

Flatø, Martin et al.

**Working Paper**

## Ready for School? Effects on School Starters of Establishing School Psychology Offices in Norway

CESifo Working Paper, No. 10352

**Provided in Cooperation with:**

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

*Suggested Citation:* Flatø, Martin et al. (2023) : Ready for School? Effects on School Starters of Establishing School Psychology Offices in Norway, CESifo Working Paper, No. 10352, Center for Economic Studies and Ifo Institute (CESifo), Munich

This Version is available at:

<https://hdl.handle.net/10419/271996>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

# Ready for School? Effects on School Starters of Establishing School Psychology Offices in Norway

*Martin Flatø, Bernt Bratsberg, Andreas Kotsadam, Fartein Ask Torvik, Ole Røgeberg, Camilla Stoltenberg*

## **Impressum:**

CESifo Working Papers

ISSN 2364-1428 (electronic version)

Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH

The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute

Poschingerstr. 5, 81679 Munich, Germany

Telephone +49 (0)89 2180-2740, Telefax +49 (0)89 2180-17845, email [office@cesifo.de](mailto:office@cesifo.de)

Editor: Clemens Fuest

<https://www.cesifo.org/en/wp>

An electronic version of the paper may be downloaded

- from the SSRN website: [www.SSRN.com](http://www.SSRN.com)
- from the RePEc website: [www.RePEc.org](http://www.RePEc.org)
- from the CESifo website: <https://www.cesifo.org/en/wp>

# Ready for School? Effects on School Starters of Establishing School Psychology Offices in Norway

## Abstract

We consider long-term impacts of establishing school psychology offices in Norway, which introduced ‘maturity testing’ to advice parents and school boards on school starting age. In the early reform period, children born close to the normative age cut-off who reached school-starting age after the establishment were more likely to finish compulsory schooling late, and experienced higher earnings as adults. When offices were instead able to block delayed school entry after a legislative change, having an office in operation led to a reduction in the likelihood of late graduation for the youngest children in each cohort, and no long-term benefits.

JEL-Codes: I210, I240, I260, I280, J240, N340.

Keywords: school psychology, maturity, school readiness, redshirting, school starting age, Norway.

*Martin Flatø\**

*Centre for Fertility and Health, Norwegian  
Institute of Public Health, Oslo / Norway  
martin.flato@fhi.no*

*Bernt Bratsberg*

*Ragnar Frisch Centre for Economic Research  
Oslo / Norway  
bernt.bratsberg@frisch.uio.no*

*Andreas Kotsadam*

*Ragnar Frisch Centre for Economic Research  
Oslo / Norway  
andreas.kotsadam@frisch.uio.no*

*Fartein Ask Torvik*

*Norwegian Institute of Public Health  
Oslo / Norway  
fartein.ask.torvik@fhi.no*

*Ole Røgeberg*

*Ragnar Frisch Centre for Economic Research  
Oslo / Norway  
ole.rogeberg@frisch.uio.no*

*Camilla Stoltenberg*

*Norwegian Institute of Public Health  
Oslo / Norway  
camilla.stoltenberg@fhi.no*

\*corresponding author

March 27, 2023

This work was funded by Research Council of Norway projects 314562, 273659, and 283603. It was also partly supported by the Research Council of Norway through its Centres of Excellence funding scheme, project number 262700. Thanks to Kåre Bævre for important input, and Kari Veia Salvanes and seminar participants for comments.

**Data statement:** The authors will make a database on school psychology offices available in an online repository before publication. Codes will also be made available. Individual data for replication may be ordered from Statistics Norway with reference number 19/1011. This study was approved by the Regional Committees for Medical and Health Research Ethics (REK) in Norway (2018/434).

**Disclosure statements:**

Martin Flatø has received funding from the Research Council of Norway in Lysaker, Norway for this work. He has nothing else to disclose.

Bernt Bratsberg has received funding from the Research Council of Norway in Lysaker, Norway for this work. He has nothing else to disclose.

Andreas Kotsadam has received funding from the Research Council of Norway in Lysaker, Norway for this work. He has nothing else to disclose.

Fartein Ask Torvik has received funding from the Research Council of Norway in Lysaker, Norway for this work. He has nothing else to disclose.

Ole Røgeberg has nothing to disclose.

Camilla Stoltenberg has received funding from the Research Council of Norway in Lysaker, Norway for this work. She has nothing else to disclose.

# I Introduction

Should all children start school at the same age? Proponents of an early starting age for all children emphasise that early childhood is a critical period for skill formation, and that disadvantaged children benefit the most from early participation in universal programmes (Cunha and Heckman, 2007; Elango et al., 2015). Delaying school start for low-performing children without providing a good alternative learning environment thus risks leaving them behind in human capital accumulation. However, enrolling a child before he or she is ready may be counter-productive (Bedard and Dhuey, 2012) and many parents therefore wish to delay school start for their children in a belief that it will benefit them (Graue and DiPerna, 2000).

This common belief is not fully supported by available evidence. A child's birth month relative to the school entry age has been used to show a disadvantage of young age on school performance (Attar and Cohen-Zada, 2018; Aune et al., 2018; Dhuey et al., 2019; Solli, 2017) and increased prevalence of ADHD diagnoses (Elder and Lubotsky, 2009; Karlstad et al., 2017). However, studies that use age relative to school entry age rules as natural experiments show mixed evidence on long-term effects of being older at school start. Black et al. (2011) find no effect of school starting age on income and educational attainment in Norway and a small positive effect of young school starting age on intelligence, and Balestra et al. (2020) do not find effects on earnings or labour market participation in the US. In contrast, Fredriksson and Öckert (2013) find small positive effects on income of older age at school entry in Sweden, and hypothesise that early tracking may be a reason that results diverge from Black et al. (2011). Landersø et al. (2020) find positive effects of older age at school start in Denmark on maternal employment and continued parental cohabitation, and Peña (2017) finds increased income, education, and spousal education from older school starting age in Mexico.

Existing evidence also does not support the notion that delaying school start for selected children, often called 'academic redshirting', is a beneficial practice. This has previously been studied using matching techniques, which has shown that delayed entrants did not perform differently than their matched class peers after the first year of school and performed worse for their age than similar on-track children (Jaekel et al., 2015), they were not significantly more likely to graduate from high school compared to matched typically progressing children (Raffaele Mendez et al., 2015), and delaying kindergarten did not create any long-term advantages for students on final high school grades, in college, or in terms of income in the US (Lincove and Painter, 2006).

Still, the evidence on long-term impacts of school starting age has several shortcomings. We argue that the literature has not been able to identify causal effects of allowing delayed school start for a relevant group of late starters. The mentioned literature that uses school age rules estimates effects of being among the youngest vs. oldest in class for an average child. However, if delayed school entry is beneficial for some students and detrimental to the performance of other students, the average effect would be misleading about the effect of redshirting children

who are not ready for school. Studies of redshirted children arguably study a more relevant group of late starters, yet such redshirting is often based on decisions made by parents who have not received professional guidance on the school readiness of their child (Graue and DiPerna, 2000). This literature has used propensity score matching, which does not fully account for the unobserved characteristics that may influence both the decision to delay school start and later outcomes. Furthermore, previous studies on school starting age have not taken into account that delaying school start for some students potentially affects all children, in spite of evidence that age composition in class affects educational outcomes (Leuven and Rønning, 2016; Foster et al., 2020). Whether a maturity-based school entry system is beneficial for the whole population of children is a crucial question for drawing policy conclusions.

We provide new evidence on long-term benefits of a maturity-based school entry system by identifying causal effects of a gradual reform in Norway. We study impacts of establishing school psychology offices, which was rolled out from 1946-1983 in Norway's more than 400 municipalities. We explore how these offices impacted both the likelihood of delayed graduation as an indicator of school starting age, and the affected children's income and education as adults. Importantly, we study how the impacts of the offices changed through different phases and legislative frameworks, from a period with extensive maturity testing to frequently advice parents to delay school start in the 1960s to an era when the offices would often block parents' requests for delayed start after 1976.

In addition to overall effects of the reform, we are interested in whether children who are more likely to receive a low maturity test score have different long-term outcomes than other children. We study three groups: Boys, children born close to the January 1st normative cut-off, and children from low income families. Boys are typically assessed as having lower school readiness in preschool years than girls (Brandlistuen et al., 2020). Boys' later development has furthermore been found to be a contributing factor to female advantage in school performance (Koerselman and Pekkarinen, 2018; Torvik et al., 2021). Identifying late developers and allowing more boys to delay school start may thus contribute to reducing the female advantage in educational attainment, found in almost all industrialised countries (Pekkarinen, 2012). Children born late in the year who are the youngest when tested for school start is another group that is likely to receive a low score. Since the maturity tests largely measure cognitive skills, children of parents with low income typically receive lower scores, although these children are not necessarily developing more slowly.

## **II Historical theories on school readiness**

The study speaks to a long-standing theoretical discussion of schooling and child development, which can broadly be categorised into maturationist vs. interactionist views on school entry (Graue and DiPerna, 2000). These perspectives shaped discussions and practices of school

psychologists at the time of the intervention. Maturationist theories of child development are in particular associated with Arnold Gesell's research in the 1930s. He saw child development as mainly a biologically determined process, and was of the opinion that children should not be induced to perform beyond their naturally unfolding patterns of growth (Thelen and Adolph, 1992). An implication of maturationist theory is that children who do not master age-typical skills will benefit from having more time to mature before starting school. It aligns with the Swiss psychologist Jean Piaget's view on child development as a transition between life stages, where the concrete operational stage is reached around age 7 and allows logical thinking which is necessary for comprehension in school (Piaget, 1953). The German term *Schulreife* is more suggestive of biological determinants than the English school readiness, and German researchers such as Charlotte Bühler and Wilfried Zeller further developed maturationist theories, which included associating school readiness with a physical development from a baby-shaped body (with a large head and short arms and legs) to a school-child shaped body around the age of six (Ljungblad, 1964).

An interactionist view would on the other hand emphasise the environmental influence on child development, and posit that teachers must develop programmes that are responsive to the students' levels of functioning. This view is consistent with early intervention rather than postponing school start to further a child's development. Its foundation can be traced to Soviet psychologist Lev Vygotsky (Graue and DiPerna, 2000), who presented a socio-cultural perspective on human development. The view became increasingly popular in the American school readiness research in the late 1960s and early 1970s (Gredler, 1992). The interactionists did not deny that genetically determined growth could influence development, but focused on development as an interaction between growth and learning. Lack of school readiness should thus be seen as indicating a need for additional learning and not an excuse for inactivity.

These perspectives on school readiness very much influenced school psychologists in Nordic countries. School readiness was there referred to as school maturity, with connotations closer to the German term. During the 1950s and 1960s, researchers and practitioners developed increasingly sophisticated methods for detecting 'immaturity' in potential school starters and professionalised systems for testing school readiness and making recommendations. Leading school psychologists in Norway during that time were convinced that test-based school entry decisions would prevent learning difficulties and behavioural problems (Hambro, 1967). In the late 1960s however, there was growing disagreement within the school psychologist community about the merits of maturity testing (Solheim, 1975). One concern was whether the tests could adequately distinguish between school-mature and immature children, with an increasingly complex understanding of the maturity concept to also include social and emotional skills. There was also a concern that to the extent that the tests made correct measurements, it was measurements of intelligence, and that the testing led to sorting of children from disadvantaged backgrounds to late school start. More fundamental criticisms were also raised, with calls for abandoning the term altogether and adapt pedagogical practices to better accommodate



for learning at different levels. The Swedish psychologist Tage Ljungblad was among the most outspoken critics of maturity-based school start assessments, and the discussion at the Nordic psychology conference in 1969 between Ljungblad and Scandinavian colleagues is a clear indication that maturity testing was perceived with increased scepticism among school psychologists (Goldschmidt et al., 1969).

### **III The establishment of school psychology offices**

We have constructed a dataset with the establishment of school psychology offices in the period from 1946-1983 in Norwegian municipalities. Up until the 1970s, the main purpose of these offices was to conduct maturity assessments to give advice on school start. Children in Norway would normally start school the year they turned 7. However, parents could enroll children who turned 6 between 1 January and 30 June a year early if deemed fit by the school board, or apply to postpone school start until the year the child turned 8 (Gabrielsen and Lundetræ, 2017). Once established, the school psychologists conducted maturity tests and made observations that would function to advise the school board and parents on school starting age. There was variation between municipalities in the content of the assessment and in which children they selected for testing. From 1950, Sandven's maturity test was most widely used. This test included hand muscle co-ordination, memory, verbal skills, spatial skills, reasoning, and quantitative perception (Sandven, 1962). The children were often tested in groups. Each school psychology office had substantial autonomy in deciding which children they would invite for examination, and participation was always voluntary. All offices tested children when requested by parents who approached the office to apply for early or late enrollment. Whether other children were tested depended on both the psychologists' beliefs about the merits of maturity testing and on available resources. Up until the late 1960s, most offices invited all potential school starters for testing the year they turned 7, yet such extensive testing was later abandoned in most places (Vik and Hansen, 1980).

Maturity testing by the school psychology office in Moss, a medium-sized Norwegian city, is particularly well documented in an article for the Norwegian School Psychologist Union by Lillestølen (1967). The office was established in 1958 and conducted its first maturity testing in 1959. This first year, they hosted a meeting where parents of all potential school starters were invited while the children were observed by teachers during a play class. When teachers observed 'signs of immaturity' in a child, the parents were approached to encourage testing for late school start. The psychologists concluded that this approach identified too few of the immature children, which resulted in school-requested testing of children after school start, and several starters were taken out of school to try again the subsequent year. They therefore expanded the programme the following year to invite all children born in the second half of the year for testing, and after expanding the office from one to two psychologists in 1965, all children turning 7 were invited. Of these, 75–95% were tested using Sandven's test and the

parents filled out questionnaires and participated in group interviews. In 1966, 62 out of 599 children who were tested were recommended to delay school start.

Besides delayed or early school start, the psychology offices could give other advice on children in school starting age to parents and schools. Some school districts had separate 'maturation classes', in which the children were enrolled to a kindergarten type of class and then subsequently started first grade the next year. In Oslo, the psychologists could recommend that the child enrolled at a special needs school or in an observational class pending later placement (Hambro, 1967) whereas no special needs school was available in Northern Norway (Pleym, 1967).

The establishment of school psychology offices in Norway started with the first office in Aker in 1946 and continued up until full coverage was achieved through the office in Bremanger in 1983. The expansion went through several phases, which affected the pace of the roll-out as well as the work that the offices were set to conduct. Only a few selected, larger municipalities established offices in the first decade of this period, until the introduction of a cost-sharing mechanism between local municipalities and the central government in 1955 gave opportunities for expansion elsewhere (Gabrielsen and Lundetræ, 2017). Maturity testing and other *preventive* work to avoid school failure was central in the first phase of the development (Hambro, 1967). Other tasks included examining students who were referred to the psychologists by schools due to behavioural problems, nervousness, or learning difficulties. A third pillar consisted of advisory tasks directed at parents and schools. The school psychologists did not engage in treatment nor diagnostisation, but they collaborated closely with schools and psychiatrists and often proposed interventions.

The 1970s saw a decline in the use of maturity testing and redshirting in Norway. A new education law from 1 January 1976 gave the right to individually adapted education to all children, and children with learning difficulties were to be aided primarily through special needs education within a common school (Gabrielsen and Lundetræ, 2017). The parents' right to postpone school start was then limited to cases where the child had not reached a level of development that is compatible with starting school. The law was followed by a government decree which instructed the offices to only use delayed school start in 'very special circumstances' (Norwegian Ministry of Church Affairs and Education, 1983). This effectively gave a gatekeeper role to the school psychology offices, who had previously often acted as promoters of delayed school start. The school psychology offices changed name to psychological-pedagogical services, which also reflected a change in orientation. Our data on office staff shows a shift in professional backgrounds with an increasing share education professionals. The service now conducted fewer but more detailed screenings that resulted in claims for special needs education and other measures within the school, rather than primarily being a sorting mechanism into schools. Maturity testing continued well into the 1980s yet was by then usually limited to parents who applied for early or late entry, or was carried out to assess the need for special needs education.

## IV Data description

### A) Data on school psychology offices

We have constructed a database with records on the first year each municipality was covered by a school psychology office with an employed school psychologist. Various sources have been used. The most detailed and complete accounts were made by the Norwegian School Psychologist Union and the first available lists of offices that we have found by this source were from letters to the Ministry of Social Affairs stored in the National Archives of Norway. These lists referred to the years 1958, 1959, 1961 and 1962. Subsequent lists were published in their journal<sup>1</sup> that is kept in the National Library of Norway and refer to the years 1967–1970, 1973, 1975, 1977, 1980, 1982, and 1983. Our secondary source is the journal *Norsk Skole* [Norwegian School] that was published by the Ministry of Church Affairs and Education and occasionally included a list of school psychology offices. This source is used for 1955, 1957, 1960, 1964, 1965, 1971 and 1972 and is also available in the National Library. Our database furthermore relies on accounts from the establishment of individual offices, particularly to cover years where no comprehensive list is available. A full list of sources is available in the online supplement.

Figure 1 shows the first year each municipality became covered by a staffed school psychology office. We see that offices were established throughout the period. The establishment peaked in 1958 and 1973. This clustering of establishments in individual years can be due to reporting and the fact that one office typically covered several municipalities. The vertical lines indicate the different phases of establishments that we use for identification in our sample. It is restricted downwards by the availability of individual data with family identifiers that we need for our identification strategy, and hence the first reforms that we study are from 1961. Information on age at school graduation is only available from cohorts born 1959 onwards, and hence 1967 is the first reform year that we can use for identification with this outcome. After the 1960s follows an intermediary period where maturity testing became less frequent, until a policy change in 1976 also provided a formal change to the role of the offices.

---

<sup>1</sup>The journal was named *Skolepsykologen* [the School Psychologist] in the period 1959–1968 and *Skolepsykologi* [School Psychology] from 1968. The Norwegian School Psychologist Union merged with The Norwegian Psychological Association in 1969, and subsequent lists were published by the school psychology section of The Norwegian Psychological Association.

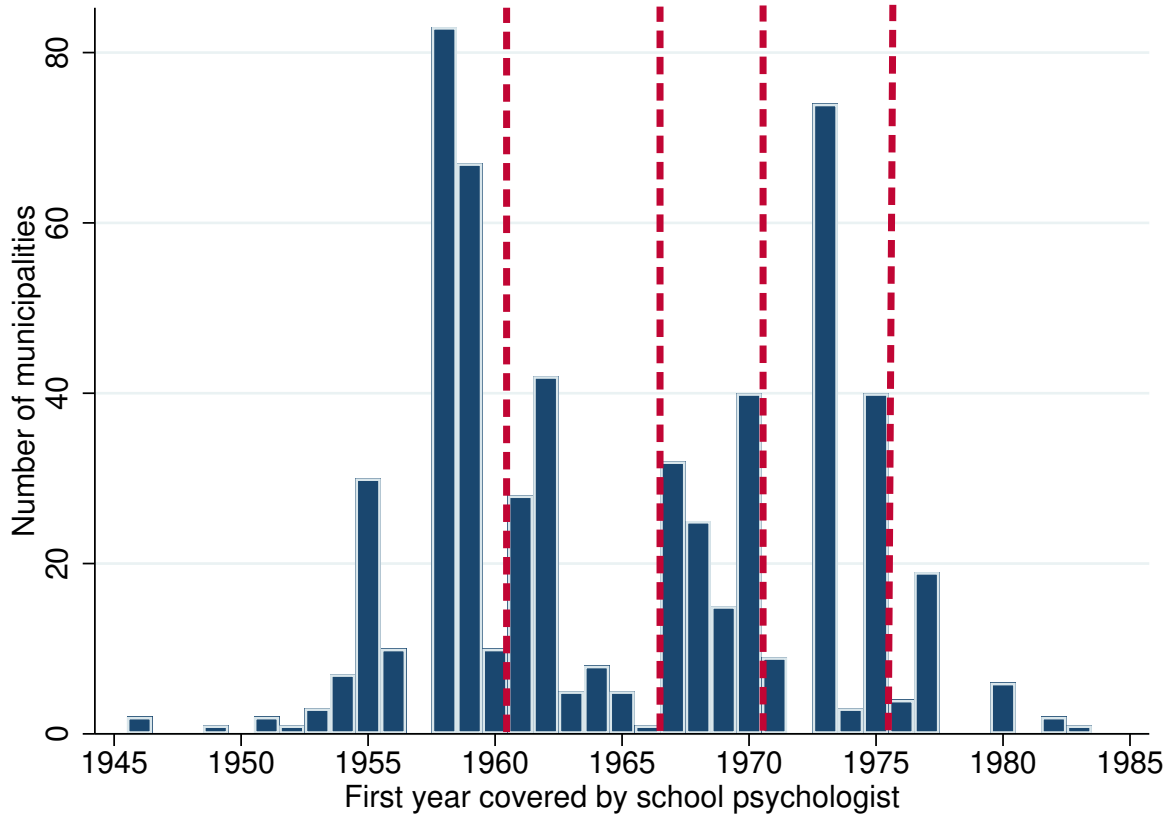


Figure 1: The establishment of school psychology offices, by year

The map in Figure 2 shows the location of Norwegian municipalities by year when they first established and staffed a school psychology office. We see that the major cities established offices first. Thereafter, offices were established in eastern and central Norway. Areas in western and northern Norway were the the last to establish offices, particularly more remote-lying and less populous municipalities. Although there are clear patterns of regional expansions, much variation also comes from neighbouring municipalities having different reform years.

## B) Data on individuals

We use administrative data on the entire Norwegian population, delivered by Statistics Norway. We use the mother’s place of residence from the 1970 census for cohorts born before 1965, and the child’s place of residence in 1974 or at age 7 for later cohorts. Effects on late or early graduation are assessed based on whether children completed lower secondary school the year they turned 16, and is available for children born 1959 or later based on the Norwegian Education Database dating back to 1974. Lower secondary school was mandatory at the time and there was no failing. A limitation in the dataset is that we do not have data on actual school starting age, only their age when finishing lower secondary school. Delayed school graduation can be a result of both retention and delayed school start, however retention was uncommon in the Norwegian

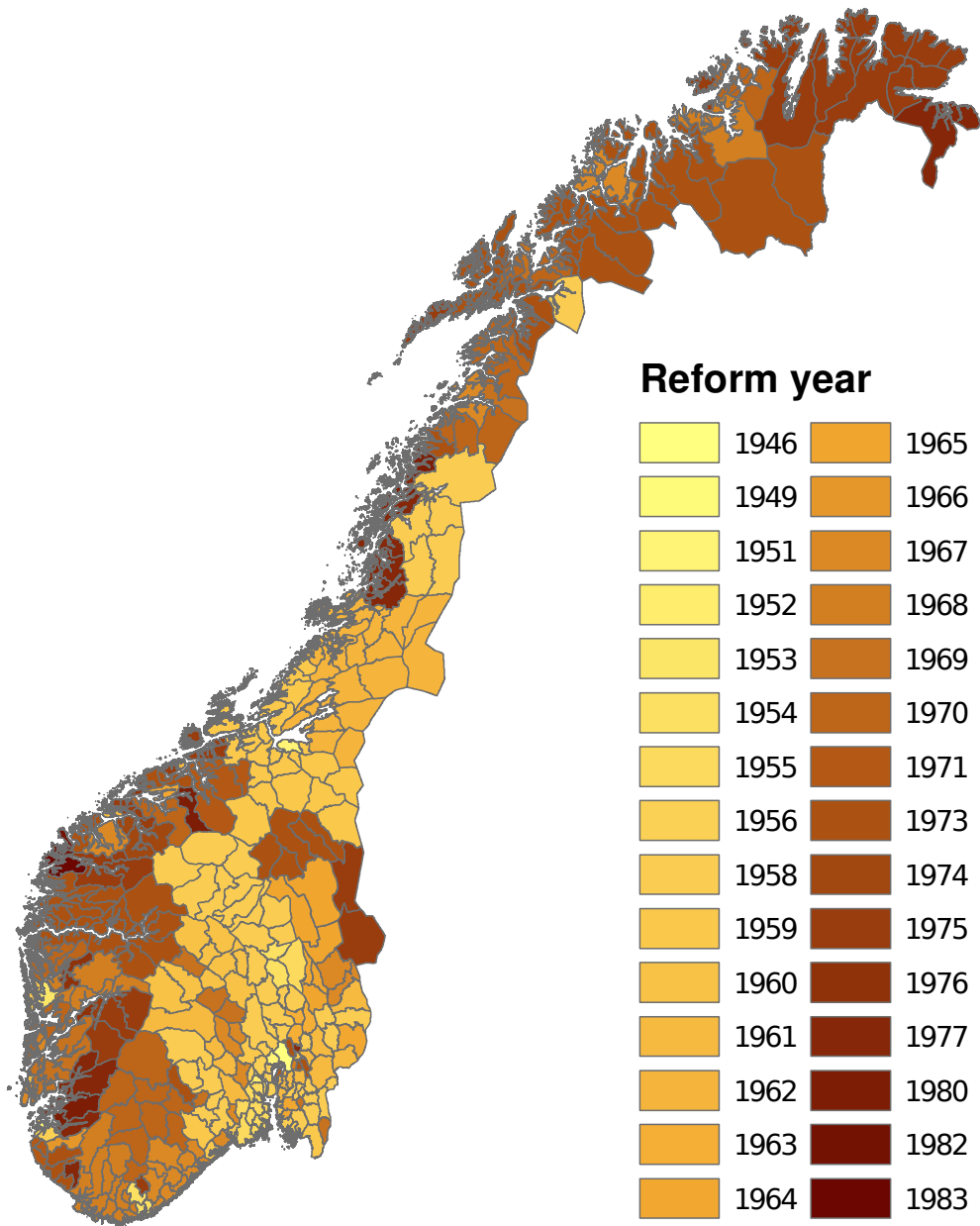


Figure 2: Map of first year with school psychology office, Norwegian municipalities 1946–1983. GIS data from Kartverket [Norwegian Mapping Authority] (2017)

school system. Furthermore, changes in school graduation age that affect children who reached school starting age shortly after the reform likely reflects delayed school start. To the extent that school psychology offices affected grade retention and grade skipping, the change is likely to also affect children who were already in school.

The basis for the income data is the Norwegian Tax register which has data on pensionable income from 1967–2017. This income is then adjusted for wage increases to make it comparable across time, using the National Insurance Scheme basic amount. To estimate effects on income, we take the log of the adjusted income at age 43, which is the latest time point that is available for all cohorts and thus the income which is closest correlated with lifetime income (Markussen and Røed, 2020). To estimate the lifetime income rank of the father, we first estimate the rank income for each year and birth cohort in available years for all men aged 30–60. We then take the rank of the average for each birth cohort. The number of years of schooling is based on codes from the Norwegian Standard Classification of Education and is available from 1974.

### **C) Descriptive statistics**

The average number of delayed and early graduates from lower secondary school in Norway is comparatively low, but masks important heterogeneities across time, birth month, and family background. Figure 3 shows the percent of students who graduate one year early or late by year of school start assessment (age 6 for early graduates and age 7 for delayed graduates). The dotted lines are individuals who resided in municipalities that established school psychology offices prior to 1966. The solid and dashed lines are the switchers, in municipalities that have and that have not yet established a school psychology office, respectively. We see a sharp drop in the share of graduates that finish one year late for all three groups. Municipalities with school psychology offices (the solid line) are, however, consistently above those without (the dashed line). The municipalities that established offices in this period furthermore display a different level and pattern than those who established offices earlier than 1966, with a more rapid drop for starters in the late 1960s and a slower drop in the late 1970s. This suggests that the not yet treated is not a good control group for those who introduced the reform early, and municipalities that introduced offices early are therefore not included in the analytical sample. We found more stable patterns in the share who graduate early, and again a higher level for those establishing offices prior to 1966. There is furthermore no systematic difference by treatment status among those who introduced the offices in later years.

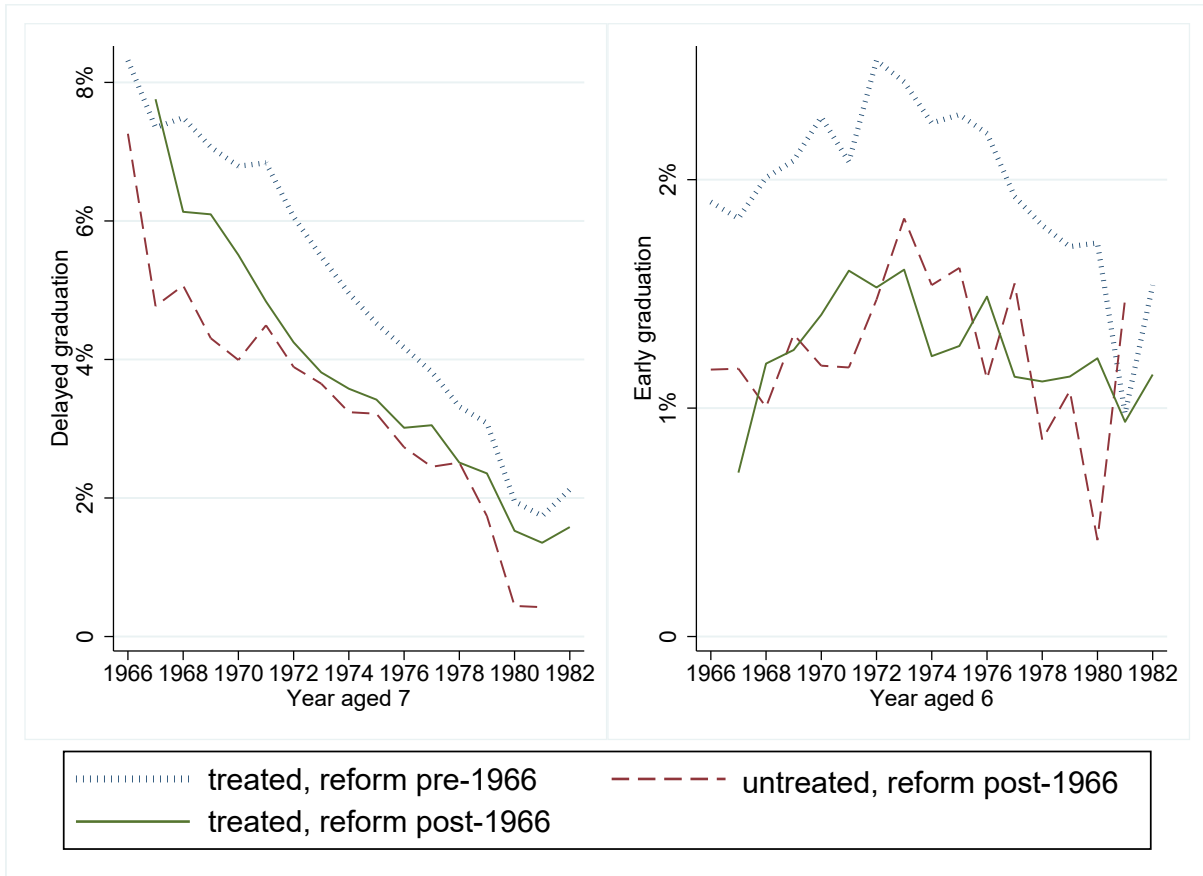


Figure 3: Delayed graduation and early graduation from lower secondary school, by year of school start assessment and treatment status

Boys, children born late in the year, and children from low income families are likely to score lower in maturity tests, and should therefore be expected to have higher rates of delayed graduation. Figure 4 shows differences by gender, birth month, and father’s lifetime income rank. We see that boys are more likely to be delayed in graduating and girls are more likely to graduate early. Furthermore, there are large differences in delayed graduation by birth month, from .6% for girls born in January to 24.7% among boys born in December. For early graduation, children born July-December were legally prohibited from starting school early and rarely graduated ahead of time (means .02% – .2%). Rates increase sharply with earlier birth month, peaking at 13.6% for girls born in January. The two lower panels show delayed and early graduation by their father’s lifetime income decile. Delayed graduation decreases linearly with income rank, and is 7.3% and 4.9% for boys and girls in the lowest paternal income decile vs. 3.1% and 1.8% in the highest paternal income decile. Early graduation shows linear increases with increased income in the 1st-7th decile but increases exponentially for the upper three deciles. It ranges from .8% and 1.2% for boys and girls in the lowest decile to 3.3% and 5.1% for boys and girls in the highest decile.

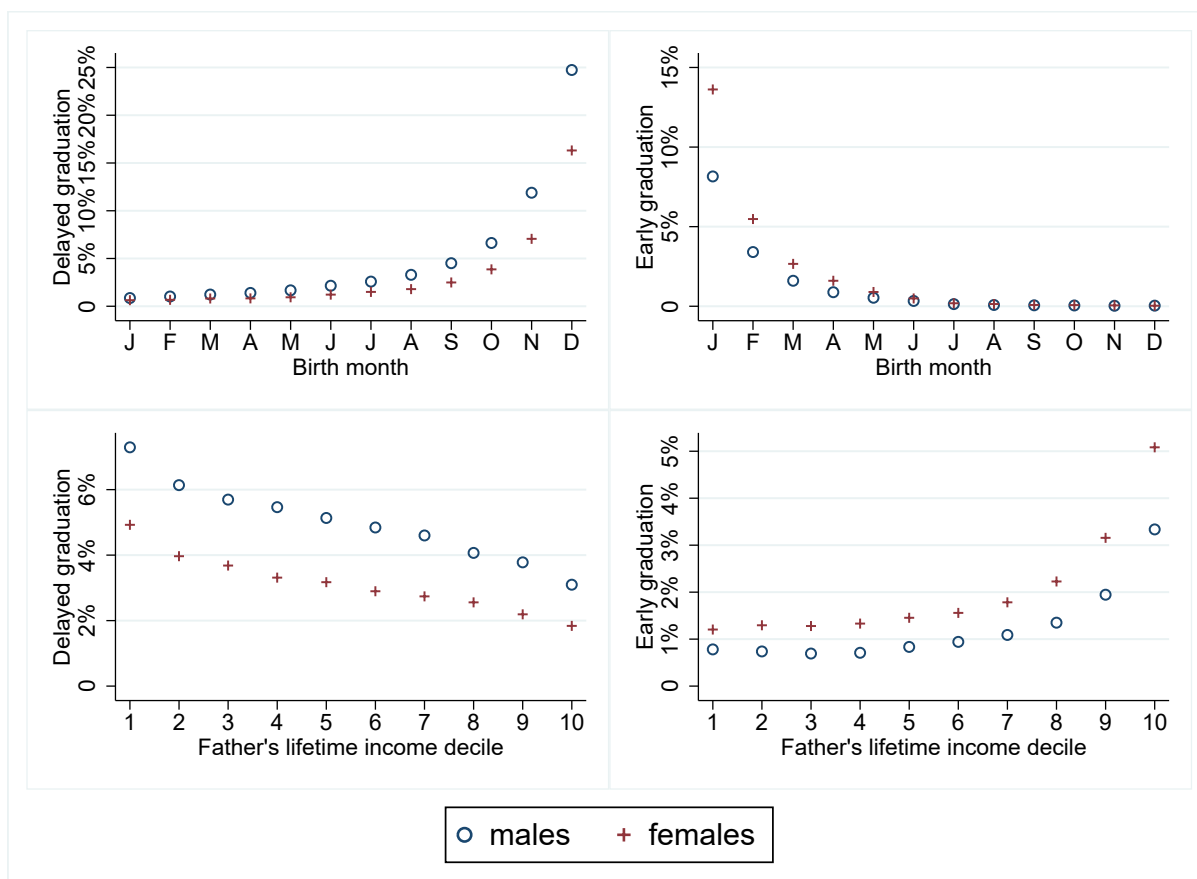


Figure 4: Delayed graduation and early graduation from lower secondary school, by gender, birth month, and father's lifetime income decile

## V Empirical strategy

Several factors were important for when municipalities decided to establish a school psychology office. Municipalities had to provide the necessary funding to cover its part of the costs, and often had to collaborate with neighbouring municipalities to achieve a critical mass of students. Once a political decision was made to establish an office, it would have to find a qualified psychologist who was willing to work at the office location which could be far from the universities where they were educated. Furthermore, the reform was part of a wider expansion of the welfare system at a time with rapid yet regional growth in Norwegian economy, partly due to the development of hydropower and petroleum-related industries (Borge et al., 2015). It is therefore likely that municipalities that introduced the reform at a particular time differ from those that did not on a wide array of relevant outcomes.

The analysis will make use of a well-established method for finding the effect of a gradually introduced policy change, namely difference-in-differences. The method controls for the fact that levels of the outcome variables may be different in municipalities that introduce the offices, and that outcomes fluctuate over time. It rests on the parallel trends assumption, i.e. that the



development in the outcomes in the municipalities with and without an office would be the same without the school psychology offices. Several confounders may violate this assumption. In particular, if the composition of families change in a different way in the municipalities with and without an office due to differential migration or parental cohort trends, a simple difference-in-differences strategy will not provide unbiased estimates.

Econometric developments have also pointed out that parallel trends is not a sufficient assumption for unbiased estimates in cases where a reform is introduced at multiple times. Goodman-Bacon (2021) has shown that in the presence of heterogeneous treatment effects, the two-way fixed effects difference-in-differences estimator does not provide unbiased estimates of the causal effect. Several solutions to this issue have been suggested in the literature (Baker et al., 2022; Callaway and Sant’Anna, 2021). However, most of these approaches require estimating group-time average treatment effects and then aggregating these effects using a weighted average. Control variables may thus only be leveraged at the aggregate level, which would be municipality times birth cohort in our case. We suspect that there are trends in parental characteristics that may be correlated with the introduction of school psychology offices, and hence want a within-family estimate of the reform impact.

Correcting for variation in the composition of families across time requires a different setup than the 2x2 identification strategy of Callaway and Sant’Anna (2021). A stacked regression design is a more flexible approach that has been developed by applied researchers to address the same issues of heterogeneous treatment effects (Cengiz et al., 2019; Baker et al., 2022). Using this methodology, we first compare individuals born prior to the reform with younger siblings born in the 5 following years in the same municipality (difference 1). This difference is then compared to the within-family difference in municipalities who are not (yet) treated in the five-year post-reform window (difference 2). We thereby avoid the problem of comparing with already treated units. The datasets with these treatment and control groups are then stacked together and analysed collectively.

Our hypothesis is furthermore that the effect of having a school psychology office varies across time. In particular, we hypothesise that the effect changes from 1976 with new legislation that changed the role of the offices. Since we know that the shift in the psychologists’ approach and abandonment of maturity testing happened prior to the legislative change, we also distinguish between the early 1970s and 1960s. A further distinction will be made between the 1966–1970 period where we have data on school completion age, and the 1960–1965 period.

The following two variables identify the reform:

$$D_m = \begin{cases} 1 & \text{if } T_m = T \\ 0 & \text{if } T_m > T + 4 \end{cases}, D_t = \begin{cases} 1 & \text{if } T \leq t \leq T + 4 \\ 0 & \text{if } T - 5 \leq t < T \end{cases} \quad (1)$$

Where  $D_m$  is a dummy variable indicating whether the municipality established an office

in year  $T_m = T$  or after year  $T + 4$ , and  $D_t$  is a dummy variable for whether the child turned 7 between years  $T$  and  $T + 4$  or in the five years prior to  $T$ . For each reform year, a separate dataset is created where the individuals in municipalities with  $D_m = 1$  born within five years on either side of the reform are compared to individuals in municipalities with  $D_m = 0$ . These datasets are then stacked together into one, single dataset.

Our OLS regression specification becomes:

$$Y_{ifmth} = \alpha_{fmh} + \alpha_{th} + (\beta_1 P_{60-65} + \beta_2 P_{66-70} + \beta_3 P_{71-75} + \beta_4 P_{76-81}) D_m D_t + \epsilon_{ifmth} \quad (2)$$

Where  $Y_{ifmth}$  is the outcome of interest of individual  $i$  in (maternal) family  $f$  living in municipality  $m$ , turned 7 in year  $t$  and part of dataset  $h$ ,  $\alpha_{fmh}$  are family-fixed effects which are the same for maternal siblings born in the same municipality within the same dataset,  $\alpha_{th}$  are birth year dummies by dataset,  $\beta_1 - \beta_4$  are the coefficients of interest for each period 1960–1965 (except graduation), 1966–1970, 1971–1975, and 1976–1981, and  $\epsilon_{ifmth}$  are error terms.

The identification of causal effects in this study thus rests on the assumption that the exact timing of the reform in each municipality is exogenous to all other differences between siblings, so that siblings born to the same mother residing in the same municipality can be regarded as if being randomly assigned between the treatment and control groups.

We are also interested in how results differ by several factors that are predictors of maturity and delayed graduation, such as month of birth, gender, and parental background. For each factor  $X_i$ , we will specify the following OLS regression:

$$Y_{ifmth} = \alpha_{fmh} + \alpha_{th} + (\beta_{X1} P_{60-65} + \beta_{X2} P_{66-70} + \beta_{X3} P_{71-75} + \beta_{X4} P_{76-81}) D_m D_t X_i + \alpha_h X_i + \epsilon_{ifmth} \quad (3)$$

## VI Results

We present results on the impact of the reform on delayed graduation in Table 1. We do not see any statistically significant overall effect of the reform in any period. However, for children born during the last three months of the year, we see that having a school psychology office increases the likelihood of a late graduation by 2.8 percentage points for children who turn 7 in 1966–1970. In contrast, there is no effect of having an office in the intermediary period from 1971–1975, and a negative effect on delayed graduation in the years 1976–1981. This supports the idea that the offices worked as promoters of delayed school start for children regarded as immature in the late 1960s and gradually developed into taking a gatekeeper role, blocking applications for delayed school start from 1976 onwards. We did not find any difference in the effect on delayed

graduation by gender. Effects by birth month are shown in the supplementary material, showing largest effects for December-born children. The supplement also shows effects by season of birth separately for each reform year, and we conduct an event study that shows absence of pre-trends. There was no significant effect on early graduation for any group (see supplementary material).

Table 1: Effects on delayed graduation of establishing a school psychology office, 1966–1981

Model	(1)	(2)		(3)	
Outcome: Delayed graduation	Overall	Born Jan-Sept	Born Oct-Dec	Males	Females
Reform $\times$ Age 7 <sub>1966-70</sub>	0.007 (0.007)	-0.001 (0.006)	0.028** (0.012)	0.008 (0.008)	0.006 (0.007)
Reform $\times$ Age 7 <sub>1971-75</sub>	-0.004 (0.006)	-0.002 (0.006)	-0.010 (0.009)	-0.006 (0.006)	-0.002 (0.006)
Reform $\times$ Age 7 <sub>1976-81</sub>	-0.008 (0.007)	-0.004 (0.008)	-0.026*** (0.010)	-0.006 (0.007)	-0.010 (0.008)
Observations	278,164	278,164		278,164	
R <sup>2</sup>	0.4870	0.5119		0.5119	

*Reform indicates turning 7 years or older the year a school psychology office was introduced in the municipality of residence. Controls for birth year and mother fixed effects interacted by dataset are included. Heterogeneous effects also include controls for the heterogeneity factor by dataset. Standard errors clustered at the psychology office level in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$*

We were furthermore interested in how the presence of school psychology offices shaped the affected children’s outcomes as adults. We regressed the logged pensionable income and years of education at age 43 on the reform, separating between the impacts during four periods. Results are shown in Tables 2 and 3. We do not see any significant effects on income in the overall sample. However, for the children born October-December, we see that having a school psychologist office increased the adjusted incomes by 3.7% in the 1966–1970 period. This is the same group who in this period saw an increase in late graduation. Effects on income are significant during most ages 30-43 as shown in the supplementary material. There were no other significant heterogeneous effects on income. For years of schooling, the effects are similarly absent for the overall sample. For this outcome, there were also no significant effects for children born late in the year. However, we see significant negative effects of the reform on years of schooling for males in the 1971–1975 and 1976–1981 periods, where the reform is estimated to reduce schooling by 0.1 and 0.2 years, constituting a .05 and .1 standard deviations reduction respectively. Event studies using income and education as outcomes are shown in the supplementary material, and robustness checks show that the results hold when excluding reforms with significant pre-trends. There was no effect of the reform on fertility (see supplementary material).

Table 2: Effects on log adjusted income of establishing a school psychology office, 1960–1981

Model	(1)	(2)		(3)	
Outcome: Log income at 43	Overall	Born Jan-Sept	Born Oct-Dec	Males	Females
Reform $\times$ Age 7 <sub>1960-65</sub>	-0.001 (0.013)	-0.003 (0.013)	0.005 (0.019)	-0.018 (0.021)	-0.004 (0.021)
Reform $\times$ Age 7 <sub>1966-70</sub>	-0.010 (0.011)	-0.024* (0.013)	0.037** (0.016)	0.008 (0.016)	-0.037* (0.020)
Reform $\times$ Age 7 <sub>1971-75</sub>	-0.002 (0.011)	-0.011 (0.012)	0.026* (0.015)	-0.0004 (0.017)	-0.005 (0.017)
Reform $\times$ Age 7 <sub>1976-81</sub>	-0.021 (0.028)	-0.018 (0.029)	-0.030 (0.040)	-0.056* (0.029)	0.018 (0.024)
Observations	748,582	748,582		748,582	
R <sup>2</sup>	0.4723	0.4723		0.5136	

The dependent variable is logged pensionable income adjusted for wage increases in 2017 Norwegian kroner. Reform indicates turning 7 years or older the year a school psychology office was introduced in the municipality of residence. Controls for birth year and mother fixed effects interacted by dataset are included. Heterogeneous effects also include controls for the heterogeneity factor by dataset. Standard errors clustered at the psychology office level in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table 3: Effects on years of education of establishing a school psychology office, 1960–1981

Model	(1)	(2)		(3)	
Outcome: Years of schooling	Overall	Born Jan-Sept	Born Oct-Dec	Males	Females
Reform $\times$ Age 7 <sub>1960-65</sub>	-0.026 (0.061)	-0.013 (0.063)	-0.065 (0.064)	-0.062 (0.063)	0.007 (0.071)
Reform $\times$ Age 7 <sub>1966-70</sub>	-0.048 (0.030)	-0.051 (0.038)	-0.034 (0.035)	-0.037 (0.038)	-0.058 (0.044)
Reform $\times$ Age 7 <sub>1971-75</sub>	-0.046 (0.032)	-0.065 (0.033)	-0.017 (0.043)	-0.106*** (0.038)	0.014 (0.041)
Reform $\times$ Age 7 <sub>1976-81</sub>	-0.109* (0.062)	-0.103 (0.065)	-0.128 (0.084)	-0.231*** (0.071)	0.018 (0.068)
Observations	828,516	828,516		828,516	
R <sup>2</sup>	0.6212	0.6212		0.6223	

The dependent variable is years of education. Reform indicates turning 7 years or older the year a school psychology office was introduced in the municipality of residence. Controls for birth year and mother fixed effects interacted by dataset are included. Heterogeneous effects also include controls for the heterogeneity factor by dataset. Standard errors clustered at the psychology office level in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

We were also interested in how effects of the reform varied by family background. For one, delayed school start was more prevalent among children born in families with low income. Furthermore, differential effects by family background on the outcomes may indicate that

maturity-based school start had different effects on the children, due to differences in effects on learning or in the returns on early school performance for later education and income. These effects are studied by whether children are born in the last months of the year or earlier, because these children are likely differentially affected by the reform.

Figure 5 shows effects on delayed graduation by the father’s lifetime income quintile. Among those born January-September, we see a slight positive gradient in the effect of the offices on delayed graduation, yet effects are quite similar and close to 0 in all periods and for all social groups. For the children born October-December, the gradient is less clear and the point estimates go from positive to negative across the periods for all groups.

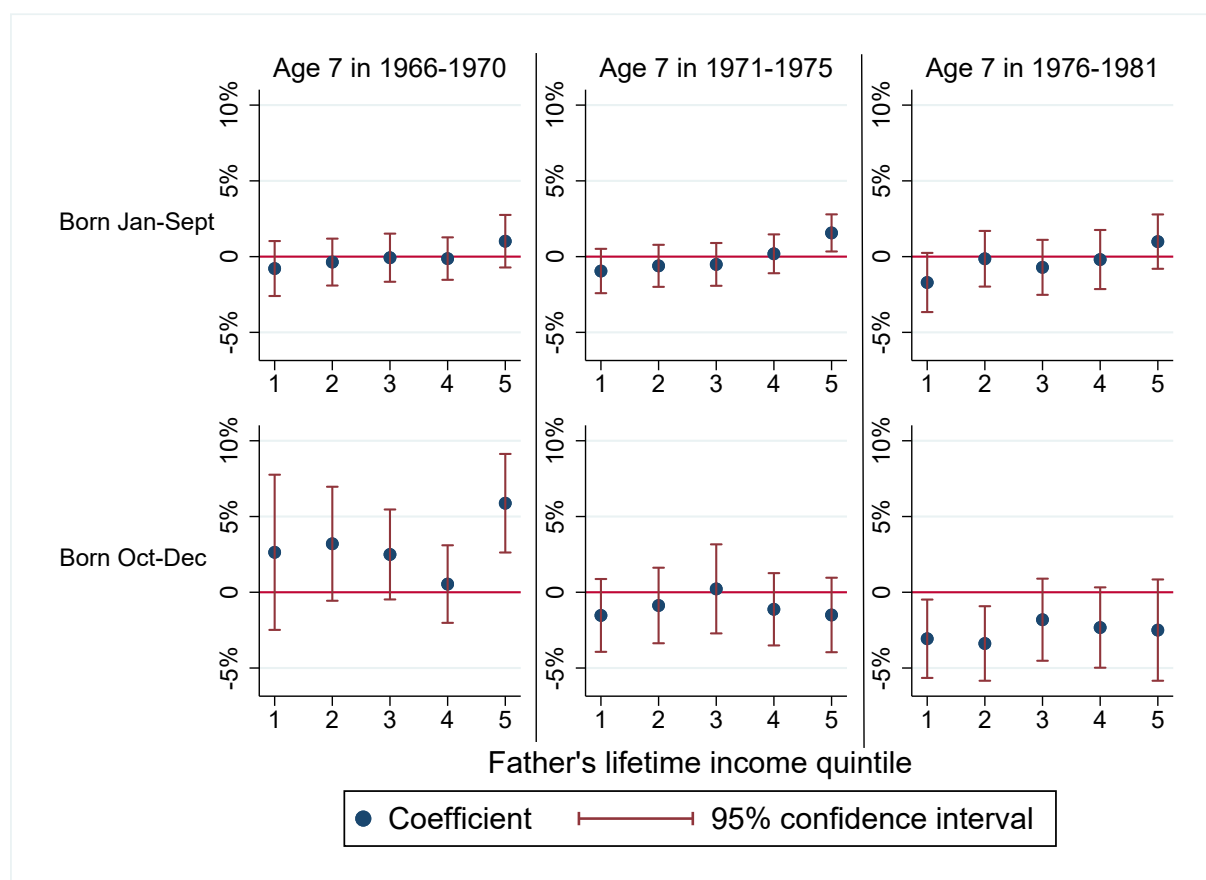


Figure 5: Effect on delayed graduation of establishing school psychology office, by father’s lifetime income quintile, period, and time of birth

Effects on adjusted income by paternal income quintile and time of birth are shown in Figure 6. Adjusted income seems to be unaffected for all social groups among children born January-September. However, there is a positive effect of offices in the 1960–1965 period on adjusted income for children born October-December in the lowest quintile, raising incomes by 12.6% (CI .058 – .195). This is in stark contrast to effects on late-born children in the lowest quintile in the 1976-1981 period, when offices restricted delayed school start. For this group, an office reduced adjusted income by 20.7% (CI -.318 – -.098).

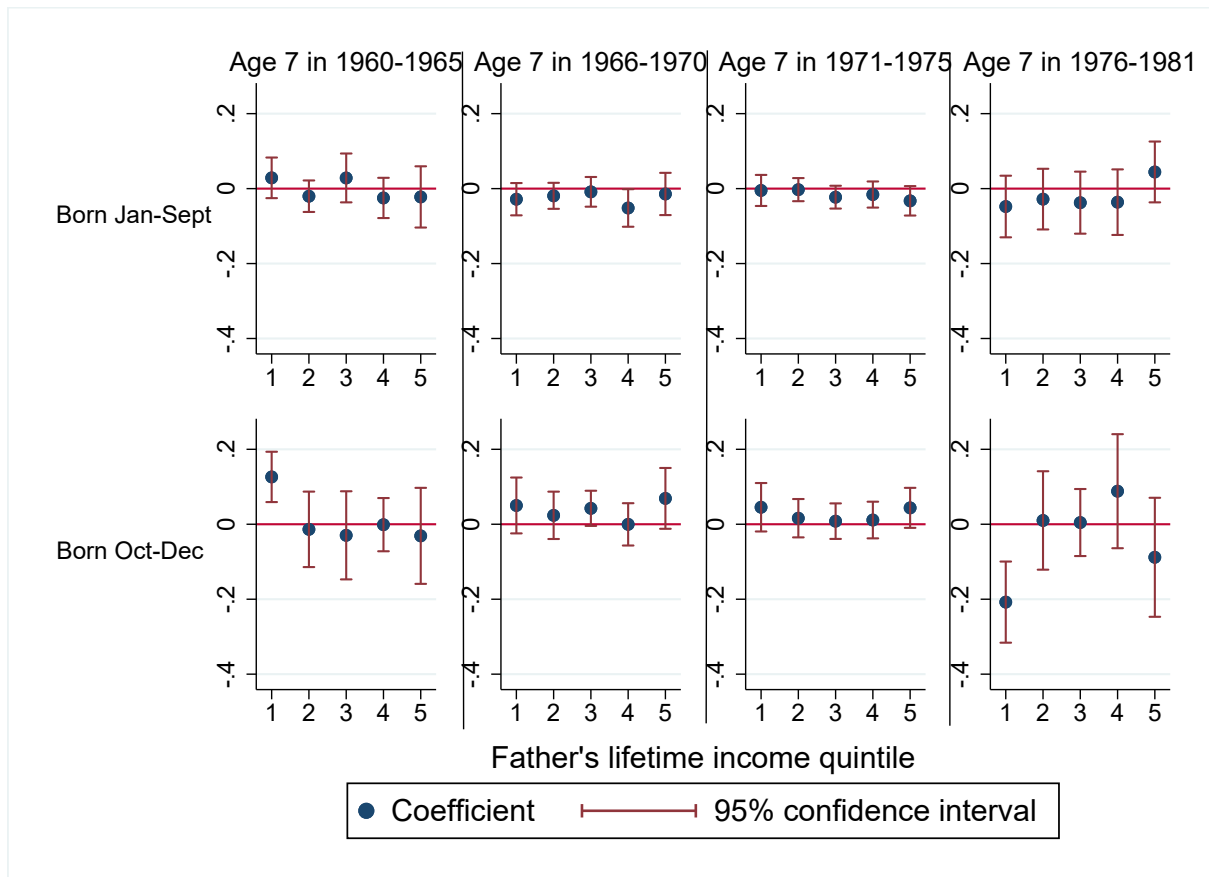


Figure 6: Effect on log adjusted income of establishing school psychology office, by father's lifetime income quintile, period, and time of birth

The effect on years of schooling by paternal income is shown in Figure 7, and it appears that the lowest quintile increased their educational attainment as a result of establishing school psychology offices in the early 1960s. This was the case for children born both early and late in the year, and there is a clear gradient in both groups, with negative effects on children born October-December for the top quintile in the early 1960s. For children born January-September, the negative gradient remains throughout the periods, with negative effects on the top quintile. For those born October-December, there is no clear socioeconomic pattern and effects are close to 0.

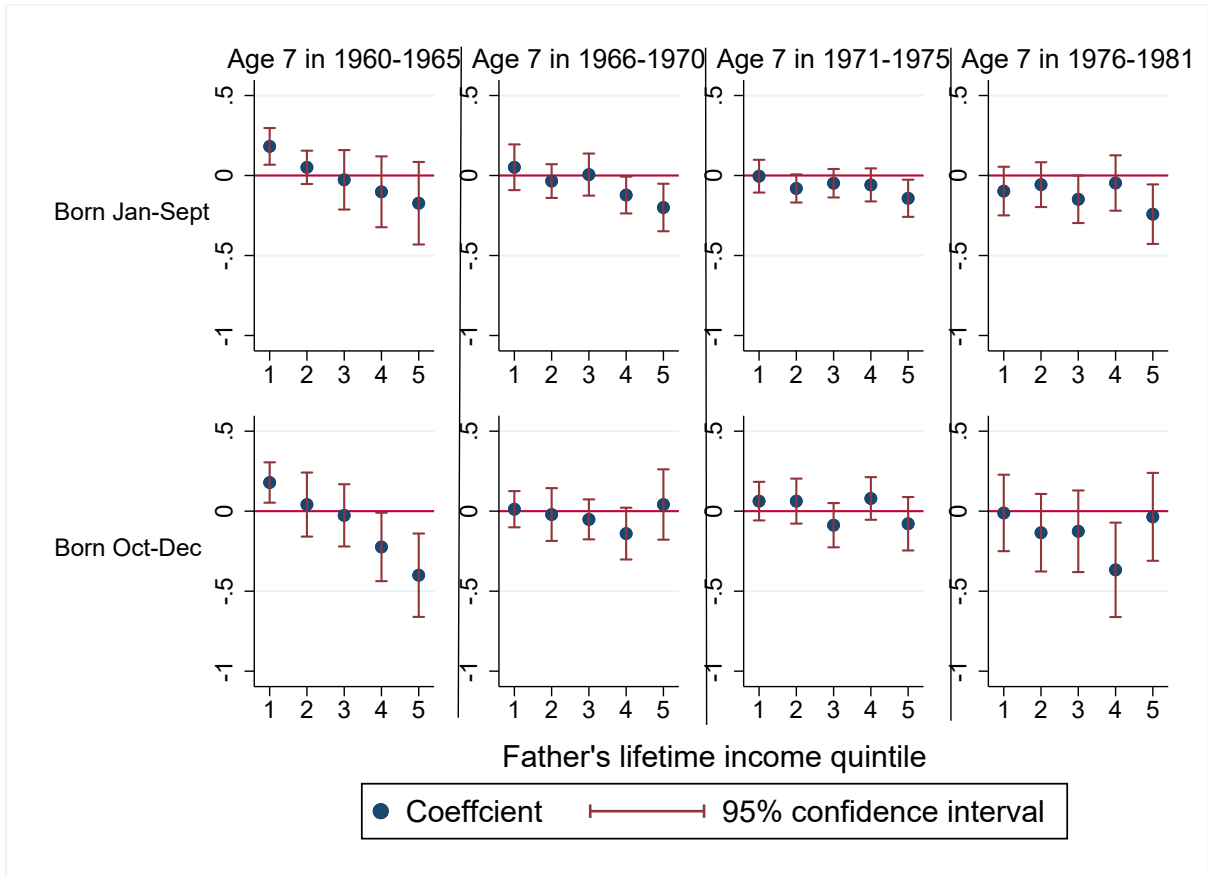


Figure 7: Effect on years of education of establishing school psychology office, by father's lifetime income quintile, period, and time of birth

We can thus relate the establishment of school psychology offices to benefits for children born late in the year in low income families in the 1960–1965 period, both in terms of years of education and higher own income at age 43. We cannot assess whether school starting age also changed for this group, however historical accounts support that the offices had an active role in conducting maturity assessments and recommending delayed school start in this period (Hambro, 1967), and our data supports that late-born children in the subsequent 1966–1970 period would be more likely to delay school start in the presence of an office. In the other end of the study period, having established a school psychology office in 1976–1981 relates to a lower share with delayed school graduation for children born late in the year for all social groups, and significantly so for the lowest and 2nd lowest quintiles. The adult earnings of the group with lowest paternal income were adversely affected by having an office in this period. Together, this suggests that blocking the option to delay school start may have adversely affected late-born children in low-income families.

## VII Conclusion

This study provides evidence on the short-term and long-term effect of establishing school psychology offices in Norwegian municipalities, exploiting variation in the timing of these establishments. We found that the effect of this reform changed over time, as the role of the school psychology offices developed. In the 1960s when the offices conducted broad assessments of school readiness and frequently advised parents to delay school start, having an operating office would increase the probability that the youngest children in each cohort would delay their education. However, as the offices changed role into institutions that would often overrule parents' wishes for delayed school start, the latest-born children of a cohort would be less likely to get a delayed graduation when an office was established. The long-term effects of the reform were for the most part small. Our study shows that there may have been benefits from having school psychology offices that conducted maturity testing and advised on school starting age for children from low income families in the 1960-1965 period and for children born late in the year in the 1966-1970 period. Having an office which could block delayed school start may have worked to the disadvantage for males in terms of years of schooling in the 1976-1981 period, as well as the adult earnings of late-born children in low-income families.

Whether to base school start on the child's level of development or on strict age intervals is a pressing policy issue in many countries. One argument for taking the child's development into account when deciding on school start has been to reduce the disadvantage in school performance of children born late in the year and boys, as boys are typically assessed as having lower school readiness in preschool years than girls (Brandlistuen et al., 2020). However, there has not been sufficient evidence that maturity-based school entry systems have led to better long-term outcomes, for these groups or the student population as a whole. This study suggests that there may be benefits of school readiness assessments prior to determining school start for the youngest children in each cohort. It also calls for caution against stricter regimes where children are not allowed to delay school start in spite of parental wishes, particularly for boys and disadvantaged groups.

There are at least two arguments for strict age-based school entry policies. One has been that children from more advantageous backgrounds would be better able to take advantage of flexible rules. We did not find this in our study. To the contrary, our study shows that benefits from a maturity-based school entry system are foremost accruing to children in low-income families, and that these are also the children who bear the largest cost in terms of adult income of a stricter regime. The second argument for age-based school entry is that the school should accommodate the children's differential development levels, rather than sorting children. The findings from the introduction of maturity-based school entry in Norway in the 1960s should be interpreted within its context, which was prior to legal rights to individually adapted education. It may be the case that more individualised teaching could be a functioning alternative with similar long-term benefits as the maturity-based entry system. Hence, our study is perhaps



more relevant to settings in today's developing world. Findings from a trial in Kenya show that dividing students by performance levels can benefit for all students (Duflo et al., 2011). Yet even in highly developed education systems, available evidence has not consistently demonstrated positive impacts of special needs education (Hanushek et al., 2002; Morgan et al., 2010; Kvande et al., 2019), which is often a main tool to individualise education for children with learning difficulties. We certainly did not find positive effects of having a school psychology office in the 1976-1981 period, when identifying and providing support to children with special needs was the core duty of the psychological-pedagogical service.

Our findings raise a number of questions for further research. We have demonstrated that targeted policies for assessing the need for delayed school start may have long-term positive impacts on education and income for selected groups, in contrast to studies using age cut-offs as natural experiments (Black et al., 2011). One difference between these two methods is that whereas the methodology common in studies of school starting age finds hypothetical effects of delayed school start for an average student around the cut-off, we show results of a reform that promoted delayed school start for individuals that were believed to benefit the most from the intervention. Another difference is that the age cut-off methodology presupposes that changes to the classroom context from delayed school start are unimportant for later-life outcomes, whereas our study takes into account that children with an age-appropriate school start may also be affected. We therefore believe our study provides the most relevant comparison for policy. Any policy that increases the use of redshirting is likely to assign the intervention to a non-random selection of the cohort, be it through testing and professional advice as is the case in our study or through the perception of parents. Furthermore, policies designed for entire education systems should take the welfare of all students into account, not only delayed entrants.

Whereas this study indicates that maturity-based entry systems create better long-term outcomes than strict age cut-offs for some groups, more research is needed to inform policies on redshirting. Using policy reforms as exogenous variation is an under-utilised tool in this field. Further research should take into account that effects of entry systems may be heterogeneous and quantify both direct benefits from delayed school start and possible peer effects. More research is also needed on how maturity-based school entry functions in education systems with different emphasis on individualised learning, provision for special needs education, and with varying ages for education tracking. Such studies should shed light on whether school systems that provide more individualised learning than the Norwegian schools in the 1960s may be better able to accommodate children at varying levels of development and whether maturity-based entry systems may also be beneficial in these settings.

## References

- ATTAR, I. AND D. COHEN-ZADA (2018): “The effect of school entrance age on educational outcomes: Evidence using multiple cutoff dates and exact date of birth,” *Journal of Economic Behavior & Organization*, 153, 38 – 57.
- AUNE, T. K., R. P. INGVALDSEN, O. P. VESTHEIM, O. BJERKESET, AND T. DALEN (2018): “Relative Age Effects and Gender Differences in the National Test of Numeracy: A Population Study of Norwegian Children,” *Frontiers in Psychology*, 9, 1091.
- BAKER, A. C., D. F. LARCKER, AND C. C. WANG (2022): “How much should we trust staggered difference-in-differences estimates?” *Journal of Financial Economics*, 144, 370–395.
- BALESTRA, S., B. EUGSTER, AND H. LIEBERT (2020): “Summer-born struggle: The effect of school starting age on health, education, and work,” *Health Economics*, 29, 591–607.
- BEDARD, K. AND E. DHUEY (2012): “School-entry policies and skill accumulation across directly and indirectly affected individuals,” *Journal of Human Resources*, 47, 643–683.
- BLACK, S. E., P. J. DEVEREUX, AND K. G. SALVANES (2011): “Too young to leave the nest? The effects of school starting age,” *The Review of Economics and Statistics*, 93, 455–467.
- BORGE, L.-E., P. PARMER, AND R. TORVIK (2015): “Local natural resource curse?” *Journal of Public Economics*, 131, 101–114.
- BRANDLISTUEN, R. E., M. FLATØ, C. STOLTENBERG, S. S. HELLAND, AND M. V. WANG (2020): “Gender gaps in preschool age: A study of behavior, neurodevelopment and pre-academic skills,” *Scandinavian Journal of Public Health*, online first.
- CALLAWAY, B. AND P. H. SANT’ANNA (2021): “Difference-in-Differences with multiple time periods,” *Journal of Econometrics*, 225, 200–230, themed Issue: Treatment Effect 1.
- CENGIZ, D., A. DUBE, A. LINDNER, AND B. ZIPPERER (2019): “The Effect of Minimum Wages on Low-Wage Jobs\*,” *The Quarterly Journal of Economics*, 134, 1405–1454.
- CUNHA, F. AND J. HECKMAN (2007): “The technology of skill formation,” *American Economic Review*, 97, 31–47.
- DHUEY, E., D. FIGLIO, K. KARBOWNIK, AND J. ROTH (2019): “School Starting Age and Cognitive Development,” *Journal of Policy Analysis and Management*, 38, 538–578.

- DUFLO, E., P. DUPAS, AND M. KREMER (2011): “Peer effects, teacher incentives, and the impact of tracking: Evidence from a randomized evaluation in Kenya,” *American Economic Review*, 101, 1739–74.
- ELANGO, S., J. L. GARCÍA, J. J. HECKMAN, AND A. HOJMAN (2015): “Early childhood education,” in *Economics of Means-Tested Transfer Programs in the United States, Volume 2*, University of Chicago Press, 235–297.
- ELDER, T. E. AND D. H. LUBOTSKY (2009): “Kindergarten entrance age and childrens achievement impacts of state policies, family background, and peers,” *Journal of human Resources*, 44, 641–683.
- FOSTER, T. J., M. BURCHINAL, AND N. YAZEJIAN (2020): “The Relation Between Classroom Age Composition and Childrens Language and Behavioral Outcomes: Examining Peer Effects,” *Child Development*, 91, 2103–2122.
- FREDRIKSSON, P. AND B. ÖCKERT (2013): “Life-cycle Effects of Age at School Start,” *The Economic Journal*, 124, 977–1004.
- GABRIELSEN, E. AND K. LUNDETRÆ (2017): “Indikerer de norske PIRLSresultatene et behov for å justere retningslinjene for skolestartsalder? [Do the Norwegian PIRLS results indicate a need to reassess the guidelines for school starting age?],” in *Klar fremgang! [Clear progress!]*, Universitetsforlaget, 204–221.
- GOLDSCHMIDT, V., R. ROMMETVEIT, E. STRÖMGREN, K. O. CHRISTIANSEN, K. LAGERSPETZ, L. J. BRAATEN, L. J. BRAATEN, B. CHRISTIANSEN, T. DALLAND, A.-M. S. DUVE, H. HAVIN, T. HELSTRUP, S. HESSELHOLDT, P. A. HOLTER, J. HUNSDAHL, J. HVIID, M. JANSEN, J. P. JENSEN, B. JÖNSSON, L. KEBBON, A.-L. KÄLVESTEN, M. LANDMARK, P. LIIKANEN, S. LINDHOLM, K. B. MADSEN, O. MYLLYNIEMI, R. MYLLYNIEMI, R. F. NIELSEN, S. NÆESS, A. PAULSSON, E. PETERSEN, J. RISBERG, D. INGVAR, H. STOCKMAN, A. STÆHR, D. SVENDSEN, I. SYLVANDER, A.-L. HESSLER, A. TALLQVIST, K. H. TEIGEN, H. URSIN, H. VEJLESKOV, K. VIGELAND, H. WELTZER, J. M. VON WRIGHT, AND A. ÅS (1969): “Kongresberetning: Ottende nordiske psykologkongres [Conference proceedings: 8th Nordic Psychology Conference],” *Nordisk Psykologi [Nordic Psychology]*, 21, 1–184.
- GOODMAN-BACON, A. (2021): “Difference-in-differences with variation in treatment timing,” *Journal of Econometrics*, 225, 254–277.
- GRAUE, M. E. AND J. DIPERNA (2000): “Redshirting and early retention: Who gets the gift of time and what are its outcomes?” *American Educational Research Journal*, 37, 509–534.

- GREDLER, G. R. (1992): *School readiness: Assessment and educational issues.*, Brandon: Clinical Psychology Publishing Company.
- HAMBRO, C. (1967): “Skolepsykologisk kontor i Oslo [The school psychology office in Oslo],” *Skolepsykologen [The School Psychologist]*, 2, 4–10.
- HANUSHEK, E. A., J. F. KAIN, AND S. G. RIVKIN (2002): “Inferring program effects for special populations: Does special education raise achievement for students with disabilities?” *Review of Economics and Statistics*, 84, 584–599.
- JAEKEL, J., V. Y.-C. STRAUSS, S. JOHNSON, C. GILMORE, AND D. WOLKE (2015): “Delayed school entry and academic performance: a natural experiment,” *Developmental Medicine & Child Neurology*, 57, 652–659.
- KARLSTAD, Ø., K. FURU, C. STOLTENBERG, S. E. HÅBERG, AND I. J. BAKKEN (2017): “ADHD treatment and diagnosis in relation to children’s birth month: Nationwide cohort study from Norway,” *Scandinavian Journal of Public Health*.
- KARTVERKET [NORWEGIAN MAPPING AUTHORITY] (2017): “N50 Kartdata,” Available from <https://kartkatalog.geonorge.no/metadata/ea192681-d039-42ec-b1bc-f3ce04c189ac> [accessed 03.07.2020].
- KOERSELMAN, K. AND T. PEKKARINEN (2018): “Cognitive consequences of the timing of puberty,” *Labour Economics*, 54, 1–13.
- KVANDE, M. N., O. BJØRKLUND, S. LYDERSEN, J. BELSKY, AND L. WICHSTRØM (2019): “Effects of special education on academic achievement and task motivation: a propensity-score and fixed-effects approach,” *European Journal of Special Needs Education*, 34, 409–423.
- LANDERSØ, R. K., H. S. NIELSEN, AND M. SIMONSEN (2020): “Effects of school starting age on the family,” *Journal of Human Resources*, 55, 1258–1286.
- LEUVEN, E. AND M. RØNNING (2016): “Classroom Grade Composition and Pupil Achievement,” *The Economic Journal*, 126, 1164–1192.
- LILLESTØLEN, R. (1967): “Opplegg og erfaringer med skolemodenhetsprøver [Arrangement and experience with school maturity testing],” *Skolepsykologen [The School Psychologist]*, 2, 11–14.
- LINCOVE, J. A. AND G. PAINTER (2006): “Does the age that children start kindergarten matter? Evidence of long-term educational and social outcomes,” *Educational Evaluation and Policy Analysis*, 28, 153–179.
- LJUNGBLAD, T. (1964): “School readiness,” *Pedagogisk Forskning (Scandinavian Journal of Education Research)*, 8, 161–175.

- MARKUSSEN, S. AND K. RØED (2020): “Economic Mobility Under Pressure,” *Journal of the European Economic Association*, 18, 1844–1885.
- MORGAN, P. L., M. L. FRISCO, G. FARKAS, AND J. HIBEL (2010): “A Propensity Score Matching Analysis of the Effects of Special Education Services,” *The Journal of Special Education*, 43, 236–254, PMID: 23606759.
- NORWEGIAN MINISTRY OF CHURCH AFFAIRS AND EDUCATION (1983): “Pedagogisk-psykologisk rådgivningstjeneste – behov, arbeidsoppgaver og organisasjonsmodeller [Pedagogical-psychological counselling service – needs, tasks, and organisational models],” Norwegian Official Report (NOU) 1983:4, Oslo: Universitetsforlaget.
- PEKKARINEN, T. (2012): “Gender differences in education,” *Nordic Economic Policy Review*, 1, 165–194.
- PEÑA, P. A. (2017): “Creating winners and losers: Date of birth, relative age in school, and outcomes in childhood and adulthood,” *Economics of Education Review*, 56, 152 – 176.
- PIAGET, J. (1953): *The origins of intelligence in the child*, New York: Routledge.
- PLEYM, B. (1967): “Skolepsykologisk kontor, Mosjøen [The school psychology office, Mosjøen],” *Skolepsykologen [The School Psychologist]*, 2, 27–32.
- RAFFAELE MENDEZ, L. M., E. S. KIM, J. FERRON, AND B. WOODS (2015): “Altering school progression through delayed entry or kindergarten retention: Propensity score analysis of long-term outcomes,” *The Journal of Educational Research*, 108, 186–203.
- SANDVEN, J. (1962): “Det teoretiske og metodiske grunnlag for modenhetsprøving [The theoretical and methodological foundation for maturity testing],” *Pedagogisk forskning [Pedagogical research]*, 6, 147–168.
- SOLHEIM, R. (1975): “Skolemodenhet [School maturity],” *Skolepsykologen [The school psychologist]*, 10, 15–26.
- SOLLI, I. F. (2017): “Left behind by birth month,” *Education Economics*, 25, 323–346.
- THELEN, E. AND K. E. ADOLPH (1992): “Arnold L. Gesell: The paradox of nature and nurture,” *Developmental Psychology*, 28, 368–380.
- TORVIK, F. A., M. FLATØ, T. A. MCADAMS, I. COLMAN, K. SILVENTOINEN, AND C. STOLTENBERG (2021): “Early Puberty Is Associated With Higher Academic Achievement in Boys and Girls and Partially Explains Academic Sex Differences,” *Journal of Adolescent Health*, in press, corrected proof.
- VIK, Å. J. AND T. B. HANSEN (1980): “Framskutt skolestart - skolemodenhet [Early school start - school maturity],” *Skolepsykologen [The school psychologist]*, 14, 21–24.

# Online Appendix

## A) Effects on early graduation

Table A1: Effects on early graduation of establishing a school psychology office, 1966-1981

Model	(1)	(2)		(3)	
Outcome: Early graduation	Overall	Born Jan-March	Born April-Dec	Males	Females
Reform $\times$ Age 6 <sub>1966-70</sub>	0.002 (0.002)	0.003 (0.005)	0.002 (0.002)	0.003 (0.002)	0.002 (0.002)
Reform $\times$ Age 6 <sub>1971-75</sub>	0.003 (0.002)	0.008* (0.004)	0.0005 (0.002)	0.001 (0.002)	0.004 (0.002)
Reform $\times$ Age 6 <sub>1976-81</sub>	0.001 (0.005)	-0.003 (0.007)	0.002 (0.005)	0.001 (0.005)	0.001 (0.006)
Observations	283,805	283,805		283,805	
R <sup>2</sup>	0.4530	0.4677		0.4830	

*Reform indicates turning 6 years or older the year a school psychology office was introduced in the municipality of residence. Controls for birth year and mother fixed effects interacted by dataset are included. Heterogeneous effects also include controls for the heterogeneity factor by dataset. Standard errors clustered at the psychology office level in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$*

## B) Effects on fertility outcomes

Table A2: Effects on having any children by age 43 of establishing a school psychology office, 1960-1981

Model	(1)	(2)		(3)	
Outcome: Any children at 43	Overall	Born Jan-Sept	Born Oct-Dec	Males	Females
Reform $\times$ Age 7 <sub>1960-65</sub>	-0.002 (0.006)	-0.006 (0.006)	0.008 (0.010)	0.008 (0.007)	-0.011 (0.007)
Reform $\times$ Age 7 <sub>1966-70</sub>	-0.001 (0.004)	-0.005 (0.005)	0.012 (0.008)	0.001 (0.005)	-0.002 (0.005)
Reform $\times$ Age 7 <sub>1971-75</sub>	-0.003 (0.005)	-0.001 (0.005)	-0.008 (0.007)	-0.001 (0.006)	-0.004 (0.006)
Reform $\times$ Age 7 <sub>1976-81</sub>	-0.001 (0.012)	0.001 (0.012)	-0.007 (0.012)	-0.005 (0.010)	0.002 (0.011)
Observations	869,020	869,020		869,020	
R <sup>2</sup>	0.4598	0.4598		0.4691	

*Reform indicates turning 7 years or older the year a school psychology office was introduced in the municipality of residence. Controls for birth year and mother fixed effects interacted by dataset are included. Heterogeneous effects also include controls for the heterogeneity factor by dataset. Standard errors clustered at the psychology office level in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$*

Table A3: Effects on number of children by age 43 of establishing a school psychology office, 1960-1981

Model	(1)	(2)		(3)	
Outcome: No. children at 43	Overall	Born Jan-Sept	Born Oct-Dec	Males	Females
Reform $\times$ Age 7 <sub>1960-65</sub>	-0.017 (0.020)	-0.017 (0.017)	-0.015 (0.039)	0.022 (0.025)	-0.052** (0.024)
Reform $\times$ Age 7 <sub>1966-70</sub>	-0.015 (0.016)	-0.018 (0.016)	-0.006 (0.028)	-0.029 (0.019)	0.003 (0.017)
Reform $\times$ Age 7 <sub>1971-75</sub>	-0.026 (0.016)	-0.024 (0.016)	-0.032 (0.026)	-0.024 (0.018)	-0.027 (0.022)
Reform $\times$ Age 7 <sub>1976-81</sub>	-0.051 (0.048)	-0.045 (0.049)	-0.072 (0.053)	-0.074* (0.037)	-0.029 (0.052)
Observations	869,020	869,020		869,020	
R <sup>2</sup>	0.4748	0.4748		0.4799	

*Reform indicates turning 7 years or older the year a school psychology office was introduced in the municipality of residence. Controls for birth year and mother fixed effects interacted by dataset are included. Heterogeneous effects also include controls for the heterogeneity factor by dataset. Standard errors clustered at the psychology office level in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$*

### C) Effects on delayed graduation by reform year

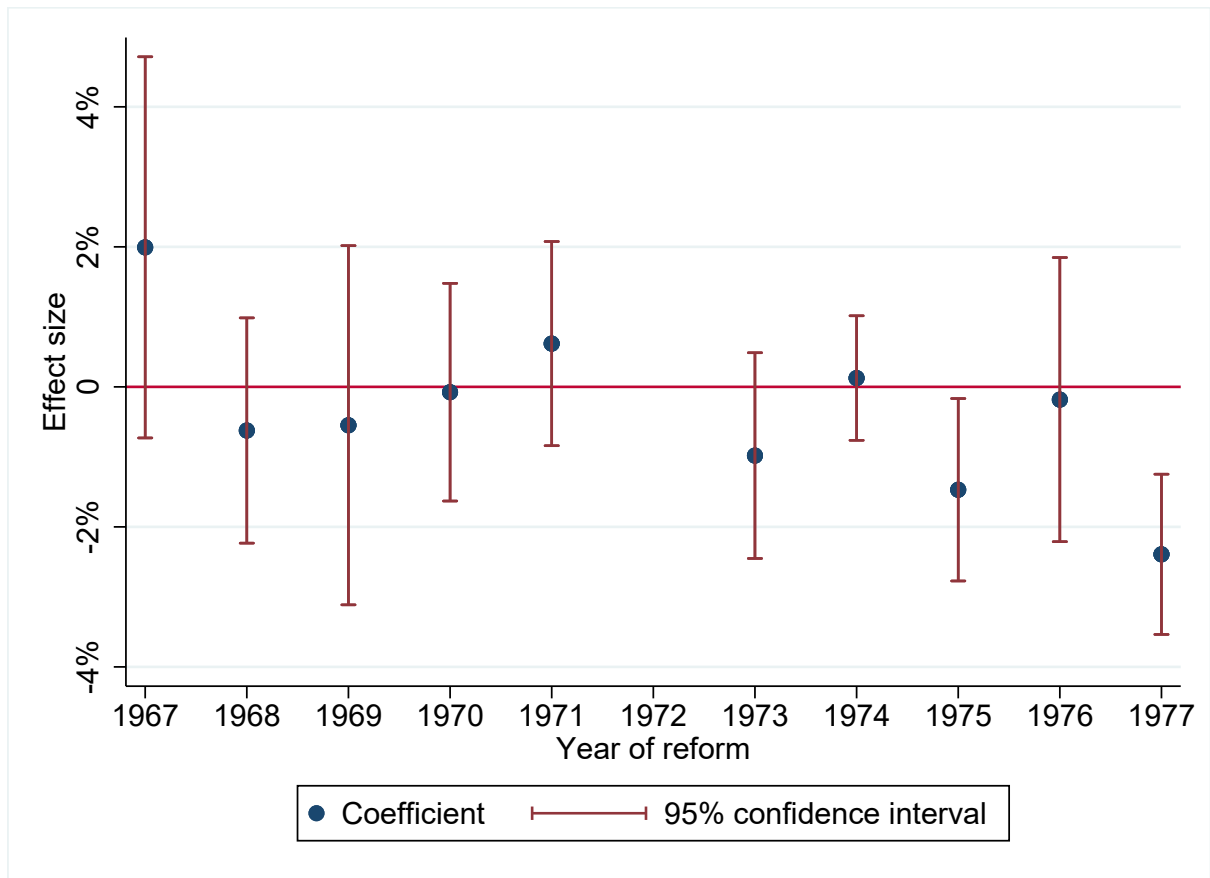


Figure A1: Effect on delayed graduation of establishing school psychology office, by reform year



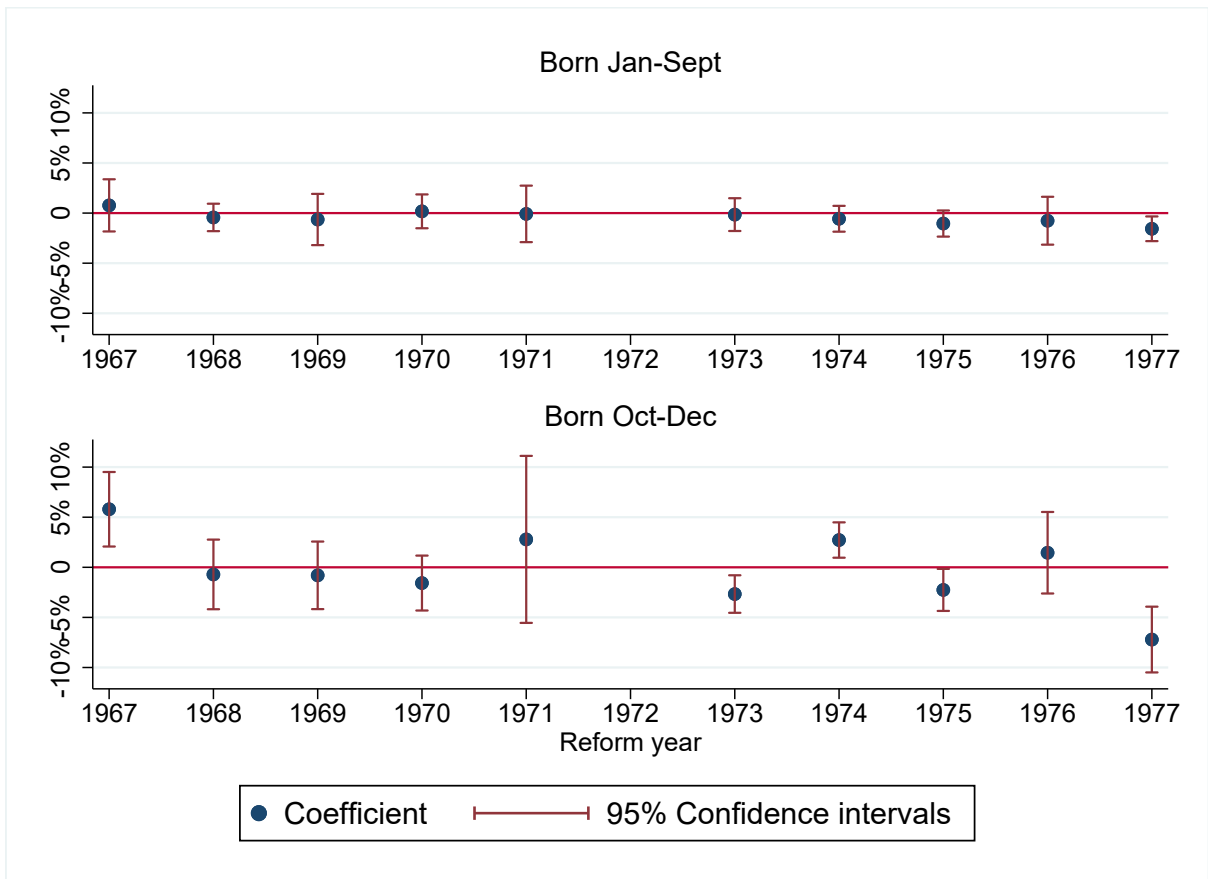


Figure A2: Effect on delayed graduation of establishing school psychology office, by reform year and season of birth

## D) Effects on delayed graduation by birth month

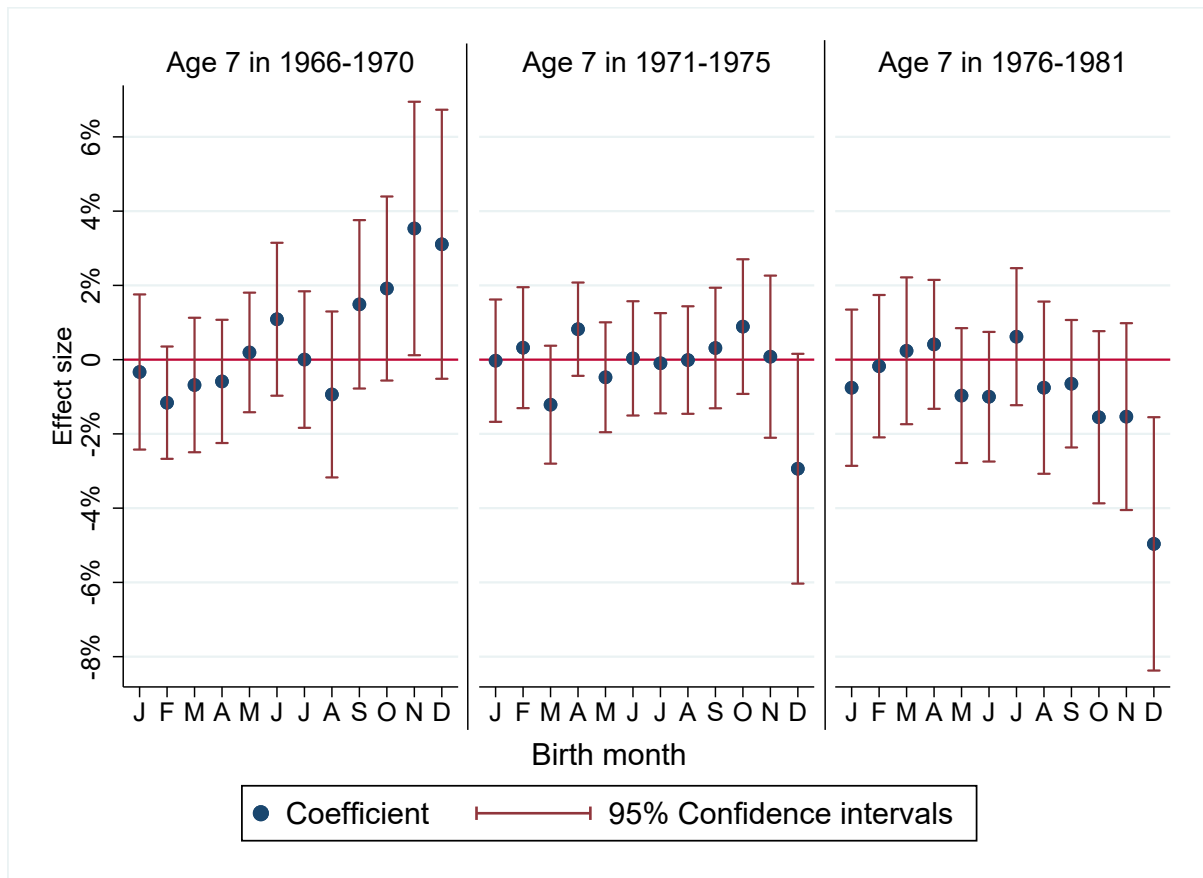


Figure A3: Effect on delayed graduation of establishing school psychology office, by birth month

## E) Event studies

Figures A4–A6 show event study plots for each reform on delayed graduation. We are not able to plot pre-trends for municipalities who introduced the reform in 1967. However, the post-trend suggests a jump in levels rather than gradual increase. No significant pre-trend is found in any of the regressions.

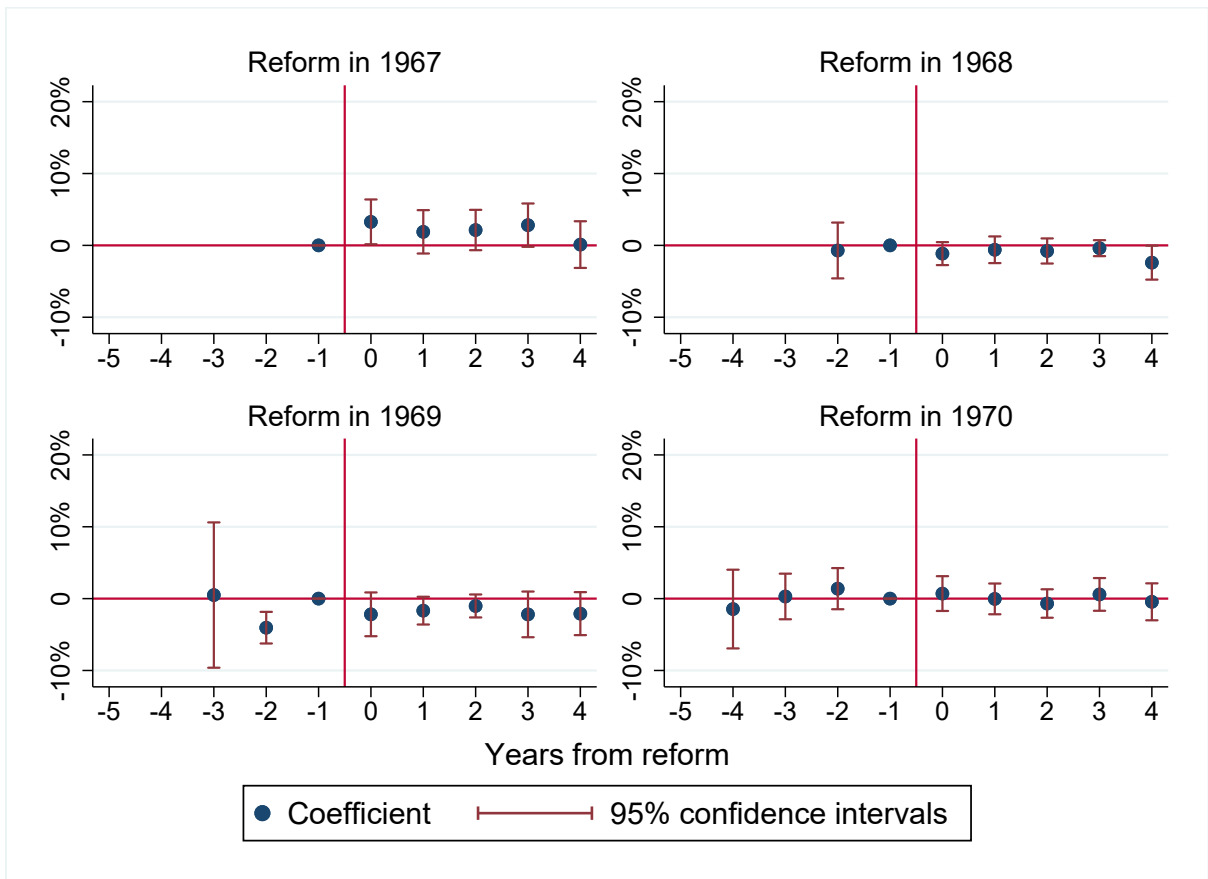


Figure A4: Event study of effect on delayed graduation, reform in 1967-1970



Figure A5: Event study of effect on delayed graduation, reform in 1971-1975

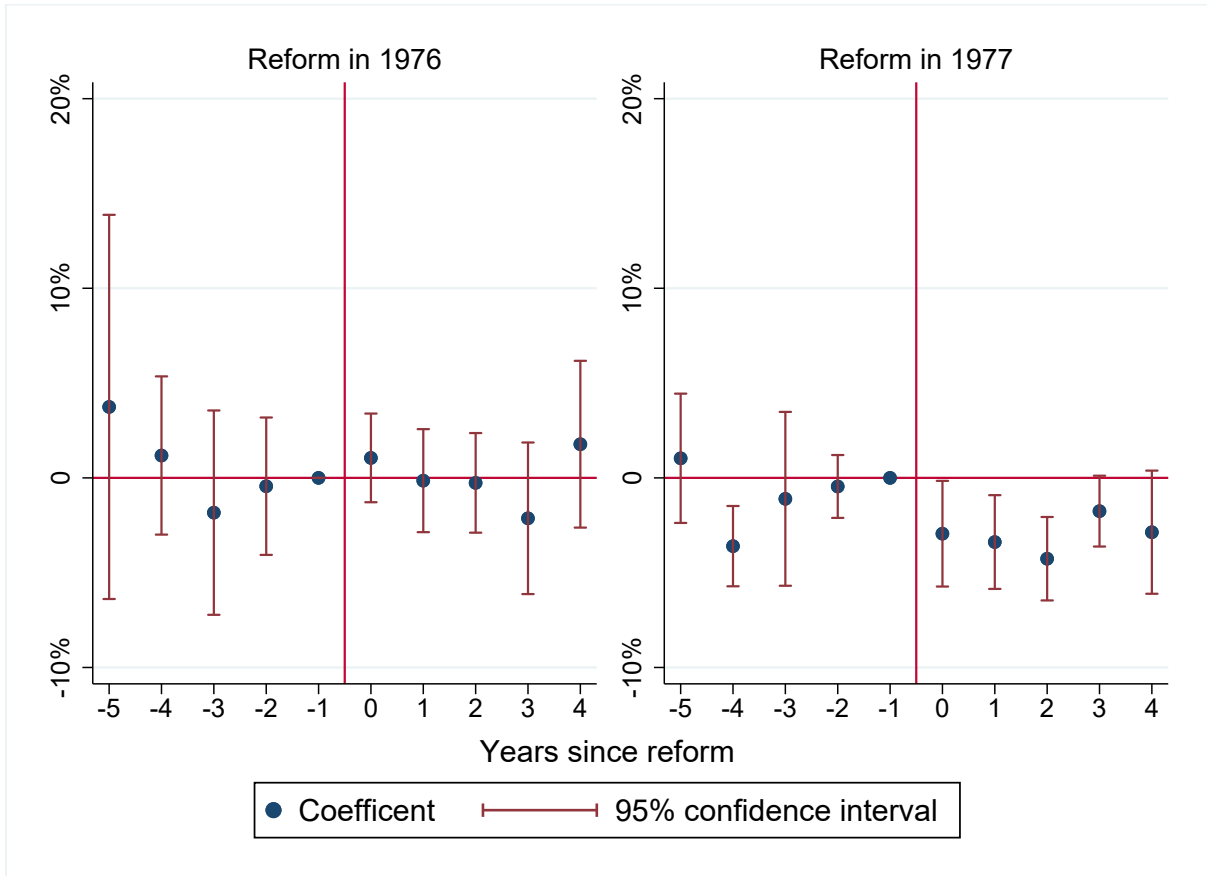


Figure A6: Event study of effect on delayed graduation, reform in 1976-1977

Event plots with logged income as an outcome are shown in Figures A7–A10. There are significant pre-trends for reform years 1965, 1966, 1968, 1969, 1974, and 1976.

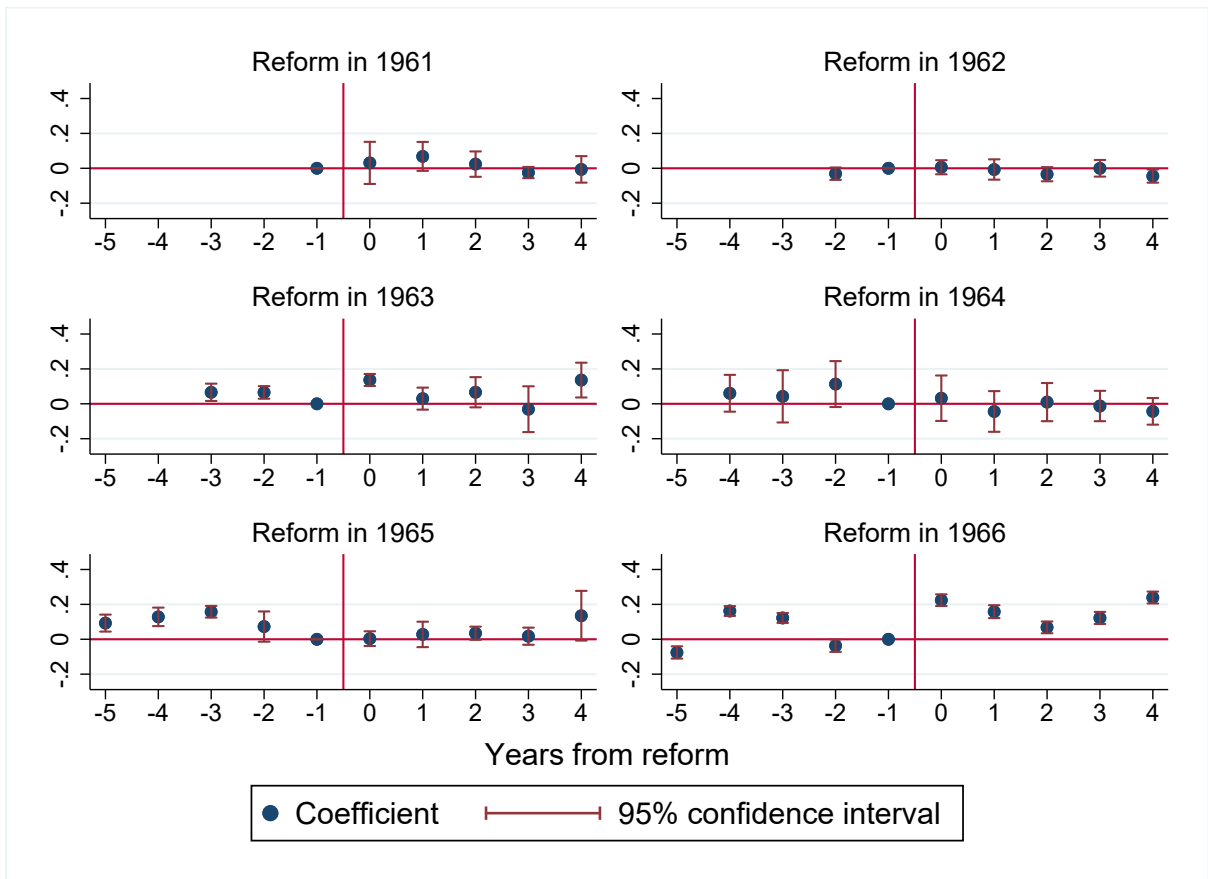


Figure A7: Event study of effect on income at 43, reform in 1961-1966

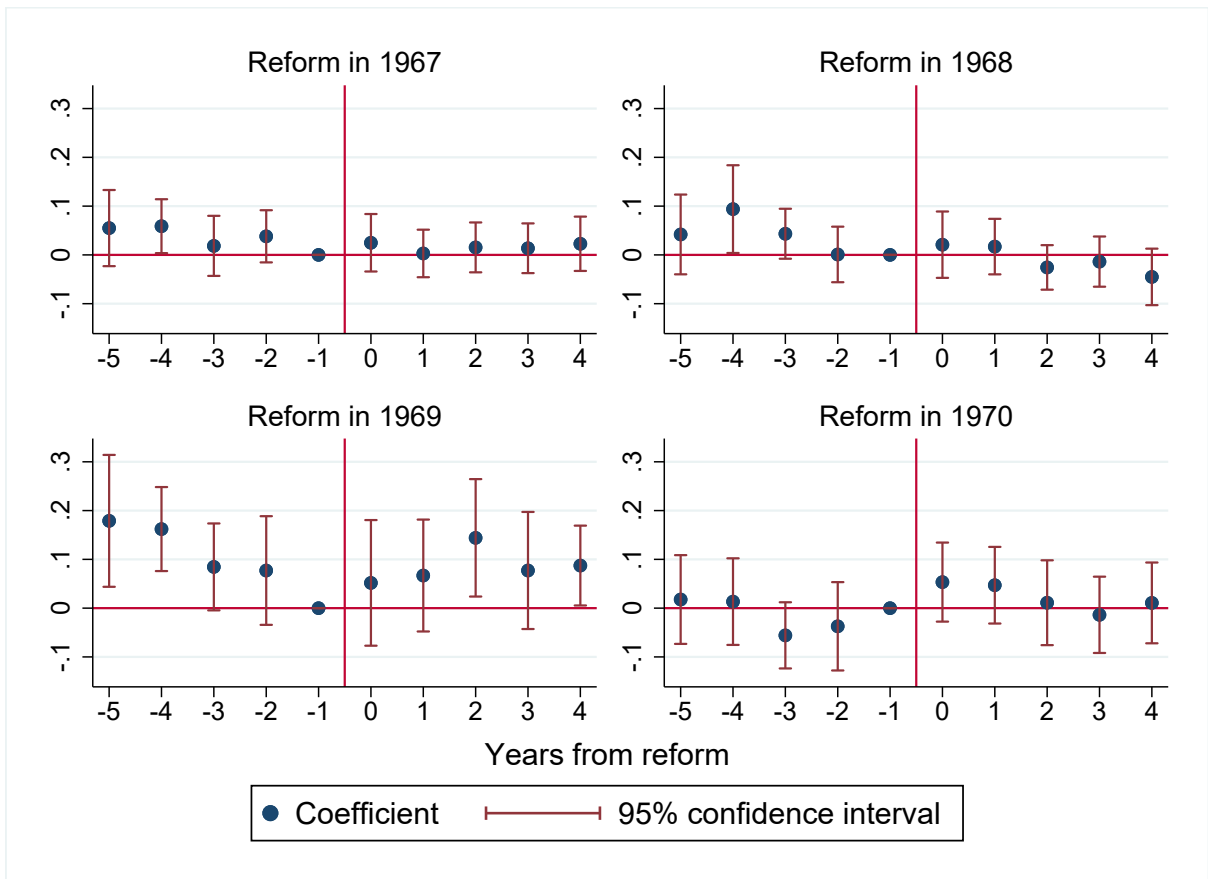


Figure A8: Event study of effect on income at 43, reform in 1967-1970

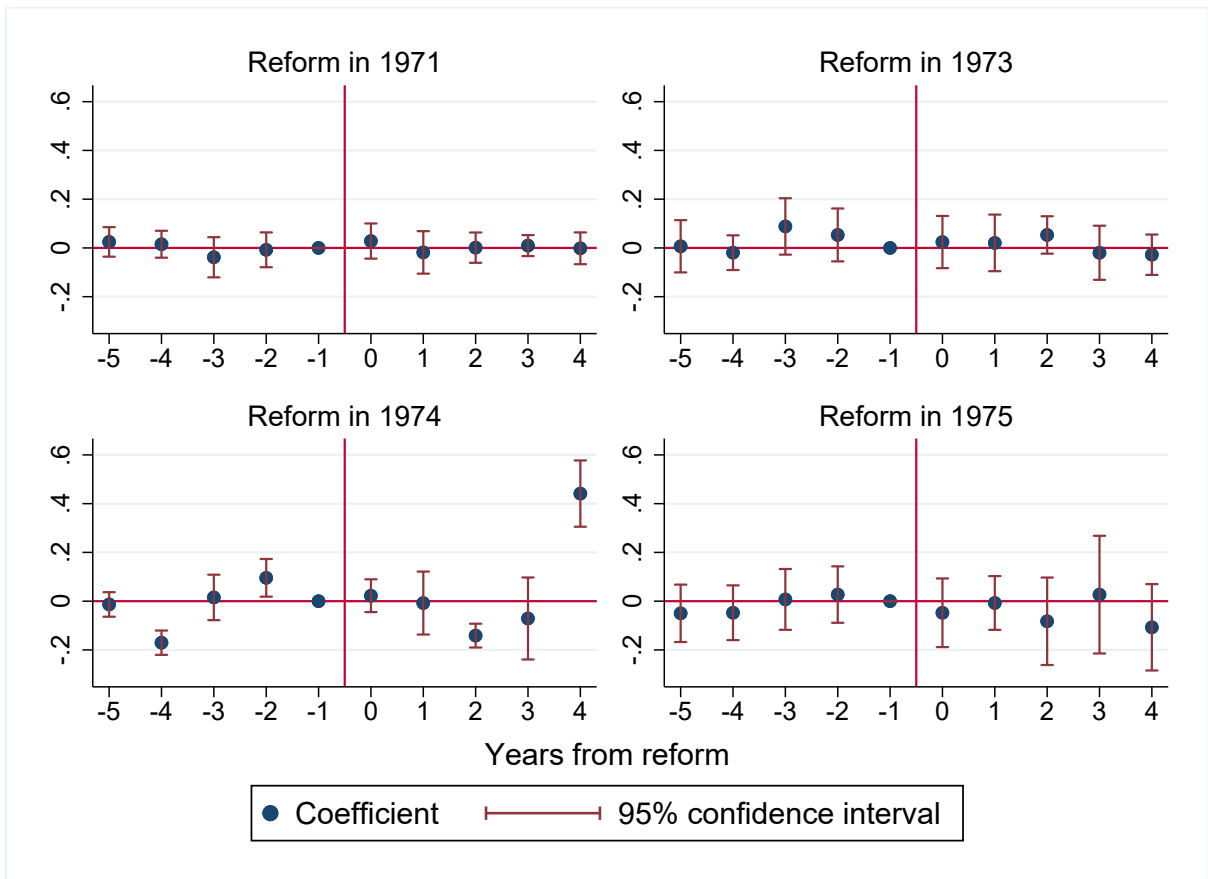


Figure A9: Event study of effect on income at 43, reform in 1971-1975



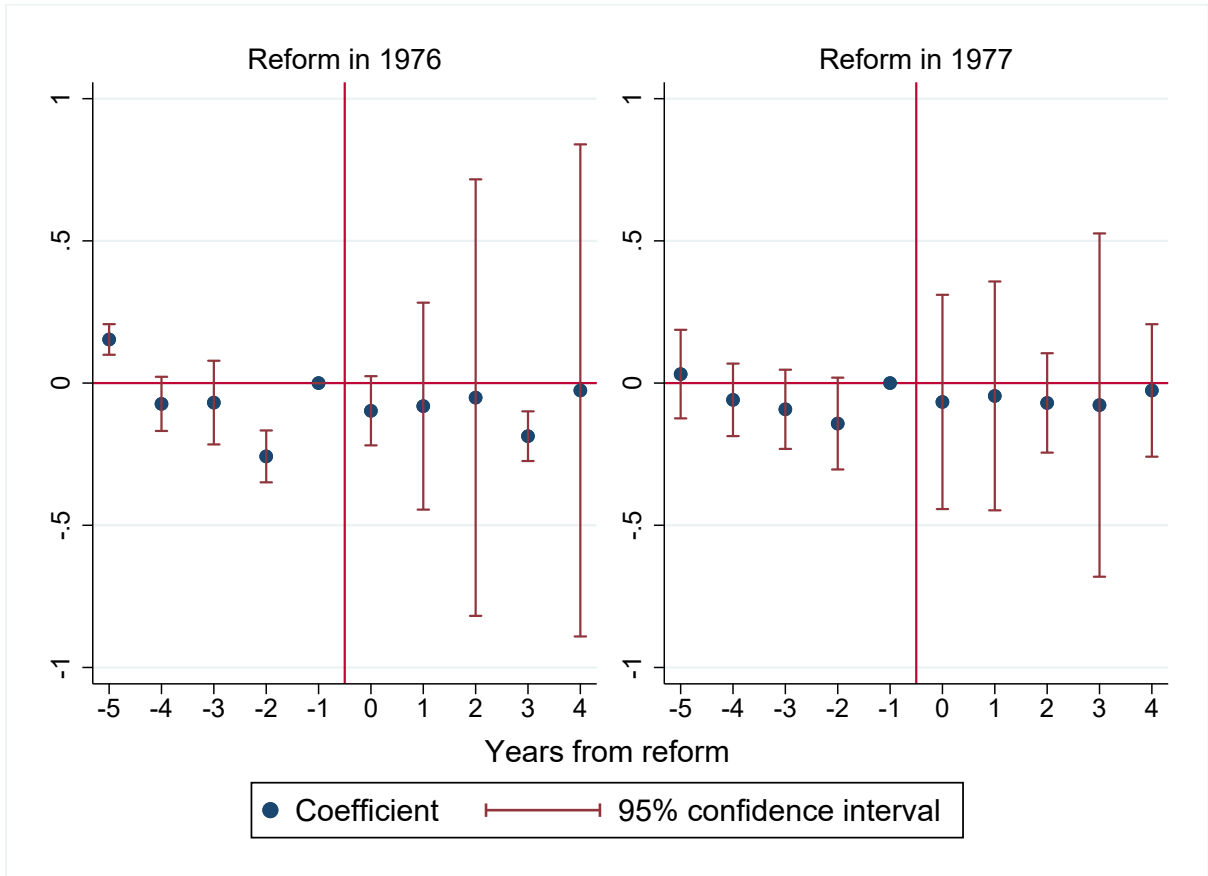


Figure A10: Event study of effect on income at 43, reform in 1976-1977

Event plots with years of education as outcome are shown in Figures A11–A14. There are significant pre-trends for reform years 1965, 1966, 1967, 1969, and 1974.

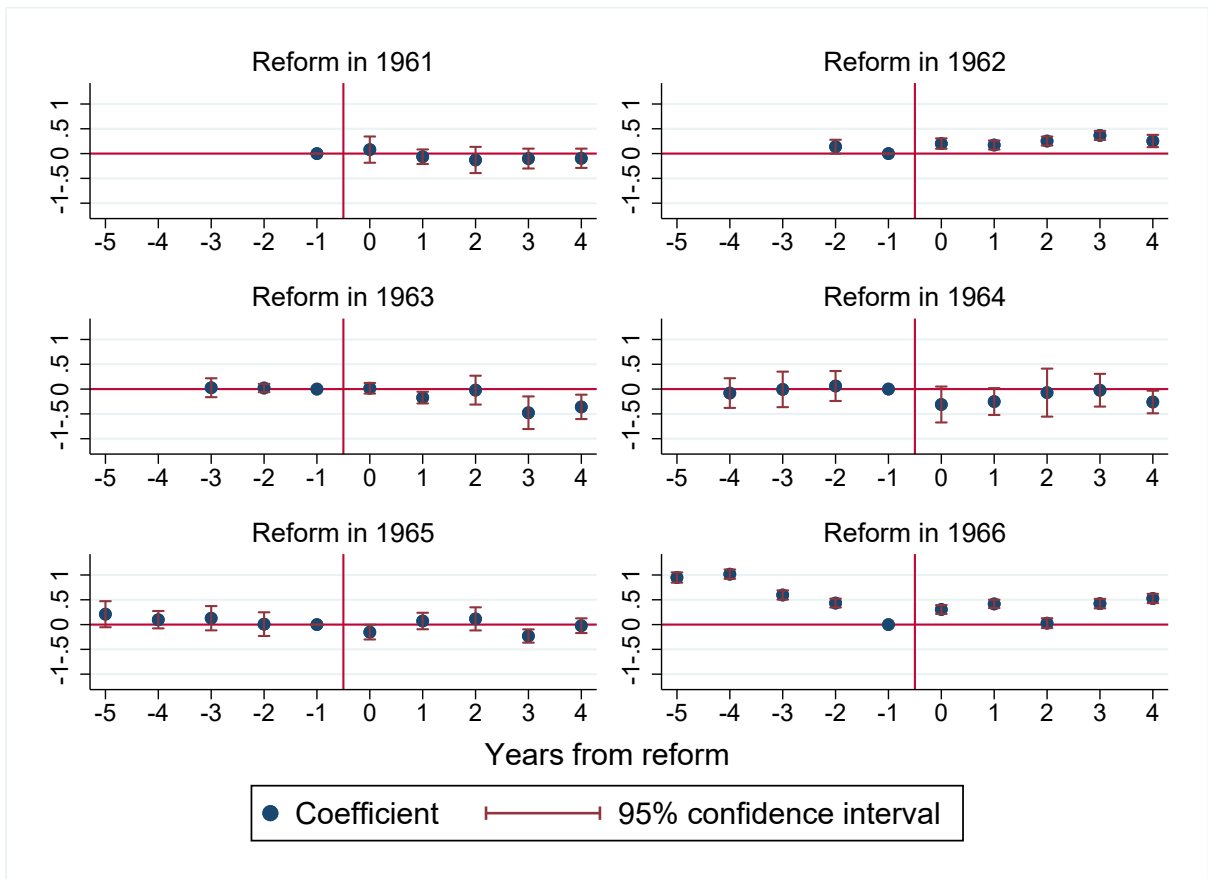


Figure A11: Event study of effect on years of education at 43, reform in 1961-1966

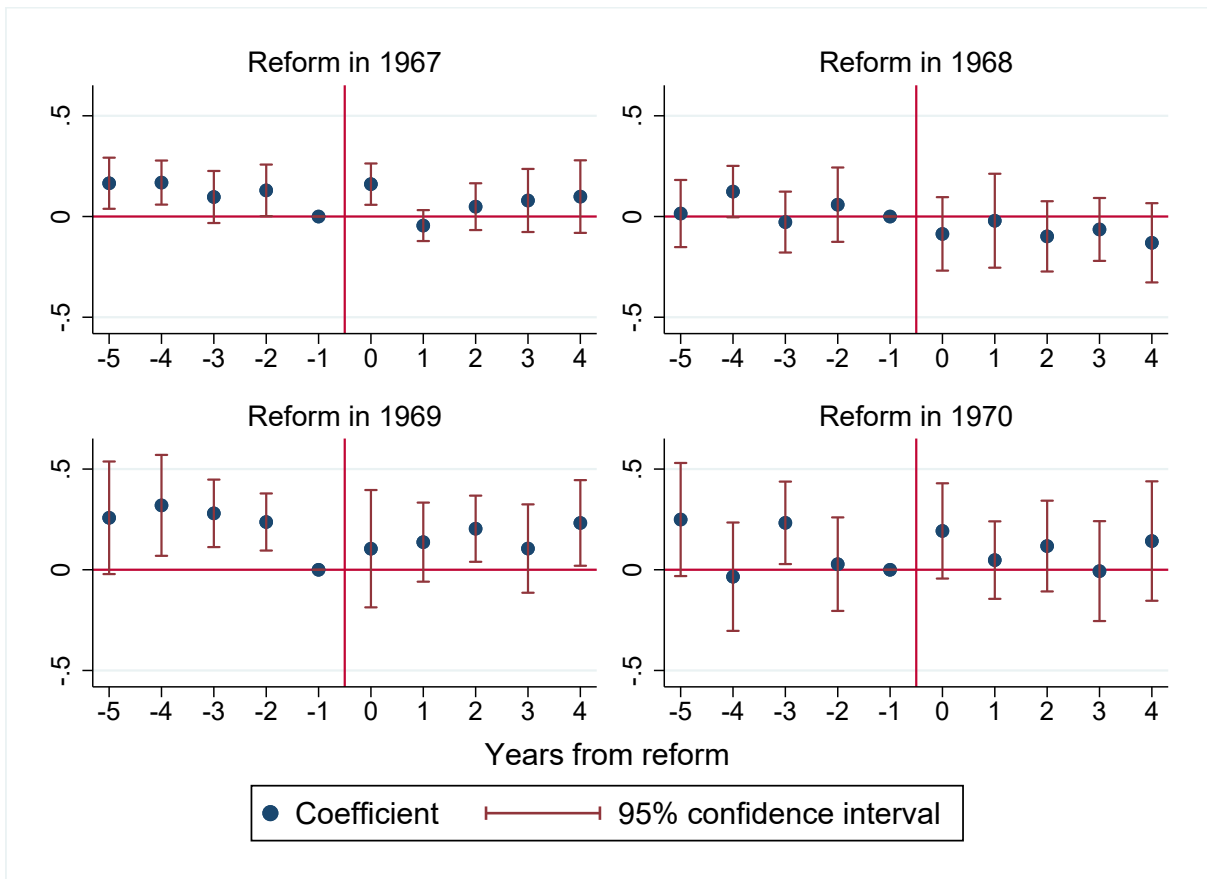


Figure A12: Event study of effect on years of education at 43, reform in 1967-1970

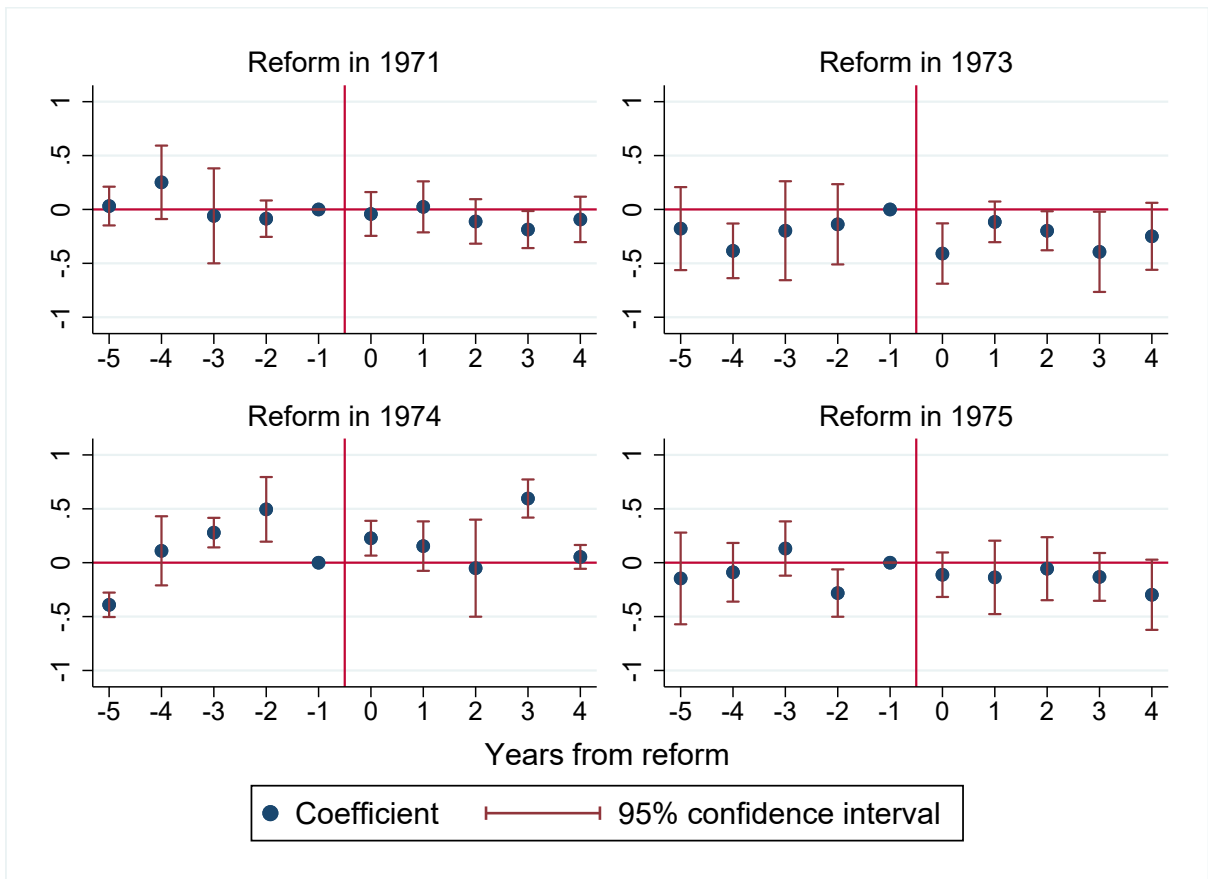


Figure A13: Event study of effect on years of education at 43, reform in 1971-1975

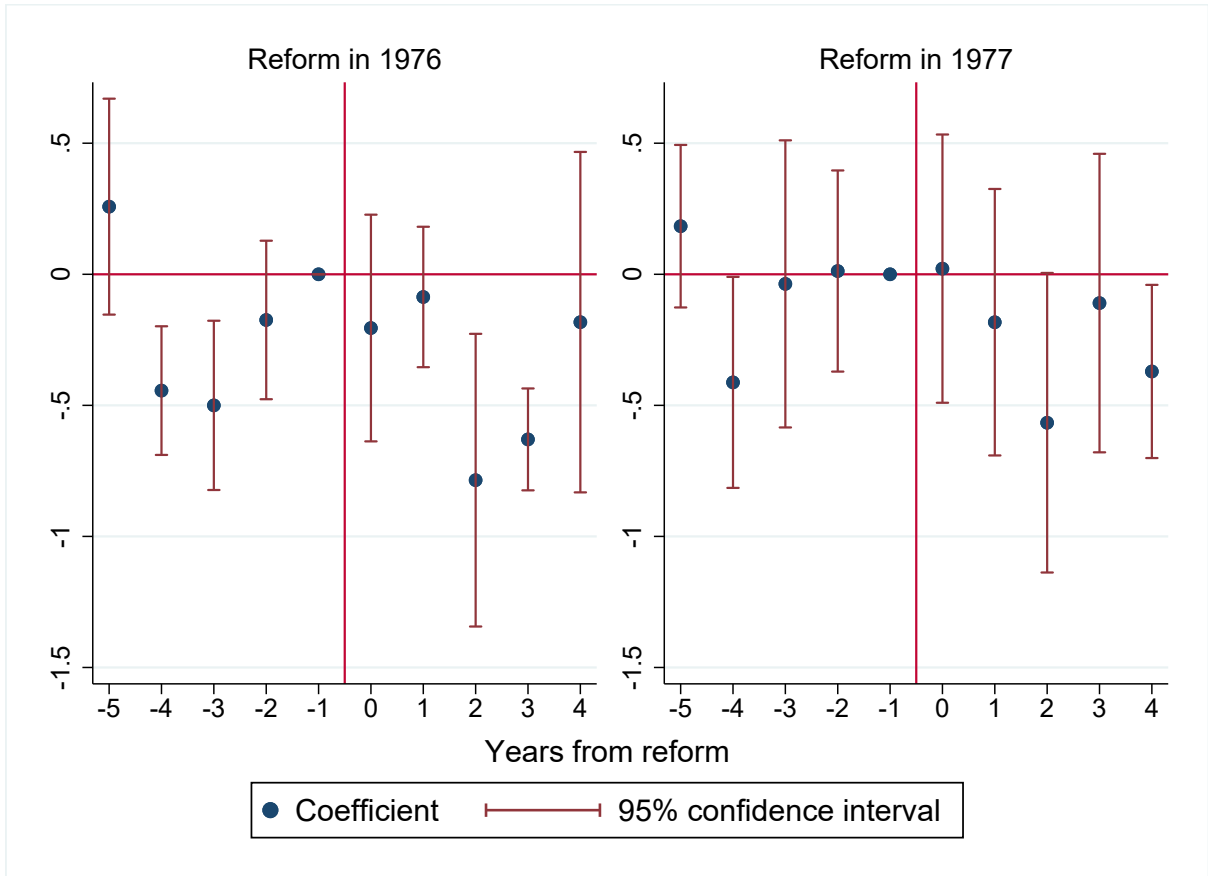


Figure A14: Event study of effect on years of education at 43, reform in 1976-1977

As a robustness check, we removed all reform years with significant pre-trends from the analysis in Tables A4–A5. The results show similar effects to the main analysis where these reforms were included.

Table A4: Effects on income of establishing a school psychology office excluding reform years with pre-trends, 1960–1981

Model	(1)	(2)		(3)	
Outcome: Log income at 43	Overall	Born Jan-Sept	Born Oct-Dec	Males	Females
Reform $\times$ Age 7 <sub>1960-65</sub>	0.006 (0.012)	0.005 (0.012)	0.007 (0.020)	-0.011 (0.022)	0.002 (0.020)
Reform $\times$ Age 7 <sub>1966-70</sub>	-0.007 (0.012)	-0.023 (0.015)	0.047** (0.019)	0.006 (0.021)	-0.033 (0.023)
Reform $\times$ Age 7 <sub>1971-75</sub>	0.007 (0.012)	-0.003 (0.013)	0.038** (0.016)	0.006 (0.017)	0.008 (0.016)
Reform $\times$ Age 7 <sub>1976-81</sub>	-0.026 (0.032)	-0.025 (0.033)	-0.028 (0.045)	-0.065* (0.033)	0.014 (0.027)
Observations	488,198	488,198		488,198	
R <sup>2</sup>	0.4767	0.4767		0.5178	

The dependent variable is logged pensionable income adjusted for wage increases in 2017 Norwegian kroner. Reform indicates turning 7 years or older the year a school psychology office was introduced in the municipality of residence. Controls for birth year and mother fixed effects interacted by dataset are included. Heterogeneous effects also include controls for the heterogeneity factor by dataset. Reform years with significant pre-trends are excluded. Standard errors clustered at the psychology office level in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table A5: Effects on years of education of establishing a school psychology office excluding reform years with pre-trends, 1960–1981

Model	(1)	(2)		(3)	
Outcome: Years of schooling	Overall	Born Jan-Sept	Born Oct-Dec	Males	Females
Reform $\times$ Age 7 <sub>1960-65</sub>	-0.008 (0.063)	0.007 (0.064)	-0.055 (0.068)	-0.037 (0.061)	0.016 (0.077)
Reform $\times$ Age 7 <sub>1966-70</sub>	-0.032 (0.057)	-0.052 (0.073)	0.038 (0.045)	-0.053 (0.059)	-0.011 (0.082)
Reform $\times$ Age 7 <sub>1971-75</sub>	-0.065* (0.035)	-0.085** (0.037)	0.003 (0.045)	-0.121*** (0.039)	-0.009 (0.045)
Reform $\times$ Age 7 <sub>1976-81</sub>	-0.129** (0.060)	-0.123** (0.062)	-0.153* (0.086)	-0.244*** (0.069)	-0.011 (0.066)
Observations	533,951	533,951		533,951	
R <sup>2</sup>	0.6276	0.6276		0.6292	

The dependent variable is years of education. Reform indicates turning 7 years or older the year a school psychology office was introduced in the municipality of residence. Controls for birth year and mother fixed effects interacted by dataset are included. Heterogeneous effects also include controls for the heterogeneity factor by dataset. Reform years with significant pre-trends are excluded. Standard errors clustered at the psychology office level in parentheses. \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## F) Varying age at observed income

We have chosen to use income at age 43 as a main outcome in the article. That is the oldest age at which all individuals are observed. Income at earlier ages may be more affected by that those with delayed school start begin their professional life later and often start childbearing at a later age. Figure A15 shows the effect on income at all ages from 30-43. We see that the effect on late-born children in 1966-1970 (which is significant positive at age 43) is positive in 12 out of 13 cases, and significant in 7 cases.

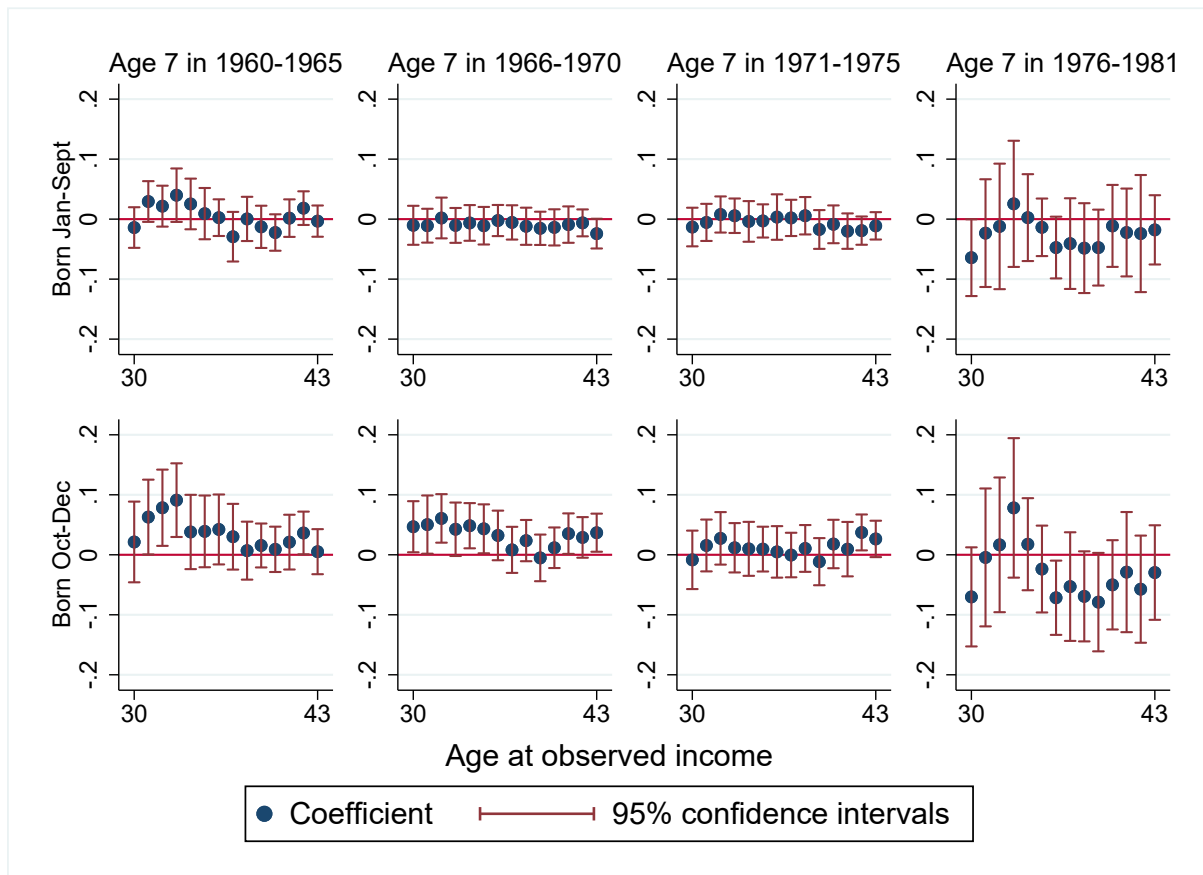


Figure A15: Effect of school psychology office on logged income at ages 30-43

## G) Sources on office establishments

### List of school psychology offices from the School Psychologists Association

S1. Association for Norwegian School Psychologists (1959). “Skolepsykologiske kontorer i Norge pr. 1/10 – 1958 [School psychology offices in Norway per 1/10 – 1958]”. Letter to the Norwegian Ministry of Social Affairs, Oslo, 18 March 1959. Available in the National Archives of Norway, archive RA/S-1274, box 484, folder 6.10.6 Skolepsykologiske kontorer [School psychology offices].

S2. Association for Norwegian School Psychologists (1960). “Skolepsykologiske kontorer i Norge pr. 1/10 – 1959 [School psychology offices in Norway per 1/10 – 1959]”. Letter to the Norwegian Ministry of Social Affairs. Available in the National Archives of Norway, archive RA/S-1274, box 484, folder 6.10.6 Skolepsykologiske kontorer [School psychology offices].

S3. Association for Norwegian School Psychologists (1962a). “Skolepsykologiske kontorer i Norge pr. 1/10 – 1961 [School psychology offices in Norway per 1/10 – 1961]”. Letter to the Norwegian Ministry of Social Affairs. Available in the National Archives of Norway, archive RA/S-1274, box 484, folder 6.10.6 Skolepsykologiske kontorer [School psychology offices].

S4. Association for Norwegian School Psychologists (1962b). “Skolepsykologiske kontorer i Norge pr. 1/4 – 1962 [School psychology offices in Norway per 1/4 – 1962]”. Letter to the Norwegian Ministry of Social Affairs. Available in the National Archives of Norway, archive RA/S-1274, box 484, folder 6.10.6 Skolepsykologiske kontorer [School psychology offices].

S5. Association for Norwegian School Psychologists (1967). “Skolepsykologiske kontorer i Norge [School psychology offices in Norway]”, *Skolepsykologen* [The School Psychologist], 2(5), p. 1-10. Available from the National Library of Norway.

S6. School Psychology Section of the Norwegian Psychological Association (1969). “Skolepsykologiske kontorer i Norge [School psychology offices in Norway]”, *Skolepsykologi* [School Psychology], 4(4), p. 3-12. Available from the National Library of Norway.

S7. School Psychology Section of the Norwegian Psychological Association (1970). “Skolepsykologiske kontorer i Norge [School psychology offices in Norway]”, *Skolepsykologi* [School Psychology], 5(1), p. 1-11. Available from the National Library of Norway.

S8. School Psychology Section of the Norwegian Psychological Association (1971). “Skolepsykologiske kontorer i Norge [School psychology offices in Norway]”, *Skolepsykologi* [School Psychology], 6(6), p. 1-14. Available from the National Library of Norway.

S9. School Psychology Section of the Norwegian Psychological Association (1974). “Skolepsykologiske kontorer i Norge [School psychology offices in Norway]”, *Skolepsykologi* [School Psychology], 9(3), p. 9-35. Available from the National Library of Norway.

S10. School Psychology Section of the Norwegian Psychological Association (1976). “Skolepsykologiske kontorer i Norge [School psychology offices in Norway]”, *Skolepsykologi* [School Psychology], 11(1), p. 23-52. Available from the National Library of Norway.

S11. School Psychology Section of the Norwegian Psychological Association (1977). “Den pedagogisk-psykologiske tjenesten i Norge [The pedagogical-psychological service in Norway]”, *Skolepsykologi* [School Psychology], 12(2), p. 1-33. Available from the National Library of Norway.

S12. School Psychology Section of the Norwegian Psychological Association (1980). “Den pedagogisk-psykologiske tjenesten i Norge [The pedagogical-psychological service in Norway]”, 15(6), p. 1-56. Available from the National Library of Norway.



S13. School Psychology Section of the Norwegian Psychological Association (1982). “Den pedagogisk-psykologiske tjenesten I Norge [The pedagogical-psychological service in Norway]”, *Skolepsykologi* [School Psychology], 17(3), p. 3-63. Available from the National Library of Norway.

S14. School Psychology Section of the Norwegian Psychological Association (1983). “Den pedagogisk-psykologiske tjenesten [The pedagogical-psychological service]”, *Skolepsykologi* [School Psychology], 19(7), p. 3-78. Available from the National Library of Norway.

## **Lists of school psychology offices from the Ministry of Church Affairs and Education**

N1. Norwegian Ministry of Church Affairs and Education (1957). “Rådgivning i skolen [Guidance in school]”. *Norsk skole* [Norwegian School], 3(1), p. 1-14. Oslo: Norwegian Ministry of Church Affairs and Education. Available from the National Library of Norway.

N2. Norwegian Ministry of Church Affairs and Education (1960). “Adresseliste for skoleverket [Address list for the school system]”. *Norsk skole* [Norwegian School], 6(9), pp. 113-216. Oslo: Norwegian Ministry of Church Affairs and Education. Available from the National Library of Norway.

N3. Norwegian Ministry of Church Affairs and Education (1964). “Adresseliste for skoleverket [Address list for the school system]”. *Norsk skole* [Norwegian School], 10(1), pp. 1-99. Oslo: Norwegian Ministry of Church Affairs and Education. Available from the National Library of Norway.

N4. Norwegian Ministry of Church Affairs and Education (1965). “Adresseliste for skoleverket [Address list for the school system]”. *Norsk skole* [Norwegian School], 11(5), pp. 93-186. Oslo: Norwegian Ministry of Church Affairs and Education. Available from the National Library of Norway.

N5. Norwegian Ministry of Church Affairs and Education (1972). “Skolepsykologiske kontorer pr. 1. juni 1971 [School psychology offices by 1 June 1971]”. *Norsk skole* [Norwegian School], 18(5), pp. 17-23. Oslo: Norwegian Ministry of Church Affairs and Education. Available from the National Library of Norway.

## **Other sources**

O1. Breivik, P. (1987). “Skulestellet fra 1945-1987 [The school system from 1945-1987]”. In Julnes, J. & Rød, K. (eds.), *Aukra kommune 150 år* [Aukra municipality 150 years]. Aukra: Aukra municipality. Available from the National Library of Norway.

O2. Bækkelund, R. (1987). *Furnes bygdebok bind 4* [Furnes local history book volume 4].

Furnes: Furnes historielag. Available from the National Library of Norway.

O3. Evjen, G. (1984). Pedagogisk-psykologisk rådgiving : et historisk perspektiv [Pedagogical-psychological counselling: An historical perspective]. Brandbu: Materiellservice. Available from the National Library of Norway.

O4. Jonasen, J. (1964). Sandnes gjennom 100 år, første bind [Sandnes through 100 years, volume 1]. Sandnes: Sandnes municipality. Available from the National Library of Norway.

O5. Juel, S. & Torp, R. (2001). Skui skole gjennom 100 år: 1901-2001 [Skui school through 100 years: 1901-2001]. Rud: Bærum municipality. Available from the National Library of Norway.

O6. Jørgensen, I. (2008). Skien PP-kontor 50 år 1958-2008 [Skien Pedagogical-Psychological Office 50 years 1958-2008]. Skien: Skien municipality.

O7. Lid, I. (1989). "PP-tenesta for Jondal og Kvam [The pedagogical-psychological service for Jondal and Kvam]". In Uppheim, J., Svarstad, H. & Laupsa, O. (eds.), Skulesoga for Kvam 1739-1989 [School narrative for Kvam 1739-1989]. Kvam: Kvam school authority.

O8. Moss Avis (1964). "Nok en psykolog ansettes ved skolepsykologisk kontor [Another psychologist will be hired at the school psychology office]". Newspaper article from Moss Avis, 28 May 1964, p. 6. Available from the National Library of Norway.

O9. Møre og Romsdal School Authority (1975). Møre og Romsdal skoledirektørdistrikt gjennom 20 år: Attersyn og perspektiv [Møre og Romsdal school district through 20 years: Hintsights and perspectives]. Molde: Møre og Romsdal School Authority. Available from the National Library of Norway.

O10. Nordic Psychologists Collaborative Committee (1955). "Personalia". *Nordic Psychology*, 7(5-6), pp. 236-237.

O11. Nøkleby, B. (1996). Drammen: En norsk østlandsbys utviklingshistorie bind V [Drammen: An eastern Norwegian city's history of development volume V]. Drammen: Drammen municipality. Available from the National Library of Norway.

O12. Ofstad, J. (1971). "En pioner trekker seg tilbake [A pioneer retires]". *Skolepsykologi [School Psychology]*, 6(3), p. 2-3. Available from the National Library of Norway.

O13. Rakvaag, G. (1968). "Skolepsykologisk kontor i Bergen [School psychology office in Bergen]." *Skolepsykologen [The School Psychologist]*, 3(1), p. 16-18. Available from the National Library of Norway.

O14. Riis, E. (1960). "Noter [Notes]". *Nordic Psychology*, 12(3), pp. 253-273.

O15. Romerikes blad (1962). "Skolepsykolog for ø. Romerike fra 1. januar [School psychologist for Eastern Romerike from 1 January] . Newspaper article from Romerikes blad, 7 September 1962, p.1. Available from the National Library of Norway.

O16. Sandvik, P. (1999). Kristiansands historie 1945-1999. Kristiansand: Sparebanken Pluss. Available from the National Library of Norway.

O17. Solum, E. (1989). "Spesialundervisning og tiltak for funksjonshemmede [Special needs education and measures for children with functional deficits]". In Røger, H. (ed.), Grunnskolen i Oppland 250 år [Elementary school in Oppland 250 years]. Lillehammer: Oppland University College. Available from the National Library of Norway.

O18. Undheim, B. (1971). Skolesoge i Sandnes fram til 1970 [A school narrative from Sandnes until 1970]. Sandnes: Author's own publication. Available from the National Library of Norway.

## **Municipality changes**

Jukvam, D. (1999). "Historisk oversikt over endringer i kommune- og fylkesinndelingen [Historical overview of changes to the municipality and county structure]." Statistics Norway Report 99/13. Oslo/Kongsvinger: Statistics Norway.