Quota vs Quality?
Long-Term Gains from an Unusual Gender Quota

Ursina Schaede* Ville Mankki†

January 2022

Click here for the most recent version

Abstract

We evaluate equity-efficiency trade-offs from admission quotas by examining effects on output once beneficiaries start producing in the relevant industry. In particular, we document the impact of abolishing a 40% quota for male primary school teachers in Finland on their pupils' long run outcomes. The quota had advantaged academically lower-scoring male university applicants, and its removal cut the share of men among new teachers by half. We combine this reform with the timing of union-mandated teacher retirements to isolate quasi-random variation in the local share of male quota teachers. Using comprehensive register data, we find that pupils exposed to a higher share of male quota teachers during primary school have higher educational and labor force attainment at age 25. Pupils of both genders benefit similarly from exposure to male quota teachers. Our findings are consistent with the quota improving the allocation of talent over the unconstrained selection process.

We are grateful to David Yanagizawa-Drott, Joachim Voth, Claudia Goldin and Ulf Zölitz for their guidance throughout this project. We thank Sara Bagagli, Anne Sofie Beck Knudsen, Augustin Bergeron, Anne Brenøe, Lorenzo Casaburi, Ana Costa-Ramón, Alessandro Ferrari, Matteo Greco, David Hémous, Andrea Hofer, Kristiina Huttunnen, Daniel Kopp, Mika Kortelainen, Ross Mattheis, Morten Olsen, Claude Raisaro, Heather Sarsons, and Hanna Virtanen for helpful comments and suggestions. We thank Topias Jalo and his colleagues at Statistics Finland, as well as the administrative staff at the Universities of Tampere and Zurich for their support. We gratefully acknowledge financial support from the Yrjö Jahnsson foundation.

*University of Zurich, Department of Economics: ursina.schaede@econ.uzh.ch
†University of Turku, Department of Teacher Education

1 Introduction

Are affirmative action policies, such as quotas, costly for economic efficiency? On one hand, when quotas in educational institutions and workplaces are binding, they require these organizations to "lower the bar" by admitting applicants who would have been rejected otherwise. As quotas force a decision maker to deviate from her preferred ranking of candidates, the overall quality of successful applicants may be lower (Welch, 1976; Lundberg and Startz, 1983; Arcidiacono and Lovenheim, 2016). Cast in this light, affirmative action policies achieve a distributional goal only at the cost of lower productivity.

In contrast to this reasoning, affirmative action policies may raise economic efficiency when evening out differences that arise from unequal opportunities that are unrelated to inherent potential ability (Hsieh et al., 2019; Coate and Loury, 1993; Becker, 1957).

Even in the absence of explicit discriminatory barriers, differential treatment of underrepresented groups can be desirable when selection processes operate under imperfect knowledge of candidates' potential abilities (Holzer and Neumark, 2000). This is the case in settings in which multiple dimensions of skill determine output, but selection criteria are limited to specific subsets of cognitive scores (Heckman et al., 2006; Deming, 2017; Bell et al., 2019; Siniscalchi and Veronesi, 2021). A similar reasoning applies to environments in which complementarities between groups materialize in production, such that diversity itself augments productivity. Taken together, these countervailing forces indicate that whether a representation quota is costly or output-enhancing is ultimately an empirical question whose answer depends on the specifics of the setting.

In this paper, we document that a quota - beyond merely achieving a representational goal - raised efficiency in the relevant industry by correcting a mis-allocation of talent. Leveraging a unique policy reform in Finland, we trace out how a quota-induced shift in the gender composition of an entire occupation affects output in the long run. We study how the termination of a quota for male primary school teachers influenced pupils' educational pathways and subsequent labor force attainment. Specifically, this quota had reserved 40% of slots in admissions for primary school teacher studies at Finnish universities for male applicants, advantaging academically lower-scoring male candidates. The removal of the quota resulted in a sharp drop in the share of men among admits to primary school teacher studies from about 40% to 20% (Uusiautti and Määttä, 2013; Räihä, 2010).

Our identification strategy isolates exogenous variation in pupils' exposure to male quota teachers with a differences-in-differences instrumental variables (DiD-IV) framework: To instrument for the local teacher gender composition that pupils experience in primary school, we use the lifting of the quota together with the timing of local demand shocks for new teachers. These demand shocks arise from local teachers reaching the union-mandated teacher retirement age when turning 60. The first stage employs a DiD specification that compares municipalities with and without retirements across the quota and post-quota period. Intuitively, municipalities in which teachers turn 60 while the quota is still in place will hire new teachers from a rookie

teacher market with quota men, compared to municipalities whose teachers turn 60 just after the quota was abolished.[1] The exclusion restriction requires that teacher retirements in the post-quota period do not differentially impact pupil outcomes except via changing the teacher gender composition. Our empirical strategy addresses this by comparing pupils who experience similar exposure to new teachers via retirements, but face a different gender composition of those rookie teachers due to the lifting of the quota.

We start by outlining a simple conceptual framework of university admissions that derives conditions under which a representation quota results in lower or higher total ability of admitted candidates. When the selection criterion fully reflects candidate ability, introducing a binding quota comes at the cost of admitting less qualified candidates. In contrast, there may be efficiency gains from a quota when the selection criterion is negatively correlated with minority group status and insufficiently captures the potential ability of candidates: This can be the case both when the mapping between the selection criterion and ability differs across groups, and when there are complementarities in production between groups. Embedding same-identity role model effects within this framework, we derive testable predictions for our specific setting.

We then turn to examine the efficiency effects of the quota empirically. First, we document how the lifting of the quota affected the local gender composition of teachers at the municipal level: Once the primary teacher cohorts that studied without the quota graduate and enter the market for rookie teachers in 1994, each retiring teacher is 20 percentage points less likely to be replaced with a male teacher relative to the quota period. These changes in the local teacher gender composition are accompanied by small, but noisily measured, increases in local teachers' average academic scores – consistent with the notion that lower scoring men are no longer admitted to primary teacher studies once the quota is abolished.

We proceed to study how these changes affect pupils, using comprehensive register data from 1988 to 2018 to trace out pupils' education and labor market pathways until age 25. Using the timing of teacher age-based retirements as an instrument for the local teacher gender composition, we show that pupils exposed to a higher share of male teachers via the quota have higher educational and labor force attainment in the long run: At age 25, these pupils are .09 standard deviations (SD) more likely to be a student or actively participating in the labor market for a 1 SD increase in the share of male quota teachers.[2] In terms of educational attainment, we observe a shift towards higher qualifications throughout the educational attainment distribution: For practically-oriented vocational degrees, pupils are more likely to have additional advanced qualifications instead of a basic three-year degree. For academic tracks, pupils are more likely to have obtained a university level BA degree by age 25.

To better understand from where these differences in long-term outcomes originate, we use rich register data to closely track pupils' educational trajectory after finishing compulsory school-

[1] We label as "quota men" those male teachers who were only able to enter primary teachers studies because the quota was in place and would not have gotten admitted otherwise. Throughout the paper, we refer to teachers turning 60 as "retirement".

[2] 1 SD in the share of male (quota) teachers corresponds to 6.5 percentage points. The average within-municipality change in the share of male teachers over our study period is 5 percentage points.

ing. We use records from the nationally-organized allocation of education slots after compulsory schooling, for which pupils can put in up to five preferred institution choices. We find that male quota teachers have important effects at this pivotal moment: Pupils exposed to a higher share of male quota teachers are more likely to directly apply to continued education. As pupils' applications are more aligned with attainable options, they are more likely to obtain one of their top two choices. These patterns translate into higher enrollment rates in post-compulsory education at age 16.

A central question that arises from our results is through which channels quota men – relative to marginal female teachers pushed out by the quota – make a difference. First, via a same-gender role model mechanism, male quota teachers could raise specifically boys' aspirations and achievement. However, adding more male role models for boys implies that girls loose female examples to aspire to, potentially making them worse off. Examining results by pupil gender, we can rule out that girls are negatively impacted by the quota policy. Further, we do not find evidence for a role model channel that would purely operate through male teachers setting an example for boys via same-gender identity: Boys' educational attainment is not more affected from exposure to male quota teachers relative to girls', and none of the other main effects differ systematically by pupil gender.

Second, quota men could inspire pupils to pursue different educational fields. Our estimates indicate that pupils move away from more gender-neutral education choices and become more likely to choose a STEM (Science, Technology, Engineering, and Mathematics) field. We also examine whether exposure to more male quota teachers inspires boys to take up education related fields themselves. We find that pupils of either gender are not more likely to have chosen education-related or teaching fields by age 25.

Third, complementarities between male and female teachers (i.e. by specializing according to comparative advantage) could result in better outcomes for all pupils. The Finnish primary school system is characterized by extensive collaboration between teacher colleagues, both in school-wide curricula design and preparation of classes, as well as in actual teaching (Sahlberg, 2021). We probe for complementarities between male and female teachers by estimating separate effects depending on the initial gender composition of the local teacher team. The benefits of adding an additional male teacher are similar in magnitude between places with few male teachers and places where the share of men among colleagues is already high. However, a lack of precision prevents us from fully disentangling whether effects arise from inherent ability of male quota teachers or from complementarities in team production.

We posit that the evidence in our setting is consistent with male quota teachers contributing positive qualities to school environments that are not sufficiently captured by the selection criteria in absence of the quota. We document that the first order effects of the misalignment between these criteria and male quota teachers' positive impacts on the job dwarf any same-gender role model effects. While the quota thus neither closed educational attainment gaps between boy and girl pupils, nor mitigated the gender-segregation of teaching fields in the long term, it succeeded in selecting male teachers that produced better outcomes for pupils.

This study makes two main contributions. First, by examining the output effects of an admissions quota, we expand on recent work that documents marginal admits under affirmative action benefiting similarly from access to selective colleges relative to marginal candidates pushed out (Bleemer, 2021b; Bleemer, 2021a; Black et al., 2020; Otero et al., 2021). Empirical evidence on how quotas impact output-related measures has almost exclusively focused on mandated representation of women in board rooms, documenting negative or neutral effects on firm performance in the short run (Ahern and Dittmar, 2012; Matsa and Miller, 2013; Eckbo et al., 2021; Ferrari et al., 2021). We contribute to these papers by cleanly documenting that a quota – applied at university entry – can have positive effects that go beyond its direct beneficiaries, such that the policy improved output in the relevant sector in the long run. Our results also highlight a broader point: Selection of candidates based on academic scores and interviews, among the most widely used methods to assess applicants, can miss out on important dimensions of talent.

Second, by shedding light on the channels through which male quota teachers matter, we contribute to the literature on role model effects in education. Several studies have provided evidence that being matched with a same-identity teacher can affect academic performance. (Gershenson et al., 2022; Dee, 2007; Antecol et al., 2015; Lim and Meer, 2017; Carrell et al., 2010). Work on targeted role model interventions has also documented positive effects for female minority students in male-dominated fields (Porter and Serra, 2019; Breda et al., 2018; Kofoed et al., 2019). In contrast to reallocating a fixed set of teachers across pupils, we examine whether same-identity role model channels are at play when changing the composition of who becomes a primary school teacher via a quota. This allows us to better understand whether policies that aim to recruit more male teachers are an effective tool to mitigate gendered academic achievement gaps. Further, we can investigate whether exposure to male teachers makes boys more likely to pick an education-related occupation themselves, thus letting us evaluate a quota's general potential to change the gender-segregation of occupations for future generations.

Documenting how trade-offs related to equitable representation targets materialize by assessing their effects on productivity is important – especially so at a time at which affirmative action policies are under scrutiny. While many countries around the world are aiming to further diversify occupation categories (UN, 2019; Long, 2019), there is also significant push back in other settings. Universities in the United States and elsewhere are facing increasing judicial challenges for admission policies that embrace broader measures of academic preparedness (Leman, 2021; Dhume, 2019). Our results suggest that carefully considering the correlates of ability and minority group status in selection processes provides a promising avenue to increase both equitable representation and economic efficiency.

The paper is structured as follows: The next section details the Finnish education and teacher training system. We outline a brief conceptual framework in Section 3. Section 4 explains our data sources and sample, followed by the empirical design in Section 5. In Section 6, we first examine the effects of the quota on teacher gender composition at the municipal level, before turning to a pupil-based panel. We document mechanisms in Section 7 and robustness checks in Section 8; the final section concludes.

2 Context

2.1 Primary school teachers in Finland

Finland has been among the top scoring countries for multiple rounds of international student assessments, leading to considerable international attention paired with efforts to adopt best practices from the Finnish education and teacher training system (Malinen et al., 2012; Niemi et al., 2016). Finland prides itself in having an equitable school system that aims at equalizing opportunities (Sahlberg, 2021).

Due to being one of the most competitive degrees in university admissions, primary school teachers enjoy high social status (Finnish National Agency for Education, 2018). While salaries are on par with OECD average, active teaching hours are comparatively low (Sahlberg, 2021). Primary school teachers are municipal employees who are hired by local schools, and are part of a powerful teacher union that sets both salary schedules, and – for the relevant period in this study – a retirement age of 60 for primary school teachers (Kivinen and Rinne, 1994; Valtiokonttori, 1988). A national curriculum outlines broad learning goals and teachers within and across schools collaborate in designing detailed learning plans under the supervision of municipal education authorities (Sahlberg, 2021; Sahlberg et al., 2019).

In contrast to the United States, primary school teachers may spend several years with one cohort of pupils as their main classroom teacher covering all subjects. However, primary school teachers are also actively embedded in their work environment through extensive collaboration with their colleagues, both in curriculum design, preparing lessons and school wide activities, as well as in active teaching (Sahlberg, 2021).

Pupils in our setting are thus experiencing and interacting regularly with the teacher body of their entire school. Conducting the analysis at the municipal level takes into account any spill-overs that arise from teachers collaborating within and across schools.[3]

2.2 Primary school teacher training and the quota reform

The first teacher training institutes in Finland were founded in the mid-1800s, and offered training separate by gender. In 1881, new education decrees allowed for co-education for children attending municipal primary schools as long as sufficient instruction in handicrafts could be guaranteed, de facto leading to "differentiation between male and female elementary school teachers and a quota system in teacher training" (Sysiharju, 1987). While the number of primary school teachers in the first half of the twentieth century ballooned from 6,800 to 25,000 from the 1920s to the late 1960s, the share of male primary teachers remained stable at 41% (Sysiharju, 1987).

In the context of educational reforms in the 1970s, primary teacher education was transferred to universities and elevated to a master's level degree at the end of the same decade (Niemi et al., 2016). With an acceptance rate of about 10%, primary school teaching has been and still is among the most competitive degrees in the country and applicants often apply multiple years in

[3]The median population size of the 461 municipalities in our sample is 5000 inhabitants. See also section 4.

a row until they are successfully admitted (Tirri, 2014; Uusiautti and Määttä, 2013).

Admissions throughout our study period closely followed the main principles established in those reforms, including that "the Ministry of Education maintained the sex quota system for the training of classroom teachers" (Sysiharju, 1987): In a first step, applicants were ranked in a centralized system according to a score that mainly considered candidates' grades in the matriculation exam (the nationally graded high school exit exam) with a few additional points given for candidates' extra-curricular activities. The highest ranked candidates were invited to an in-person second round (Uusiautti, Määttä, et al., 2013). In this second step of the selection process, candidates' teaching qualities were evaluated independently by a faculty board through an extensive host of exercises, including (among others) a live teaching exercise in front of real pupils, a pedagogical analysis of this practice lesson, and in-depth interviews (Räihä, 2010; Uusiautti, Määttä, et al., 2013). The highest ranked candidates in the second step were admitted to study primary teacher education according to the number of available study slots. Within this process, the Ministry of Education jointly with the education departments ensured that around 40% of candidates invited to the second round were men (Liimatainen, 2002). Documentary evidence on how strongly the universities were constrained in their final admission decisions for the decentralized second round is somewhat inconclusive (Räihä, 2010; Liimatainen, 2002). However, aggregate statistics imply that the general gender guidelines issued by the Ministry resulted in the desired gender mix of primary teachers: About 40% of active primary school teachers in the country were male until the mid-1980s (Sysiharju, 1987).[4]

The quota was abolished for the cohort applying to university in the fall of 1989 (thus graduating from primary school teacher studies in 1994), as it was not in compliance with a broad anti-discrimination law passed by parliament in 1987 (Tasa-Arvovaltuutetu, 1987). With the entry cohort of 1989, the share of men among candidates being invited to the second selection step dropped to 20% (Liimatainen, 2002). Since the quota's lifting, politicians and the general public have repeatedly argued for the quota's reinstatement, motivated by the fact that boys are increasingly lagging behind academically and that a growing number of children raised by single mothers may lack a father figure (Etelä Suomen Sanomat, 1988; Liiten, 2012).

Using aggregate statistics issued by the Ministry of Education, Figure 1 shows the share of men among those applying to primary teacher studies, and among those being invited to the second round of the selection process. While we observe a sharp drop from 40% to 20% for second round invitees 1989, the share of men who apply evolves smoothly around the time of the reform.[5] While final admits to primary teacher studies were not recorded, with register

[4]It is difficult to find statistics on pass rates and scores for the second step of the selection process for this time period. Uusiautti and Määttä (2013) cite a statistic from the University of Lapland in 1978, where about three applicants were invited per available study slot. In light of the quota expiring, a working group of the Ministry of Education recommended universities to invite at least four candidates per available study slot for the second round to ensure enough diversity among selected teachers without the quota (Etelä Suomen Sanomat, 1988). Mankki et al. (2020) examine scores received in the second step of the selection process in more recent years (after the quota), and show that male candidates receive higher scores than women.

[5]We can only assess whether the quota was binding in this indirect way. While the lifting of the quota was widely discussed in policy and media reports at the time, we have found no documentary evidence that either application numbers (see Appendix Figure A1) or the composition of applicants would have drastically changed

data we can characterize changes in the share of men among incoming primary school teachers. Figure 2 plots the share of men against the year of their last attempt at the matriculation exam that qualifies students for university studies.[6] While the measure presented here only includes students who end up working as a primary school teacher, we can still observe a sharp and sudden drop of about 15 percentage points in the share of male teachers among matriculation exam cohorts.[7]

As the quota did not only change the gender composition of incoming teachers but also advantaged academically lower scoring men, Figure 3 plots future teachers' national percentile rank in the matriculation exam for the first attempt of the exam, against the last year in which they ever took this exam. We use the average national percentile score across all subjects for the *first* time that future teachers took the exam in order to get at a measure of inherent ability that is not influenced by repeated test taking. We plot this percentile rank against the date of their *last* exam to most closely approximate the point of entry to university studies.[8] While the quota was in place, men on average scored about 10 percentiles lower. Once the quota was lifted, the average score among male teachers increased a bit, consistent with universities no longer admitting relatively lower scoring male applicants. We will return both to the changes in primary teacher gender composition and academic scores more formally in section 6.1.

Teacher gender in our setting is correlated with a bundle of other characteristics that may matter for teaching. Table 1 presents summary statistics on male and female teachers who are active in the profession before the lifting of the quota (i.e. before 1994 as the year in which the first non-quota cohort graduates from teacher studies), and thereafter. In Panel A, we can observe that male teachers are slightly more likely to come from rural areas and to live in their region and municipality of birth when compared to female teachers. Regarding educational trajectories in Panel B, there is no difference in having obtained a high school degree and being a certified teacher, but male teachers on average are a bit older both when finishing high school and when being awarded their teaching degree. In Panel C, statistics on the matriculation exam show no difference in having passed the exam, but again illustrate that male teachers perform much lower, even when considering the best exam take for repeated attempts. High school students had some flexibility to choose either mathematics or a combination of other natural and social sciences ("Reaali") in the matriculation exam. Male teachers are about 9 percentage points more likely to have taken the mathematics exam compared to female teachers, and 10 percentage points more likely to have chosen advanced level mathematics rather than the basic level exam.[9]

with the lifting of the quota. Note that it is unlikely that the best candidates no longer apply post-quota given that admission rates are very low. Figure 3 shows no unexpected discontinuity in the test scores of those admitted post-quota.

[6]The register data does not contain the year of admission to university. Since students can repeat the matriculation exam if they want to increase their score, the year in which they last took the exam serves as the closest proxy for when they start university studies: Anyone taking the exam in and after 1989 will with certainty have studied under the non-quota application regime.

[7]Notice that the gradual drop before 1989 is consistent with a setting in which students apply multiple years in a row.

[8]See also Appendix Figure A2 for the distribution of percentile ranks.

[9]Each exam field and level of difficulty is graded on a curve within that group.

2.3 Related literature

We contribute to two large branches of literature. First, we contribute to a large literature that has examined questions regarding the impacts of affirmative action policies on representation, quality and potential mismatch of marginal candidates. Studies of affirmative action policies have largely used different policies in the context of university admissions, most of them in the United States. Empirical evidence on quota policies, a subset of affirmative action policies which prescribe a fixed number or share of slots for a particular group, has to date almost exclusively examined two specific settings, both regarding female representation: quotas for board rooms in firms, and quotas in the context of political leadership.

A large body of work has documented that affirmative action policies succeed in raising representation for their intended beneficiaries from underrepresented minority (URM) groups (Bertrand et al., 2010; Yagan, 2016; Bleemer, 2021b; Bleemer, 2021a), but it has been a more contested issue whether lower levels of academic preparedness result in a mismatch of URM candidates to an environment that may be too demanding (Arcidiacono and Lovenheim, 2016). Recent quasi-experimental work on affirmative action at state flagship colleges in the United States suggests that these policies benefit their target group as intended and do not change outcomes for marginal students who are crowded out, rendering such policies both equity and efficiency enhancing on the margin (Bleemer, 2021a; Black et al., 2020; Bleemer, 2021b). In a similar vein, studies on quotas for female politicians have documented that 'mediocre men' are replaced with more highly qualified women in Swedish and Italian politics (Besley et al., 2017; Baltrunaite et al., 2014).[10]

Questions on whether affirmative action policies affect proxies for output have only been examined in the context of quotas. Survey-based evidence from a quota rule for female village heads in India documents that female leaders invest more in public goods favored by female voters, but these findings do not necessarily imply that female quota politicians are more efficient in delivering public goods overall (Chattopadhyay and Duflo, 2004).[11] Evidence on how quotas for board rooms affect output related measures for firms has been inconclusive: The most frequently studied setting is Norway's introduction of a 40% quota for female board members on publicly listed companies in the mid-2000s. Studies examining the quota's effect on various measures of firm performance (Tobin's Q: Ahern and Dittmar, 2012; operating profits: Matsa and Miller, 2013; stock market returns: Eckbo et al., 2021) arrive at contradictory results that depend on the chosen counterfactual (see also Bertrand et al., 2018 for a review). Similarly, the direction

[10] In the context of the Norwegian board quotas, Bertrand et al. (2018) document that female board members hired due to the quota are more qualified relative to the average female board member before the quota took effect, but have lower levels of experience relative to the average male board room member.

[11] Chattopadhyay and Duflo (2004) specifically highlight that it is through the characteristic of being female herself that the leader's preferences are more closely aligned with female constituents, thus moving the status quo to more closely reflect preferences of the median voter. Related studies are Beaman et al. (2012) and Beaman et al. (2009) who expand on the same setting and document that voters' gender role attitudes regarding female leaders change in villages in which the quota rule assigned female chiefs twice in a row. These changes in attitudes drive increased representation of female politicians in the longer term (Beaman et al., 2009) and a reduction in gender gaps for adolescents' aspirations and educational attainment, consistent with a role model channel (Beaman et al., 2012).

of effects for analogous board quotas introduced in other European countries do not indicate a clear pattern.[12] Two recent studies by Peck (2017) and Cortés et al. (2021) document negative effects on performance of a policy that required firms to hire native workers in Saudi Arabia.

In this paper, we can go one step further with respect to previous work on affirmative action and quota policies and cleanly document that preferential access to primary teacher studies does not just increase men's representation, but that their contributions to production in their industry lead to sizeable efficiency gains. We focus on a setting in which the entire composition of a broad and socially relevant occupation category is shifted by a quota rule and measures of output are readily observable in the long term. We further develop a conceptual framework to guide the analysis of how these efficiency gains may materialize despite male candidates' lower average quality in terms of academic achievement upon admission.

Second, we contribute to research that has been interested in examining the effects of teacher characteristics, and specifically teacher gender, on pupil outcomes. A large body of work has documented that measures of teacher value added, rather than certification or test scores (Kane et al., 2008; see Hanushek and Rivkin (2006) for a review), drive variation in pupil outcomes (Chetty et al., 2014; Rivkin et al., 2005). Several studies have documented that exposure to a same-gender or same-race teacher can improve academic performance (Dee, 2004; Dee, 2007; Lim and Meer, 2017, Carrell et al., 2010), and suggest a role model mechanism such that pupils become more motivated when paired with a same-identity teacher (Dee, 2005; Sansone, 2017).[13] An active literature has studied such role model effects also with respect to short and medium-run course enrollment in mathematically oriented fields for women (Carrell et al., 2010; Porter and Serra, 2019; Breda et al., 2018). These studies tend to document effects for specific underrepresented sub-groups, i.e. high achieving women attending a science track. Due to the level of detail and comprehensiveness of the Finnish register data, we can follow individuals throughout a substantial portion of their young adult life, and analyze their specialization choices in the long run. We add to prior studies by being able to observe a quota-induced shift in the gender composition of the entire occupation category of primary school teachers, thus being able to examine role-model effects in the light of quota policies.

3 Conceptual framework

This section develops a conceptual framework assessing the trade-offs between teacher quality and gender representation. In our setting, the admissions office is the decision maker who would like to maximize future teacher ability. However, true teacher ability is unobserved by the

[12] Results from Italy show no effect of a female quota on performance, but a positive reaction of markets to the quota-induced turnover of boards (Ferrari et al., 2021), while Comi et al. (2020) document opposite effects of gender quotas in Belgium and France (negative) versus Spain and Italy (positive).

[13] Antecol et al. (2015) show that random exposure to a female primary school teacher with weak math background lowers girls' (but not boys') math performance, indicating that same-gender identity can also lead to undesired outcomes.

admissions office so that it selects candidates based on scores.[14] We outline how a quota's effect on total candidate quality depends on the interplay between scores as the selection criterion and teacher ability: We first examine a benchmark case in which scores fully reflect teaching ability, such that a quota is costly. We then proceed to examine two cases in which the mapping of scores into ability is imperfect, such that a quota has the potential to be efficiency enhancing: We discuss a case where the mapping of scores is group-specific, and a case in which there exist complementarities in production between teachers of different genders. Finally, we embed same-identity role-model effects and show how a quota has differential impacts by pupil gender. We summarize these theoretical points by deriving testable predictions for the empirical part.

3.1 Set-up

Consider an admissions office that seeks to select a fixed mass of candidates C from a pool of applicants by considering their scores, s. Candidates belong to one of two groups j, with $j \in \{M, F\}$ for Male and Female, and are heterogeneous with respect to their score. Scores are defined on $[\underline{s}, \bar{s}]$, the density of scores $h_j(s)$ is twice continuously differentiable, and we assume full support, $h_j(s) > 0$ on the relevant interval. We assume that the distribution of scores of the M group is first order stochastically dominated by the distribution of F scores to reflect the empirical fact that male applicants tend to have lower scores in our setting:

$$H_F(s) \leq H_M(s)$$

for all s, with strict inequality whenever $H_M > 0$ and $H_F < 1$. The mass of candidates of each group that is admitted above a cutoff score s^* is given by $M = \int_{s^*}^{\bar{s}} h_M(s)ds = 1 - H_M(s^*)$ and $F = \int_{s^*}^{\bar{s}} h_F(s)ds = 1 - H_F(s^*)$.

We further introduce a measure of candidates' teaching ability, a, that we will return to in more detail in iterations below. We define a welfare function W as the total teaching ability of admitted candidates for a given ability threshold, a^*:

$$W(a^*) = \int_{a^*}^{\bar{a}} a\, h_M(a)da + \int_{a^*}^{\bar{a}} a\, h_F(a)da \tag{1}$$

In our setting, the admissions office's aim is to pick the highest ability teachers, but since it can not observe a or is perhaps restricted to only consider s, it has to rely on candidates' scores as a proxy for ability.

Admissions without quota: The admissions office picks a threshold score s_j^* above which all

[14] Without loss of generality, we make a simplification in the model relative to the actual selection process in our setting: We only look at a one-stage selection process based on scores (that can be any combination of academic score and evaluator score) to illustrate the main forces at play.

candidates are admitted subject to a capacity constraint:[15]

$$\max_{s_M, s_F} \int_{s_M}^{\bar{s}} s\, h_M(s) ds + \int_{s_F}^{\bar{s}} s\, h_F(s) ds \tag{2}$$

$$s.t.\ \ M + F = C$$

When maximizing total scores of admits, the optimal cutoff s_j^* is the same for both groups: $s_M^* = s_F^* = s^*$, resulting in the mass of admitted women outnumbering admitted men due to first order stochastic dominance.

Admissions with quota: Suppose we now introduce a quota rule that adds an additional constraint to the admissions office's optimization by requiring that at least mass q of students from group M be admitted. The admissions office then solves the problem in equation 2 with the additional constraint:

$$s.t.\ \ M \geq q \tag{3}$$

When the quota constraint is binding, the admission cut-offs between groups diverge and the admissions office chooses optimal cutoffs that are group-specific:

$$s_M^*(q) = s_F^*(q) - \delta \tag{4}$$

where δ is the Lagrange multiplier of the quota constraint and indicates the shadow price of admitting a male candidate at the margin. The following iterations of the model briefly discuss how total teaching ability evaluated by W changes for different mappings of scores s into teaching ability a when the admissions office picks optimal cut-off scores, relative to admissions under full information.

3.2 Candidate choice when scores fully reflect ability

We start by evaluating a benchmark case: Scores fully reflect teaching ability, so that

$$a = s$$

In this case, requiring the admissions office via a quota to admit more men relative to the unconstrained optimization in equation 2 will result in total teaching ability of admits being lower under a quota: $W(s^*(q)) < W(s^*)$. This illustrates one of the main concerns frequently brought

[15] The admissions office's problem here is similar to Chan and Eyster (2003), who make the theoretical point that forbidding universities whose utility function contains an exogenous preference parameter for diversity from using race as a selection criteria will result in lower quality of admits. This results from the optimal admissions rule under race-blind admissions consisting in randomly selecting applicants above a lower cut-off score, whereas color-sighted admissions select the best scoring candidates within each group (see also Ray and Sethi, 2010). Ellison and Pathak (2021) bring the reasoning of Chan and Eyster (2003) to the data to evaluate the efficiency of a place-based affirmative action rule in two Chicago Public Schools. Instead of assuming a preference parameter for diversity, their model defines students' outcomes as a trade-off between an optimal level of school diversity and academic match. Our set-up does not assume a taste parameter for diversity.

forward against quota rules: Requiring the admissions office to forgo its preferred allocation of slots will lower total candidate quality, as the ability of additional men admitted due to the quota is less than the ability of women who must be rejected to satisfy the quota:

$$\int_{s_M^*(q)}^{s^*} s\, h_M(s)ds < \int_{s^*}^{s_F^*(q)} s\, h_F(s)ds \tag{5}$$

3.3 Group-specific mapping of scores into ability

Consider now a case in which the association between scores and teaching ability is group-specific:

$$a = s + \alpha \mathbb{1}_M$$

with $\alpha > 0$, $\mathbb{1}_M$ an indicator function that denotes membership in group M, and density ρ such that $\rho(s + \alpha\mathbb{1}_M) = h(s)$. For any given teaching ability level a, the score of members of the M group is reduced by a penalty parameter α.[16] In such a world, switching out a marginal female with a marginal male teacher who has the same score increases total teacher ability.

Full information: When evaluating total teaching ability of admits under full information, W takes into account men's true ability. Substituting for a with the above relation, the optimization problem when fully observing teacher ability becomes:

$$\max_{s_M, s_F} \int_{s_M}^{\bar{s}} (s+\alpha)\rho_M(s+\alpha)ds + \int_{s_F}^{\bar{s}} s\rho_F(s)ds \tag{6}$$

$$s.t.\ \ M + F = C$$

The first order conditions under full information (FI) imply that the optimal cutoff scores in this case are such that:

$$s_M^{FI} = s_F^{FI} - \alpha$$

The marginal male admit here has a strictly lower score than the marginal female admit and the optimal allocation of slots fully takes into account that M group members' scores suffer a test score penalty α for any given ability level a.

Admissions Office: In contrast, the admissions office continues to select candidates based on scores alone (equation 2): $s_M^* = s_F^* = s^*$. In this case, it is the lack of differential score thresholds that is costly as the admissions office does not take into account men's score penalty, and $W(s^*) < W(s^{FI})$.

With a quota rule, the admissions office chooses $s_M^*(q) = s_F^*(q) - \delta$. The wedge between marginal male and female admission scores grows with the mass of male candidates required by

[16] Note that richer models deliver a penalty parameter of this form. For example, when scores are a differentially noisy signal of ability for different groups, the conditional expectation of ability given score may take this form (Phelps, 1972; Aigner and Cain, 1977).

the quota, and achieves the optimum under full information when the quota is set such that $\delta = \alpha$. This illustrates that the admissions office deviates further from the optimum under full information both when a quota under- as well as when it over-corrects for differences in scores: Total teaching ability will steadily decline with the mass of men required by the quota rule once $\delta > \alpha$, and will eventually yield an outcome worse than $W(s^*)$.

3.4 Candidate choice with complementarities

Even when scores fully reflect individual teacher ability, the existence of complementarities between M and F teachers can motivate differential treatment by group status. If the gains in total teacher ability from complementarities outweigh the costs in terms of individual scores, switching out marginal female with marginal male teachers will increase overall teacher quality, but with decreasing marginal returns. This could be the case if, for example, pupils are more motivated when exposed to same-gender teachers, or when diverse teams of male and female teachers perform better when designing school curricula.

We return to the assumption in the benchmark case that scores perfectly map into ability, $s = a$. We introduce complementarity in teaching ability with a production function V that exhibits positive cross-derivatives, and treats M and F candidates symmetrically:[17]

$$V = \sqrt{L_M L_F}$$

with $L_M = \int_{s_M}^{\bar{s}} s\, h_M(s) ds$ and $L_F = \int_{s_F}^{\bar{s}} s\, h_F(s) ds$ as total teacher ability for group M and F respectively. Under full information of V, the optimum equates the relative test score thresholds to the relative total ability of admitted candidates:

$$\frac{s_M^{FI}}{s_F^{FI}} = \frac{L_M}{L_F}$$

For a common threshold score $s_M^{FI} = s_F^{FI}$, it has to be that $L_M = L_F$, which is inconsistent with the assumption that $H_F(s)$ first order stochastically dominates $H_M(s)$ with strict inequality. The threshold for M must be lower, so that in the optimal allocation, $s_M^{FI} < s_F^{FI}$.

3.5 Same-gender role model effects

An interesting point to consider within this framework is how a quota would affect welfare separately by pupil gender due to the presence of same-gender role-model effects. To do so, we define total welfare as the sum of welfare for boy and girl pupils, and by adding a same-gender role-model constant r to teaching ability. Consider two groups of pupils with $p \in [b, g]$ where b stands for boy and g for girl pupils. We define teaching ability separately by pupil gender p:

$$a_p = s + r_p \, \mathbb{1}_{p=j}$$

[17] We focus here on homogeneity of degree 1, which implies that double the amount of teachers can teach double the amount of pupils, but any degree of homogeneity larger than zero yields the same conclusions

with r_p a constant role model effect that depends on pupil gender and switches on whenever pupil and teacher gender coincide. In addition, we define W as consisting of total teaching ability for boys and girls. Substituting with the above equation for teaching ability and assuming equal shares of boy and girl pupils, we get:

$$W = \frac{1}{2}W_b + \frac{1}{2}W_g = \int_{s_M}^{\bar{s}} s\, h_M(s)ds + \int_{s_F}^{\bar{s}} s h_F(s)ds + \frac{1}{2}\, r\, M + \frac{1}{2}\, r\, F \tag{7}$$

Full information: Under full information, optimal cut-off scores at university admissions are:

$$s_M^{FI} = s_F^{FI} + \frac{1}{2}(r_g - r_b)$$

The relative magnitudes of r_g and r_b will determine the overall effect of a binding quota for male applicants. Irrespective of the overall effect, the impact of a quota will differ between boy and girl pupils: For girls, W_g declines both because of a decrease in teacher scores s and from loosing r_g for every female teacher being switched out with a male teacher. W_b instead experiences some gains from r_b. The impact of a quota that increases the number of male teachers at the expense of female teachers will thus always be less positive (or more negative) for girl pupils relative to boy pupils.

i) $\mathbf{r_g = r_b}$: This reduces to the case discussed in section 3.2, such that a binding quota for male teachers will be costly in the aggregate.

ii) $\mathbf{r_g < r_b}$: This reduces to the case in section 3.3, such that a binding quota for male teachers can be efficiency enhancing in the aggregate, and achieves the optimal allocation under full information whenever $\delta = \frac{1}{2}(r_g - r_b)$.

iii) $\mathbf{r_g > r_b}$: In such a case, a binding quota will be costly both in terms of s and r.

The same reasoning applies as above when r is only beneficial up to a certain threshold (e.g. 50% of teachers of either gender). However, the relatively more negative effect for girls will be less pronounced compared to the cases discussed above.

3.6 Empirical predictions from conceptual framework

We therefore have several potential descriptions of the relationship between scores, output, and the effect of quotas.

Negative output effect of a quota: If test scores perfectly reflect future teacher ability, quotas will reduce output in the absence of complementarities. Our empirical set-up directly serves as a test of whether the quota was efficieny-enhancing by examining output in terms of pupils' outcomes.

Positive output effect of a quota: If test scores imperfectly reflect teacher ability, so that men of a given test score tend to have higher ability than women, a quota may improve output so long as it is not too stringent. Complementarities may cause greater output from male teachers with lower test scores even if all components of ability are reflected in scores, but will do so with

decreasing marginal returns.

Presence of same-gender role model effects: Irrespective of the impact of a quota in the aggregate, girl pupils will be more negatively/less positively affected from a male teacher quota relative to boys in the presence of same-gender role model effects. This is driven by boys gaining additional same-gender role-models when increasing the number of male teachers.

4 Data and sample

Our main data source is register data maintained by Statistics Finland which span the years 1988 - 2018, and contain detailed yearly information on all residents of Finland. We compile two main data sets that correspond to the respective parts of the analysis. For primary school teachers, we construct a panel of active primary school teachers from 1990 - 2000 for all individuals whose occupation at any point in time between 1990 - 2005 is classified as a primary school teacher by Statistics Finland's occupation classification system in the employment register. Since occupation categories are first available in 1990 and are not reported in every year, we use a combination of workplace, industry, salary, degree and career information to infer active teacher status in any given year (FOLK employment, basic, and degree). We can match teachers' matriculation exams scores and dates for all cohorts born after 1952 (YTL moduuli), but we unfortunately do not observe university enrollment or study progress for teachers as these registers were not maintained at the time.

For the pupils, we observe the universe of children living in Finland who turn seven years old (and therefore start school in that calendar year) between 1988-2000, reaching age 25 until 2018 as the last year of our data. We assign children to a municipality (and teacher gender composition during grades 1-6) based on their place of residence in the year in which they start school. We further match pupils to their parents which allows us to observe a rich host of variables related to families' socio-demographic characteristics at age seven (FOLK family). We use a variety of registers, available on a yearly basis after age 16, to measure pupils' outcomes.

Early adulthood (age 25): We measure pupils' labor force status as recorded in the last week of the calendar year in which they turn 25 years old (FOLK employment). Regarding educational outcomes, we observe pupils' highest degree achieved, and we construct their field of education using information on their latest degree (FOLK degree). We also examine fertility patterns up to early adulthood with yearly data from the population register (FOLK basic).

Intermediate outcomes: We merge pupils to registers on post-compulsory education applications that typically occur in the last year of middle school, i.e. the year in which pupils turn 16 (EDU-THYR). This allows us to observe when pupils apply, their preference ranking of up to five degree choices, as well as which option they are allocated in the centralized admissions process. For the school starting cohorts from 1990 onwards, we can observe final enrollment in post-compulsory education (EDU-OPISK).

We measure all of the treatment variables at the municipal level as data to link pupils and teachers to classrooms or schools does not exist. As our main goal is to estimate the impact of

a quota per se, and not the impact of having a teacher of a particular gender, aggregating the data to a level higher than the classroom is consistent with both the research question and a setting in which collegial collaboration is widely practiced. The median population size among the 461 municipalities in our sample is 5000 inhabitants in 1990, with a median of 73 children by cohort in primary school. Appendix Figure A21 shows the CDF of the number of primary and middle schools combined across municipalities in the year 2005, as earlier or more detailed data was unobtainable. About 20% of municipalities have fewer than 5 primary and middle schools combined.

To comply with data disclosure regulations by Statistics Finland, we exclude municipalities that contain fewer than three teacher observations in a given year from our analysis. Once we move to a pupil level panel, we restrict the sample to municipality*year cells for which we are able to observe at least six teacher observations (i.e. the teaching staff for grades 1-6 of one school) to deal with noise arising from overlapping cohorts.

5 Empirical strategy

We want to study whether and how output is affected when the gender composition of teachers changes via a quota. Lifting the quota at the point of university admissions will impact the gender composition among active primary school teachers only gradually over time, but the changes in the flow of incoming teachers are sharp and immediate. In the estimation strategy, we therefore use shocks to the demand for new teachers in municipalities that arise from idiosynchratic local teacher retirement. Since teacher retirement could respond endogenously to the policy reform itself, we only use variation from teachers reaching the union mandated retirement age of 60. We use the term "retirement" exclusively to refer to teachers turning 60 throughout the paper.

Ideally, we would like to observe yearly pupil level outcomes and classroom specific links of pupils and teachers in order to differentiate between direct and indirect exposure effects, but such data does not exist. An ideal experiment, taking the aggregation level of our data as given, would consist in randomly removing some teachers from municipalities, and deciding with a coin flip whether replacement teachers are drawn either from a pool of male quota teachers, or from a pool of marginal female teachers.[18]

Our DiD-IV estimation strategy closely approximates this experiment, taking into account that changes in quota teachers materialize via the inflow of rookie teachers and that we cannot observe quota male and marginal female teachers in the data. Municipalities in our setting are randomly assigned quota men – and thus more male teachers in general – via the *timing* of their open positions arising from teacher retirement. We thus estimate a local average treatment effect for complier municipalities: Variation stems from those municipalities that via the timing of retirements are induced to hire more vs less quota men among their teachers. While this notion

[18] We label as "male quota teachers" those male teachers who were only able to enter primary teachers studies because the quota was in place and would not have gotten admitted otherwise. We refer to "marginal female teachers" as those female teachers who were able to be admitted to primary teacher studies once the quota was abolished and would not have gotten in if the quota were still in place.

matters for assessing the external validity of results, we think that our estimates get us close to the policy relevant parameter of interest: What happens when we change the composition of an occupation via a quota that operates through the inflow of incoming candidates?

Figure 4 outlines the timeline of our reform: The primary school teacher students who enter university before 1989 are selected via the quota rule. As the official time to complete the degree is five years, the quota and non-quota cohorts of new teachers will leave university around the year 1994 and will be hired by municipalities for their local schools. If municipalities have open positions during the time when quota cohorts enter the teacher market, they will be more likely to hire candidates from a pool with relatively more male rookie teachers compared to municipalities that have to fill open positions once new teacher cohorts selected without the quota are entering the teacher market.

5.1 Municipal level: Changes in teacher composition

We first document that local retirement interacted with the timing of abolishing the quota changes the local gender composition of teachers. Consider the following fixed effects specification:

$$share\ male_{mt} = \pi_0 + \pi_1\ total\ share\ 60_{mt} + \pi_2\ \mathbb{1}_{t=post}\ total\ share\ 60_{mt} + X_{mt}\delta + \eta_{rt} + \gamma_{mp} + \zeta_{mt} \quad (8)$$

with $share\ male_{mt}$ the share of male teachers in municipality m in a given year t, and $total\ share\ 60_{mt}$ the cumulative teacher retirements in a municipality up to that point in time.[19] The indicator function $\mathbb{1}_{t=post}$ switches on once non-quota teacher cohorts graduate and start entering the teacher market in 1994. The coefficient of interest, π_2, measures how additional retirements in the post-quota period affect the share of local male teachers *relative* to when the quota was still in place. We add region-by-year fixed effects η_{rt} to control for time-varying shocks whose impacts may vary regionally, with a total of 19 regions comprising on average 24 municipalities. In addition, we can also add controls for time-varying municipal characteristics X_{mt}. The municipality-by-period fixed effects γ_{mp} 'reset' the measure of total retirements to zero once the post period starts to separately estimate how retirements affect the local share of male teachers in the post period.[20]

[19] The fixed effects specification of equation 8 uses the stock of the dependent variable (the share of male teachers) and the independent variable (the cumulative share retiring teachers over time). The corresponding first difference equation uses flows on both sides of the equation by regressing the year-on-year changes in the share of male teachers within municipality on the share retiring teachers in each year, dropping the municipal fixed effects:

$$\Delta share\ male_{mt} = \pi_0 + \pi_1\ share\ 60_{mt} + \pi_2\ \mathbb{1}_{t=post}\ share\ 60_{mt} + X_{mt}\delta + \eta_{rt} + \zeta_{mt} \quad (9)$$

We report first stage results for both equations, and use equation 9 when thinking in flows is more intuitive for some robustness checks on hiring patterns.

[20] The reset is necessary so as to properly net out any effect of the quota-period retirements from the post-quota estimate. The effect of retirements on the gender composition in the post should be independent of how much retirement the municipality faced in the quota period.

5.2 Pupil level: Does the quota shift in teacher gender affect outcomes?

Structural equation: Our main equation of interest is the following structural equation:

$$y_{im,t+x} = \beta_0 + \beta_1 \overline{share\ male}_{mt} + \beta_2 \overline{total\ share\ 60}_{mt} + X_i\delta + \gamma_m + \eta_{rt} + u_{imt} \tag{10}$$

with $y_{im,t+x}$ the outcome of interest at time $t+x$ for pupil i who at age seven lived in municipality m, and X_i individual level controls for socio-economic status, also measured at age seven.[21] We add municipal fixed effects γ_m, as well as region-by-cohort fixed effects, η_{rt}. We are interested in how increasing the average share of male teachers via the quota affects pupils' outcomes, with $\overline{share\ male}_{mt}$ the average of the share of male teachers across the years we observe pupils in primary school.[22]

Our empirical strategy isolates variation in the share of male quota teachers from gender changes in the inflow of recently graduated teachers that are caused by retirements. Rookie teachers may differ from older teachers along various dimensions: they have less experience, but they might also be differentially motivated to teach. We control for the overall potential share of rookie teachers a pupil is exposed to via retirements by controlling for the average aggregate share of teacher retirements during a pupils' time in primary school, $\overline{total\ share\ 60}_{mt}$. This measure is the average across all cumulative retirements a pupil experiences from grade 1-6, and we discuss it in more detail below. Note that it is possible that schools' hiring decisions, and thus the impact of being exposed to retirements, may change due to the quota. As such, our estimates measure the total effect of the policy that could include differential responses to retirement shocks. We elaborate on this in more detail in the robustness section 8, and do not find evidence that schools changed their practices over time.

First stage: We instrument for $\overline{share\ male}_{mt}$ with the following first stage equation on the pupil level that closely mimics the municipal level first stage in equation 8. Since every time period t corresponds to a particular cohort starting school at time t, we will refer to t as a cohort identifier in the following:

$$\overline{share\ male}_{mt} = \pi_0 + \pi_1 \overline{total\ share\ 60}_{mt} + \pi_2 \mathbb{1}_{t=post} \overline{total\ share\ 60}_{mt} + X_i\delta + \gamma_m + \eta_{rt} + \epsilon_{imt} \tag{11}$$

Variation in treatment intensity arises from how much teacher retirement different cohorts of pupils across different municipalities experience in the post-quota relative to the quota period. The coefficient of interest, π_2, measures how the share of male teachers a pupil experiences is affected by retirements in the post-quota relative to the quota period. By measuring the differential impact of retirements, we compare the causal effect of being exposed to new teachers against the causal effect of being exposed to new teachers with a changed gender composition due

[21] The controls we include are pupil gender, language (Swedish, Finnish, other), foreign origin, single parent household, and highest level of education in the household (Compulsory, Secondary, Tertiary, n/a).

[22] Our pupil panels spans 13 cohorts that are starting school in the years 1988-2000, and thus experience teachers who we can observe from 1990 - 2000. For some cohorts of pupils, we observe the teacher composition for each year that pupils are in school, while for others, we only know it for their starting or ending years. Appendix Figure A20 depicts the cohorts over time observed in our data.

to the lifting of the quota. In the structural equation, β_1 then measures the causal effect of being exposed to relatively more male teachers via incoming quota men. This relative comparison addresses exclusion restriction concerns that retirement triggered increases in rookie teachers matter for pupil outcomes.

We measure pupils exposure to retirements during their time in primary school, $\overline{total\ share\ 60}_{mt}$, by taking the average over the cumulative retirements a pupil is exposed to during their six grade levels g in primary school:

$$\overline{total\ share\ 60}_{mt} = \frac{1}{6}\sum_{g=1}^{6} R_{mtg} \tag{12}$$

with $R_g = share\ 60_g + R_{g-1}$ and $R_1 = share\ 60_{-2} + share\ 60_{-1} + share\ 60_1$
For example, the retirement measure for grade 6 (R_6) adds retirements that occur just before a pupil enters grade 6 ($share\ 60_6$) to all retirements the pupil has experienced up to this point: $R_6 = share\ 60_6 + R_5$. R_1 considers all retirements up to two years before a pupil starts school. We construct $\overline{total\ share\ 60}_{mt}$ in this way to reflect the fact that retirements that happen later in the pupils' school career will have an impact on the teacher composition for relatively fewer years compared to retirements when pupils start school: Retirements that occur before a pupil enters grade 1 have the potential to change the gender composition, and thus the average share of male teachers, for all grades a pupil spends in primary school. In contrast, any retirements occurring just before a pupil enters grade 6 will affect the teacher composition only in their last year in school. In the empirical analysis, we report grade level results for the first stage that directly motivate the construction of this measure.

5.3 Discussion of identifying assumptions

We revisit explicit and implicit identifying assumptions of our setting in more depth. To start with, our identification strategy needs to satisfy the two main IV assumptions. Relevance requires that teacher retirements in the post-quota period decisively impact the local share of male teachers, which we can assess directly in the first stage regressions. The exclusion restriction, briefly touched on in the above, warrants more discussion: We require that teacher retirements affect pupils' outcomes only via changes in the share of male teachers, and thus changes in male quota teachers. However, retirements themselves, by triggering teacher turnover, may have a direct effect on pupils. We tackle this by measuring relative changes in outcomes between cohorts that experience similar exposure to retirements, but with different timing. The underlying assumptions here are twofold: First, we need to assume that there are no other policy changes that happen simultaneously with the quota that have effects on students *via the channel of retirements*. To the best of our knowledge, there are no such policies. Secondly, we assume that exiting patterns and hiring practices to replace retiring teachers do not differentially change as

a response to the quota.[23] We test for such patterns in Section 8 and do not find evidence for differential changes in the post-quota period.

Implicit in our empirical design is the further assumption that the local timing of retirements is idiosyncratic, and therefore uncorrelated with any other shocks that could affect pupil outcomes. We address such concerns by only using variation arising from teachers turning 60 (instead of actual exits), by controlling for a rich host of pupils' socio-economic characteristics at age 7, and by including region-by-cohort fixed effects. As such, we are only comparing cohorts in municipalities within the same region and year, with the notion that relevant economic shocks (in the past and currently) will similarly affect neighboring places.

Finally, while our regressions are measuring the effect of having more male quota teachers, we see teacher gender not just as a biological distinction, but as something that proxies for a bundle of characteristics that may differentiate quota male and marginal female teachers.

6 Main results

6.1 Municipal level: Effects on teacher gender composition

We start by documenting the effects on teacher gender composition at the municipal level after the quota was lifted. We first examine teacher exit patterns. Figure 5 plots the exit probability by age for all primary school teachers in our sample. We report the probability of a primary teacher not teaching at a given age, conditional on having been a teacher in the previous year. There is a large spike in exits exactly at the union mandated retirement age of 60. In our estimation, we are only using variation from teacher exits that is due to teachers turning 60 years old. [24]

To illustrate the intuition of the first stage using the raw data, Figure 6 displays the relationship between teacher retirement in a municipality (on the horizontal axis) and changes in the share of male teachers by separately plotting the period in which quota cohorts enter the teacher market (1991-93) and a period of similar length in the post-quota period (1994-96). We can see that teacher retirement has a small positive effect on the local share of male teachers in the quota years. In the post-quota period, higher shares of teachers retiring are associated with substantial local drops in the share of male teachers.[25]

Figure 7 formalizes this intuition by running the first stage equation 8 as an event study, estimating separate coefficients year-by-year, relative to 1993 as the baseline year. Teacher

[23] This includes the monotonicity assumption that rules out defiers in a LATE framework. In our case, these would be municipalities that would not want to hire male teachers while the quota is in place when facing retirements, but start hiring differentially more male teachers for retiring teachers in the post period.

[24] Appendix C shows municipal level statistics on teachers turning 60. Around 45% of municipalities in the sample have a retirement in any given year. We also examine teachers' likelihood of changing jobs across municipalities in Appendix Figure A6. Less than 1% of teachers in the age bracket above 55 are changing the location of where they teach across all years of our panel.

[25] Note that since our teacher panel spans 1990-2000, the first time we can calculate the share of teachers turning 60 that is relevant for re-hiring for the upcoming academic year is for 1991 (i.e. the 1991/92 academic school year)

retirements in the years in which the quota was still in place do not differentially have an effect on the local share of male teachers relative to the year 1993, while retirements in the post period lead to a sizeable drop of about 20 percentage points. Table 2 summarizes this result for both the first difference and fixed effects specifications, by bundling years into a quota and post-quota period. Results are quantitatively similar across specifications. While retirements in the pre-period have a small positive effect on the local share of male teachers, the coefficient of interest on retirements in the post-quota period consistently reports large drops. We assess potential negative weights arising from two-way fixed effects estimation in our setting in section 8 following De Chaisemartin and d'Haultfoeuille (2020).

The magnitude of reported coefficients corresponds to measuring what would happen if all teachers in a municipality were to retire in the post-quota period: In this scenario, the local share of male teachers would drop by about 17-22 percentage points. These magnitudes match the drop in incoming male teachers reported by the literature and observed in teacher graduates in Figure 2. We can re-scale this coefficient to reflect a more realistic retirement pattern: If 10% of local teachers reach age 60 in the post-quota period, this translates into a 2 percentage point drop in the share of male teachers, which corresponds to a 5.5% decrease over the mean in the baseline period.

6.2 Municipal level: Effects on teachers' academic ability

While the quota targeted the gender composition of incoming primary school teachers, it simultaneously affected overall academic ability among teachers by giving preferential access to men with lower academic scores on average. While we only observe matriculation exam scores for teachers born after 1952, we can report a first stage estimating the effect of teacher retirement on average academic scores of teachers at the municipal level using these cohorts.[26] We restrict the sample to those municipalities for which we observe at least one teacher with a score in the baseline period. In Table 3, we report the results across different fields of the matriculation exam, using teachers' score in their first attempt at the exam. Albeit noisily estimated, the coefficient for average scores in column 1 implies that retirements in the post period lead to an increase of about 1.25 percentile scores in the local teacher body, relative to the quota period. This magnitude is consistent with replacing approximately 20% of teachers with an on average 7-8 percentile point higher test score in the post period (see Figure 3).[27] Coefficients are of similar magnitudes and precision when looking separately at different fields of the matriculation exam in columns 2 - 4.

Insofar as one might think that academic test scores translate into actual teacher quality or ability, there is an indication for small increases in average local test scores. These are noisily estimated as we do not observe score data for the entire sample of teachers, and accompany

[26] We observe scores for roughly 59% of the total teacher sample. For all specifications in which we need to restrict the sample due to data availability, we also run the first stage regression to ensure comparability. Those coefficients are reported in Appendix Table A1.

[27] The average decrease in test scores estimated for the quota period relative to the stock of teachers are also present in the raw data and represent a general downward trend in teacher test scores (Izadi, 2021).

sizeable impacts on local teacher gender composition in the first stage. We next turn to examine how these changes affect pupils.

6.3 Pupils: Labor force and educational attachment at age 25

We next turn to our panel of pupils, spanning the cohorts that enter primary school between the years 1988 to 2000. We start by documenting the first stage relationship: Are children who experience more teacher retirement post-quota exposed to fewer male quota teachers? Our outcome here is the average share of male teachers across all of the six years a pupil spends in primary school.

Figure 8a shows the first stage results if we regress the average share of male teachers on the share of retirements pupils experience just before they start each grade level, starting up to two years before they enter school and until grade six.[28] Figure 8a depicts coefficients separately for the quota period (grey) and the post-quota period (green), while Figure 8b shows the effect of retirements in the post-quota period *relative* to the quota period. Teacher retirements in the early years of students' primary school time have a large and significant impact on the average share of male teachers pupils experience during their time in primary school. At higher grade levels, this effect gradually peters out. This pattern is as expected as it shows that retirements in early grades, which affect the teacher composition during the entire six years a pupil spends in primary school, matter more for explaining the exposure measure which averages the share of male teachers a pupil faces across their entire time in primary school. Similarly, retirements that happen just before a pupil enters grade six will only impact the share of male teachers for one year, and therefore contribute less to moving the average share of male teachers over all six years. This pattern, as explained in section 5.2, informs our construction of the instrument when bundling a pupil's exposure measure across all grades. We define a pupils' average total exposure to retirements as the cumulative share of teachers retiring in each grade level, which gives more weight to retirements that have the potential to change the teacher composition for a longer time.

In Table 4, columns 1-3 show results for the pupil level first stage. Due to the cumulative nature of the explanatory variable, we can interpret this coefficient as 'how much does the average share of male teachers change if all teachers were to retire just before a pupil starts school'. The magnitudes are therefore similar to the municipal level regressions: Pupils facing 10% of teachers retiring just before they start school are exposed to about 1.8 percentage points fewer male teachers.

Turning to outcomes, we examine pupils' labor market attachment at age 25 as reported to Statistics Finland in the last week of the calendar year. As many youths are still studying at this age, but are classified as employed due to part time work, we combine the categories of being a student and being employed into one measure that reflects not sitting idle. For this age

[28] Appendix Figure A20 gives a detailed overview over which cohorts are exposed to quota years in which grade levels.

group, this metric is considered relevant to measure the propensity to successfully integrate into the labor market (Eurostat, 2021; OECD, 2021). Columns 4-6 in Table 4 report reduced form, and columns 7-9 IV results: Being exposed to more male quota teachers during primary school results in higher likelihood of being either employed or a student at age 25.

The coefficients report the effect size associated with an increase of male quota teachers from zero to all of the teaching staff being male quota teachers. To scale effect sizes to match a more realistic pattern, we can consider the impact of a 1 SD increase in the share of male (quota) teachers, which is around 0.065. For a 1 SD increase in the share of male (quota) teachers, pupils have a 0.03 percentage points increase in likelihood of working or studying, which corresponds to a 4% increase over the mean. Translated into standardized effect sizes (see the bottom row of Table 5), exposure to 1 SD higher share of male (quota) teachers during primary school leads to a .09 SD increased attachment to the labor/education market.[29]

Figure 9a and the corresponding Table 5 report effects for our preferred specification (column 9 of Table 4) for the remaining, mutually exclusive labor market status categories. While we observe no effect on unemployment, pupils are somewhat less likely to be on a disability pension, and significantly less likely to be out of the labor force for reasons other than disability. We report reduced form estimates for all main results in Appendix section E.

Figure 9b and Appendix Table A7 show results by gender. Instead of splitting the sample, we run our main specification (Equation 10) and include separate treatment effects for boys and girls while estimating controls and fixed effects jointly. Results are qualitatively similar to splitting the sample, but less noisily estimated.[30] We further discuss and relate results by pupil gender to the conceptual framework in section 7.2.

Next, we turn to examine educational attainment at age 25. After compulsory education, the Finnish education system has two tiers: vocational and academic. Standard three year vocational degrees offer training in occupation-specific skills. In addition to working towards the completion of a basic vocational degree, pupils may take academic high school coursework that qualifies them to study a broader range of subjects at higher education institutions and adds an extra year to their study time. Alternatively, or in addition, pupils can also take further specialization training that expands and deepens occupation-specific skills.[31] While students from the vocational track may qualify for specific fields of tertiary education at university, the typical study path for the tertiary level is at polytechnics. The academic path, on the other hand, leads from a three year high school degree to a Bachelor's degree (3 years) and a Master's degree (2 years) at university.

[29] We can also ask how many pupils in a school this corresponds to. An increase in the share of male teachers of 0.065 corresponds roughly to switching out 1 in 15 teachers from marginal female to quota male at a local school. As the average class size is 20 pupils, this place would have a total of 300 pupils, and therefore about 9 pupils switch their labor market status.

[30] Estimating heterogeneity by pupil gender requires taking a stance on how to think about common shocks that are absorbed by the municipality and cohort*region fixed effects. When estimating these fixed effects jointly, the underlying assumption is that we expect time-varying economic shocks to affect the choices of boys and girls to a similar extent. We also report split sample results for the main outcomes in Appendix G.

[31] An example for a basic vocational degree is training to work in the vehicles sector which covers subjects from car sales to vehicle mechanics, while additional qualifications allow pupils to specialize e.g. in specific areas of vehicle repair.

Appendix Figure A18 shows the organization of the Finnish education system in detail.

Figure 10a and Table 6 present results for educational attainment by examining the highest degree achieved at age 25 using mutually exclusive education categories. We can see a shift towards higher attainment both in vocationally oriented as well as in academic education paths. As such, we observe a shift away from remaining with compulsory education or a standard three year vocational degree only, towards a "vocational plus degree", defined as vocational degree holders with additional specialist or high school qualifications. A 1 SD increase in the share of male (quota) teachers makes pupils .09 SD more likely to shift towards such a higher skilled degree. Turning to academically oriented degrees, we similarly observe a shift away from high school degrees towards having completed a university bachelor level degree. Results by pupil gender are displayed in Figure 10b and Appendix Table A8.

We can also look at realized fertility up to age 26. In Finland, there is low prevalence of teenage pregnancies and the average age at first birth increased from 27.2 in 1995 to 29 in 2016 and is close to the OECD average (OECD, 2019). Consistent with our finding that pupils invest more in education and have a higher attachment to the labor force when exposed to more male quota teachers, we can document in Appendix D that female pupils are less likely to have given birth by age 26, which is indicative of delaying fertility.[32]

7 Mechanisms

Where do these effects at age 25 stem from, and how would male quota teachers make a difference? This part first explores in more detail the step-by-step educational decisions that lead to the observed differences when pupils are young adults. We then examine how our empirical results tie back into the predictions of the conceptual framework: First, we discuss whether any of the main effects are driven by boy pupils benefiting more from male quota teachers due to the presence of same-identity role model effects. We then turn to examine if effects derive from male teachers inspiring pupils to pursue different educational fields. Lastly, we try to differentiate between a mechanism where either male quota teachers make teacher teams more productive via complementarities, or where male quota teachers are of overall higher teaching ability than the marginal female teachers they replace.

7.1 Intermediate outcomes: Applications to post-compulsory education

In order to better understand where the long run effects measured at age 25 originate, we next examine application choices to higher education options that take place after compulsory schooling at age 16.[33] After primary school (grades 1-6) and middle school (grades 7-9), pupils in Finland have the option to apply to upper secondary education, which typically takes three

[32] For male pupils there is a small increase in the likelihood of having a first child by age 26, but it is statistically not significant and economically small.

[33] Virtually everyone (99.7% of a cohort) successfully graduate from compulsory education (Virtanen, 2016). See Appendix Figure A18 for more details on the Finnish education system

years to complete, is provided free of charge, and is divided into a vocational and academic track. In grade 9, the final year of middle school, pupils apply for their desired institution, and in the case of the vocational track also their desired field. While further education is not mandatory after age 16, application rates for upper secondary degrees are very high with around 90% of a cohort applying in early spring of their final year in middle school. Raising completion rates of upper secondary education is a policy priority as a post-compulsory degree is deemed crucial for labor force attachment: Finns with only basic education are four times more likely to be out of the labor force, and have significantly lower employment rates in adulthood (Virtanen, 2016; Niemi et al., 2016).[34]

In the centrally organized application process, each pupil can submit up to five choices for institution (and field), and a student proposed ranked choice algorithm allocates available study slots.[35] Institutions rank applicants based on grades and other qualifications such as extracurriculars. As applications take place before pupils obtain their final grades that are used to allocate slots, and with the popularity of institutions and fields varying over the years, students face uncertainty over whether they are able to obtain a study slot. The number of available slots per degree is centrally regulated and about 4% of a cohort end up without a study slot in the fall after finishing middle school.

Figure 11a and Table 8 report results on pupils' application timing and choices (Table 7 reports the first stage, reduced form and IV for the main outcome for this section). Having more male quota teachers makes pupils more likely to apply directly in their final year of middle school at age 16, and less likely to postpone applying to up to five years later.[36] We see no significant effect on never applying to upper secondary education. When considering the allocation of slots, we further observe that pupils are more likely to get one of their top two choices, while the effect of not getting any slot at all is muted. Consistent with Virtanen (2016), we find that these patterns translate into higher enrollment rates in upper secondary education in general, and significantly so in the year in which students turn 16. Figure 11b and Appendix Table A9 report heterogeneity by pupil gender.

Why are pupils who are exposed to more male quota teachers more successful in obtaining their preferred choice? We can check whether pupils apply more cautiously, with their main choice between aiming for an academic high school degree or a vocational training. We report effects in this part directly by pupil gender, as for these outcomes results differ significantly and overall effects mask more intricate patterns. Appendix Table A10 in Appendix F reports results. Male pupils are more likely to include any vocational training option among their choices (column

[34]Prior research with Finnish data has shown that the choices and slot allocations in upper secondary education can be pivotal: With an RDD design, Virtanen (2016) shows that failing to obtain a preferred choice or a study slot at all results in a lower probability of graduation. Virtanen (2016) also provides an excellent in-depth description of the allocation process of slots for upper secondary schooling.

[35]For an infinite number of choices, the algorithm would be strategy proof. Since students can only submit five choices, some may choose to enter a 'safe' option to make sure they get a study spot.

[36]With a simple back-of-the-envelope calculation, the increase in the propensity to apply can explain close to a quarter of the labor force attachment effect in section 6.3 (the raw difference in labor force attachment for pupils who directly apply against those who do not is 25.4 percentage points).

2), while refraining from applying exclusively to academic high schools (column 3). For the girls, while not statistically significant, the effect goes in the opposite direction. Overall, boys seem to become somewhat more cautious in their applications, and girls more confident. When examining for which track options pupils obtain a slot in columns 4-6, we see that the margin for boys shifts from not obtaining a slot at all (column 4) towards getting a vocational spot (column 5), while girls become more likely to obtain an academic spot (column 6) rather than a vocational one. Taken together, these results imply that having more male quota teachers makes pupils apply more in line with attainable options: Boys adjust their aspirations downwards, which prevents them from ending up without a slot at all, and girls correctly have high aspirations as they are more likely to get into academic high schools.

7.2 Role model effects

While the main effects clearly demonstrate that the overall impact of the quota was positive, boys should benefit more from having more male teachers relative to girls in the presence of same-gender role model effects (see section 3.5). This further raises the question whether the overall impact of the policy could mask that boys benefited while girls were made worse off.

As displayed in the figures and tables of our main results at age 16 and 25 by pupil gender, girls' outcomes are not negatively impacted from exposure to male quota teachers. We then test whether boys benefited more from male quota teachers: For educational outcomes at age 16 (Figure 11b), we cannot reject the null hypothesis of the coefficients being the same for boys and girls for any outcome at the 5% level, with the exception of remaining without a study slot (p-value of 0.017). While some coefficients differ significantly by pupil gender for highest degree achieved at age 25 (Figure 10b), these are the ones where boys are not benefiting as much as girls.[37] There are significant differences by pupil gender for our main labor market outcomes at age 25, with boys having better outcomes than girls. However, this pattern is quite sensitive to the choice of whether to estimate fixed effects jointly or separately by pupil gender. As shown in Appendix G, this gendered pattern reverses when estimating results in a split sample, and we cannot reject that coefficients are the same for boys and girls for those specifications.

Rather than providing a same-gender role model for boys, male teachers could also substitute for male role models at home for children growing up in single parent households (about 13% of the sample), of which most are headed by single mothers. With the caveat that heterogeneity along this dimension is not randomly assigned and may be correlated with other characteristics, in Appendix H we display effects by whether pupils live in a single parent household when starting primary school. While effect sizes are the same for outcomes at age 16, pupils growing up in single parent households have somewhat stronger benefits from exposure to male quota teachers in the longer run outcomes at age 25.

Taken together, we do not detect main effects that differ systematically by pupil gender. A

[37] The results that are significantly different at the 5% level with girls better off are: compulsory education, and having a tertiary vocational, BA and MA degree.

same-gender role model channel that would make boys better off is thus not driving the positive impacts of the quota in the aggregate.

7.3 Education fields

We next turn to study whether exposure to more male quota teachers inspires pupils to pursue different education fields. The previous section highlighted that the main effects do not differ by pupil gender. However, a same-gender role model effect could also consist in male teachers setting an important example of men working in an occupation that is female dominated. As such, they may inspire primarily boy pupils to pursue a teaching-related field. Advocates of quotas often argue that temporary quota measures could be enough to inspire the next generation to pick less gender-stereotypical occupations.

On the other hand – and separate from a classical same-gender role model effect – male teachers could motivate pupils to pursue different education fields. This could be either via generally improving pupils' achievements or via male teachers' skills and motivation for particular subjects. As we have seen in section 2.2, male teachers are on average more likely to have chosen advanced math as one of their matriculation exam fields, and may thus be more skilled or motivated to teach mathematically oriented topics.

In order to investigate these hypotheses, we measure pupils' choice of education field at age 25. We classify their career choices via their education field rather than their occupation because many youths at this age are still studying. For each pupil in our sample, we pick the field of the highest degree acquired if they are no longer a student. For anyone who is still studying, we take the field of their current degree. We define fields as primarily female or male dominated based on the generation prior to our sample, i.e. the 13 cohorts who are seven years old during the years 1975-87. If either gender constitutes more than 40% within a field and degree level cell, we define the field as male or female leaning, and gender neutral otherwise.[38] This results in 30% of pupils being in "Male" fields, 43% in gender-neutral, and 27% in "Female" fields. We also report results on STEM and STEM-M (STEM plus Medical) fields as well as teaching-related fields in general and primary school teacher in particular.[39]

Figure 12a and Table 9 report results on the choice of education field. The first three coefficients report results for primarily male, gender neutral and primarily female fields. We can observe a shift away from gender neutral fields towards both more male- and female-dominated fields, but these effects are muted. Turning to STEM and STEM-M, we observe that pupils are more likely to take up such fields when exposed to more male quota teachers, with effect sizes

[38] I.e. we define share female based separately for a vocational degree in business vs. an academic degree in business. For the group that has never finished a degree beyond compulsory education and is currently not a student (9.8% of the sample), we assign the gender share of compulsory education, which is categorized as a gender-neutral field based on the previous generation.

[39] We define both academic and vocational degrees as STEM if the three-digit classification of Statistics Finland is one of the following fields: Agriculture (incl. Forestry and Fishery), Biology, Engineering, Environment, ICT, Mathematics and Statistics, Physical Sciences, Veterinary, and the 4-digit category related to Materials (glass, paper, plastic and wood). STEM-M in addition includes the 3-digit field Health.

corresponding to a 0.08 and 0.09 SD increase for a 1 SD increase in the share of male quota teachers, respectively.

Figure 12b and Appendix Tables A11 and A12 show results separately by pupil gender.[40] For both boys and girls, we can observe a shift away from gender neutral fields towards both more male- and female-dominated fields, but only the coefficient of boys moving away from gender neutral fields is significant at a conventional level. In column 4 and 5, we observe coefficients that show a shift towards STEM fields when being exposed to male teachers. Regarding teaching fields overall and primary teacher education specifically, we fail to reject a null effect. The patterns outlined are similar when we control for level of education.

We can do a simple back-of-the-envelope calculation to understand how much of the labor market effects could be explained from these results: If we increase pupils exposure to quota men by .1, this would result in an increase of 0.06 of pupils switching into STEM fields. Pupils with a STEM field have a 5 percentage point higher attachment to the labor force (0.88 vs 0.83 for non-STEM pupils). Increasing the share in the population with a STEM field by 0.06 would thus result in a 0.003 increase in labor force attachment, or put differently, explain about 5.8% of the total increase in attachment measured in section 6.3.

The results for pupils' choice of field are thus somewhat indicative of both male and female pupils moving away from gender-neutral fields and becoming more inclined to pursue STEM oriented fields when exposed to more male quota teachers. As effects move in the same direction for both pupil genders and we do not find evidence for boys becoming more likely to take up education related fields, we again fail to establish support for same-gender role model channels.

7.4 Complementarities between male and female teachers

Based on the predictions outlined in the conceptual framework in section 3, we also try to distinguish whether our results are driven by complementarities between male and female teachers. We do this by assessing marginal returns to more male quota teachers along the distribution of the share of male teachers at baseline (i.e. in 1990): If male and female teachers are complements, adding an additional male teacher at a place with mostly female teachers should have larger marginal returns compared to adding an additional male teacher in an environment that is close to gender parity. We split the sample by the median of initial share of male teachers in a municipality. The first group has initially a low share of male teachers (on average 29% within the group), and the second group has a relatively higher share of male teachers (on average 43%).[41] Appendix I reports results: The estimated coefficients in both groups are similar, but the standard errors are too large to draw decisive conclusions.[42] We can thus not convincingly

[40] In all of the regressions on field choices, we do not estimate joint fixed effects for both genders, but report separate regressions by splitting the sample. We do this since for these gendered outcomes, the assumption that shocks would affect boys and girls similarly does not seem justified (i.e. a shock that raises demand for health care workers is likely to have quite different effects on young women vs. young men).

[41] We can split the sample at other points in the distribution, with results qualitatively similar across different splits.

[42] Potential unobserved sorting of teachers into schools that deviates from the average municipal gender composition further makes our setting not an ideal case to test such a channel if collaboration matters more within

distinguish whether we find positive effects in our setting because diversity itself makes teacher teams more productive, or because within the scope of the policy, quota men have higher inherent teaching ability than the marginal women they replace.

8 Robustness

8.1 Do schools change hiring practices due to the reform?

Our treatment coefficients measure the effect of the quota policy, and thus include any impacts that may be due to schools responding endogenously to the policy, for example by changing their hiring patterns and recruiting more experienced teachers in lieu of rookies. While this is not a direct threat to identification, assessing these aspects helps to understand the underlying drivers of our effects. We therefore examine whether any other aspects of local teacher composition changes in response to the reform. Table 10 reports first difference municipal regressions, with all specifications assessing changes in flows for consistency (equation 9). Our goal is to understand whether retirements that happen in the post-quota period differentially change proxies of teacher experience relative to retirements in the quota period.

We start by assessing the effect of teachers turning 60 on overall teachers leaving their current job in columns 1 and 2. The share of teachers turning 60 has almost a 1:1 impact on the share of teachers leaving, but not differentially so in the quota period. This effect is not driven by turnover of relatively younger teachers (column 2), and rather reinforces the observation that teachers reaching age 60 corresponds to actual exits from the teaching profession. In column 3, we examine how retirements affect the average age of the local teacher body. Retirements in general reduce the average age among local teachers by 16 years. Importantly, we do not detect a sizeable or significant change in the post-quota period. In the fourth column, we observe similar effect sizes for the average number of years since obtaining a teaching degree as a proxy for teaching experience. These results refer to composite changes and could just stem from teacher exit, therefore columns 5 and 6 examine as outcomes two different ways to calculate the share of first entrants to the teaching profession among newly arriving teachers in any given year and municipality.[43] While noisily estimated, retirements in general result in a higher share of new entrants among newly arriving teachers at a municipality, but this does not change differentially in the post-quota period. Taken together, we fail to find corroborating evidence for changed re-hiring strategies as a response to the quota reform.

than across schools.

[43] We define as a first entrant any teacher who is first observed in a given year as a teacher and is below the age of 28 (column 5) or below the age of 30 (column 6). We examine first entrants as a share of new arrivals since the truncated panel structure of our data results in differential likelihood of observing first entrants and new arrivals at any given point in time, but affects both variables similarly.

8.2 Teachers on parental leave

Apart from hiring patterns, the lifting the quota coincides with bringing more young female teachers to schools, who may have a higher propensity to go on leave when giving birth. The positive effects we detect from having more male quota teachers could then simply arise from pupils having less teacher turn-over, with high turn-over potentially having a negative effect on pupil outcomes. During the 1990s, Finland had 6.5 months of entirely shareable parental leave taking effect after 3 months of birth-related maternity leave (Kamerman and Moss, 2009).

To investigate whether any changes related to leave taking of teachers becoming mothers (or fathers) could affect pupils, we repeat the municipal first stage regressions. Table A18 (in Appendix J) shows that teachers turning 60 in the post period do not have a differential impact on either female or male teachers having a birth in their household. The last column documents that the share of a female teachers leaving the teacher force subsequent to becoming a mother is also not differentially affected by retirements in the post-quota period. In this set-up, the variation used stems from such patterns arising immediately as a response to teacher retirements. We therefore also document that, conditional on municipal and region-by-cohort fixed effects, higher exposure to female teachers having a newborn child does not matter for pupil outcomes (Appendix Table A19). We conclude that differential leave taking patterns due to maternity from more female teachers post-quota are unlikely to drive our results.

8.3 Heterogeneous treatment effects in twoway fixed effects designs

An active literature has documented that the treatment coefficient of a two-way fixed effects (TWFE) regression, $\hat{\beta}_{fe}$, reports a weighted sum of average treatment effects (ATE) (De Chaisemartin and d'Haultfoeuille, 2020; Arkhangelsky et al., 2021; Athey and Imbens, 2021; Sun and Abraham, 2020; Imai and Kim, 2021; Goodman-Bacon, 2021). If treatment effects are heterogeneous, it is possible that treated observations can receive negative weight such that the sign of the overall effect is of the opposite side than each of the individuals ATEs. Heterogeneous treatment effects in our setting could be an issue if, for example, municipalities that experience a retirement shock early in the post period systematically exhibit a treatment effect of the opposite sign (i.e. an increase in share male), and receive a negative weight.[44] Negative weights by themselves are mechanically the product of any two-way fixed effects specification – it is in combination with heterogeneous treatment effects that problems with sign reversal may arise.

The TWFE literature to date has almost exclusively focused on staggered adoption designs with a binary treatment. An exception are De Chaisemartin and d'Haultfoeuille (2020) who also touch on a more general case where treatment is ordered and finite, such that there are observations that are untreated. De Chaisemartin and d'Haultfoeuille (2020) suggest sensitivity measures that are based on the variance of any weights associated with groups that have a treatment value that is strictly positive. In our setting, and somewhat contrary to the cases

[44] Due to for example municipal fixed effects differencing out a larger retirement shock later in the panel such that the earlier event is below the average level of retirements in this municipality.

tackled in this literature to date, the treatment variable is infinite, and takes on the value of zero only for a very few extremely selected observations, which makes the suggested sensitivity measures in De Chaisemartin and d'Haultfoeuille (2020) not directly applicable.

Still, we can follow the reasoning of De Chaisemartin and d'Haultfoeuille, 2020 (also highlighted by Jakiela, 2021), to examine the weights attached to our municipality-by-year groups. Intuitively, groups with lower treatment values should be more likely to receive negative weights as their treatment assignment is below average. The weights derived in De Chaisemartin and d'Haultfoeuille (2020) are proportional to the residual from a regression of the treatment variable on the fixed effects. Assessing the sign of the residuals in our setting is informative about the sign of this weight. For equation 8, this corresponds to:

$$total\ share\ 60\ post_{mt} = \beta_0 + \beta_1 total\ share\ 60_{mt} + \gamma_{mp} + \eta_t + \epsilon_{mt} \tag{13}$$

With $total\ share\ 60\ post_{mt}$ the share of teachers turning 60 interacted with an indicator for the post period. Appendix Figure A12 plots the mean of binned residuals along the distribution of our treatment variable for equation 8, with colors indicating above (red) or below (blue) median values of treatment intensity (Appendix K). Reassuringly, the weights attached to the municipality-by-year groups follow a clear pattern where observations with below median values of treatment are the ones that on average receive negative weight.

We also probe whether treatment effects in our setting are likely to be heterogeneous across various dimensions. To this extent, we assess whether treatment effects are driven by particular years, municipalities, cohorts or levels of treatment assignment. Appendix Section L report leave-one-out specifications, with coefficients not sensitive to dropping particular groups at a time. We also examine whether treatment effects differ across different levels of retirement in the post period (see Appendix Figure A13). While we cannot rule out that there may be some heterogeneity in our estimated treatment effects, given the probing outlined in this section, we think it is unlikely to be sufficient to change the sign of our treatment coefficients.

9 Conclusion

In this paper, we document that a quota that advantaged academically lower scoring men to obtain a study slot for primary teacher education has positive effects on output as measured by their pupils' long run educational and labor market outcomes. We find that pupils who were exposed to a higher share of male quota teachers during their time in primary school are more likely to be either in employment or studying at age 25, and have higher educational attainment as measured by their highest degree achieved.

Using comprehensive register data, we trace these long term effects back to consequential application patterns to post-compulsory education: Pupils exposed to a higher share of male quota teachers are more likely to apply to continue education directly after middle school, to obtain their preferred study slots and to enroll. We show that pupils of either gender apply more

in line with their academic abilities, albeit along different margins. We do not find evidence that our main effects are more pronounced for male pupils, ruling out a same-gender role model channel as the main mechanism. We then examine whether more male quota teachers inspire pupils to pursue different educational fields and show that pupils of either gender are more likely to choose a STEM field, but boys in particular are not more likely to choose education or teaching related fields.

The male teacher quota thus did not have an impact along two essential dimensions frequently emphasized in policy debates: It did not contribute to reduce occupational segregation – one of the main drivers of raw gender wage gaps – for the future generation, as boys were not inspired to pick an education-related occupation when exposed to more male teachers via the quota. Neither did the quota contribute to close educational attainment gaps between girls and boys, as both pupil genders benefited equally from exposure to male quota teachers.

Instead, the quota in our setting fixed an inefficiency present in the selection process of teachers. Our results show that the quota succeeded in recruiting male teachers that contributed valuable qualities to the school environment within the parameters of the policy. A promising avenue for future research lies in more thoroughly disentangling whether increased representation affects efficiency via a channel of complementarities in team work, via channels of inherent candidate ability, or via a mix of both. A further limitation of our setting is that it explores a partial equilibrium, and we refer to prior (Hsieh et al., 2019; Bleemer, 2021b) and future research to gauge the general equilibrium consequences of such policies for the allocation of talent in the wider economy.

Our study directly speaks to concurrent policy issues on affirmative action and optimal selection of candidates and illustrates the importance of carefully considering the relationship between selection criteria and minority status. In settings where a main criterion for choosing candidates is more negatively correlated with a particular group status than that group's effectiveness on the job, representation targets can help to overcome such misalignment if the selection criteria themselves cannot be easily changed. Both in academia, with current experimentation on SAT requirements for US college applications, and in the private sector, where companies are starting to use balanced candidate lists, such avenues are increasingly being explored. Our results suggest that this may pay off not only in terms of achieving more equitable representation, but also in terms of economic efficiency.

References

Ahern, K. R., & Dittmar, A. K. (2012). The changing of the boards: The impact on firm valuation of mandated female board representation. *The Quarterly Journal of Economics*, *127*(1), 137–197.

Aigner, D. J., & Cain, G. G. (1977). Statistical theories of discrimination in labor markets. *Ilr Review*, *30*(2), 175–187.

Antecol, H., Eren, O., & Ozbeklik, S. (2015). The effect of teacher gender on student achievement in primary school. *Journal of Labor Economics*, *33*(1), 63–89.

Arcidiacono, P., & Lovenheim, M. (2016). Affirmative action and the quality-fit trade-off. *Journal of Economic Literature*, *54*(1), 3–51.

Arkhangelsky, D., Imbens, G. W., Lei, L., & Luo, X. (2021). Double-robust two-way-fixed-effects regression for panel data. *arXiv preprint arXiv:2107.13737*.

Athey, S., & Imbens, G. W. (2021). Design-based analysis in difference-in-differences settings with staggered adoption. *Journal of Econometrics*.

Baltrunaite, A., Bello, P., Casarico, A., & Profeta, P. (2014). Gender quotas and the quality of politicians. *Journal of Public Economics*, *118*, 62–74.

Beaman, L., Chattopadhyay, R., Duflo, E., Pande, R., & Topalova, P. (2009). Powerful women: Does exposure reduce bias? *The Quarterly Journal of Economics*, *124*(4), 1497–1540.

Beaman, L., Duflo, E., Pande, R., & Topalova, P. (2012). Female leadership raises aspirations and educational attainment for girls: A policy experiment in India. *science*, *335*(6068), 582–586.

Becker, G. S. (1957). *The economics of discrimination*. University of Chicago Press.

Bell, A., Chetty, R., Jaravel, X., Petkova, N., & Van Reenen, J. (2019). Who becomes an inventor in America? The importance of exposure to innovation. *The Quarterly Journal of Economics*, *134*(2), 647–713.

Bertrand, M., Black, S. E., Jensen, S., & Lleras-Muney, A. (2018). Breaking the Glass Ceiling? The Effect of Board Quotas on Female Labour Market Outcomes in Norway. *The Review of Economic Studies*, *86*(1), 191–239.

Bertrand, M., Hanna, R., & Mullainathan, S. (2010). Affirmative action in education: Evidence from engineering college admissions in India. *Journal of Public Economics*, *94*(1-2), 16–29.

Besley, T., Folke, O., Persson, T., & Rickne, J. (2017). Gender quotas and the crisis of the mediocre man: Theory and evidence from Sweden. *American Economic Review*, *107*(8), 2204–42.

Black, S. E., Denning, J. T., & Rothstein, J. (2020). *Winners and losers? The effect of gaining and losing access to selective colleges on education and labor market outcomes* (Working Paper). National Bureau of Economic Research.

Bleemer, Z. (2021a). Affirmative Action, Mismatch, and Economic Mobility after California's Proposition 209* [qjab027]. *The Quarterly Journal of Economics*.

Bleemer, Z. (2021b). *Top percent policies and the return to postsecondary selectivity* (Research & Occasional Paper Series: CSHE. 1.2021). Center for Studies in Higher Education.

Breda, T., Grenet, J., Monnet, M., & Van Effenterre, C. (2018). Can female role models reduce the gender gap in science? Evidence from classroom interventions in French high schools. *HAL Working Paper, halshs-0173068*.

Carrell, S. E., Page, M. E., & West, J. E. (2010). Sex and science: How professor gender perpetuates the gender gap. *The Quarterly Journal of Economics*, *125*(3), 1101–1144.

Chan, J., & Eyster, E. (2003). Does banning affirmative action lower college student quality? *American Economic Review*, *93*(3), 858–872.

Chattopadhyay, R., & Duflo, E. (2004). Women as Policy Makers: Evidence from a Randomized Policy Experiment in India. *Econometrica*, *72*(5), 1409–1443.

Chetty, R., Friedman, J. N., & Rockoff, J. E. (2014). Measuring the impacts of teachers II: Teacher value-added and student outcomes in adulthood. *American Economic Review*, *104*(9), 2633–79.

Coate, S., & Loury, G. C. (1993). Will affirmative-action policies eliminate negative stereotypes? *The American Economic Review*, 1220–1240.

Comi, S., Grasseni, M., Origo, F., & Pagani, L. (2020). Where women make a difference: Gender quotas and firms' performance in three European countries. *ILR Review*, *73*(3), 768–793.

Cortés, P., Kasoolu, S., & Pan, C. (2021). *Labor market nationalization policies and exporting firm outcomes: Evidence from Saudi Arabia* (Working Paper). National Bureau of Economic Research.

De Chaisemartin, C., & d'Haultfoeuille, X. (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review*, *110*(9), 2964–96.

Dee, T. S. (2004). Teachers, race, and student achievement in a randomized experiment. *Review of Economics and Statistics*, *86*(1), 195–210.

Dee, T. S. (2005). A teacher like me: Does race, ethnicity, or gender matter? *American Economic Review*, *95*(2), 158–165.

Dee, T. S. (2007). Teachers and the gender gaps in student achievement. *Journal of Human Resources*, *42*(3), 528–554.

Deming, D. J. (2017). The growing importance of social skills in the labor market. *The Quarterly Journal of Economics*, *132*(4), 1593–1640.

Dhume, S. (2019). India's ethnic quotas are a cautionary tale [2019-01-24]. *The Wall Street Journal*.

Eckbo, B. E., Nygaard, K., & Thorburn, K. S. (2021). Valuation effects of Norway's board gender-quota law revisited. *Management Science*.

Ellison, G., & Pathak, P. A. (2021). The efficiency of race-neutral alternatives to race-based affirmative action: Evidence from Chicago's exam schools. *American Economic Review*, *111*(3), 943–75.

Etelä Suomen Sanomat. (1988). Koulutuspaikkojen lisäzksellä eroon opettajapulasta [1988-08-25]. *Etelä Suomen Sanomat*.

Eurostat. (2021). Education and training in the EU - facts and figures [Online; accessed 21-Sep-2021].

Ferrari, G., Ferraro, V., Profeta, P., & Pronzato, C. (2021). Do board gender quotas matter? Selection, performance and stock market effects. *Management Science*.

Finnish National Agency for Education. (2018). *Finnish teachers and principals in figures*. Finnish National Agency for Education.

Gershenson, S., Hart, C. M., Hyman, J., Lindsay, C., & Papageorge, N. W. (2022). *The long-run impacts of same-race teachers* (tech. rep.).

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*.

Hanushek, E. A., & Rivkin, S. G. (2006). Teacher quality. *Handbook of the Economics of Education*, *2*, 1051–1078.

Heckman, J. J., Stixrud, J., & Urzua, S. (2006). The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. *Journal of Labor Economics*, *24*(3), 411–482.

Holzer, H., & Neumark, D. (2000). Assessing affirmative action. *Journal of Economic Literature*, *38*(3), 483–568.

Hsieh, C.-T., Hurst, E., Jones, C. I., & Klenow, P. J. (2019). The allocation of talent and US economic growth. *Econometrica*, *87*(5), 1439–1474.

Imai, K., & Kim, I. S. (2021). On the use of two-way fixed effects regression models for causal inference with panel data. *Political Analysis*, *29*(3), 405–415.

Izadi, R. (2021). *Teacher selection in Finland* (Unpublished manuscript).

Jakiela, P. (2021). Simple diagnostics for two-way fixed effects. *arXiv preprint arXiv:2103.13229*.

Kamerman, S., & Moss, P. (2009). *The politics of parental leave policies: Children, parenting, gender and the labour market*. Policy Press.

Kane, T. J., Rockoff, J. E., & Staiger, D. O. (2008). What does certification tell us about teacher effectiveness? evidence from New York City. *Economics of Education review*, *27*(6), 615–631.

Kivinen, O., & Rinne, R. (1994). The Thirst for Learning, or Protecting One's Niche? The shaping of teacher training in Finland during the 19th and 20th centuries. *British Journal of Sociology of Education*, *15*(4), 515–527.

Kofoed, M. S. et al. (2019). The effect of same-gender or same-race role models on occupation choice evidence from randomly assigned mentors at West Point. *Journal of Human Resources*, *54*(2), 430–467.

Leman, N. (2021). Can affirmative action survive? [2021-07-26]. *The New Yorker*.

Liimatainen, S. (2002). Opettajankoulutuksen valintayhteistyö. In P. Räihä & J. Kari (Eds.), *Opettajaksi soveltuvuuden moni-ilmeisyys. Opiskelijavalintavaltakunnallisesti puntaroituna.* (pp. 24–31). Jyväskylän yliopisto.

Liiten, M. (2012). Opetus- ja sosiaalialan koulutukseen harkitaan mieskiintiöitä [2012-10-06]. *Helsingin Sanomat*.

Lim, J., & Meer, J. (2017). The impact of teacher–student gender matches random assignment evidence from South Korea. *Journal of Human Resources*, *52*(4), 979–997.

Long, H. (2019). 80 nations set quotas for female leaders. Should the U.S. be next? [2019-03-29]. *Washington Post*.

Lundberg, S. J., & Startz, R. (1983). Private discrimination and social intervention in competitive labor market. *The American Economic Review*, *73*(3), 340–347.

Malinen, O.-P., Väisänen, P., & Savolainen, H. (2012). Teacher education in finland: A review of a national effort for preparing teachers for the future. *Curriculum Journal*, *23*(4), 567–584.

Mankki, V., Mäkinen, M., & Räihä, P. (2020). Teacher educators' predictability and student selection paradigms in entrance examinations for the Finnish primary school teacher education programme. *European Journal of Teacher Education*, *43*(2), 151–164.

Matsa, D. A., & Miller, A. R. (2013). A female style in corporate leadership? evidence from quotas. *American Economic Journal: Applied Economics*, *5*(3), 136–69.

Niemi, H., Toom, A., & Kallioniemi, A. (2016). *Miracle of education: The principles and practices of teaching and learning in Finnish schools*. Springer.

OECD. (2019). Society at a glance 2019: Oecd social indicators [Online; accessed 21-Sep-2021].

OECD. (2021). Oecd employment outlook [Online; accessed 21-Sep-2012].

Otero, S., Barahona, N., & Dobbin, C. (2021). *Affirmative action in centralized college admission systems: Evidence from brazil* (tech. rep.). Working paper.

Peck, J. (2017). Can hiring quotas work? The effect of the Nitaqat program on the Saudi private sector. *American Economic Journal: Economic Policy*, *9*(2), 316–47.

Phelps, E. S. (1972). The statistical theory of racism and sexism. *The American Economic Review*, *62*(4), 659–661.

Porter, C., & Serra, D. (2019). Gender differences in the choice of major: The importance of female role models. *American Economic Journal: Applied Economics*.

Räihä, P. (2010). Koskaan et muuttua saa! Luokanopettajakoulutuksen opiskelijavalintojen uudistamisen vaikeudesta. *Tampere University Press*.

Ray, D., & Sethi, R. (2010). A remark on color-blind affirmative action. *Journal of Public Economic Theory*, *12*(3), 399–406.

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

Sahlberg, P. (2021). *Finnish lessons 3. 0: What can the world learn from educational change in Finland?* Teachers College Press.

Sahlberg, P., Johnson, P., & Strauss, V. (2019). What Finland is really doing to improve its acclaimed schools. *Washington Post*.

Sansone, D. (2017). Why does teacher gender matter? *Economics of Education Review*, *61*, 9–18.

Siniscalchi, M., & Veronesi, P. (2021). *Self-image bias and lost talent* (Working Paper). National Bureau of Economic Research.

Sun, L., & Abraham, S. (2020). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of Econometrics*.

Sysiharju, A.-L. (1987). Women school employees in Finland. In P. A. Schmuck (Ed.), *Women educators: Employees of schools in Western world countries* (pp. 21–41). Suny Press.

Tasa-Arvovaltuutetu. (1987). Tasa-Arvovaltuutetun toimisto 126/1987, lausunto kiintiöiden käytöstä [Office of the High Commissioner of Equality (Paavo Nikula): Opinion on quotas 126/1987, obtained by private correspondence with the Office of the Equality Ombudsman].

Tirri, K. (2014). The last 40 years in Finnish teacher education. *Journal of Education for Teaching*, *40*(5), 600–609.

UN. (2019). Progress on the sustainable development goals: The gender snapshot 2019.

Uusiautti, S., & Määttä, K. (2013). Significant trends in the development of Finnish teacher education programs (1860-2010). *Education Policy Analysis Archives*, *21*, 59.

Uusiautti, S., Määttä, K. et al. (2013). Who is a suitable teacher? The over-100-year long history of student selection for teacher training in Finland. *International Journal of Sciences*, *2*(03), 109–118.

Valtiokonttori. (1988). Valintaoikeus: Valitsijan opas.

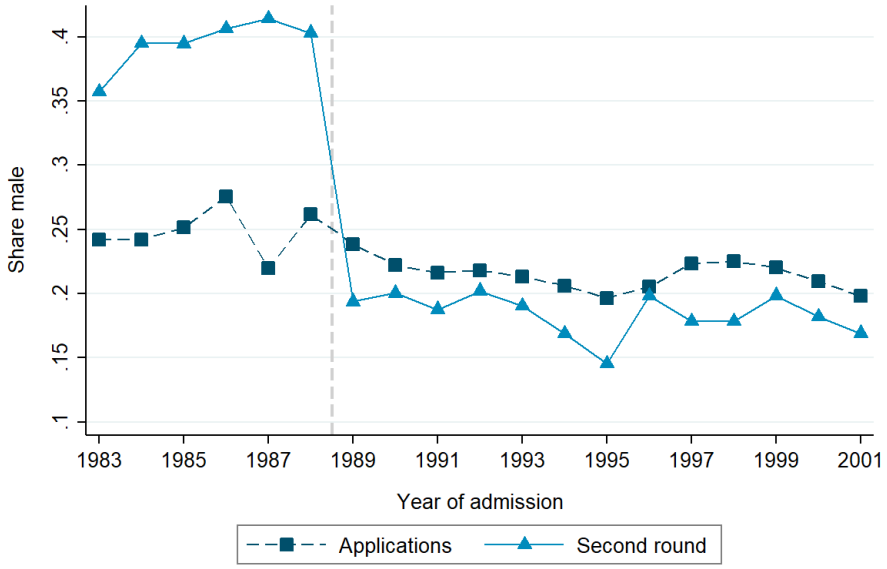
Virtanen, H. (2016). Essays on Post-Compulsory Education Attainment in Finland.

Welch, F. (1976). Employment quotas for minorities. *Journal of Political Economy*, *84*(4, Part 2), S105–S141.

Yagan, D. (2016). Supply vs. demand under an affirmative action ban: Estimates from UC law schools. *Journal of Public Economics*, *137*, 38–50.

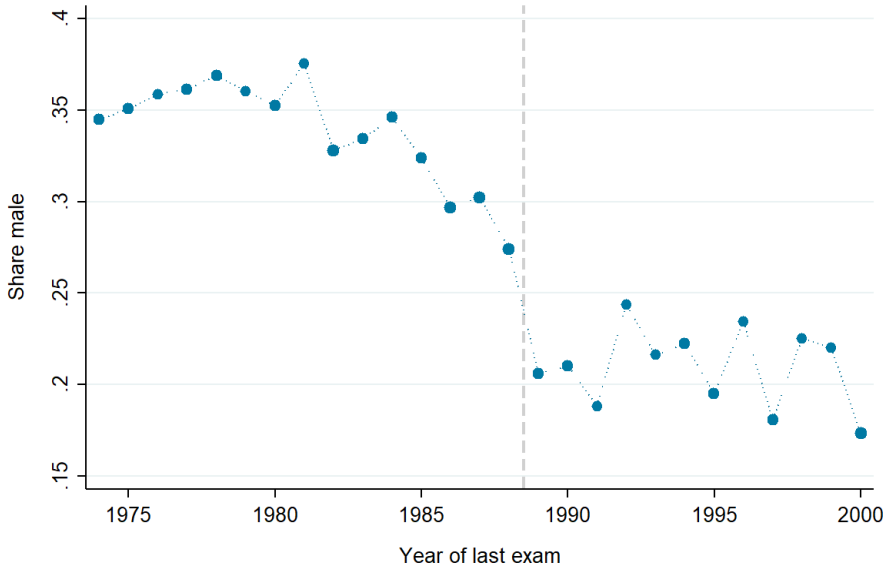
Tables and Figures

Figure 1: Share male in applications to primary school teacher



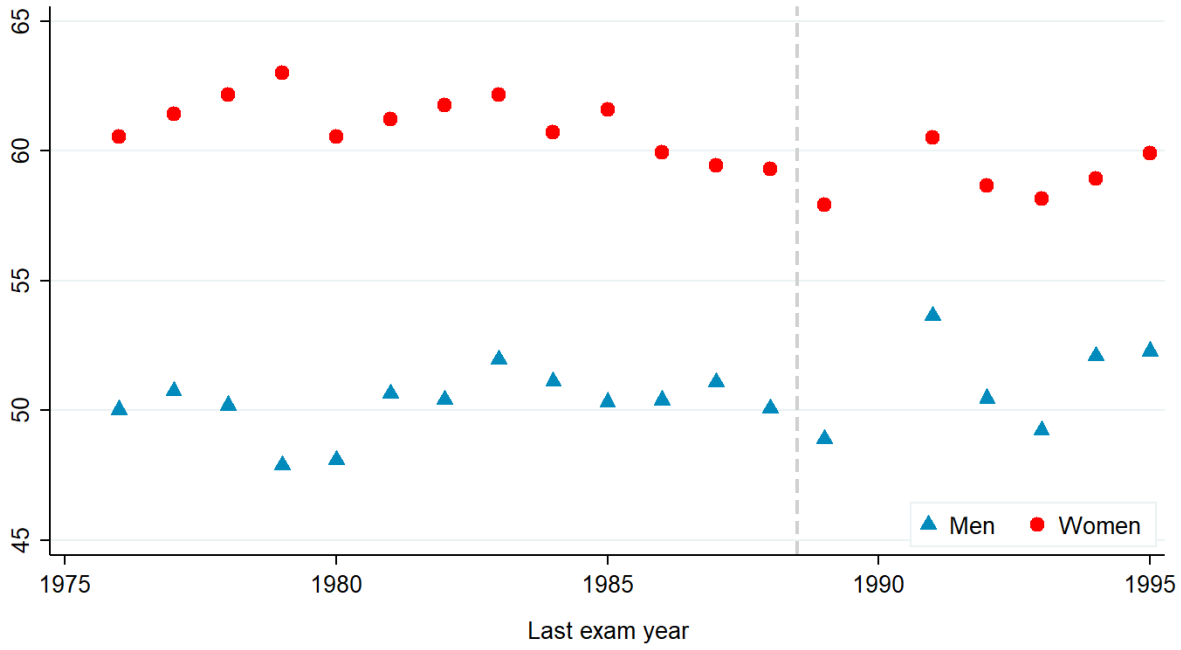
Note: Share male among applicants and invitees to the second round of admission to primary teacher studies. *Source:* Liimatainen (2002). (back)

Figure 2: Share male among primary school teachers by year of last matriculation exam



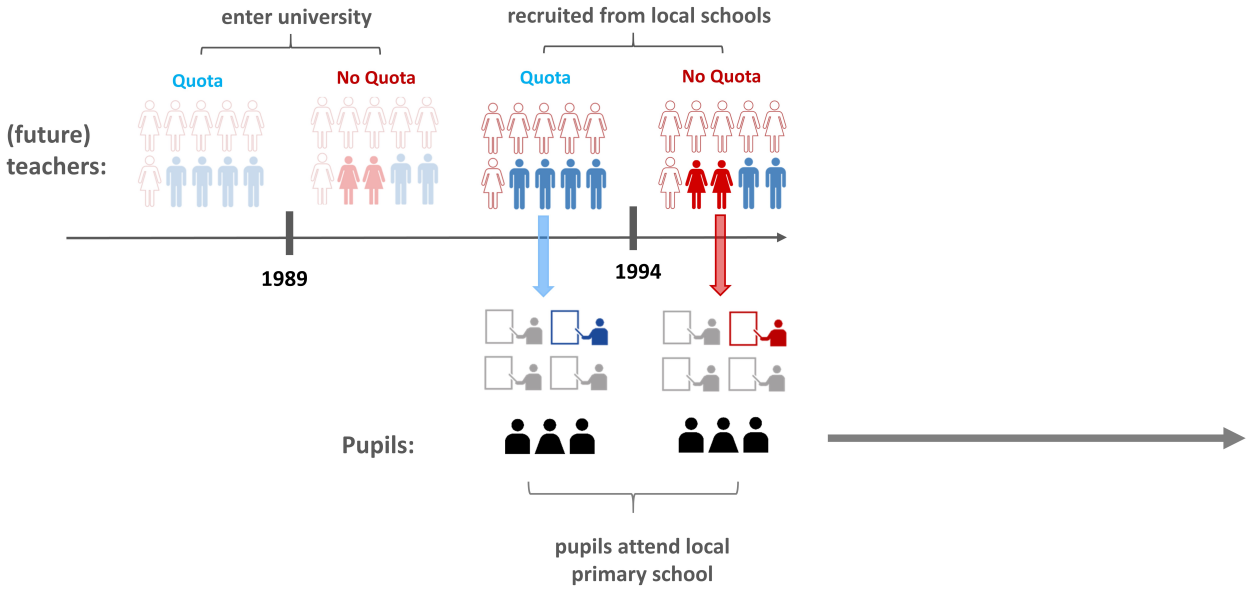
Note: Share male among active primary school teachers, by the last year in which they took the matriculation exam, which qualifies applicants for university admissions. Exam takers in 1989 (dashed grey line) and thereafter will have studied after the male quota was abolished. (back)

Figure 3: Matriculation exam percentile rank among primary school teachers by year of last matriculation exam



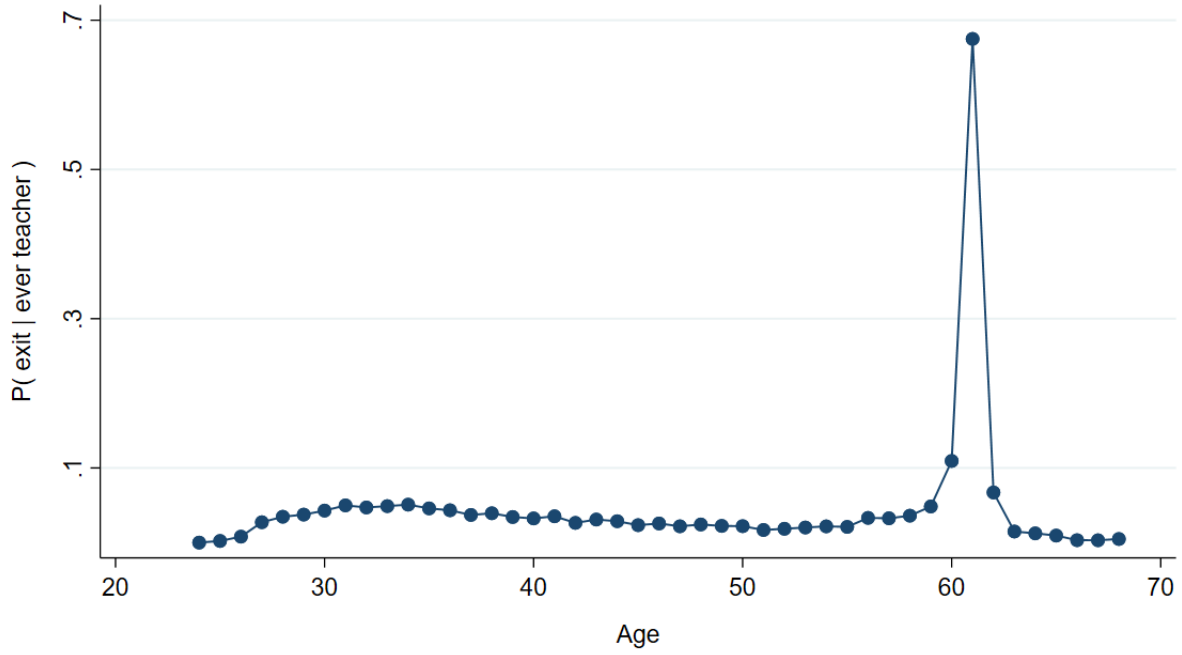
Note: National percentile rank across all subjects in the matriculation exam among primary school teachers, by gender and the last year in which they took the matriculation exam (qualifies applicants for university admissions). Exam takers in 1989 (dashed grey line) and thereafter will have studied after the male quota was abolished. Data on exam points for the year 1990 are missing, so that we cannot calculate the national distribution of scores according to percentiles for that year. Note that if the worst scorers are those that repeat the exam, this will bias the average scores in the years after 1990 upwards (the worst performers will not be counted in these averages as their scores are missing). We address this issue by also examining average grades, for which we have data in 1990. We can show that the pattern is similar and upward bias in the percentile scores after 1990 should be small. (back)

Figure 4: Timeline of the reform



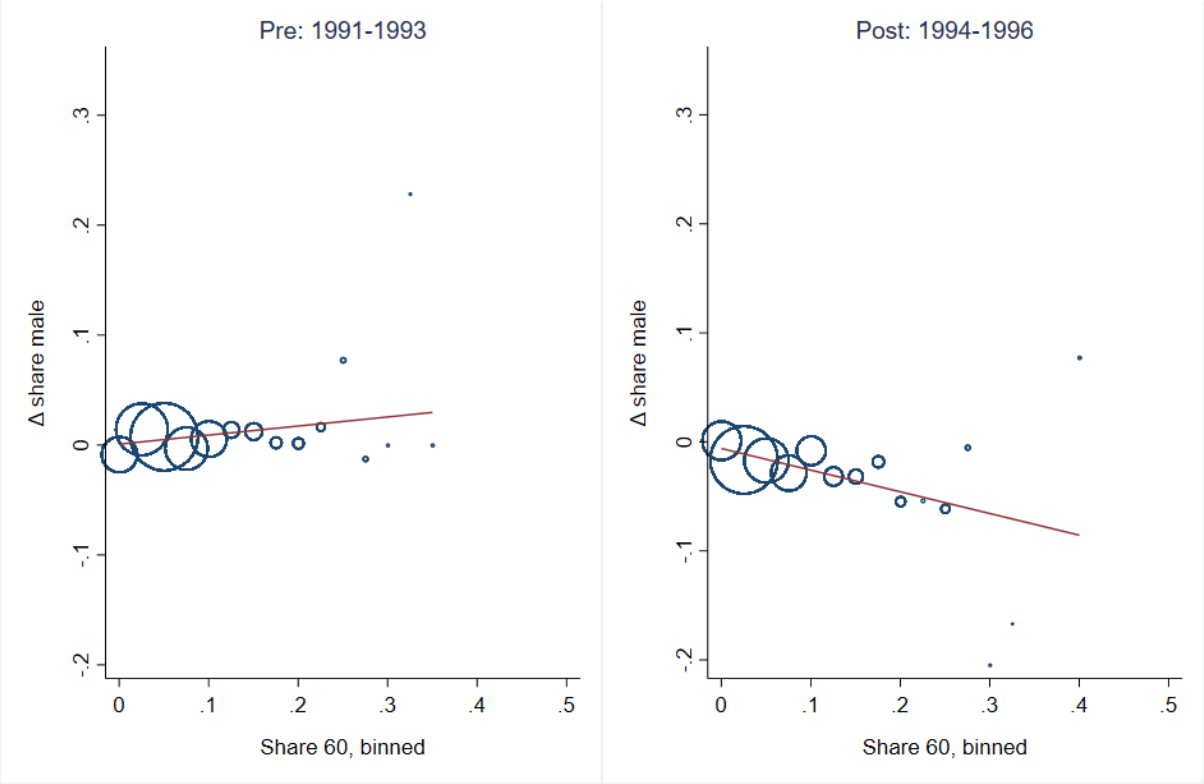
Note: Future primary school teachers enter university with the quota (pre-1989) and without the quota (1989 and thereafter), and graduate from the five year primary school teaching degree around the year 1994. Primary teacher graduates get hired by municipalities to teach in local schools. Pupils will experience differential exposure to quota teachers, described in detail in section 5 of the paper. (back)

Figure 5: Probability of teacher exit by age



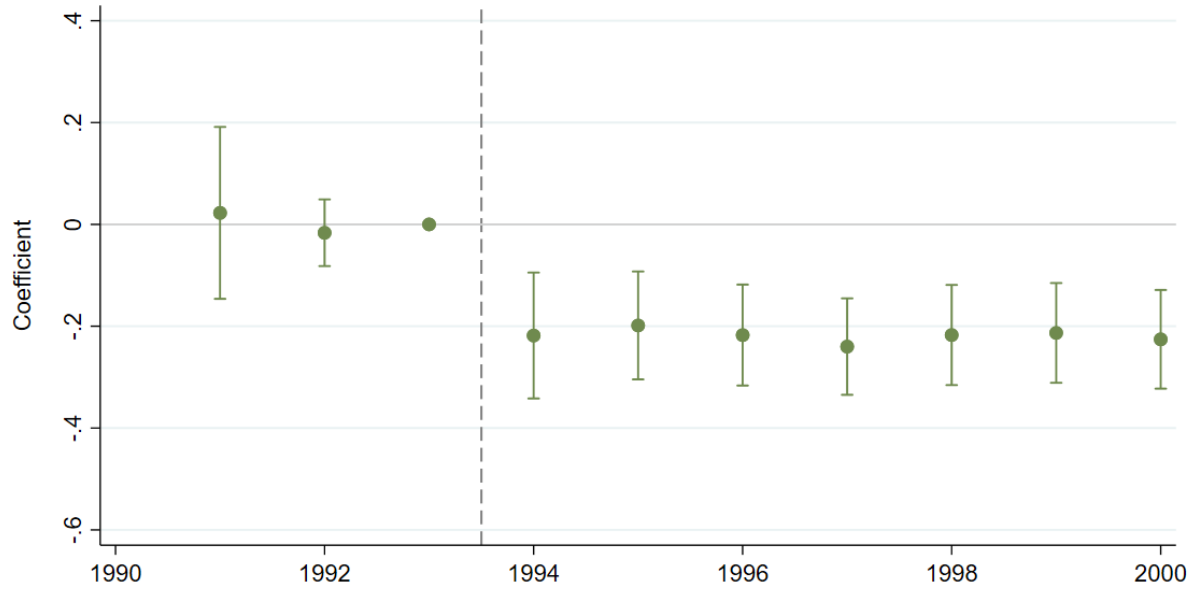
Note: Share of primary school teachers not working as a primary school teacher at a given age, conditional on having worked as a primary school teacher in the previous year. Data for all active primary school teachers in the years 1990-2000. Multiple exits per teacher possible. (back)

Figure 6: First stage intuition: Changes in share male teachers by local retirements, raw data



Note: Municipality level data, binned: Change in the share of male primary school teachers for a period of similar length in the quota (1991-93) and post-quota (1994-96) period against total share of teachers turning 60. Linear fit, weighted by the number of municipalities per bin.
(back)

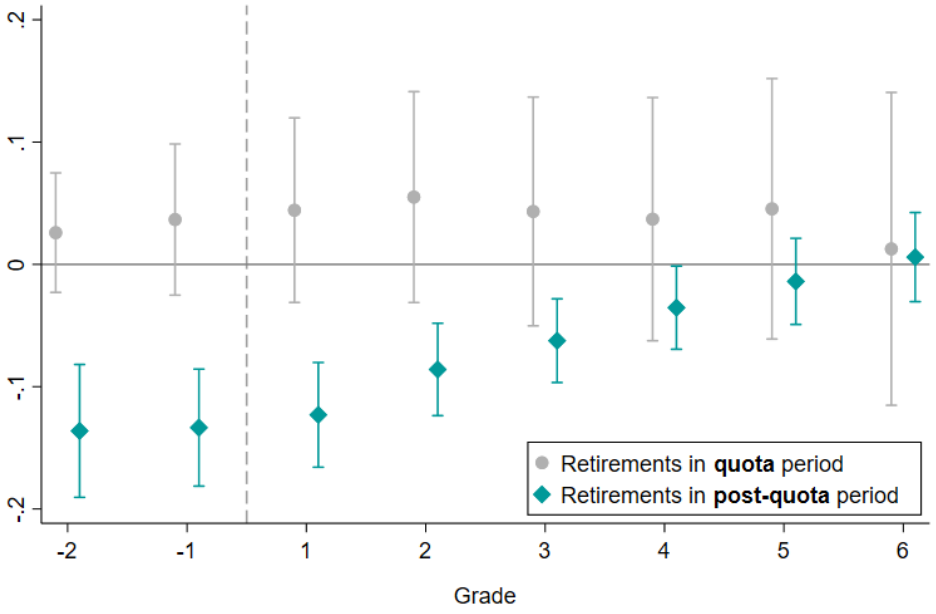
Figure 7: Municipal level first stage as event study



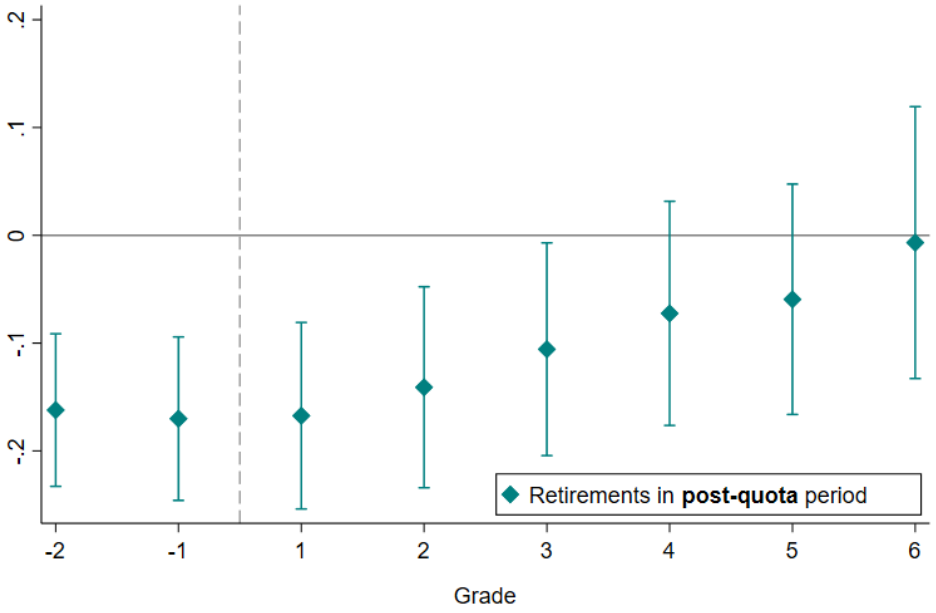
Note: Year-on-year estimates of π_2 for the fixed-effects first stage Equation 8, showing impact of primary teachers turning 60 on the local share of male teachers (relative to 1993). Standard errors clustered at the municipality level. Population weighted. (back)

Figure 8: First stage pupil level

(a) Separate estimation of quota and post-quota coefficients



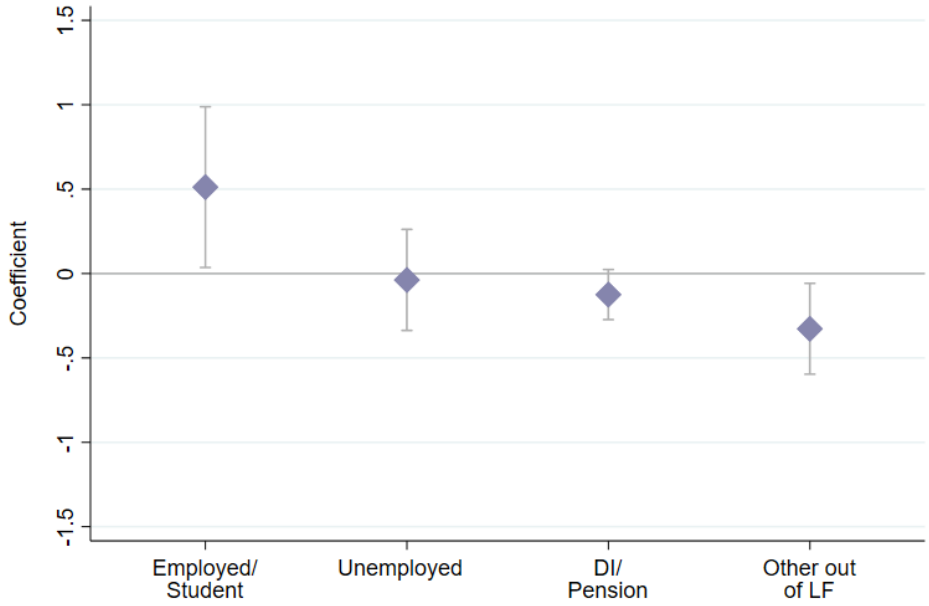
(b) Post-quota (relative to quota coefficients)



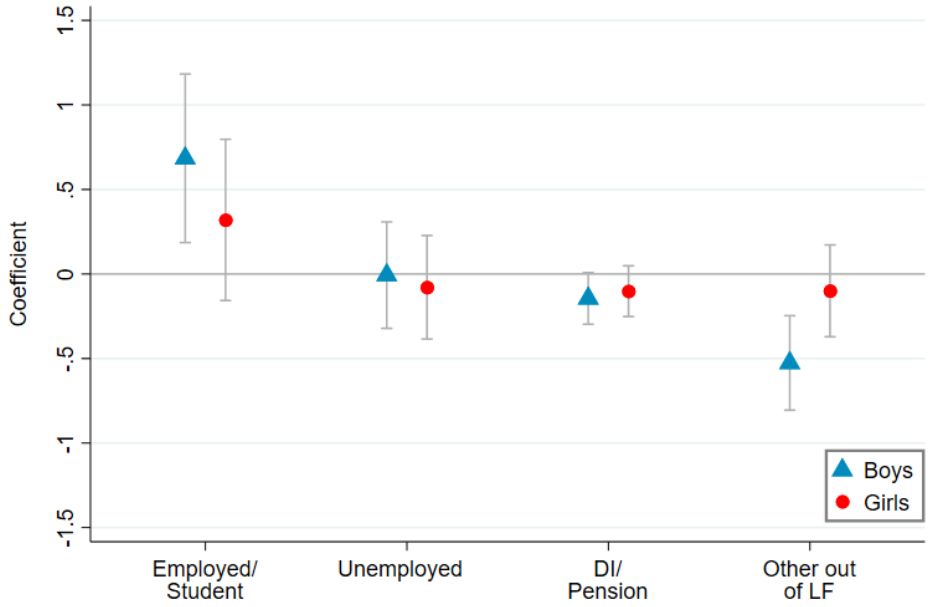
Note: Grade level estimation of pupil level first stage (c.f. Equation 11). Panel (a) estimates absolute coefficients for effect of retirements pupils experience in the quota and the post-quota period. Panel (b) depicts coefficients for the post-quota period *relative* to the quota period (i.e. it shows the difference between quota and post-quota estimates depicted in Panel (a)). Outcome is the average share of male teachers a pupil is exposed to during their time in primary school (Grades 1-6). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. (back)

Figure 9

(a) Labor market outcomes at age 25



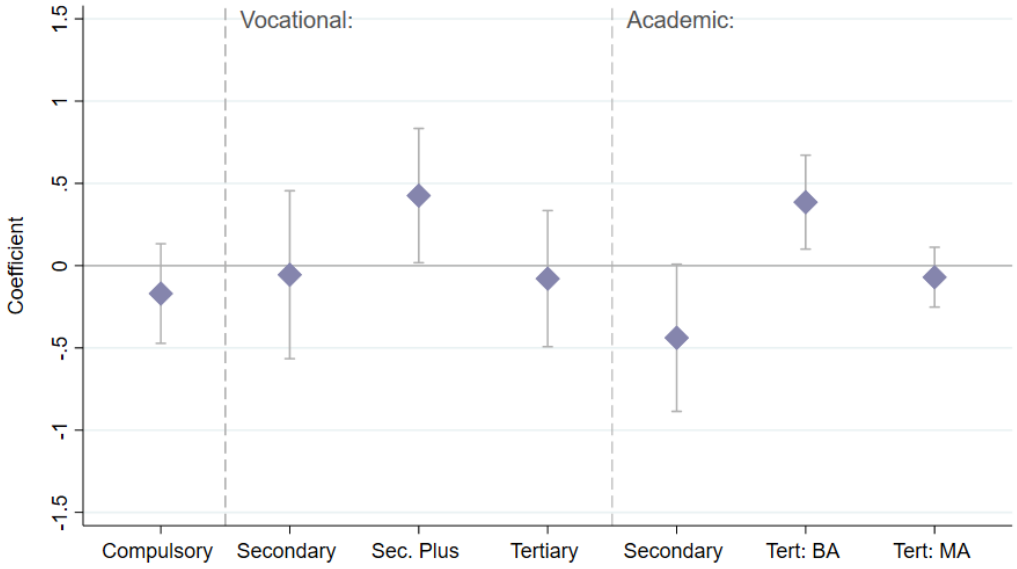
(b) By gender: Labor market outcomes at age 25



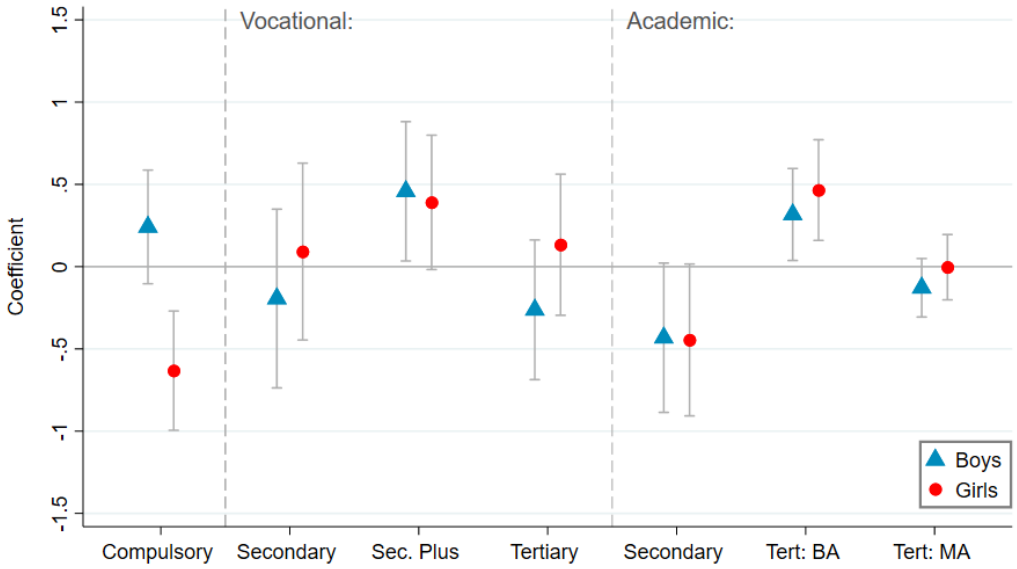
Note: IV estimates of Equation 10. Outcome: Mutually exclusive categories of labor market status in last week of the year in which pupils turn 25 years old. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. (back)

Figure 10

(a) Highest degree achieved at age 25



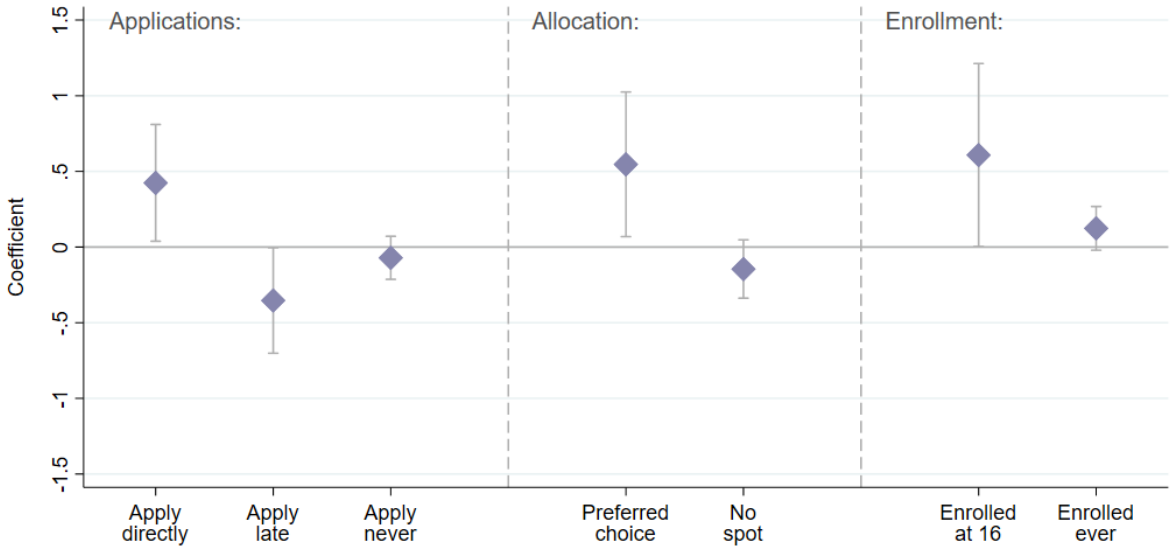
(b) By gender: Highest degree achieved at age 25



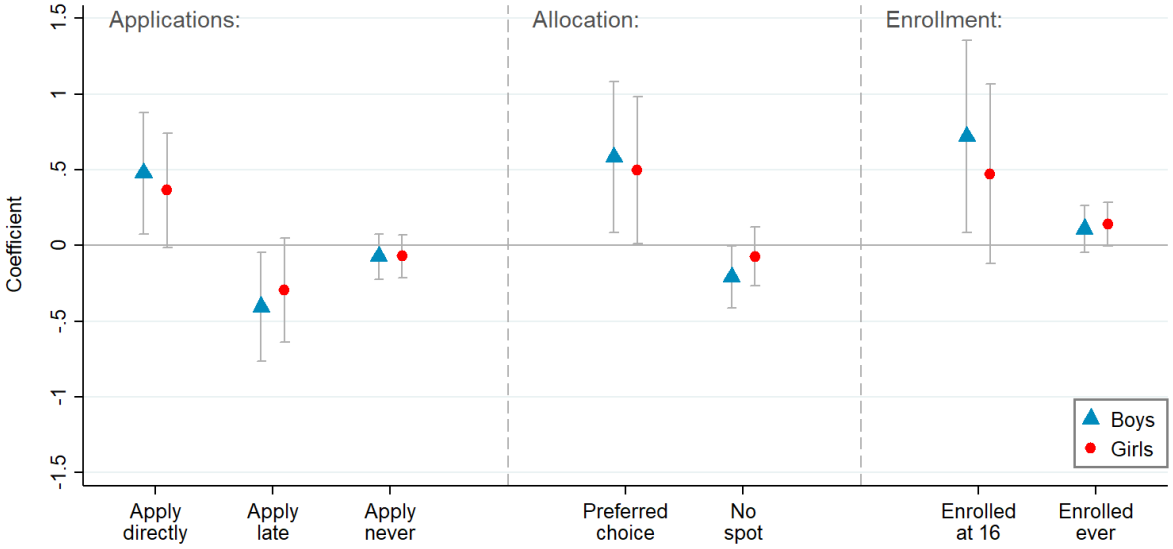
Note: IV estimates of Equation 10. Outcomes are mutually exclusive categories of pupils' highest degree achieved at age 25: Having only Compulsory education. For the Vocational track: Having a basic three year secondary degree (Secondary), having additional qualifications or high school coursework beyond a basic degree (Sec. Plus), having a tertiary degree from a polytechnic (Tertiary). For the Academic track: Having a three year high school degree (Secondary), having a three year university BA degree (Tert: BA), having a two year university MA degree (Tert: MA) or higher. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. (back)

Figure 11

(a) Applications and enrollment for post-compulsory education



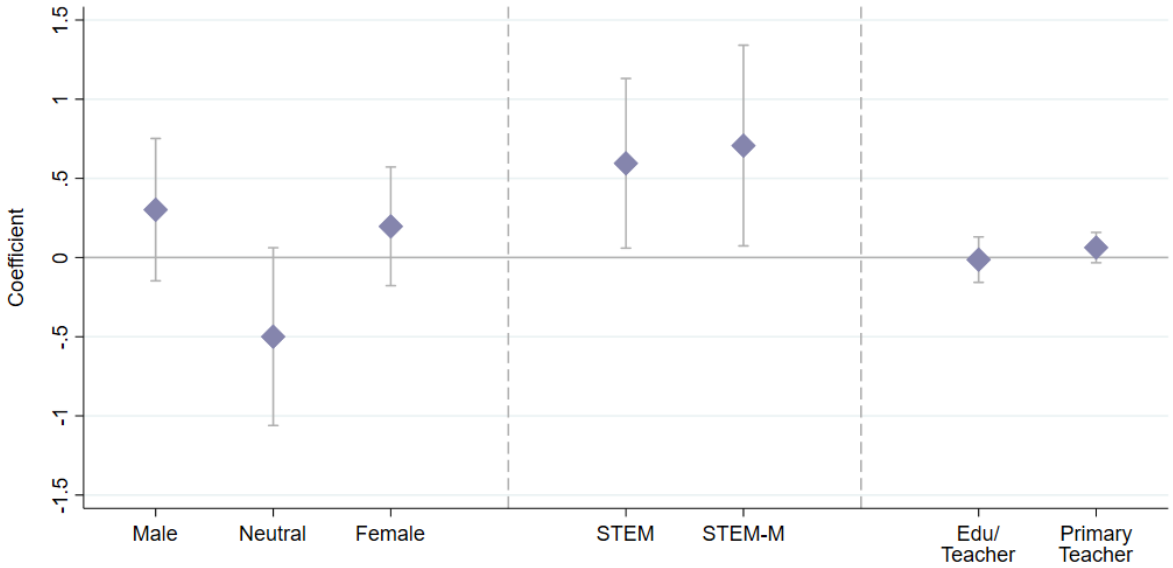
(b) By gender: Applications and enrollment for post-compulsory education



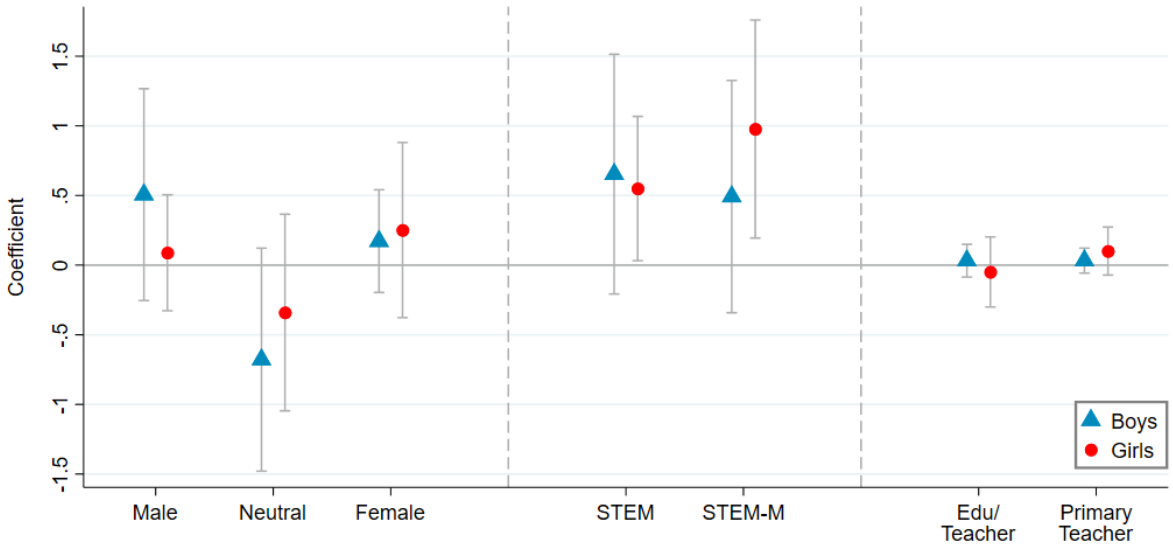
Note: IV estimates of Equation 10. Outcomes from left to right: "Applications" to upper secondary education (mutually exclusive categories): Pupils apply directly in spring of the year in which they turn 16 (Apply directly), they apply up to four years after they have turned 16 (Apply late), or they apply never or later than five years after having turned 16 (Apply never). "Allocation": Pupils obtain one of their first two preferred choices in the application (Preferred choice), or do not obtain a study slot (No spot). "Enrollment": Pupils are enrolled in upper secondary education in the fall of the year in which they turn 16 (Enrolled at age 16), and ever enrolled in upper secondary education up to age 25 (Ever enrolled). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. (back)

Figure 12

(a) Education field at age 25



(b) By gender: Education field at age 25



Note: IV estimates of Equation 10, separate regressions by gender. Outcomes from left to right: Field is 'Male' dominated ($\geq$ 40% male), (gender) 'Neutral' or 'Female' dominated ($\geq$ 40% female). Field is STEM or STEM + Medicine (STEM-M). Field is Education Science or Teacher. Field is Primary School Teacher. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. (back)

Table 1: Summary statistics of teachers by gender

	Quota			Post Quota		
Variable	Female	Male	Difference	Female	Male	Difference
A) Background and current place of living						
Urban residence at birth	0.586	0.562	-0.023***	0.612	0.590	-0.022***
			(0.007)			(0.007)
Rural residence at birth	0.371	0.392	0.021**	0.358	0.376	0.018**
			(0.007)			(0.006)
Born on Russian territory	0.043	0.046	0.003	0.028	0.033	0.005*
			(0.003)			(0.002)
Finnish mother tongue	0.922	0.947	0.025***	0.916	0.940	0.024***
			(0.004)			(0.004)
Lives in region of birth	0.457	0.488	0.031***	0.473	0.496	0.023***
			(0.007)			(0.007)
Lives in municipality of birth	0.229	0.268	0.039***	0.249	0.277	0.028***
			(0.006)			(0.006)
B) Education path (born after 1952)						
High school degree	0.980	0.979	-0.002	0.983	0.980	-0.003
			(0.003)			(0.003)
Teaching degree	0.894	0.889	-0.005	0.920	0.910	-0.010
			(0.007)			(0.006)
Age at high school degree	19.25	19.47	0.23***	19.23	19.46	0.23***
			(0.02)			(0.02)
Age at teacher degree	25.54	26.50	0.96***	25.48	26.48	1.00***
			(0.09)			(0.09)
C) Academic performance (born after 1952)						
Matriculation exam	0.986	0.984	-0.003	0.982	0.976	-0.006**
			(0.003)			(0.004)
National percentile rank, first take	62.85	50.73	-12.12***	61.01	50.46	-10.54***
			(0.36)			(0.31)
National percentile rank, best take	63.86	52.40	-11.45***	62.00	52.05	-9.96***
			(0.34)			(0.30)
Mathematics exam	0.741	0.826	0.086***	0.768	0.842	0.074***
			(0.009)			(0.007)
Advanced mathematics exam	0.281	0.387	0.106***	0.268	0.390	0.122***
			(0.010)			(0.008)

Note: Characteristics of male and female primary school teachers who are active teachers for at least one year in the quota period (1990-93) or in the post quota period (1994-2000) and who are between 24 and 60 years old.(back)

Table 2: First stage at the municipal level

	First Differences				Fixed Effects		
Dependent variable	Δ male				share male		
Share 60	0.062	0.062	0.074*	0.072*			
	(0.038)	(0.039)	(0.041)	(0.039)			
Share 60 * post	–0.165***	–0.170***	–0.175***	–0.161***			
	(0.044)	(0.044)	(0.047)	(0.044)			
Total share 60					0.068	0.086*	0.078*
					(0.043)	(0.045)	(0.043)
Total share 60 * post					–0.218***	–0.232***	–0.194***
					(0.049)	(0.054)	(0.049)
M*Post FE					X	X	X
Y FE		X		X	X		X
R*Y FE			X			X	
M*Y controls				X			X
Adj. R^2	0.017	0.022	0.011	0.025	0.869	0.866	0.869
Obs	4448	4448	4439	4448	4443	4434	4443
Dep mean	.0007	.0007	.0007	.0007	.3601	.3601	.3601

Note: Estimates for Equation 9 (columns 1-4) and Equation 8 (columns 5-7). Standard errors clustered at the municipality level. Regressions weighted by population, means unweighted. Time-varying municipal controls include log population, log household income, share unemployed, share of adult population with compulsory, secondary and tertiary education, share of families in single parent HH. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table 3: First stage: Teachers' matriculation exam scores

	Total	Language	Math	Science
Total share 60	–1.07	–4.27	–3.51	–1.09
	(4.25)	(5.09)	(7.67)	(5.45)
Total share 60 * post	1.25	3.02	1.28	1.95
	(4.70)	(5.68)	(8.55)	(6.08)
M*Post FE	X	X	X	X
Y FE	X	X	X	X
Adj. R^2	0.85	0.86	0.80	0.82
Obs	4329	4329	4314	4317
Dep mean	58.88	60.92	52.17	61.93

Note: Estimates for Equation 8 with average of local teachers' national percentile rank in first attempt of matriculation exam as the outcome. Language includes scores for mother tongue (FI/SE) and second national language (SE/FI). Science (Reaali) scores include the combined scores across subjects ranging from history and religion to chemistry and physics. Data available only for teacher cohorts born after 1952. Sample is restricted to municipalities where there is at least one teacher with observed score in 1991. Standard errors clustered at the municipality level. Regressions weighted by population. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table 4: Pupil level first stage, reduced form and IV for being Employed/Student at age 25

	First stage			RF			IV		
	Avg share male			Employed or student			Employed or student		
Total share 60	0.034	0.034	0.044	0.031	0.032	0.042	0.021	0.019	0.020
	(0.036)	(0.036)	(0.037)	(0.028)	(0.028)	(0.029)	(0.026)	(0.027)	(0.027)
Total share 60 * post	–0.177***	–0.177***	–0.168***	–0.053	–0.071**	–0.086***			
	(0.042)	(0.042)	(0.043)	(0.033)	(0.032)	(0.033)			
Avg share male							0.297	0.403*	0.512**
							(0.215)	(0.216)	(0.243)
Municipal FE	X	X	X	X	X	X	X	X	X
Cohort FE	X	X		X	X		X	X	
Region*Cohort FE			X			X			X
Ind. controls		X	X		X	X		X	X
MOP F^{eff}							17.96	17.94	15.37
Adj. R^2	0.916	0.916	0.921	0.008	0.025	0.025			
Obs	811,392	811,392	811,392	811,392	811,392	811,392	811,392	811,392	811,392
Dep mean	.3133	.3133	.3133	.8423	.8423	.8423	.8423	.8423	.8423

Note: Columns 1-3 show estimates for Equation 11 with the average share male teachers pupils are exposed to during primary school as the outcome. Columns 4-6 show reduced form estimates (corresponding to Equation 11), and Columns 7-9 show IV estimates of Equation 10 with being either employed or a student at age 25 as the outcome. Standard errors clustered at the municipality level. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table 5: Labor market outcomes at age 25

	Employed/ Student	Un-employed	DI/ Pension	Other out of LF
Avg share male	0.512**	–0.038	–0.124	–0.327**
	(0.243)	(0.153)	(0.076)	(0.137)
Municipal FE	X	X	X	X
Region*Cohort FE	X	X	X	X
Ind. controls	X	X	X	X
MOP F^{eff}	15.37	15.37	15.37	15.37
Obs	811,392	811,392	811,392	811,392
Dep mean	.842	.086	.017	.053
Std effect	.089	-.009	-.061	-.093

Note: IV estimates of Equation 10. Outcomes are mutually exclusive categories of pupils' labor market status measured at age 25: Being in employment or a student, unemployed, on disability insurance (DI) or receiving pension payments, or being out of the labor force for other reasons. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. This table and all other labor market status results at age 25 do not report estimates for the separate category of "conscripts/community service" that contains a total of 1185 observations. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table 6: Highest degree achieved at age 25

	Compulsory schooling	Vocational			Academic		
		Sec	Sec Plus	Tert	Sec	Tert: BA	Tert: MA
Avg share male	–0.169	–0.055	0.426**	–0.079	–0.438*	0.386***	–0.070
	(0.154)	(0.260)	(0.208)	(0.211)	(0.228)	(0.146)	(0.093)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	15.36	15.36	15.36	15.36	15.36	15.36	15.36
Obs	810,065	810,065	810,065	810,065	810,065	810,065	810,065
Dep mean	.127	.316	.108	.146	.211	.054	.038
Std effect	-.032	-.008	.088	-.014	-.068	.108	-.023

Note: IV estimates of Equation 10. Outcomes are mutually exclusive categories of pupils' highest degree achieved at age 25: Having only Compulsory education. For the Vocational track: Having a basic three year secondary degree (Sec), having additional qualifications or high school coursework beyond a basic degree (Sec Plus), having a tertiary degree from a polytechnic (Tert). For the Academic track: Having a three year high school degree (Sec), having a three year university BA degree (Tert: BA), having a two year university MA degree (Tert: MA) or higher. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table 7: First stage, reduced form and IV: Applications for post-compulsory education

	First stage			RF			IV		
	Avg share male			Apply			Apply		
Total share 60	0.033	0.033	0.043	0.048**	0.048**	0.018	0.031	0.025	–0.001
	(0.036)	(0.036)	(0.037)	(0.020)	(0.021)	(0.021)	(0.025)	(0.027)	(0.020)
Total share 60 * post	–0.176***	–0.176***	–0.168***	–0.096***	–0.122***	–0.071***			
	(0.042)	(0.042)	(0.043)	(0.026)	(0.031)	(0.027)			
Avg share male							0.544***	0.696***	0.424**
							(0.202)	(0.234)	(0.197)
Municipal FE	X	X	X	X	X	X	X	X	X
Cohort FE	X	X		X	X		X	X	
Region*Cohort FE			X			X			X
Ind. controls		X	X		X	X		X	X
MOP F^{eff}							17.66	17.64	15.28
Adj. R^2	0.916	0.916	0.922	0.038	0.069	0.070			
Obs	825,094	825,094	825,094	825,094	825,094	825,094	825,094	825,094	825,094
Dep mean	.313	.313	.313	.9106	.9106	.9106	.9106	.9106	.9106

Note: Columns 1-3 show estimates for Equation 11 with the average share male teachers pupils are exposed to during primary school as the outcome. Columns 4-6 show reduced form estimates (corresponding to Equation 11), and Columns 7-9 show IV estimates of Equation 10, with a pupil applying directly in the spring of the year they turn 16 (i.e. the last year of middle school) as the outcome. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table 8: Applications and enrollment for post-compulsory education

	Apply directly	Apply late	Apply never	Pref. choice	No spot	Enrolled at 16	Enrolled ever
Avg share male	0.424**	–0.353**	–0.071	0.547**	–0.145	0.608**	0.124*
	(0.197)	(0.178)	(0.073)	(0.244)	(0.098)	(0.309)	(0.074)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	15.28	15.28	15.28	15.28	15.28	13.00	13.00
Obs	825,094	825,094	825,094	825,094	825,094	695,340	695,340
Dep mean	.911	.067	.022	.862	.04	.861	.98
Std effect	.095	-.09	-.031	.101	-.047	.11	.055

Note: IV estimates for Equation 10. Outcomes in columns 1-3 are mutually exclusive categories of applications to upper secondary education: Pupils apply directly in spring of the year in which they turn 16 (Apply directly), they apply up to four years after they have turned 16 (Apply late), or they apply never or later than five years after having turned 16 (Apply never). "Allocation" (columns 4-5): Pupils obtain one of their first two preferred choices in the application (Pref. choice), or do not obtain a study slot (No spot). "Enrollment" (columns 6-7): Pupils are enrolled in upper secondary education in the fall of the year in which they turn 16 (Enrolled at age 16), and ever enrolled in upper secondary education up to age 25 (Ever enrolled). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table 9: All: Field of education at age 25

	Male	Neutral	Female	STEM	STEM-M	Education/ Teacher	Primary Teacher
Avg share male	0.302	–0.500*	0.197	0.595**	0.707**	–0.013	0.063
	(0.229)	(0.286)	(0.191)	(0.273)	(0.323)	(0.073)	(0.049)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	15.37	15.37	15.37	15.37	15.37	15.37	15.37
Obs	811,392	811,392	811,392	811,392	811,392	811,392	811,392
Dep mean	.303	.433	.264	.264	.379	.023	.011
Std effect	.042	-.064	.028	.086	.093	-.006	.039

Note: IV estimates of Equation 10. Outcomes from left to right: Field is 'Male' dominated ($\geq$ 40% male), (gender) 'Neutral' or 'Female' dominated ($\geq$ 40% female), based on previous generation. Field is STEM or STEM + Medicine (STEM-M). Field is Education Science or Teacher. Field is Primary School Teacher. Individual level controls are measured at age 7 and include language (SE/FI), foreign origin, single parent HH, highest degree attained in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table 10: Exit and hiring patterns in municipalities

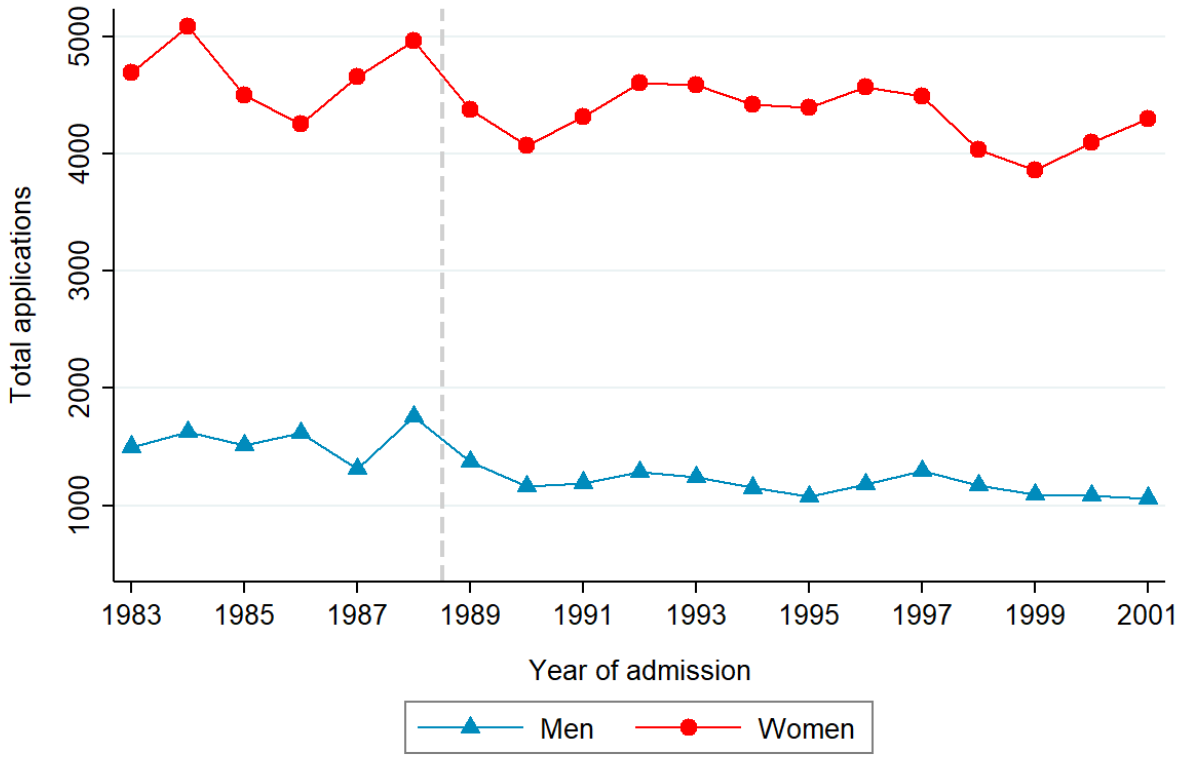
	Leave	Leave $\leq$ 55	Δ Age	Δ Time since degree	First entr ($\leq$ 28)	First entr ($\leq$ 30)
Share 60	0.873***	–0.049	–16.088***	–15.599***	0.335	0.386
	(0.061)	(0.057)	(1.215)	(1.154)	(0.315)	(0.314)
Share 60 * post	0.041	–0.000	–1.300	–1.051	–0.043	–0.126
	(0.067)	(0.063)	(1.387)	(1.323)	(0.375)	(0.372)
Y FE	X	X	X	X	X	X
Adj. R^2	0.176	0.011	0.222	0.211	0.038	0.036
Obs	4448	4448	4448	4448	3746	3746
Dep mean	.1	.07	-.21	-.2	.35	.4

Estimates for Equation 9. Outcomes from left to right are: Share of teachers exiting, share of teachers below age 55 exiting, year-on-year changes in average age of all local teachers (Δ Age), average time since obtaining a teaching degree of all local teachers (Δ Time since degree). The share of new teacher arriving that are first entrants defined as not having taught before and being below age 28 (column 5), and below age 30 (column 6). Standard errors clustered at the municipality level. Regressions weighted by population, means unweighted. * p<0.1, ** p<0.05, *** p<0.01 (back)

Appendix Tables and Figures

A Total applications

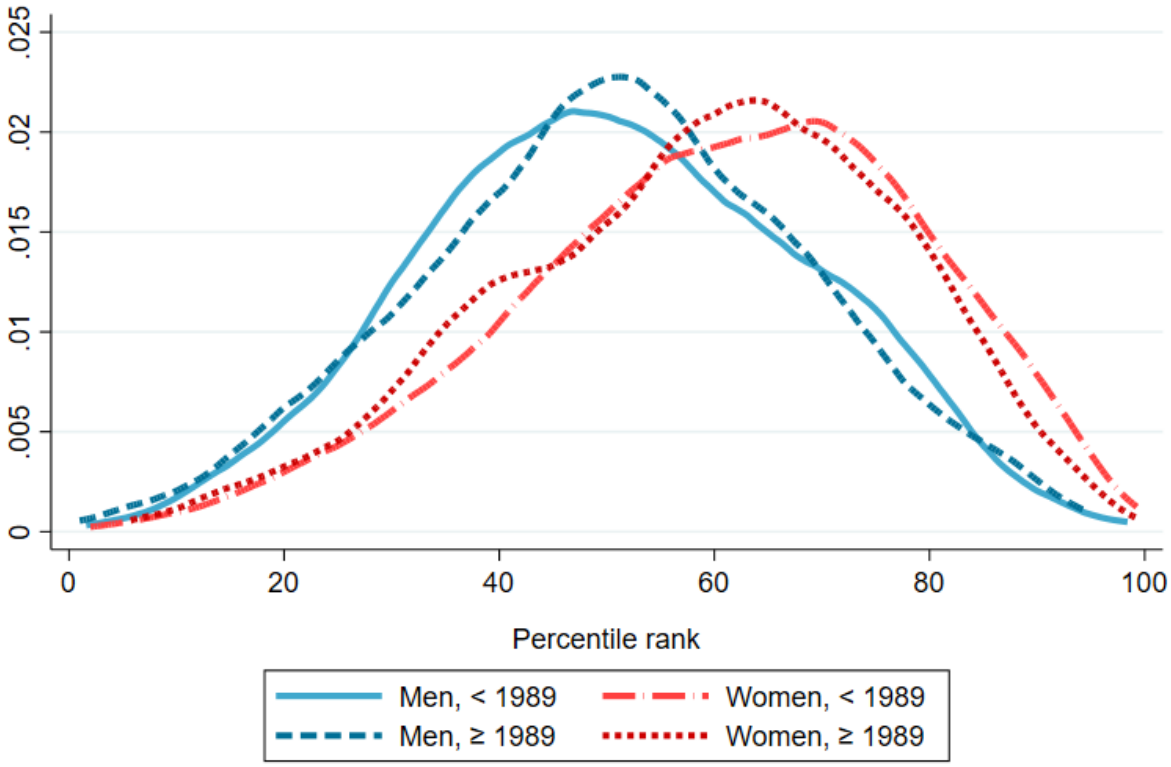
Figure A1: Total applications by gender



Note: Total number of male and female applicants to primary teacher studies. *Source:* Liimatainen (2002). (back)

B Matriculation score distribution

Figure A2: Distribution of matriculation exam percentile rank by teacher gender



Note: Smoothed density of national percentile rank across all subjects in the matriculation exam among primary school teachers, by gender and year in which they took the matriculation exam (qualifies applicants for university admissions). Bundled into six cohorts of exam takers pre-1989, and six cohorts in 1989 and thereafter. Cohorts taking the exam in 1989 and thereafter will have studied after the male primary teacher quota was abolished. (back)

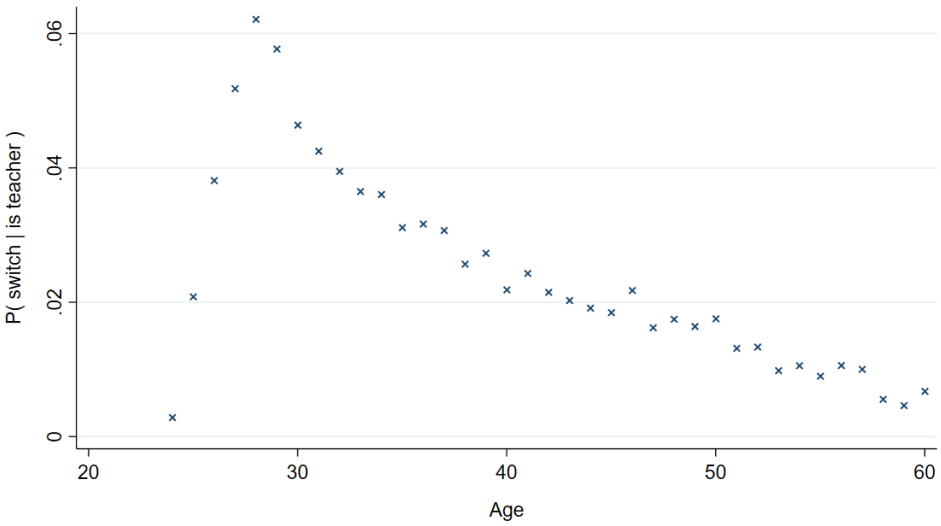
Table A1: First stage in teacher score sample

Total share 60	0.067
	(0.043)
Total share 60 * post	–0.223***
	(0.050)
M*Post FE	X
Y FE	
R*Y FE	X
M*Y controls	
Adj. R^2	0.870
Obs	4351
Dep mean	.34

Note: Estimates for Equation 8 for restricted sample of municipalities where at least one teacher test score is observable at baseline. Standard errors clustered at the municipality level. Regressions weighted by population, means unweighted. * p<0.1, ** p<0.05, *** p<0.01 (back)

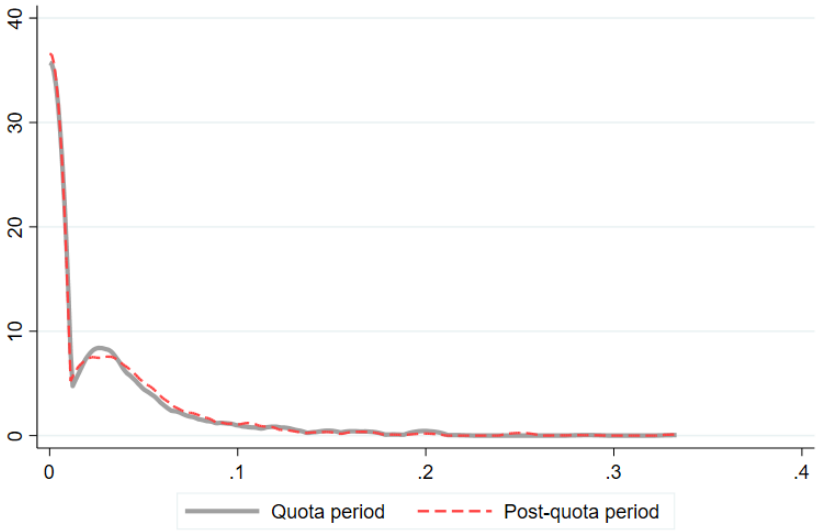
C Teacher switching and retirement

Figure A3: Probability of switching municipality of work for active teachers by age



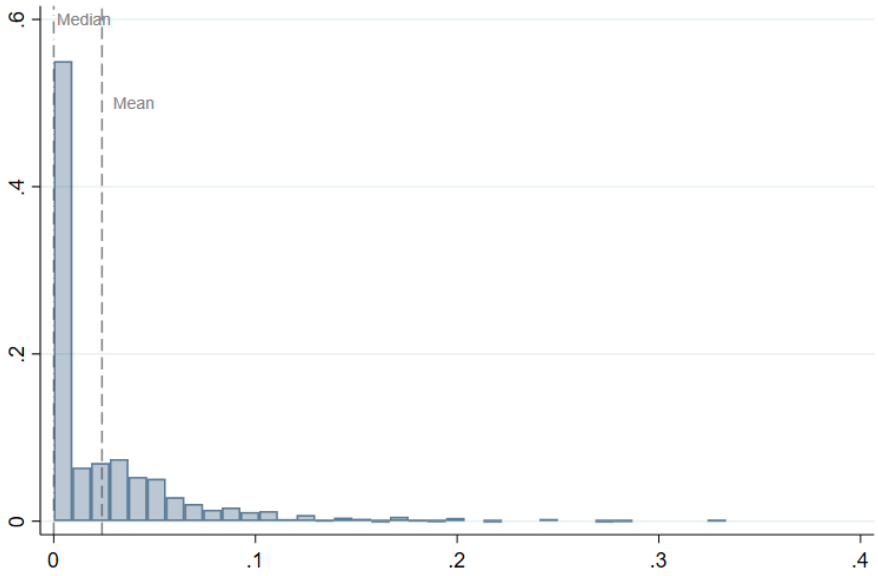
Note: Share of primary school teachers having switched the municipality in which they are working as a primary school teacher at a given age, conditional on having worked as a primary school teacher in the previous year. Data for all active primary school teachers in the years 1990-2000. (back)

Figure A4: Distribution of share primary teachers turning 60



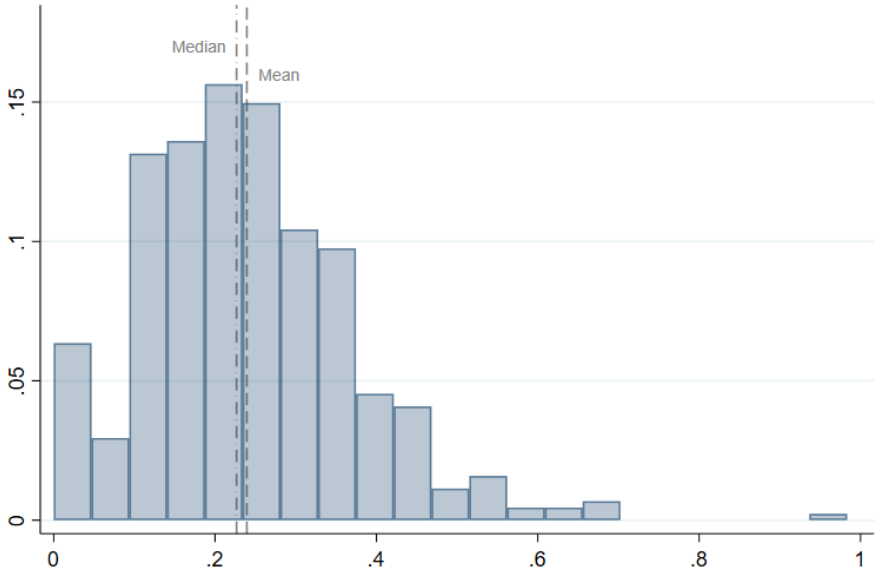
Note: Smoothed density of yearly municipal share of primary school teachers turning 60, separately by years in the quota period (1991-93) and post-quota period (1994-2000). (back)

Figure A5: Distribution of share primary teachers turning 60 (yearly)



Note: Histogram of yearly municipal share of primary school teachers turning 60. (back)

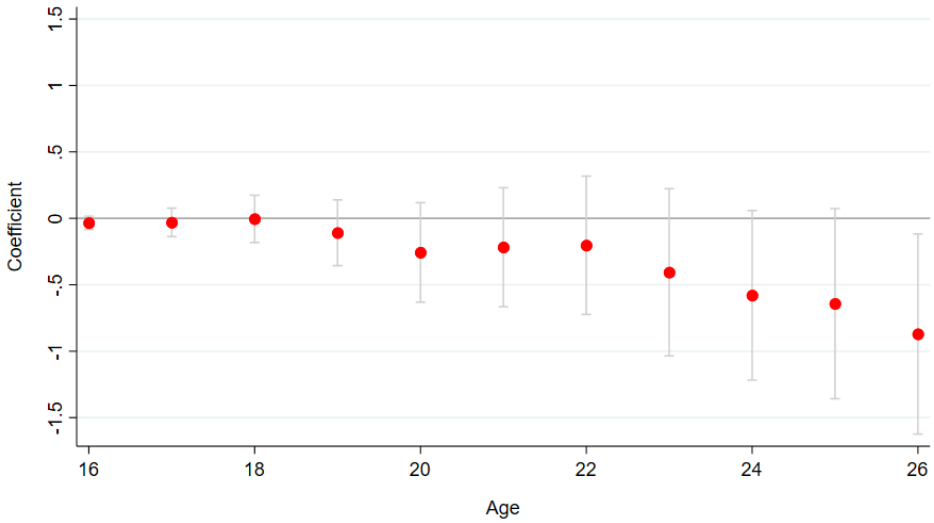
Figure A6: Distribution of total share primary teachers turning 60, 1991-2000



Note: Histogram of cumulative municipal share of primary school teachers turning 60 (adding up all retirements within municipality from 1991-2000). (back)

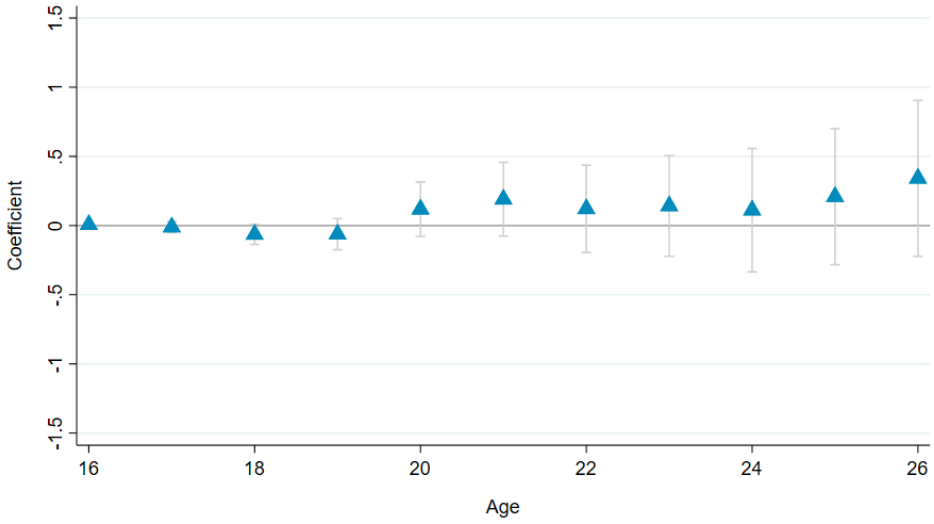
D Fertility

Figure A7: Female pupils: Probability of first birth having occurred by age



Note: IV estimates of Equation 10. Outcome: First birth having occurred by age. Individual level controls are measured at age 7 and include language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. (back)

Figure A8: Male pupils: Probability of first birth having occurred by age



Note: IV estimates of Equation 10. Outcome: First birth having occurred by age. Individual level controls are measured at age 7 and include language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. (back)

Table A2: Female pupils: Probability of first birth having occurred by age

	16	17	18	19	20	21	22	23	24	25	26
Avg share male	–0.034	–0.031	–0.004	–0.109	–0.257	–0.217	–0.203	–0.406	–0.579*	–0.642*	–0.871**
	(0.026)	(0.055)	(0.091)	(0.126)	(0.191)	(0.229)	(0.266)	(0.321)	(0.326)	(0.365)	(0.384)
Municipal FE	X	X	X	X	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X	X	X	X	X
MOP F^{eff}	15.75	15.75	15.75	15.75	15.75	15.75	15.75	15.75	15.75	15.75	15.75
Obs	396,108	396,108	396,108	396,108	396,108	396,108	396,108	396,108	396,108	396,108	396,108
Dep mean	.001	.005	.013	.03	.056	.087	.119	.152	.188	.229	.273
Std effect	-.059	-.028	-.002	-.041	-.071	-.049	-.04	-.072	-.094	-.097	-.124

Table A3: Male pupils: Probability of first birth having occurred by age

	16	17	18	19	20	21	22	23	24	25	26
Avg share male	0.007	–0.011	–0.064*	–0.063	0.119	0.190	0.121	0.142	0.111	0.209	0.342
	(0.009)	(0.021)	(0.037)	(0.057)	(0.100)	(0.136)	(0.161)	(0.186)	(0.227)	(0.251)	(0.288)
Municipal FE	X	X	X	X	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X	X	X	X	X
MOP F^{eff}	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92	14.92
Obs	415,679	415,679	415,679	415,679	415,679	415,679	415,679	415,679	415,679	415,679	415,679
Dep mean	0	.001	.003	.008	.018	.032	.052	.075	.101	.131	.165
Std effect	.027	-.023	-.076	-.045	.057	.069	.035	.034	.023	.039	.059

Note: IV estimates for Equation 10. Outcome is the likelihood of having had the first birth (for male pupils: becoming a father) by age, from 16 to 26. Individual level controls are measured at age 7 and include language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

E Reduced form

Table A4: Reduced Form: Labor market outcomes at age 25

	Employed/ Student	Un-employed	DI/ Pension	Other out of LF
Total share 60	0.042	–0.001	–0.005	–0.034**
	(0.029)	(0.022)	(0.009)	(0.015)
Total share 60 *	–0.086***	0.006	0.021*	0.055***
post	(0.033)	(0.026)	(0.011)	(0.018)
Municipal FE	X	X	X	X
Region*Cohort FE	X	X	X	X
Ind. controls	X	X	X	X
Obs	811,392	811,392	811,392	811,392
Dep mean	.842	.086	.017	.053

Note: Reduced Form estimates as in Equation 11. Outcomes are mutually exclusive categories of pupils' labor market status measured at age 25: Being in employment or a student, unemployed, on disability insurance (DI) or receiving pension payments, or being out of the labor force for other reasons. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table A5: Reduced Form: Highest degree achieved at age 25

	Compulsory schooling	Vocational			Academic		
		Sec	Sec Plus	Tert	Sec	Tert: BA	Tert: MA
Total share 60	–0.007	–0.005	0.029	–0.005	–0.034	0.027	–0.005
	(0.019)	(0.036)	(0.023)	(0.028)	(0.027)	(0.016)	(0.012)
Total share 60 * post	0.029	0.009	–0.072**	0.013	0.074**	–0.065***	0.012
	(0.024)	(0.044)	(0.029)	(0.036)	(0.034)	(0.022)	(0.015)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
Obs	810,065	810,065	810,065	810,065	810,065	810,065	810,065
Dep mean	.127	.316	.108	.146	.211	.054	.038

Note: Reduced Form estimates as in Equation 11. Outcomes are mutually exclusive categories of pupils' highest degree achieved at age 25: Having only Compulsory education. For the Vocational track: Having a basic three year secondary degree (Sec), having additional qualifications or high school coursework beyond a basic degree (Sec Plus), having a tertiary degree from a polytechnic (Tert). For the Academic track: Having a three year high school degree (Sec), having a three year university BA degree (Tert: BA), having a two year university MA degree (Tert: MA) or higher. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table A6: Reduced Form: Applications and enrollment for post-compulsory education

	Apply directly	Apply late	Apply never	Pref. choice	No spot	Enrolled at 16	Enrolled ever
Total share 60	0.018	–0.021	0.003	–0.010	0.002	0.026	0.005
	(0.021)	(0.019)	(0.009)	(0.027)	(0.014)	(0.028)	(0.008)
Total share 60 * post	–0.071***	0.059**	0.012	–0.092***	0.024	–0.089**	–0.018*
	(0.027)	(0.025)	(0.012)	(0.035)	(0.016)	(0.035)	(0.010)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
Obs	825,094	825,094	825,094	825,094	825,094	695,340	695,340
Dep mean	.911	.067	.022	.862	.04	.861	.98

Note: Reduced Form estimates as in Equation 11. Outcomes in columns 1-3 are mutually exclusive categories of applications to upper secondary education: Pupils apply directly in spring of the year in which they turn 16 (Apply directly), they apply up to four years after they have turned 16 (Apply late), or they apply never or later than five years after having turned 16 (Apply never). "Allocation" (columns 4-5): Pupils obtain one of their first two preferred choices in the application (Pref. choice), or do not obtain a study slot (No spot). "Enrollment" (columns 6-7): Pupils are enrolled in upper secondary education in the fall of the year in which they turn 16 (Enrolled at age 16), and ever enrolled in upper secondary education up to age 25 (Ever enrolled). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

F IV estimates by gender

Table A7: By gender: Labor market outcomes at age 25

	Employed/ Student	Un-employed	DI/ Pension	Other out of LF
Boys * avg share	0.685***	–0.007	–0.145*	–0.526***
male	(0.254)	(0.161)	(0.078)	(0.143)
Girls * avg	0.320	–0.079	–0.102	–0.099
share male	(0.243)	(0.156)	(0.077)	(0.139)
Municipal FE	X	X	X	X
Region*Cohort FE	X	X	X	X
Ind. controls	X	X	X	X
MOP F^{eff}	15.37	15.37	15.37	15.37
Obs	811,392	811,392	811,392	811,392
Boys: Dep mean	.84	.102	.019	.037
Girls: Dep mean	.845	.07	.015	.07
Boys: Std effect	.119	-.001	-.067	-.179
Girls: Std effect	.056	-.02	-.053	-.025

Note: IV estimates for Equation 10. Outcomes are mutually exclusive categories of pupils' labor market status measured at age 25: Being in employment or a student, unemployed, on disability insurance (DI) or receiving pension payments, or being out of the labor force for other reasons. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table A8: By gender: Highest degree achieved at age 25

	Compulsory schooling	Vocational			Academic		
		Sec	Sec Plus	Tert	Sec	Tert: BA	Tert: MA
Boys * avg share	0.242	–0.194	0.458**	–0.262	–0.432*	0.317**	–0.128
male	(0.176)	(0.277)	(0.216)	(0.217)	(0.232)	(0.143)	(0.091)
Girls * avg	–0.632***	0.092	0.391*	0.133	–0.446*	0.465***	–0.003
share male	(0.185)	(0.274)	(0.208)	(0.219)	(0.236)	(0.156)	(0.101)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	15.36	15.36	15.36	15.36	15.36	15.36	15.36
Obs	810,065	810,065	810,065	810,065	810,065	810,065	810,065
Boys: Dep mean	.152	.378	.081	.094	.231	.042	.022
Girls: Dep mean	.101	.251	.136	.201	.19	.067	.054
Boys: Std effect	.043	-.025	.107	-.057	-.065	.101	-.056
Girls: Std effect	-.133	.013	.073	.021	-.072	.118	-.001

Note: IV estimates for Equation 10. Outcomes are mutually exclusive categories of pupils' highest degree achieved at age 25: Having only Compulsory education. For the Vocational track: Having a basic three year secondary degree (Sec), having additional qualifications or high school coursework beyond a basic degree (Sec Plus), having a tertiary degree from a polytechnic (Tert). For the Academic track: Having a three year high school degree (Sec), having a three year university BA degree (Tert: BA), having a two year university MA degree (Tert: MA) or higher. Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table A9: By gender: Applications and enrollment for post-compulsory education

	Apply directly	Apply late	Apply never	Pref. choice	No spot	Enrolled at 16	Enrolled ever
Boys * avg share male	0.478**	–0.405**	–0.073	0.585**	–0.207**	0.720**	0.110
	(0.205)	(0.184)	(0.076)	(0.254)	(0.104)	(0.323)	(0.079)
Girls * avg share male	0.364*	–0.294*	–0.070	0.498**	–0.073	0.474	0.141*
	(0.193)	(0.176)	(0.072)	(0.247)	(0.099)	(0.301)	(0.074)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	15.28	15.28	15.28	15.28	15.28	13.00	13.00
Obs	825,094	825,094	825,094	825,094	825,094	695,340	695,340
Boys: Dep mean	.889	.086	.025	.857	.041	.845	.977
Girls: Dep mean	.933	.047	.02	.867	.039	.876	.982
Boys: Std effect	.097	-.092	-.03	.106	-.067	.124	.046
Girls: Std effect	.093	-.088	-.032	.093	-.024	.09	.066

Note: IV estimates for Equation 10. Outcomes in columns 1-3 are mutually exclusive categories of applications to upper secondary education: Pupils apply directly in spring of the year in which they turn 16 (Apply directly), they apply up to four years after they have turned 16 (Apply late), or they apply never or later than five years after having turned 16 (Apply never). "Allocation" (columns 4-5): Pupils obtain one of their first two preferred choices in the application (Pref. choice), or do not obtain a study slot (No spot). "Enrollment" (columns 6-7): Pupils are enrolled in upper secondary education in the fall of the year in which they turn 16 (Enrolled at age 16), and ever enrolled in upper secondary education up to age 25 (Ever enrolled). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table A10: By gender: Aspirations for post-compulsory education

	Apply	Choose:		Get:		
	never	any Voc	only Acad	no spot	Voc	Acad
Boys * avg share	–0.073	0.811**	–0.744**	–0.207**	0.263	0.017
male	(0.076)	(0.381)	(0.375)	(0.104)	(0.324)	(0.350)
Girls * avg	–0.070	–0.367	0.431	–0.073	–0.820**	0.962***
share male	(0.072)	(0.402)	(0.395)	(0.099)	(0.348)	(0.371)
Municipal FE	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X
MOP F^{eff}	15.28	15.28	15.28	15.28	15.28	15.28
Obs	825,094	825,094	825,094	825,094	825,094	825,094
Boys: Dep mean	.025	.629	.346	.041	.501	.433
Girls: Dep mean	.02	.443	.537	.039	.329	.612
Boys: Std effect	-.03	.107	-.1	-.067	.034	.002
Girls: Std effect	-.032	-.047	.055	-.024	-.111	.126

Note: IV estimates for Equation 10. Outcomes are mutually exclusive categories for columns 1-3: Pupils 'Apply Never', pupils put in a vocational degree in any of five available choices (Choose any Voc), or pupils put in only academic track choices (Choose only Acad) (We don't report an estimate for the separate category of 287 pupils who never put in a choice, but obtain a study slot nevertheless). Columns 1 and 4-6 are also mutually exclusive categories: Pupils 'Apply never', get allocated a spot in a vocational track (Voc), or get allocated a spot in the academic track (Acad). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table A11: Boys: Field of education at age 25

	Male	Neutral	Female	STEM	STEM-M	Education/ Teacher	Primary Teacher
Boys: Avg share male	0.506	–0.679*	0.172	0.653	0.492	0.032	0.032
	(0.388)	(0.408)	(0.188)	(0.439)	(0.425)	(0.060)	(0.046)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	14.91	14.91	14.91	14.91	14.91	14.91	14.91
Obs	415,571	415,571	415,571	415,571	415,571	415,571	415,571
Dep mean	.526	.39	.084	.412	.446	.009	.005
Std effect	.065	-.089	.04	.085	.063	.022	.031

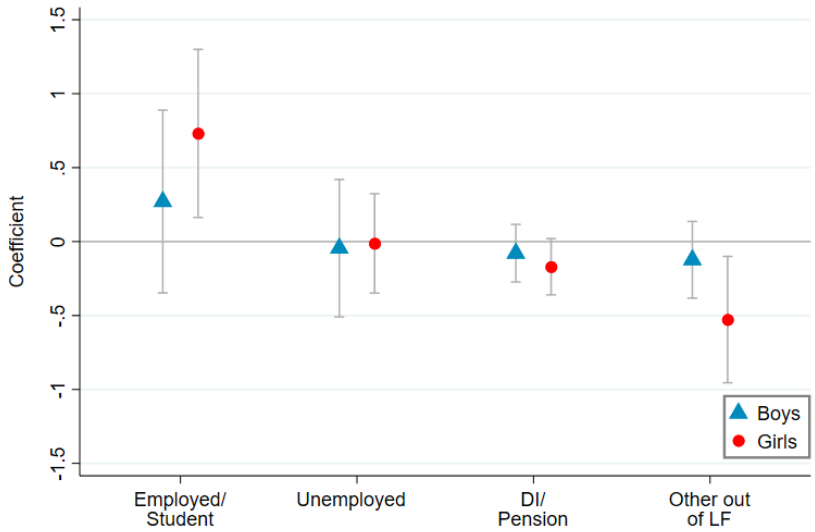
Table A12: Girls: Field of education at age 25

	Male	Neutral	Female	STEM	STEM-M	Education/ Teacher	Primary Teacher
Girls: Avg share male	0.089	–0.340	0.252	0.550**	0.977**	–0.049	0.101
	(0.212)	(0.360)	(0.321)	(0.264)	(0.399)	(0.128)	(0.088)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	15.75	15.75	15.75	15.75	15.75	15.75	15.75
Obs	395,821	395,821	395,821	395,821	395,821	395,821	395,821
Dep mean	.069	.478	.453	.108	.309	.038	.017
Std effect	.022	-.043	.032	.113	.134	-.016	.05

Note: IV estimates for Equation 10, separate regressions by gender. Outcomes from left to right: Field is 'Male' dominated ($\geq$ 40% male), (gender) 'Neutral' or 'Female' dominated ($\geq$ 40% female), based on previous generation. Field is STEM or STEM + Medicine (STEM-M). Field is Education Science or Teacher. Field is Primary School Teacher. Individual level controls are measured at age 7 and include language (SE/FI), foreign origin, single parent HH, highest degree attained in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

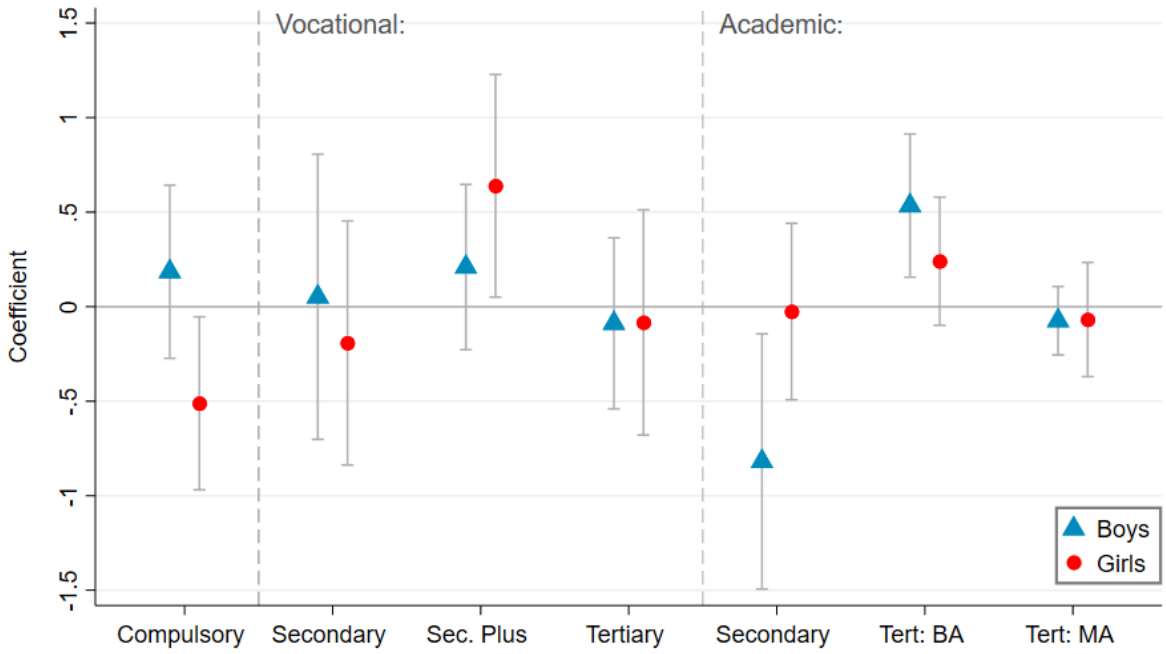
G Results by pupil gender: Split sample estimates

Figure A9: By gender: Labor market outcomes at age 25



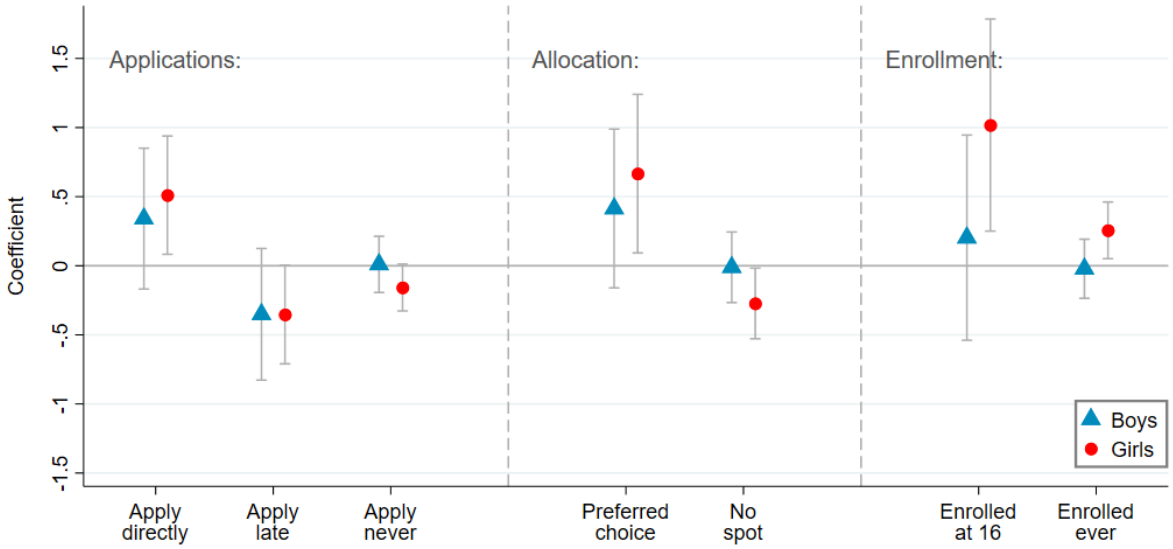
Note: IV estimates of Equation 10, split sample estimates by gender. See Figure 9b. (back)

Figure A10: By gender: Highest degree achieved at age 25



Note: IV estimates of Equation 10, split sample estimates by gender. See Figure 10b. (back)

Figure A11: By gender: Applications and enrollment for post-compulsory education



Note: IV estimates of Equation 10, split sample estimates by gender. See Figure 11b. (back)

H Results by single parent status

Table A13: By single parent status: Labor market outcomes at age 25

	Employed/ Student	Unemployed	DI/ Pension	Other out of LF
Both: Avg share	0.461*	–0.012	–0.107	–0.321**
male	(0.239)	(0.153)	(0.074)	(0.138)
Single: Avg	0.986***	–0.272	–0.315***	–0.354*
share male	(0.349)	(0.266)	(0.114)	(0.187)
Municipal FE	X	X	X	X
Region*Cohort FE	X	X	X	X
Ind. controls	X	X	X	X
MOP F^{eff}	15.32	15.32	15.32	15.32
Obs	804,799	804,799	804,799	804,799
Both: Dep mean	.854	.08	.016	.049
Single: Dep mean	.776	.125	.024	.075
Both: Std effect	.084	-.003	-.055	-.096
Single: Std effect	.138	-.048	-.121	-.079

Table A14: By single parent status: Highest degree achieved at age 25

	Compulsory schooling	Vocational			Academic		
		Sec	Sec Plus	Tert	Sec	Tert: BA	Tert: MA
Both: Avg share	–0.226	0.025	0.384*	–0.093	–0.352	0.319**	–0.056
male	(0.155)	(0.263)	(0.205)	(0.211)	(0.228)	(0.145)	(0.093)
Single: Avg	0.233	–0.591	0.741***	0.077	–1.258***	1.027***	–0.229*
share male	(0.249)	(0.370)	(0.264)	(0.268)	(0.328)	(0.233)	(0.119)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	15.31	15.31	15.31	15.31	15.31	15.31	15.31
Obs	803,494	803,494	803,494	803,494	803,494	803,494	803,494
Both: Dep mean	.11	.309	.11	.155	.217	.058	.041
Single: Dep mean	.227	.362	.097	.093	.171	.033	.018
Both: Std effect	-.047	.003	.079	-.017	-.055	.088	-.018
Single: Std effect	.032	-.072	.146	.015	-.195	.336	-.101

Note: IV estimates for Equation 10. Heterogeneity with respect to whether pupils live with two parents (Both) or a single parent (Single) at age 7. Outcomes are pupils' labor market status (see Table 5) and highest degree achieved (see Table 6). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table A15: By single parent status: Applications and enrollment for post-compulsory education

	Apply directly	Apply late	Apply never	Pref. choice	No spot	Enrolled at 16	Enrolled ever
Both: Avg share	0.407**	–0.338*	–0.069	0.570**	–0.158	0.599*	0.154**
male	(0.195)	(0.175)	(0.073)	(0.246)	(0.099)	(0.309)	(0.077)
Single: Avg	0.409	–0.277	–0.132	0.573*	–0.200	0.664	0.027
share male	(0.314)	(0.246)	(0.128)	(0.328)	(0.148)	(0.445)	(0.204)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
MOP F^{eff}	15.23	15.23	15.23	15.23	15.23	12.94	12.94
Obs	818,112	818,112	818,112	818,112	818,112	689,105	689,105
Both: Dep mean	.922	.058	.02	.873	.035	.878	.984
Single: Dep mean	.849	.118	.034	.797	.072	.772	.962
Both: Std effect	.098	-.093	-.032	.11	-.055	.115	.077
Single: Std effect	.067	-.05	-.043	.083	-.045	.091	.008

Note: IV estimates for Equation 10. Heterogeneity with respect to whether pupils live with two parents (Both) or a single parent (Single) at age 7. Outcomes are pupils' applications to post-compulsory education (see Table 8). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

I Complementarities between male and female teachers

Table A16: Complementarities: Low share male - Main outcomes at age 25

	Employed/ Student	Un-employed	DI/ Pension	Other out of LF
Low: Avg share male	0.752	–0.149	–0.199	–0.344
	(0.599)	(0.342)	(0.197)	(0.294)
Municipal FE	X	X	X	X
Region*Cohort FE	X	X	X	X
Ind. controls	X	X	X	X
MOP F^{eff}	3.78	3.78	3.78	3.78
Obs	579,101	579,101	579,101	579,101
Dep mean	.846	.082	.017	.053
Std effect	.099	-.026	-.073	-.073

Table A17: Complementarities: High share male - Main outcomes at age 25

	Employed/ Student	Un-employed	DI/ Pension	Other out of LF
High: Avg share male	0.663	0.002	–0.208	–0.453
	(0.488)	(0.301)	(0.161)	(0.280)
Municipal FE	X	X	X	X
Region*Cohort FE	X	X	X	X
Ind. controls	X	X	X	X
MOP F^{eff}	5.00	5.00	5.00	5.00
Obs	226,794	226,794	226,794	226,794
Dep mean	.832	.097	.018	.052
Std effect	.098	0	-.088	-.113

Note: IV estimates for Equation 10, split sample by initial share male teachers in a municipality in 1990. Outcomes are pupils' labor market status (c.f. Table 5). Individual level controls are measured at age 7 and include gender, language (SE/FI/other), foreign origin, single parent HH, highest level of education in HH. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

J Maternity/Paternity of teachers

Table A18: Teachers having children in municipalities

	Birth total	Birth fem	Birth male	Maternity leave
Share 60	–0.127***	–0.109***	–0.018	–0.003
	(0.040)	(0.029)	(0.025)	(0.030)
Share 60 * post	0.075	0.036	0.039	–0.040
	(0.050)	(0.036)	(0.029)	(0.032)
Y FE	X	X	X	X
Adj. R^2	0.007	0.006	0.012	0.005
Obs	4448	4448	4448	4448
Dep mean	.06	.03	.02	.02

Note: Estimates for Equation 9. Outcomes from left to right are: Share of teachers with the birth of a child, share of teachers who are female and have a birth (column 2), and who male and have a birth (column 3), share of teachers who are female and on leave after birth (defined as not being an active teacher in the year subsequent to having given birth). Standard errors clustered at the municipality level. Regressions weighted by population, means unweighted. * p<0.1, ** p<0.05, *** p<0.01 (back)

Table A19: Effect on main outcomes of female teachers having a newborn child

	Employed/ Student	Un-employed	DI/ Pension	Other out of LF	Apply directly	Apply late	Apply never
Female teachers	–0.003	–0.007	0.006*	0.003	–0.009	0.006	0.003
having a child	(0.010)	(0.008)	(0.003)	(0.005)	(0.008)	(0.008)	(0.003)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
Obs	811,392	811,392	811,392	811,392	825,094	825,094	825,094
Dep mean	.842	.086	.017	.053	.911	.067	.022

Note: Specification equivalent to Equation 11, but estimating the effect of total exposure to female teachers having a newborn child while pupils are in primary school. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

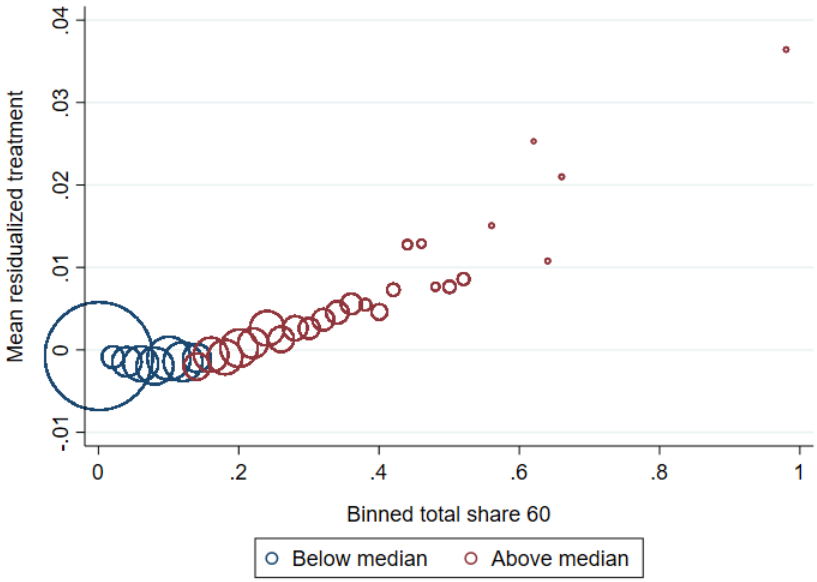
Table A20: Effect on main outcomes of male teachers having a newborn child

	Employed/ Student	Un-employed	DI/ Pension	Other out of LF	Apply directly	Apply late	Apply never
Male teachers having a child	–0.021 (0.013)	0.009 (0.010)	–0.007* (0.004)	0.018** (0.007)	–0.008 (0.010)	0.006 (0.009)	0.002 (0.005)
Municipal FE	X	X	X	X	X	X	X
Region*Cohort FE	X	X	X	X	X	X	X
Ind. controls	X	X	X	X	X	X	X
Obs	811,392	811,392	811,392	811,392	825,094	825,094	825,094
Dep mean	.842	.086	.017	.053	.911	.067	.022

Note: Specification equivalent to Equation 11, but estimating the effect of total exposure to male teachers having a newborn child while pupils are in primary school. Standard errors clustered at the municipality level. * p<0.1, ** p<0.05, *** p<0.01 (back)

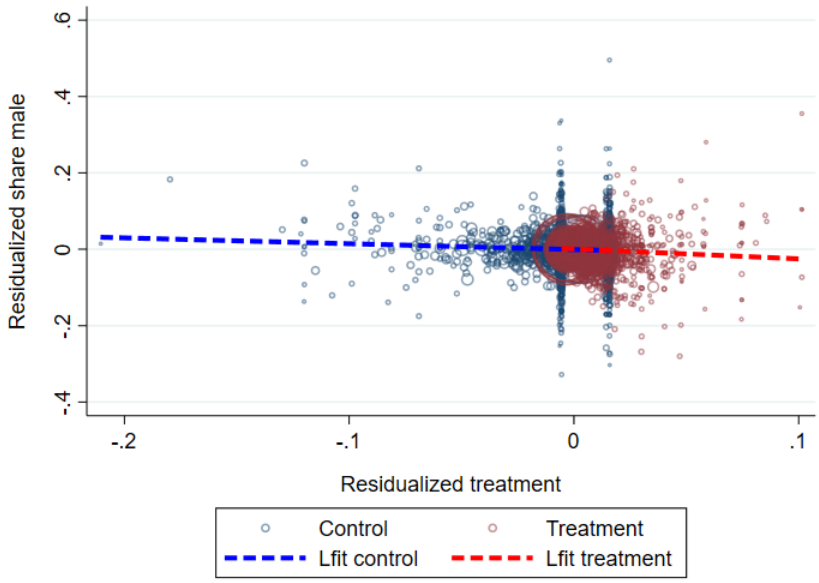
K TWFE robustness

Figure A12: Municipality level: Residuals by treatment intensity



Note: Residuals of Equation 13. Average residual against binned total exposure to retirements in the post period (treatment variable). Weighted by number of municipalities per bin. (back)

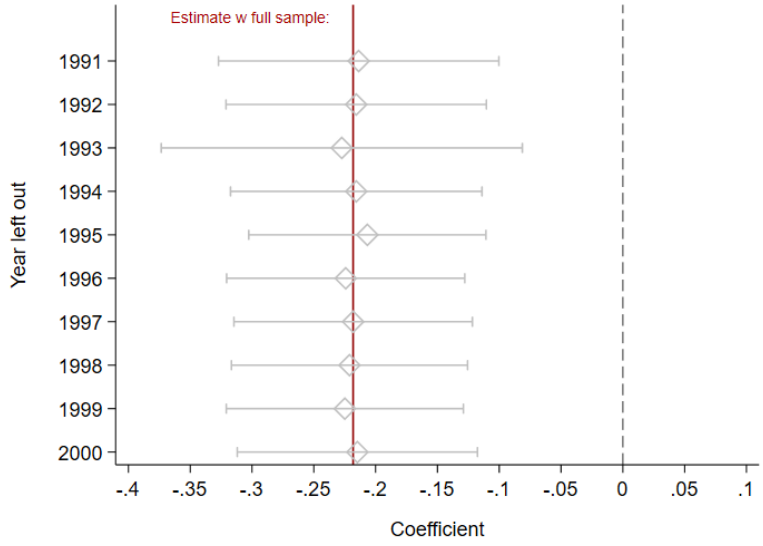
Figure A13: Municipality level: Residual plot



Note: Residual plot of Equation 8 with residualized outcome against residualized treatment. Data and linear fits are population weighted. Each dot is a municipal*year observation. Control observation are those without a retirement in the post-quota period in that municipal*year cell, and Treatment observations are those with a positive retirement value in the post-quota period in that municipal*year cell. (back)

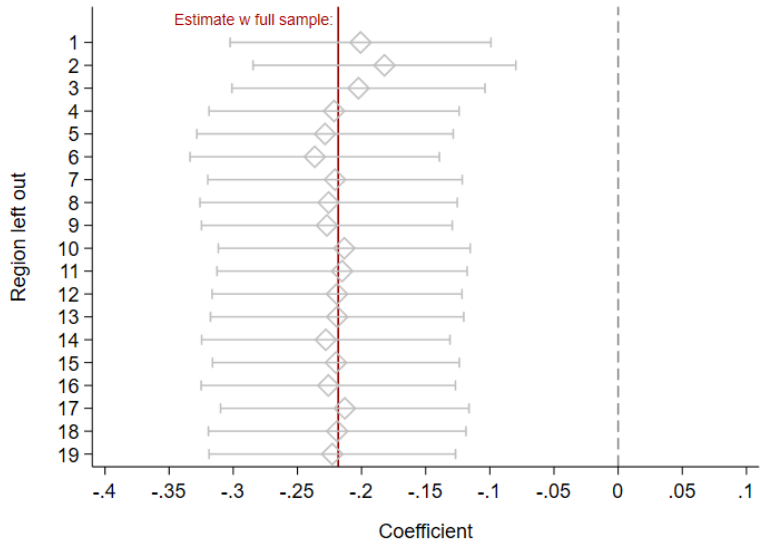
L Leave one out estimation

Figure A14: Municipality level: Leave one out - years



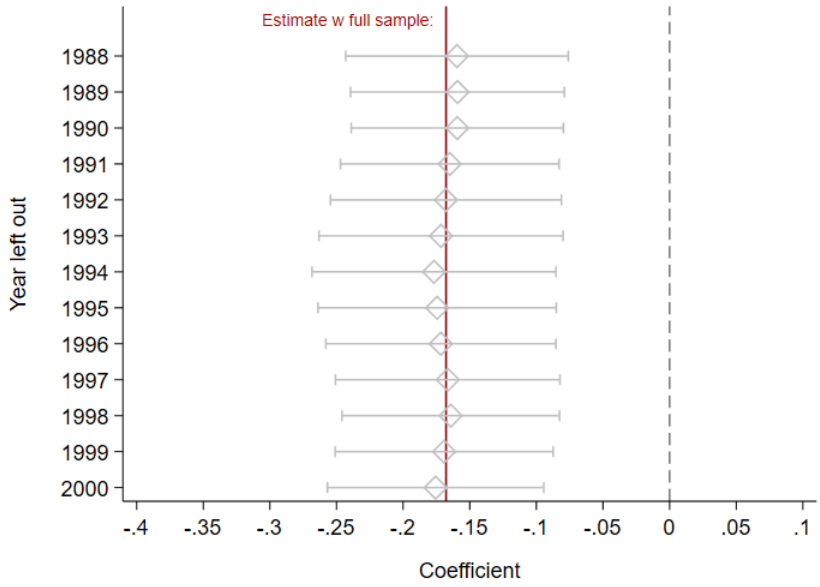
Note: Leave one out estimation of treatment coefficient in Equation 8 with respect to years. (back)

Figure A15: Municipality level: Leave one out - region



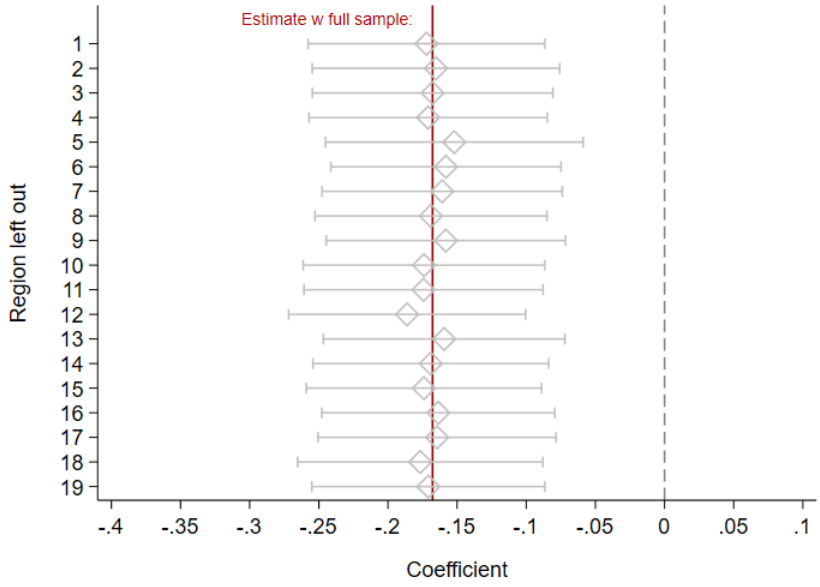
Note: Leave one out estimation of treatment coefficient in Equation 8 with respect to regions. (back)

Figure A16: Pupil level: Leave one out - cohort



Note: Leave one out estimation of treatment coefficient in Equation 11 with respect to cohorts.

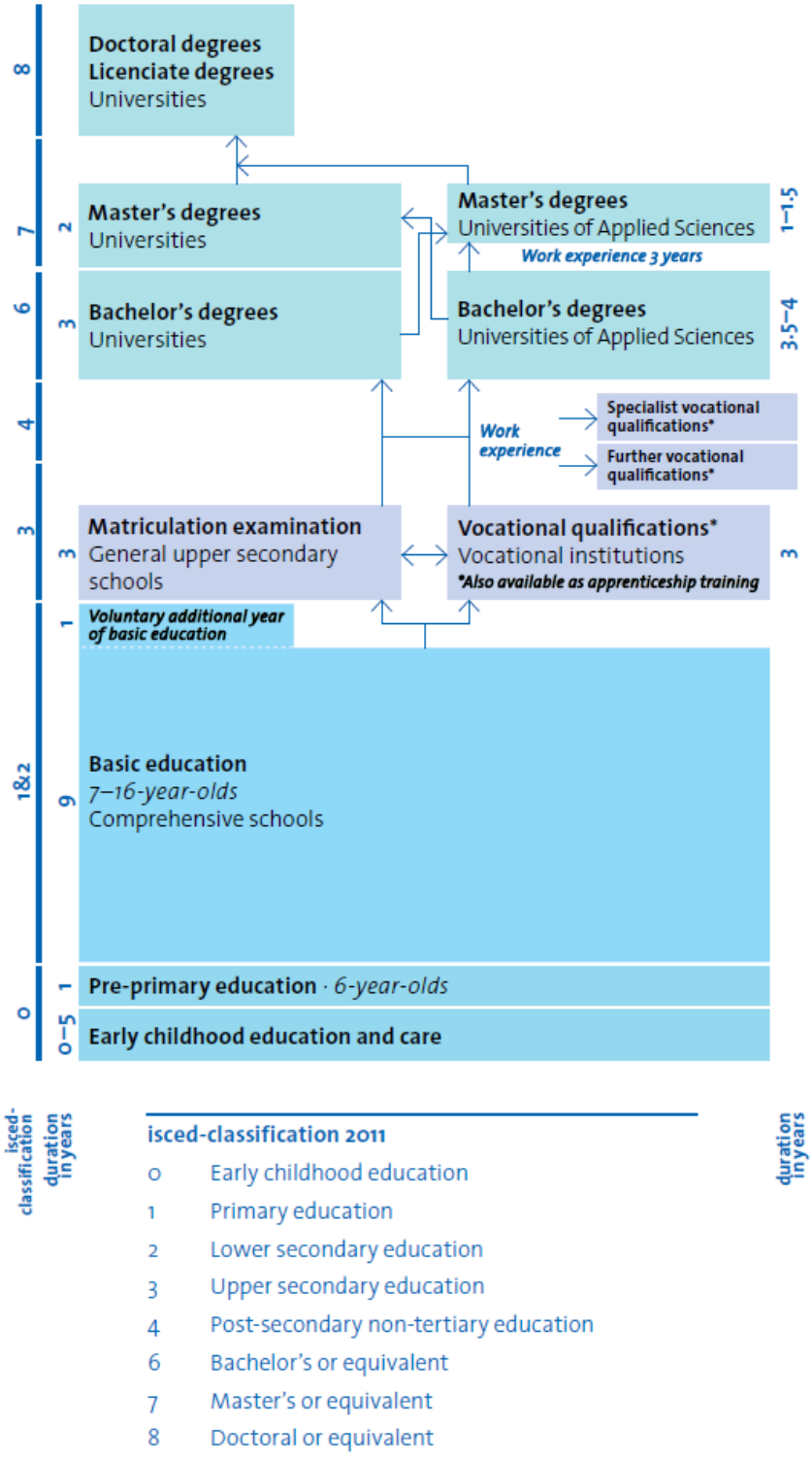
Figure A17: Pupil level: Leave one out - region



Note: Leave one out estimation of treatment coefficient in Equation 11 with respect to regions. (back)

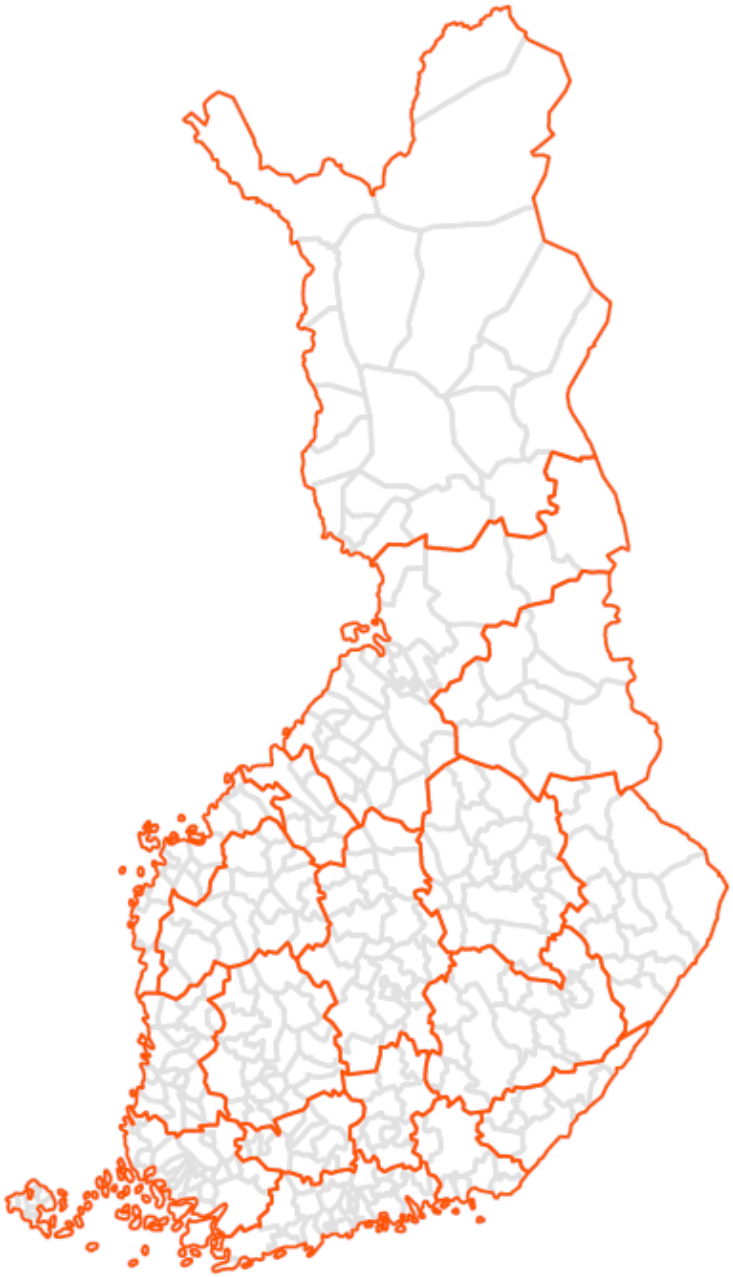
M Context

Figure A18: Finnish Education System



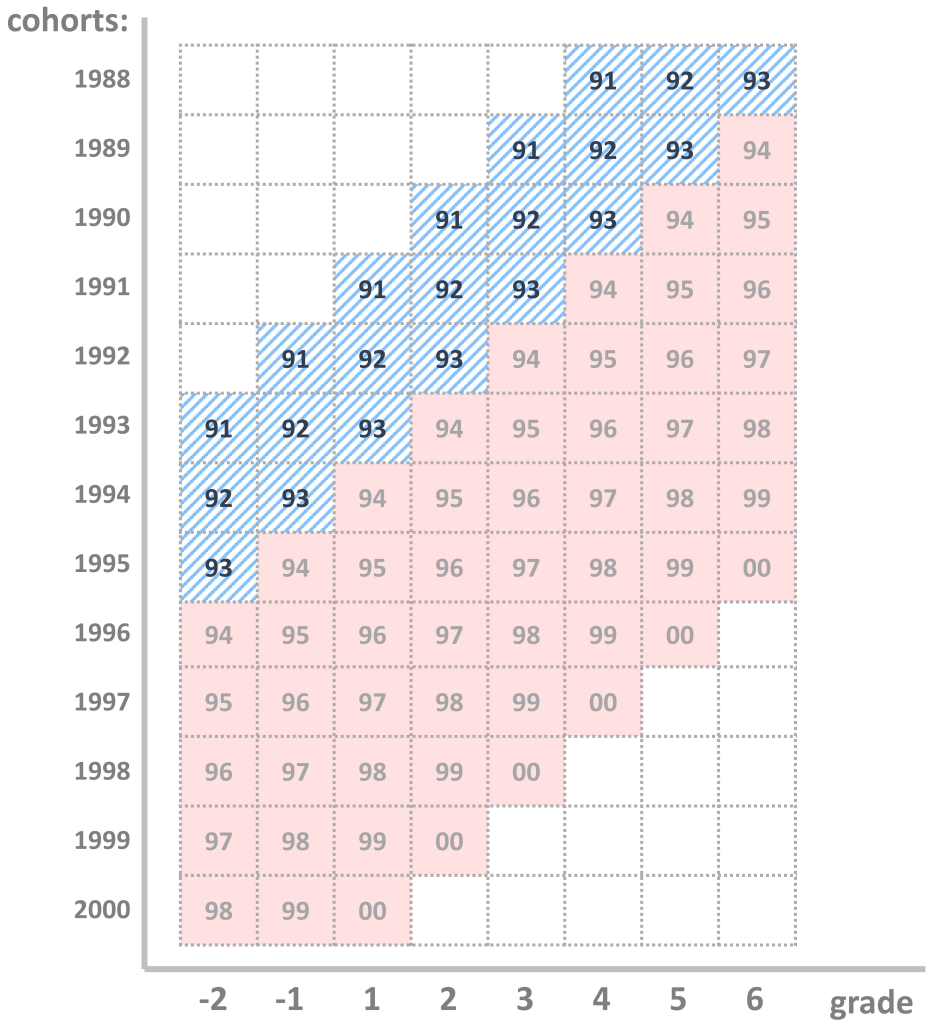
Note: Source: Ministry of Education, Finland. (back)

Figure A19: Region and municipality borders, Finland



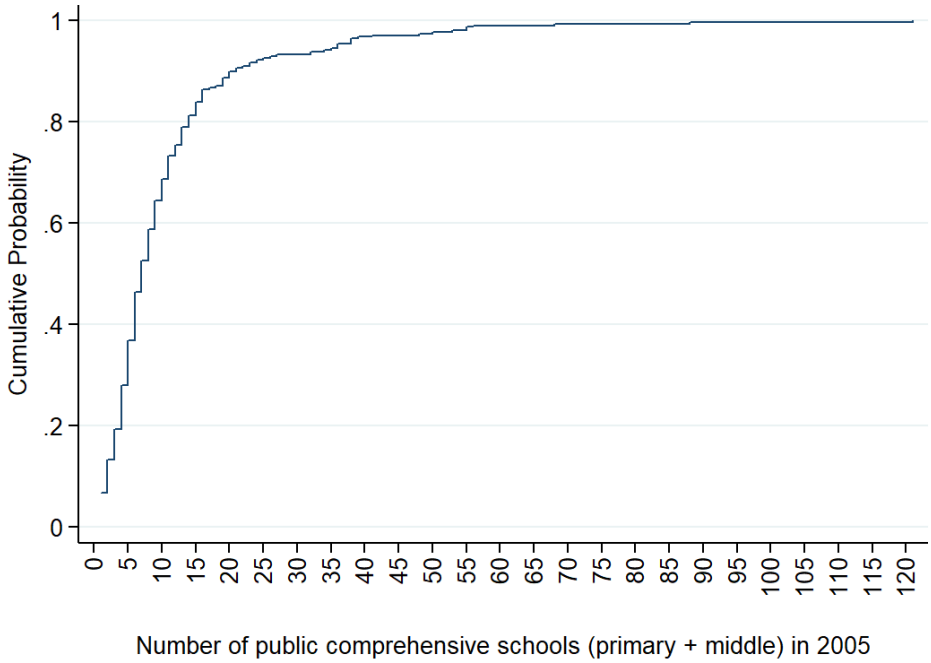
Note: Borders for 2019, shapefiles provided by Statistics Finland.

Figure A20: Pupil cohorts and exposure to quota period



Note: Figure shows cohorts by year in which they turn seven years old, and exposure to the quota by the grades which they spend in primary school. Years in which the quota was still in place colored in blue (with stripes), years in which the quota was abolished in red. (back)

Figure A21: CDF number of comprehensive (primary + middle) schools by municipality, 2005



Note: Figure shows CDF of number of total comprehensive schools by municipality. Not possible to differentiate by middle schools and primary schools. Data for 2005. (back)