4] However, the share of leaders increases. Teachers leave teaching positions partly for leadership positions within the educational sector. In addition, there is a positive trend in the share working outside the educational sector.

The pattern in Figure 3 has clear similarities to the findings of Goldhaber et al. (2022), who considers the early career paths for teachers in the Washington state. Goldhaber et al. find that 71% of the graduates are employed in the educational sector one year after graduation, compared to 78% in Figure 3. In both cases, the share start to decline in year 4 after graduation. Goldhaber et al. only consider years 1–5 after graduation.

Figure 4 and Table 1 present working patterns separately for the different teacher education types. Figure 4 shows apparent differences in the propensity to work as a teacher, but the developments over experience levels are very similar. The same is generally the case for the other employment categories. Table 1 presents the shares in different employment categories at two points: one year and ten years after graduation.

Compared to teacher graduates for compulsory schooling, who are teachers to the largest degree, ECEC teacher graduates are in leadership positions and other positions within the educational sector to a larger degree. The former is probably because ECEC institutions are typically much smaller than schools, implying relatively more leadership positions. Leaders in ECEC are most likely combining leader tasks with ordinary teacher
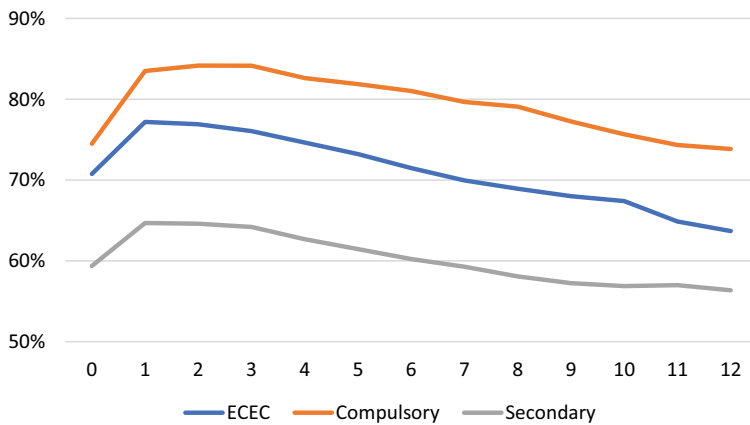
Figure 4. The share working as teacher related to years since graduation.

**Table 1.** Employment categories and different types of teacher education.

	All	ECEC	Compulsory	Secondary
Teacher				
1 year since graduation	74.0%	77.2%	83.5%	64.7%
10 years since graduation	67.1%	67.4%	75.7%	56.9%
Leader position in educational sector				
1 year since graduation	1.2%	2.8%	0.3%	0.7%
10 years since graduation	6.6%	9.6%	5.8%	4.7%
Other position in educational sector				
1 year since graduation	2.9%	6.3%	1.1%	2.0%
10 years since graduation	1.9%	3.2%	1.1%	1.8%
Work outside educational sector				
1 year since graduation	14.7%	7.4%	9.0%	23.8%
10 years since graduation	16.6%	12.0%	11.0%	27.3%
Not working				
1 year since graduation	7.2%	6.3%	6.1%	8.7%
10 years since graduation	7.8%	7.8%	6.5%	9.4%

tasks to a larger degree than in schools. In addition, formal ECEC teacher education is relatively new. Thus, relatively few older ECEC teachers are qualified for leadership positions. Regarding other relevant positions, ECEC teacher graduates are more often registered as 'assistants', both in ECEC institutions and in schools. About half of the observations of ECEC graduates in other relevant positions are different kinds of assistant positions. An assistant position seems to be a more common route into teacher positions for ECEC graduates than for the other two types of teacher education.

Regarding graduates for secondary schooling, they work outside the education sector to a much larger degree than other teacher graduates. This is probably partly because they have broader qualifications and thus are more attractive outside teaching.

4. Characteristics of teacher graduates

This chapter considers different aspects of the backgrounds of the teacher graduates. First, Figure 5a shows that there are distinct differences in the share of female graduates between the teacher education programmes. While about 90% of ECEC graduates are
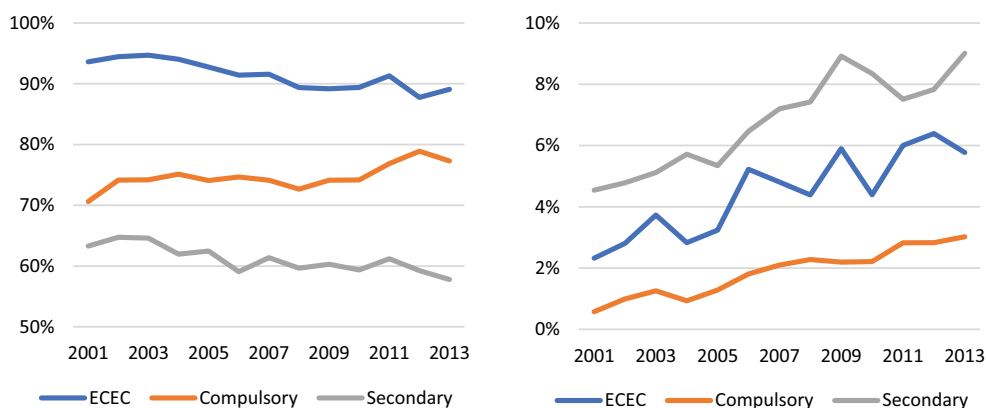
a. Female share among graduates   b. Immigrant share among graduates

Figure 5. a. Female share among graduates. b. Immigrant share among graduates.

female, the corresponding numbers for compulsory and secondary schooling are about 75% and 60%, respectively. During the empirical period, there is a reduction in the share of female graduates for ECEC and secondary schooling, while there is an increasing trend for graduates to compulsory schooling.

The skewed distribution of gender in the teaching profession is often considered a problem. It is argued that the background of teachers should reflect the composition of the population. A related issue is lack of teachers with immigrant background. In this paper, I define immigrants as both parents are born abroad without being Norwegian citizens. The graduate can have been born abroad (first generation immigrant) or in Norway (second generation immigrant). Nationally, in the year 2000, it was 6,2% immigrants when calculated this way, increasing to 11,4% in 2010. The share of immigrants among teacher graduates, presented in Figure 5b, is clearly lower but strongly growing over time for all programmes. The highest share of immigrants is for graduates for secondary schooling, reaching 9% in 2013, while it is lowest for graduates for compulsory schooling.

I use the register of students in HEIs to calculate average grade in higher education as a measure of academic ability. The grade point average (GPA) is calculated using all exams where the student does not fail, weighted by the number of credits in each course. During 2000–2004, Norway introduced the European system for grading defined by the Bologna process. This implies that several individuals in the sample have grades from two different grading systems. The European grading system is a five-point scale for non-failing results, with a reasonably normal distribution. It replaced a more detailed grading system. I convert grades from the old system to the new system by forcing on, within the sample of teacher graduates, the same distribution of grades as in the new system. This conversion makes it possible to calculate individual averages across the two systems.[5] Figure 6 shows that the distribution of grades is similar for graduates for ECEC and compulsory schooling, while the grades are better for secondary schooling graduates.
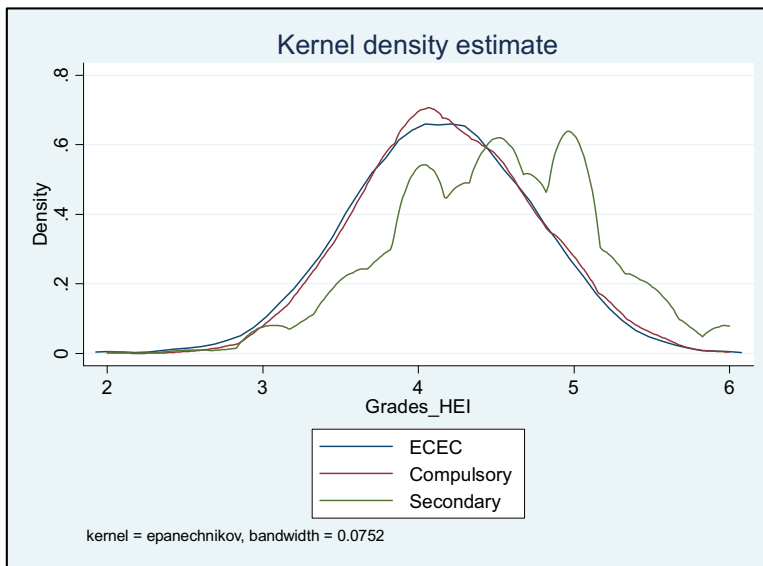
Figure 6. The density of average grades from higher education.

5. Analyses of teacher careers

5.1. Model specification

The characteristics of the individuals are in general correlated. In order to get closer to main drivers of teacher attrition, I estimate multivariate models. I use a linear probability model approach by using the ordinary least square method. The dependent variable in the main specification is an indicator variable for working as a teacher. Since this is a linear model, the estimated coefficients must be interpreted for the mean values of the variables in the model.[6] The sample includes 1–12 observations per individual. The analyses do not consider the past working career of the individuals but consider the outcome each year as independent. This implies that attrition is not exaggerated by including only individuals that potentially can leave a teaching position, as in a standard survival modelling approach, but additionally includes individuals with teacher education who can potentially enter a teaching position at any time.[7]

Descriptive statistics for the analytical sample are presented in Appendix Table A1. In addition to the individual characteristics described above, the regression models include age and indicator variables for parental education and being a student. For parental education, an indicator variable for whether at least one of the parents has higher education, i.e., a bachelor's degree or a higher degree, is used. Parental education is at the same level for graduates for compulsory and secondary schooling, but lower for graduates from the ECEC teacher education programme. On average, at least one of the parents has higher education in 37% of the observations. For being a student, information in the educational register is exploited. The individual is registered as a student in higher education in 30% of the observations in the analytical sample. This is most common for graduates for secondary schooling and least common for graduates for ECEC. Since a bachelor's is sufficient for being qualified as a teacher in the empirical

period, some choose to take a master's education or further in-service education. Even though part-time studies very common, I expect being in education reduces the probability of working.

Years since graduation is included in the model, and since Figure 4 shows that the actual year of graduation is very specific, I include an indicator variable for this particular year. Notice that years since graduation is by definition the actual year less the year of graduation. Thus, these three variables are collinear and cannot be included linearly in the same regression model. The model controls for time as flexible as possible by including fixed effects for both each graduation year (2001–2013) and for each year of observed outcome in the labour market (2004–2013). The descriptive statistics for these variables reflect a specific feature of the sample: new graduates enter the sample each year. Thus, the number of observations per year increases close to linearly (from 4% of the total number of observations in 2004 to 16% in 2013), the number of observations per graduation year decreases close to linearly from 2004 (from 12% of the total number of observations in 2004 to 2% in 2013), and the average years since graduation is relatively low (4.17 years) compared to the variation from zero to 12 years. The average age is 35.2 years, which reflects that some graduates are relatively old (see, Figure 2). The most common age in the regression sample is 29 years.

The match of individuals and jobs is determined by supply and demand. The schools might have preferences for some kinds of teachers, for example, teachers with high measured academic ability and male teachers, which makes it easier for teachers with these traits to get a teaching position. Some characteristics might also be more attractive outside the educational sector, influencing attrition. Likewise, the individual might have preferences for specific types of jobs, for example, in a specific region or a specific school. Demand and supply factors affect both the transition from study to jobs for new graduates and the dynamic patterns during the working career. It is in general difficult to distinguish empirically between demand and supply when only the actual work contracts are observed. However, the dynamic patterns during the early work careers investigated towards the end of the analysis below shed some light on demand and supply factors.

5.2. Main results

The main results are presented in column (1) in Table 2. In our sample of teacher graduates in the period 2001–2013, observed in the labour market in 2004–2013, I find that graduates from teacher education programmes designed for compulsory schooling are most likely to work as a teacher, while graduates from teacher education programmes designed for secondary schooling are the least likely to work as a teacher, conditional on the other variables in the model. The differences, compared to graduates from ECEC teacher education, are 8 and 10 percentage points (pp), respectively.

There is only a small and insignificant difference between males and females. This is in accordance with the recent findings in the literature. Below I present findings that might explain the seemingly contradictory findings in the recent and the older literature (Borman & Dowling, 2008; Nguyen et al., 2020).

Graduates with an immigration background are 2.5 pp less likely to work as a teacher than others. In addition to being underrepresented in teacher education programmes,

Table 2. Main results. The dependent variable is working as a teacher.

	(1)	(2)	(3)	(4)
Compulsory schooling teacher graduate	0.080**	0.080**	0.091**	0.096**
	(0.005)	(0.005)	(0.005)	(0.006)
Secondary schooling teacher graduates	−0.103**	−0.106**	−0.102**	−0.088**
	(0.006)	(0.006)	(0.007)	(0.008)
Female	0.008	0.008	0.009	0.020**
	(0.005)	(0.005)	(0.005)	(0.005)
Immigrant	−0.026**	−0.015	−0.012	−0.031*
	(0.005)	(0.011)	(0.011)	(0.013)
Grade point average from higher education	−0.020**	−0.020**	−0.021**	−0.024**
	(0.002)	(0.002)	(0.002)	(0.003)
At least one parent has higher education	−0.018**	−0.016**	−0.017**	−0.019**
	(0.003)	(0.003)	(0.003)	(0.003)
Years since graduation	−0.013**	−0.013**	−0.013**	−0.011**
	(0.001)	(0.001)	(0.001)	(0.001)
The graduation year	−0.056**	−0.057**	−0.057**	−0.045**
	(0.004)	(0.004)	(0.003)	(0.007)
Age	−0.00002	0.0005	0.0004	−0.0005
	(0.0002)	(0.0003)	(0.0003)	(0.0004)
In education	−0.052**	−0.050**	−0.049**	−0.040**
	(0.005)	(0.005)	(0.004)	(0.005)
Year of graduation fixed effects	Yes	Yes	Yes	Yes
Year of observation fixed effects	Yes	Yes	Yes	Yes
Controls for complexities in HEI grades	Yes	Yes	Yes	Yes
Municipal fixed effects	No	Yes	Yes	Yes
HEI fixed effects	No	No	Yes	Yes
Sample period	2004–2013	2004–2013	2004–2013	2012–2013
Observations	420,581	420,581	420,581	130,580
R-squared	0.043	0.052	0.060	0.061
Mean value of dependent variable	0.712	0.712	0.712	0.710

Note. Robust standard errors in parentheses, clustered by municipality in adolescence. ** and * denotes significance at 1% and 5%, respectively.

those with a degree use it in the teaching profession to a relatively small extent. This is the opposite finding than for minorities in the US, which can be related to the fact that immigrants are a much smaller share of the population in Norway than minorities in the US.

Further, the probability to work as a teacher is negatively related to parental education and academic ability, measured by the grade point average in higher education. One grade point increase (which is about 1.6 standard deviations) reduces the propensity to be a teacher by 2.0 pp, which is in accordance with the findings for the US.

The relationship with years since graduation reflects the unconditional relationship in Figure 4. The large majority of the students graduate in the spring, and in the fall of the same year the probability of working as a teacher is 5.5 pp lower than in later years. Finding a teacher position takes some time for a significant share of graduates. From the first year after graduation and onwards, the probability of working as a teacher declines on average by 1.3 pp yearly. Teachers leave teaching as they gain experience. Eleven years after graduation, the probability of working as a teacher is 13 pp lower than one year after graduation. This is a major extent of teacher attrition.

There is no effect of age, given the effect of years since graduation. Lastly, as expected, there is a negative effect of being registered as a student in higher education.

The baseline model only includes variables measured at the individual level. There might be regional differences in teacher posts available, and graduates might wish to

Table 3. Heterogenous relationships. The dependent variable is working as a teacher.

Sample	(1) ECEC	(2) Compulsory	(3) Secondary	(4) Males	(5) Females
Compulsory schooling teacher graduate	-	-	-	0.102**	0.085**
				(0.014)	(0.005)
Secondary schooling teacher graduates	-	-	-	−0.045**	−0.118**
				(0.014)	(0.006)
Female	0.060**	0.042**	−0.026**	-	-
	(0.012)	(0.005)	(0.008)		
Immigrant	−0.018	−0.081**	−0.007	−0.036**	−0.021**
	(0.017)	(0.020)	(0.008)	(0.008)	(0.007)
Grade point average from higher education	0.005	−0.020**	−0.032**	−0.025**	−0.018**
	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)
At least one parent has higher education	−0.023**	−0.022**	−0.005	−0.016**	−0.018**
	(0.006)	(0.005)	(0.006)	(0.006)	(0.003)
Years since graduation	−0.008**	−0.010**	−0.016**	−0.019**	−0.011**
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
The graduation year	−0.010	−0.069**	−0.066**	−0.057**	−0.057**
	(0.007)	(0.006)	(0.005)	(0.005)	(0.004)
Age	−0.003**	0.001**	0.001**	0.002**	−0.001**
	(0.0003)	(0.0003)	(0.0005)	(0.0004)	(0.0003)
In education	−0.097**	−0.065**	−0.018**	−0.039**	−0.055**
	(0.006)	(0.005)	(0.006)	(0.008)	(0.004)
Year of graduation fixed effects	Yes	Yes	Yes	Yes	Yes
Year of observation fixed effects	Yes	Yes	Yes	Yes	Yes
Controls for complexities in HEI grades	Yes	Yes	Yes	Yes	Yes
Observations	115,776	143,286	161,519	108,345	312,236
R-squared	0.018	0.022	0.012	0.035	0.048
Mean value of dependent variable	0.728	0.807	0.616	0.689	0.720

Note. Robust standard errors in parentheses, clustered by municipality in adolescence. ** and * denotes significance at 1% and 5%, respectively.

work close to where they are born. Column (2) in Table 3 includes a full set of fixed effects for the municipality where the individual resided at age 16 (475 variables). The profiles of the graduating institutions differ, particularly for the composition of the teacher education programmes. Column (3) additionally includes a full set of fixed effects for graduating institution (35 variables). The results in columns (2) and (3) are very similar to the baseline model in column (1). The relationships between individual characteristics and the probability of working as a teacher are mainly unrelated to regional and institutional differences. The only exception is the relationship with immigration status, which gets smaller and insignificant when regional factors are taken into account. This is probably due to the fact that the share of immigrants among teacher graduates varies to a great extent across municipalities. Given that the effect of immigrants is sensitive to regional factors, the effect of this variable must in the following be interpreted with care.

The feature of the data implies that a relatively large share of the observations is a few years after graduation. Column (4) in Table 2 is restricted to the two last years in the sample, 2012–2013. This implies that the number of observations for each experience level is of about similar size, in contrast to the other regressions that overweight low experience levels. The estimated results are, however, mainly qualitatively unchanged. The main difference is the significant effects of gender and immigration. The positive relationship with female and the negative relationship to immigrant, in contrast to the comparable regression in column (3), indicate some important dynamics of these characteristics. They seem to matter more some years after graduation than earlier on. I return to this issue below.

5.3. Heterogenous relationships

Table 3 investigates heterogenous effects. The table presents results for separate models for the three teacher education types and for males and females. The last row of the table presents the mean value of the dependent variable in each subsample.

I have shown above that average background characteristics vary across graduates from different teacher education types. It turns out that the relationships with the probability of working as a teacher also differ markedly. The relationships for compulsory schooling graduates in column (2) in Table 3 are closest to the average relationships across all three types of teacher education in Table 2.

The effect of being female is strongly positive for ECEC teacher education graduates, while it is negatively significant among secondary schooling graduates. The small average effect of gender in Table 3 masks important differences across teacher education types. Female teachers dominate in ECEC and primary schools.[8] Interestingly, the skewer the gender composition is, the less likely are male graduates to be in a teacher position compared to females. The differences in the probability of working as a teacher exaggerate the skewed pattern in the choice of education.

Immigrant status has a significant effect only on graduates for compulsory schooling, while parental education does not affect secondary schooling graduates. On the other hand, measured academic ability has no effect for ECEC teacher graduates and the largest effect for secondary schooling graduates. Achievement in higher education matters for the propensity to be a teacher, and to the largest extent in the upper part of the schooling system, where the scientific requirements are higher than in the lower part of the schooling system.

Experience, measured by years since graduation, has a similar effect for all teacher education types. Interestingly, for ECEC graduates, there is not a significantly lower probability of being a teacher the year of graduation. This is likely because of the major expansion of ECEC during the empirical period.

The two last columns in Table 3 estimate separate models for males and females. The associations are surprisingly similar across gender, but with two exceptions. First, there is a weaker negative effect of being secondary schooling graduate for males than females. This corroborates the finding in column (3) that females are less likely to work as a teacher in this group. Second, the negative effect of years since graduation is larger for males than females. Teacher attrition is a larger problem for male teachers than for female teachers. Over a period of ten years, the estimated coefficients imply a difference in the propensity to be a teacher of 7 pp. This corroborates the findings in Table 2 that the relationship with gender depends on the sample.

5.4. The alternatives to teacher positions

Individuals not working as teachers do something else. For example, when graduates with high measured academic ability are less likely to have a teacher post, they have to be more likely to do something else. Table 4 presents results for models using the different labour market outcomes in Table 1 as the dependent variables. Column (1) replicates the model in Table 2 for comparability reasons.

Regarding teacher education types, the estimated coefficients are relative to the graduates from ECEC teacher education. Graduates for compulsory schooling are less

Table 4. Different job outcomes.

Dependent variable	(1) Teacher	(2) Leader in education	(3) Other in education	(4) Work outside education	(5) Not working
Compulsory schooling teacher graduate	0.080**	−0.040**	−0.034**	−0.003	−0.002
	(0.005)	(0.002)	(0.002)	(0.003)	(0.003)
Secondary schooling teacher graduates	−0.103**	−0.045**	−0.025***	0.151**	0.022**
	(0.006)	(0.002)	(0.002)	(0.005)	(0.003)
Female	0.008	−0.011**	0.003**	−0.031**	0.030**
	(0.005)	(0.001)	(0.001)	(0.005)	(0.002)
Immigrant	−0.026**	−0.010**	−0.001	−0.028**	0.064**
	(0.005)	(0.002)	(0.002)	(0.009)	(0.009)
Grade point average from higher education	−0.020**	0.007**	−0.003**	0.021**	−0.005**
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
At least one parent has higher education	−0.018**	0.0001	−0.003**	0.009**	0.012**
	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)
Years since graduation	−0.013**	0.005**	−0.002**	0.008**	0.002**
	(0.001)	(0.0003)	(0.0003)	(0.001)	(0.001)
The graduation year	−0.056**	−0.003**	0.010**	0.035**	0.013**
	(0.004)	(0.001)	(0.001)	(0.003)	(0.004)
Age	−0.00002	0.001**	−0.0002**	−0.001**	−0.0001
	(0.0002)	(0.0002)	(0.0001)	(0.0002)	(0.0003)
In education	−0.052**	0.013**	−0.001	0.014**	0.026**
	(0.005)	(0.001)	(0.001)	(0.003)	(0.003)
Year of graduation fixed effects	Yes	Yes	Yes	Yes	Yes
Year of observation fixed effects	Yes	Yes	Yes	Yes	Yes
Controls for complexities in HEI grades	Yes	Yes	Yes	Yes	Yes
Observations	420,582	420,581	420,581	420,581	420,581
R-squared	0.043	0.025	0.013	0.053	0.012
Mean value of dependent variable	0.712	0.029	0.023	0.157	0.079

Note. Robust standard errors in parentheses, clustered by municipality in adolescence. ** and * denotes significance at 1% and 5%, respectively.

likely to be leaders and in other positions in education, and are thus more likely to work as a teacher. Graduates for secondary schooling have a much higher propensity to work outside the educational sector, and thus are less likely to work as a teacher. The reasons for these different patterns might be related both to differences in demand from the educational sector and from other sectors, differences in individual preferences, and differences in the quality of the teacher education programmes.

The main difference between females and males is that males to a larger extent work outside the educational sector while females to a larger extent are not registered with paid work. In addition, females are significantly less likely to be leaders. The patterns are similar for immigrants as for females. Another interesting finding is that graduates with high measured academic ability to a larger extent work as leaders and outside the educational sector than others.

As time passes since graduation, more individuals get into leadership positions and jobs outside the educational sector. Mobility to leadership positions is as expected. Attrition from the educational sector is lower than attrition from teacher positions. The two last columns in Table 4 combined are the probability of not working in the educational sector. The attrition measured this way is 1.0 pp yearly, somewhat lower than the attrition from teacher positions of 1.3 pp.

5.5. Dynamic relationships

The working hypothesis in this section is that demand factors are relatively more important for the job matches observed for recent graduates than for experienced workers, and that supply factors are relatively more important for the job matches observed some years after graduation. Some graduates must expect to use some time to be employed in the job they prefer, in particular teachers with characteristics of relatively low demand. It seems reasonable that recent graduates must expect to accept a job offer somewhat down the ladder of their preferences. Experienced workers have had time to climb the ladder and will to a larger extent have positions in accordance with their preferences. The argument is that changes in the relationship between individual characteristics and the propensity to work as a teacher will inform on demand and supply factors. Relationships shortly after graduation reflect demand factors to a larger degree than supply factors, while changes in the relationships as the graduates' gain experience reflect supply factors to a larger degree than demand factors.

I estimate separate models for each number of years since graduation in the data, using the baseline specification in column (1) in Table 2. Because there are relatively few observations 10–12 years since graduation by construction of the data, I cluster them into the same regression.[9] The figures below present the point estimates from each model together with approximately the 95% confidence intervals for the estimates.

Figure 7a presents the finding for female graduates relative to male graduates. There is a striking and close to linear pattern related to gender. Shortly after graduation, females are less likely to work as teachers than males. This indicates that schools prefer to appoint male teachers, which might be because of the skewed gender composition of teachers ((Heinz et al., 2022), and Figure 5a above). Over time the difference shrinks, changes sign, and increases. From five years after graduation and onwards, female graduates are significantly more likely to work as a teacher than males, and the difference is 6.8 pp 10–12 years after graduation. Females likely need more time to find a teaching position and that supply factors explain the higher male attrition rate. The supply side factors seem to exaggerate the gender imbalance in the teaching profession. During the first 10–12 years of the working career, the gender difference in the propensity to be a teacher increases by 10.4 pp., or 14.6% of the average probability of being a teacher. This corresponds to the findings in Table 3.[10]
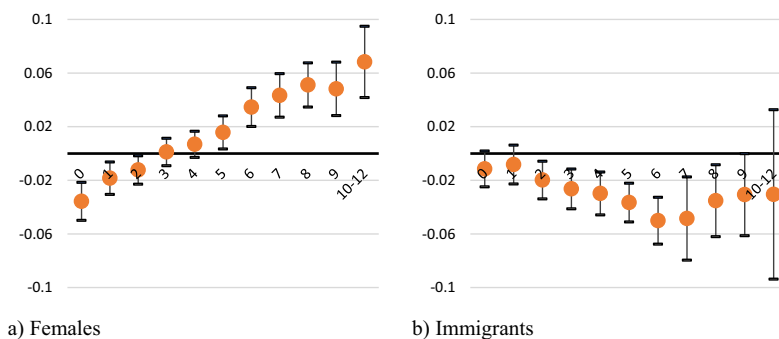

a) Females   b) Immigrants

Figure 7. Dynamic relationship between gender and immigrant and the propensity to be a teacher. Estimated coefficients and ± 2 standard errors.

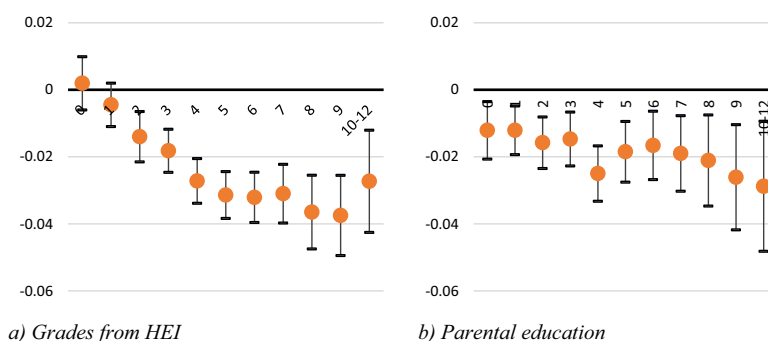a) Grades from HEI   b) Parental education

Figure 8. Dynamic relationships between measured academic ability and parental education and the propensity to be a teacher. Estimated coefficients and ± 2 standard errors.

Given the results in Figure 7a, the contradicting findings in the attrition literature are not surprising ((Borman & Dowling, 2008; Nguyen et al., 2020). Empirical patterns seem to depend on features of the data. If novice teachers dominate the data, the results in the present paper indicate that the finding will be higher attrition among female teachers than among male teachers. If, on the other hand, old and experienced teachers dominate the data, the findings are likely to be the opposite.

The difference in the dynamic attrition pattern of male and female teachers is interesting in light of the overall gender imbalance in teaching. Teacher gender and student-teacher gender matching do not seem to affect student achievement, see for example, Cho (2012). Heinz et al. (2022) conclude that this finding casts doubt of the need for male teachers as role models and father figures, but argue that female dominance might have other important impacts.

The dynamic pattern is less linear for immigrants than for gender, see, Figure 7b, but also immigrants become less represented in teacher positions after some years. Right after graduation, the difference in the probability of being a teacher is small and insignificant. Thereafter, the difference becomes statistically negative. It seems like supply factors, shaping immigrant graduates' interest, drive the average negative association.

Finally, Figure 8 presents the findings for measured academic ability from higher education and parental education. Academic ability is unrelated to the propensity to be a teacher shortly after graduation. The result indicates that schools do not use academic ability as a screening device in their appointment decisions of recent graduates. From two years after graduation and onwards, the relationship is negatively significant. It seems like supply factors pull teachers with high academic ability out of schools. They might be more interesting to other employers, or they might find teacher jobs less attractive than other teachers. Regarding parental education, the relationship is negative all years. The attrition in this group seems to increase over time compared to others, but this tendency is weak relative to the dynamics of measured academic ability.

6. Conclusion

This paper quantifies teacher attrition and relates the attrition to individual characteristics. Using longitudinal Norwegian register data, I investigate the probability that

graduates of teacher education work as a teacher during the first years after graduation. The analyses are on net attrition since mobility both out of and into teaching is taken into account.

Teacher education graduates get teaching positions reasonably fast, similar to the findings for the US (Goldhaber et al., 2022). The share of the graduates in teacher positions is highest 1–3 years after graduation. Thereafter, there is a steadily major net attrition. Some of the attrition is natural in the sense that there are career possibilities within the educational sector. Some move to leadership positions. From the perspective of teaching positions, the net attrition is 1.3 percentage points yearly, while from the perspective of the educational sector, the net attrition is 1.0 percentage points yearly. The present paper is not able to investigate the underlying causes of why teachers leave schools. However, the attrition is related to individual characteristics.

Shortly after graduation, male graduates are more likely to work as teachers than female graduates. This indicates that it is easier for male graduates to get their first teaching job than for female graduates. Due to a skewed gender distribution in schools, with a majority of female teachers, the schools might prefer male graduates. However, male teachers leave teaching to a significantly higher degree than female teachers. Five years after graduation, female graduates are more likely to have a teacher position than male graduates, and the difference increases each year thereafter. This exaggerates the initial gender distribution in school. Male attrition is highest in ECEC, where they are the least represented, and lowest in secondary schooling, with the highest representability. The more skewed the initial gender distribution among teachers, the more skewed the gender composition of new graduates, and the higher male attrition from teaching positions. This gender imbalance strengthens the need for a better understanding of how teacher gender affects students.

A similar pattern is found for immigration background. Immigrants are underrepresented in teacher positions, and teacher education graduates with immigration background seem to work as teachers to a smaller degree than other graduates. The gap seems to increase over time, and it is largest for the schooling level with the initially lowest share of immigrant graduates (compulsory schooling). However, there are relatively few immigrants in the sample, which implies that the results are more uncertain than for gender.

Evaluation of academic ability is an important part of teacher education, and these evaluations are meant to reflect abilities relevant to teaching positions. Arguably, measured academic ability in teacher education is more relevant for schools with old students than for primary education than ECEC. Teacher quality for young students might to a larger extent depend on factors that are hard to measure, such as social and relationship skills. I find that measured academic ability is unrelated to having a teaching position shortly after graduation, which might depend on both demand and supply factors. The attrition is, however, positively related to measured academic skills. Teachers with high grades from their education leave teacher positions to a larger degree than others, and the attrition is largest at the secondary level. It seems that graduates with high academic ability leave teaching to the largest extent at the schooling level where such ability is of the highest value.

These systematic patterns related to who works as a teacher and who leaves teaching are related to both the preferences of schools (the demand side) and the individuals (the

supply side). By investigating whether these patterns are related to years since graduation, I argue that the findings inform on the importance of demand and supply conditions separately. The findings clearly suggest that the attrition challenge in teaching is related to males, minorities, and teachers with high academic ability. It is unlikely that they work as teachers to a smaller degree because of lower demand than others, particularly because the teacher employment gap widens over time. In order to combat teacher shortages, it seems important for schools to make themselves more attractive for these groups of individuals certified to be teachers.

Notes

1. The limited number of studies from the Nordic countries includes Falch and Strøm (2005) and Karbownik (2020), which are quantitative studies of teacher turnover, Skaalvik and Skaalvik (2011) and Räsänen et al. (2020), who study teachers' intentions, Smith and Ulvik (2017), who use interviews to investigate motives and resilience, and Flores and Niklasson (2014) on student teachers motivation.
2. The data sources are described in Chapter 3.
3. The register is for employees and thus does not include self-employed persons. Teaching tasks as self-employed can only take the form of private tutoring, which is very rare. In the analyses below, the group denoted 'not working' includes self-employment. Notice that while yearly about 7–10% of the graduates are not registered with work (see, Figure 3 below), only 1.3% of the sample are not registered to work at all during the first five years after graduation
4. Notice that due to the sample design, there are relatively few observations with high experience levels. Only graduates from 2001 are observed 12 years after graduation (observed in 2013), only graduates from 2001 and 2002 are observed 11 years after graduation (observed in 2012 and 2013, respectively), etc. This feature of the data implies that 6.6% of the sample have 10–12 years of potential experience, while 36.1% have 0–2 years of potential experience.
5. In the empirical sample, 29.4% and 94.8% of the graduates have at least one grade from the old and the new system, respectively, while 4.6% do not have any grade information. The latter group consists mainly of graduates from one specific institution only providing ECEC teacher education. The regression analyses below add control variables in order to take these complications into account. Dummy variables for missing grade information, having at least one grade from the old system and having at least one grade from the new system are used. The effects of the average grade reported do not, however, depend on whether these three control variables are included or not.
6. Alternative model specifications can explicitly ensure that probabilities are between zero and one by assuming specific functional forms of the model, such as the probit and logit models. In these types of models, the estimated relationships can be interpreted outside the mean values of the included variables, under the assumed distributional function. However, such models give approximately the same effects for mean values, which is the only interest in the present paper.
7. When there are several observations for each individual, the precision of the estimated coefficients will most likely be overestimated without corrections. To account for this feature, all standard errors are estimated by allowing for clustering. I cluster at the municipal level, defined as the residential municipality at the age of 16. There are 475 municipalities in the data. I use a higher level than the individual level in the adjustment of the standard errors in order to take other potential common factors into account.
8. In 2016, 92.1%, 74.8% and 53.8% of the teachers were females in ECEC, compulsory schooling and upper secondary schooling, respectively, which is close to the female shares among the graduates presented in Figure 5a.

9. The number of observations is 50,243 for 2 years since graduation, 34,645 for 6 years since graduation, 13,912 for 10 years since graduation and 4,661 for 12 years since graduation.
10. The difference in the dynamic attrition pattern of male and female teachers is interesting in light of the overall gender imbalance in teaching. Teacher gender and student-teacher gender matching do not seem to affect student achievement (Cho, 2012), which casts doubt of the need for male teachers as role models and father figures (Heinz et al., 2021). However, some scholars argue that female dominance might have other important impacts (Heinz et al., 2022).

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Appendix Table A1. Descriptive statistics

	Mean value	Standard deviation
ECEC teacher graduate	0.28	-
Compulsory schooling teacher graduate	0.34	-
Secondary schooling teacher graduates	0.38	-
Female	0.74	-
Immigrant	0.04	-
At least one parent has higher education	0.37	-
The graduation year	0.12	-
In education	0.30	-
Years since graduation	4.17	3.11
Age	35.2	8.5
Average grade from higher education	4.31	0.62
Grade information missing	0.04	-
Have at least one grade from new grading system	0.83	-
Have at least one grade from old grading system	0.58	-
Graduation year		
2001	0.11	-
2002	0.11	-
2003	0.11	-
2004	0.12	-
2005	0.11	-
2006	0.10	-
2007	0.09	-
2008	0.07	-
2009	0.06	-
2010	0.05	-
2011	0.04	-
2012	0.03	-
2013	0.02	-
Observation year		
2004	0.04	-
2005	0.05	-
2006	0.07	-
2007	0.08	-
2008	0.09	-
2009	0.11	-
2010	0.12	-
2011	0.13	-
2012	0.15	-
2013	0.16	-
Number of observations	420,581	-