

# Left Behind by Birth Month

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## Abstract:

Utilizing comprehensive administrative data from Norway I investigate birth month effects on school performance at age 16, educational achievement at age 19 and 25 and earnings at age 30. I demonstrate that the oldest children in class have a substantially higher 10<sup>th</sup> grade GPA than their younger peers. The birth month differences are similar across gender, but stronger for less advantaged children. The birth month effects are robust to controlling for sibling fixed effects. On longer term outcomes, I find that the youngest children in class have a significantly lower probability of having completed high school at age 19, are less likely to enroll into college by age 25, and have substantially lower earnings at age 30. The effects on educational achievement and earnings are more pronounced for boys and for less advantaged children.

**Keywords:** Birth date effect, relative age effect

**JEL classification:** I20, J10, J20, J30

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## 1. Introduction

Since most education systems have a single cutoff date for age at school enrollment, the age difference between the youngest and oldest pupils in class is close to one year. A number of studies have shown that this age difference has a significant impact on school performance, not only during the early grades when the age difference is relatively more pronounced, but also persisting into higher grades: The oldest pupils in class outperform their younger peers.<sup>1</sup> If this relative age effect disappears after compulsory school, such age related performance gaps may be of less importance. On the other hand, if relative age differences persist into adulthood, this may have important implications for adult outcomes and productivity. Furthermore, in some countries the public school and strict enforcement of enrollment regulations is considered to promote social mobility and equal opportunities. However, if parental investment at home compensate for relative age effects at school, strict enforcement of enrollment regulations may propagate social differences through the relative age effect.

In this paper I explore birth month effects on school performance, educational achievement and labor market performance across birth months for boys and girls, respectively. Furthermore, I investigate how the impact of relative age varies across socioeconomic status. For instance, if higher educated parents to a larger extent allocate more time and better support for the child when school performance drops, children from more advantaged families may be less negatively affected by being among the youngest in class.<sup>2</sup>

There are several reasons for why birth month may have an effect on school performance and long term outcomes. First, relative age differences in class obviously stem from different ages at school start. If being older and more mature has a positive effect on learning, the oldest in class have an advantage when starting school. In accordance with Heckman's theories on skill accumulation, this initial advantage will not only remain but will also increase over time, since the initially most advantaged pupils progress through the curriculum at a faster rate (Heckman 2006). Second, early tracking in the schooling system may propagate initial maturity differences related to relative age (Bedard and Dhuey, 2006).<sup>3</sup> Third, the oldest children in class are stronger and more mature, and this relative standing in class may have an effect on self-esteem, aspirations and the child's social development.

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<sup>1</sup> See e.g. Bedard and Dhuey (2006).

<sup>2</sup> Crawford, Dearden and Greaves (2011) find that parental investment increases substantially for the youngest relative to the oldest in class at the time when the child enrolls in school.

<sup>3</sup> Although tracking or ability based streaming is not practiced in the Norwegian schooling system, it can be argued that allowing the weakest students to fall progressively behind their stronger peers is also a kind of streaming, see Bedard and Dhuey (2006).

Fourth, since students are evaluated at the same point in time, the oldest pupils in class may outperform their younger peers simply because they are older at the time of assessment. Finally, if relative age has an impact on final grades from compulsory school, this is likely to affect educational achievement and future career, firstly by performance based tracking into high schools.<sup>4</sup> I do not intend to identify or quantify the effect of any of these mechanisms separately. A potential birth month effect will therefore reflect a mix of these and possibly more mechanisms. I will interchangeably refer to this mix of effects as a birth month effect and a relative age effect.

I investigate the birth month effect by utilizing a comprehensive registry database containing annual records for all Norwegians during the period 1992 to 2003. Personal identifiers allow me to merge the registry data to an educational database containing final grades from compulsory school for the graduating cohorts 2002 to 2007. Links between parents and children allow for identifying socioeconomic status, measured by the mother's education level, in particular if she holds a high school degree or not. I allow for a non-linear relationship between birth month and outcomes. The birth month effect is identified by using simple OLS regression models including birth month dummies.

A potential challenge when comparing outcomes for children born in different birth months is that other characteristics also affecting outcomes may be correlated with birth month. If, for example, more advantaged families time their births to early in the year, then positive outcomes associated with being relatively old in class may be entirely due to parental resources. I deal with this challenge in two different ways. First, the rich dataset allows me to investigate if the estimated birth month effects are robust to controlling for a number of parent and child characteristics. Second, having unique identifiers for parents, the dataset allows me to control for mother fixed effects and identify the birth month effect only between siblings. Notably, when adding mother fixed effects to the model, the birth month effect is identified only between siblings of the same gender.

I find that the oldest in class perform significantly better in school than their younger peers, in line with existing empirical evidence. The difference in the 10<sup>th</sup> grade GPA between the youngest and oldest in class constitutes as much as 20 percent of a standard deviation. The birth month effect is of similar magnitude for boys and girls. The effect is robust to controlling for background characteristics. Also when controlling for mother fixed effects I

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<sup>4</sup> There is no formal tracking into high schools in Norway, but since students apply and get accepted into different high schools based on the grade point average from compulsory school, there is in practice a performance based tracking.

find the same effect, suggesting that the performance gap is not related to parent characteristics associated with birth month. The birth month effect on GPA is more pronounced for less advantaged children.

Observing longer term outcomes, I find that children born early in the year are more likely than their younger peers to proceed directly to high school after compulsory school, and more likely to enroll into college. I also find that they have higher earnings at age 30. Effects on educational achievement are of similar magnitude for boys and girls, but effects on long term labor market outcomes are stronger for boys. Importantly, the birth month effects on education and earnings are stronger for less advantaged children. This may reflect that parental resources and support may offset the drawback of being relatively young in class.

There are several studies investigating how relative age in class affects school performance, and findings suggest that the oldest students outperform their younger peers.<sup>5</sup> In particular, Bedard and Dhuey (2006) find that the oldest pupils in class outperform their younger peers across a large number of countries and different cutoff dates.<sup>6</sup> Interestingly, despite similar effects across countries of relative age on test scores at the fourth grade level, they find substantial variation in relative age effects at eighth grade level, and point to the fact that different education structures across countries are likely to have an impact on the relative age effect. For instance, they find substantially smaller relative age effects for countries practicing performance based promotion to the next grade level and ability based early tracking. The Norwegian education structure, on the other hand, is characterized by substantial rigidity, with few children enrolling into school earlier or later than according to the statutes, social/automatic promotion from one grade level to the next, and no formal tracking before high school.

Empirical evidence on the birth month effect on school performance across gender suggests that the effect is more pronounced for boys, see Elder and Lubotsky (2007) and Cascio and Schanzenbach (2007) on US data. Empirical evidence on differential effects across socioeconomic status is, however, less conclusive. While Elder and Lubotsky (2007) find that the birth month effect is strongest for advantaged children, Cascio and Schanzenbach (2007) find that the effect is strongest for less advantaged children, and Crawford, Dearden and Meghir (2007) find no differences across socioeconomic status.

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<sup>5</sup> See e.g. Strøm (2004) on Norwegian data; Crawford, Dearden and Greaves (2011) on British data; Jürges and Schneider (2007) and Puhani and Weber (2007a,b) on German data. For differential probabilities across relative age of entering academic or high ability tracks, see e.g. Jürges and Schneider (2007).

<sup>6</sup> Note that finding similar relative age effects across different cutoff dates excludes the possibility that performance gaps are due to health differences associated with season of birth.

The literature on long term effects of relative age is less extensive and also less conclusive. Bedard and Dhuey (2006) find that the youngest children in class have a lower probability of participating in pre-university programs (Canada and US) and are underrepresented in accredited four-year college enrollments (US). Crawford, Dearden and Greaves (2011) find that, conditional on being in full-time education after the age of 16, the youngest in class are more likely to take vocational qualifications during college and are less likely to enter a high-status university, and that these differences are mainly driven by individuals from low-income groups. Kawaguchi (2011) finds positive effects on educational achievement on Japanese data, but no effect on labor market outcomes (earnings). Utilizing German data Fertig and Kluve (2005) find no evidence for school starting age to have an impact on educational achievement. Dobkin and Ferreira (2010) find a positive effect on educational achievement of being oldest in class but no effects on labor market performance (wages) on US data. The latter study also investigates differential effects across gender and socioeconomic status on educational achievement and labor market outcomes, but find no differential effects across subgroups.<sup>7</sup>

This study contributes to the literature in three important ways: First, this is the first study investigating heterogeneous birth month effects across gender and socioeconomic status on long term outcomes. Second, due to lack of appropriate data, no other studies have been able to control for all fixed unobservable background characteristics that possibly generate a birth month effect. In this paper I demonstrate that relative age effects on school performance and earnings at age 30 are robust to parental fixed effects. Third, this is the first Norwegian study investigating long term effects of relative age. Norway may serve as an interesting case with its rigid enrollment regulations and educational structure in general.

The remainder of the paper is laid out as follows: Section 2 gives a brief introduction to the Norwegian schooling system. Section 3 describes the empirical strategy and Section 4

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<sup>7</sup> Dobkin and Ferreira (2010) utilize the discontinuity occurring around the cutoff point for school enrollment to identify the birth month effect. This identification strategy is also utilized on a strand of literature focusing on the effect of school starting age. School starting age is obviously perfectly correlated with relative age in class, and several studies aim at isolating the effect of school starting age from the relative age effect by comparing children born just before or just after the cut off point for school enrollment. The relative age effect, which is the main focus in my study, is controlled for by adding a linear term to the model specification. Hence, estimated effects of age at school start also capture the effect of graduating one year earlier and thereby allowing for an additional year of labor market experience, rather than an additional year in kindergarten before entering school. Relevant contributions within this strand of literature are Black, Devereux and Salvanes (2012) using Norwegian data and finding no effects of school starting age on educational achievement or earnings at age 30. Fredriksson and Öckert (2006) data find on the other hand positive effects on the same outcomes on Swedish data.

describes the data and construction of central variables. Results are presented in Section 5, and Section 6 concludes.

## 2. Institutional background

And important aspect of Norwegian school policy has been to integrate children with different backgrounds and abilities throughout compulsory school. Equal treatment of all children is presumed to promote social mobility and equal opportunities. There is no ability or performance based group placement of pupils<sup>8</sup>, no tracking of pupils before they enroll in high school at age 16, pupils advance automatically from one grade level to the next independent of performance; and there is no promotion of pupils. Hence, all pupils enrolled into compulsory school the same year are exposed to the same curriculum and classroom teaching.

For the cohorts of this study, the administrative rule for enrollment into school was that all children start school in mid August the calendar year in which they turn seven, and they graduate after nine years when they are 16 years old.<sup>9</sup> Strict enforcement of enrollment regulations together with social promotion to the next grade level implies that individuals born within a given cohort enroll into school at the same time and graduate at the same time.

Non-compliance with enrollment regulations requires an expert assessment stating that the child is too immature to enter school. Non-compliance was around 5 percent in the late 1960s and dropped to less than 1 percent in the 1990s.<sup>10</sup> However, the likelihood of being an early or late school enroller is highly associated with birth month: Most deferred children are December borns, and deferred children constitute a substantially larger share of December borns than of the cohort at large.<sup>11</sup> When non-compliance was at its highest, as much as 20 (13) percent of boys (girls) born in December were deferred. Note that due to strict enforcement of enrollment regulations and requirements for expert assessment on school ability, there is a negative selection to deferment: Less advantaged children constitute two thirds of deferred children and only one third of children early enrolled.

Compulsory schooling is publicly funded and free of charge for all pupils, and less than one percent of all pupils attend private schools. Pupils generally attend the school designated

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<sup>8</sup> Since 2004, schools have been entitled to develop more flexible groups also based on abilities.

<sup>9</sup> In 1997 compulsory schooling was extended to ten years, and enrollment age changed to 6 years old. However, all individuals in the sample enrolled in school before 1997.

<sup>10</sup> See Table A1 in appendix for compliance rates (own calculations based on official data from Statistics Norway).

<sup>11</sup> Among deferred children 55 percent were born in December and 20 percent born in November.

for the area where they live. All schools adhere to a national standard regarding curriculum and teacher resources and qualifications. Pupils are allocated to classrooms regardless of their characteristics and abilities.

Students apply to high school and acceptance is based on their grade point average from compulsory school. Students proceeding directly to high school after compulsory school graduate from high school in June the year they turn 19 years old.

### 3. Empirical strategy

I specify a flexible functional form in order to allow for non-linear birth month effects, with no functional restrictions on how various mechanisms may generate a birth month effect. The effect of birth month on outcomes will be identified by the following equation:

$$(1) \quad Y_i = \alpha + \sum_{m=2}^{12} \beta_m \cdot BMT_i + \sum \mu_y \cdot COH_i + \alpha X_i + \varepsilon_i$$

where  $Y_i$  is the outcome for individual  $i$  at a given age,  $BMT_i$  are dummy-variables indicating birth month,  $COH_i$  denote cohort fixed effects, and  $X_i$  is a vector of background characteristics. The coefficient  $\beta_m$  measures the effect on  $Y_i$  of being born in month  $m$  compared to being born in the reference category January. All analyses are done separately for males and females, since education and career paths differ substantially across gender. Furthermore, separately for boys and girls, I investigate if the birth month effect is different across socioeconomic status.

The coefficients of interest,  $\beta_m$ , are reduced form birth month effects, capturing the net effect of all mechanisms of relative age effects. Although the birth month effect is not restricted to be linear, I expect a trend in the birth month coefficients: If relative age in class has an impact on outcomes, it is unlikely to bounce up and down across birth months.

Notably, for outcomes observed at a given point in time, the coefficients also capture the effect of enrolling into school one year earlier or later than according to the enrollment regulations. This is important to keep in mind, since it is mainly children born in December (January) that enroll into school later (earlier) than according to the statutes. While comparing outcomes across birth month within a cohort is a good identification strategy for generating birth month estimates on GPA that are not biased by delayed school start, the interpretation of the birth month estimates is different for longer term outcomes. For outcomes observed at a given point in time, e.g. high school completion at age 19 and earnings at age 30, deferred children lag one year behind their cohort peers, and this will directly affect the estimates. This

should carefully be taken into account when interpreting the impact of birth month on longer term outcomes. For college enrollment at age 25, which is likely to reflect a final achievement, deferment is unlikely to affect the estimates.

In order for birth month to capture the effect of relative age in class, birth month should not be correlated with other characteristics affecting the outcome. For example, if highly educated parents time the birth to a specific season, children born this season may outperform their peers due to parental resources rather than relative age in class.<sup>12</sup> I will investigate if children are equal across birth month firstly by comparing birth month distribution across mother's education level (having completed high school or not). Second, I will investigate if the estimates of relative age effects are robust to controlling for a rich set of observable parental characteristics. Finally, adding mother fixed effects to the model controls for all unobservable differences in family background across birth month. Notably, when controlling for mother fixed effects the birth month effect is identified from variation across siblings of the same gender, which constitutes around 20 percent of the sample.

#### 4. Data

The association between birth month and long term outcomes is investigated by utilizing a combination of several official Norwegian registers, prepared and provided by Statistics Norway. The dataset contains records for every Norwegian from 1992 to 2003. Variables include individual demographic information (gender, birth date, number of children), socio-economic data (education level and earnings) and employment status (full-time, part-time, minor part-time). In addition, data on final grades from compulsory school for the graduation cohorts 2002 to 2007 are available. With unique personal identifiers these can be merged with registry data for information on child and parent characteristics.

In order to capture effects on individuals who have attended school in Norway and who have been exposed to the Norwegian cutoff regulations of school enrollment, immigrants are excluded in all analyses. Notably, I will investigate effects of relative age on educational performance, educational attainment and earnings, and the sample will be different in all these analyses depending on data availability. In particular, cohorts included in the analyses depend on age when outcome is observed: I observe outcomes for ages 19 to 30 years old, and the intention is to identify birth month effects and how these may change over time as the individuals get older. Since birth month effects may also vary across cohorts, e.g. due to

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<sup>12</sup> Buckles and Hungerman (2008) find strong evidence on US data for correlation between birth month and parental characteristics that are likely to affect a number of outcomes.

changes in the schooling system or enforcement of enrollment regulations, ideally I want to observe the same cohorts for all ages. However, data for outcomes from 19 to 30 years old are available only for the 1973 cohort. In order to utilize the large dataset available, I observe outcomes at age 19 for the 1980-1984 cohorts, and outcomes at ages 25 and 30 for the 1969-1973 cohorts. Birth month effects on GPA are observed for the 1986-1991 cohorts, see Table 1.<sup>13</sup>

#### Outcome variables:

The data allows for several outcome measures to be constructed. First, I observe the grade point average (GPA) when graduating from compulsory school (9<sup>th</sup> grade). GPA is constructed as the average of grades in all ten subjects entered onto the final diploma from compulsory school. Grades are teacher-evaluated and range from 1 (lowest) to 6 (best). Second, I observe if the individual has graduated from high school by age 19, which is the graduation age for individuals “marching in pace”, i.e. enrolling into school according to the statutes and proceeding to high school directly after compulsory school. Third, I observe college attendance at age 25. An individual is coded enrolled in college if he/she has completed at least one college exam. Since most individuals who ever attend college will have completed at least one exam before the age of 25, the estimates will also reflect final education achievement. Fourth, I observe (log of) earnings at age 30. Earnings are measured as total pension-qualifying earnings reported in the tax registry, and include labor earnings, sick benefits, unemployment benefits, parental leave payments, and pensions. In the earnings analysis individuals with zero earnings are excluded. This sample selection criterion would be problematic if the likelihood of having zero earnings is associated with birth month. In separate regressions (not reported here) I find that the association between zero earnings and birth month is small and insignificant.

#### Background characteristics:

I construct a rich set of family background characteristics. I control for mother and father education level (indicators for high school degree or higher and some college education), mother and father’s labor market status (indicator for working at least 30 hours per week),

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<sup>13</sup> Data for the graduation cohorts 2002-2007 are available. Among these pupils a total of 1.5 percent enrolled in school earlier or later than statutory enrollment age. These are included in the analytical sample. Observing GPA for graduation cohorts implies that the sample selection criterion deviates slightly from the remaining analysis where birth cohort is the selection criterion.

number of siblings (six categories: 0, 1, 2, 3, 4,  $\geq 5$ ), and birth order: (six categories: 1, 2, 3, 4, 5,  $\geq 6$ ).

The indicator for whether the mother has completed high school is a strong predictor for educational and labor market performance, and will also serve as the measure for socioeconomic status when investigating heterogeneous birth month effects.<sup>14</sup>

With data available only for the years 1992 to 2003, background variables cannot be observed at a similar age for all analyses. Background characteristics are observed when the child is 10 years old in the analysis of GPA, and in analyses of long term outcomes background characteristics are observed the same year as outcome is observed, see Table 1.

## 5. Results

Before turning to the main analyses, I provide a brief description of socioeconomic status across birth months. Figure 1 illustrates the birth month distributions for children from low versus high socioeconomic strata. Notably, I find that less advantaged children are somewhat overrepresented in January and February, and underrepresented in April and October. In general, the deviation in birth month distribution across socioeconomic strata is small and insignificant, and suggests that our analyses of relative age effects should not be biased by differential parent characteristics across birth month. Nevertheless, as discussed above, I will conduct robustness checks and control for mother fixed effects in order to further assure that my estimated birth month effects are not biased by parent characteristics.

For all four outcomes (GPA, high school graduation, college enrollment and earnings) I report estimates from regressions run on the following ten subsamples (bullet point numbers refer to model number in tables):

- 1: All boys (a) and all girls (b), with covariates
- 2: All boys (a) and all girls (b), without covariates
- 3: All boys (a) and all girls (b), with covariates and mother fixed effects
- 4: Boys with low socioeconomic status (a) and high socioeconomic status (b)
- 5: Girls with low socioeconomic status (a) and high socioeconomic status (b)

The estimated birth month coefficients,  $\beta_m$ , for February to December reflect incremental effect on outcome of being born in month  $m$  as compared to January, which serves as the

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<sup>14</sup> In regressions not reported here I find that defining socioeconomic status by the whether the father holds a high school degree, or by setting the education threshold to college education has no effect on the estimated effects.

reference category. Standard errors for regression coefficients are close to constant, and reported only once for each regression. Regression coefficients, including the 0 for January, from models 1, 4 and 5 are also reported as figures for each outcome.

i. Grade Point Average (GPA)

The first outcome is the grade point average when graduating from compulsory school (10<sup>th</sup> grade). Models 1a and b in Table 2 report regression coefficients for the birth month effect on GPA for all boys and all girls. These coefficients are also illustrated in Figure 2.1. We can see that children born early in the year outperform their younger peers, and the birth month effect on GPA is close to linear: The GPA score of children born in December is about 0.15 lower than the GPA score of children born in January, which constitutes 20 percent of the standard deviation. Notably, the birth month effect is similar for boys and girls.<sup>15</sup>

As discussed, if children born early in the year have background characteristics associated with good school performance, the birth month effect may be due to such compositional effects. In Table 2, Models 2a and b, all covariates are dropped from the regression model, and we find that the birth month effect remains nearly constant. In Table 2, Models 3a and b, mother fixed effects are added to the regression model. Here the birth month effect is identified only between siblings of the same gender, both graduating between 2002 and 2007. The birth month effects are robust to the inclusion of fixed effects.

In Table 2, Models 4a and b for boys and 5a and b for girls, we can see that the birth month effects on GPA are stronger for less advantaged children. This is also illustrated in Figures 2.2 and 2.3.<sup>16</sup>

ii. Educational achievement I: Completing high school by age 19

GPA from compulsory school is likely to have an impact on the motivation to proceed to and complete high school. Empirical evidence suggests that there is a negative association between the dropout rate from high school and GPA: Nearly 75 percent of all high school students in the lowest GPA-decile from compulsory school do not follow statutory progress in high school.<sup>17</sup> Related to this, it has also been shown that students accepted into their first

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<sup>15</sup> For the sake of comparison, moving a student from a low quality school to a high quality school is found to improve the student's GPA with a similar magnitude as the January-December difference, see Fiva and Kirkebøen (2011).

<sup>16</sup> In regressions not reported here, I find no birth month effect at all on a small subsample of girls having a mother with a Master's degree, i.e. with very high socioeconomic status.

<sup>17</sup> Byrhagen et. al (2006).

choice of high school have a lower dropout rate, also after controlling for GPA.<sup>18</sup> I investigate differences across birth months in high school graduation at age 19, which is the statutory graduation age for students proceeding to high school directly after compulsory school.

Table 3, Models 1a and b, report birth month coefficients for all boys and all girls, respectively, for having graduated from high school at age 19 (see also Figure 3.1). We can see that children born late in the year have significantly lower probability of having graduated at this age, and the birth month effect is especially strong for December borns: December born boys (girls) have 7.2 (4.7) percentage points lower probability of having completed high school at age 19, a difference that constitutes 17 (8) percent of the average completion rates for boys (girls) at this age. Models 2a and b demonstrate that excluding controls from the model specification does not affect the estimates. Moreover, when adding mother fixed effects to the model, in Models 3a and b, the birth month effect remains for boys, but is no longer significant for girls.

Birth month effects may reflect that the youngest children within a cohort have an overall lower probability of ever graduating from high school. Alternatively, the birth month effects may reflect that individuals born late in the year lag behind, for instance by having a higher probability of taking a break from the education track before proceeding to high school, or benefiting from “second chance” possibilities after poor performance in compulsory school.<sup>19</sup> If children born late in the year have a higher probability of enrolling into vocational training this will also be reflected in the birth month effects since most vocational trainings require four years. And finally, pupils being deferred at enrollment into primary school will not graduate from high school until the year they turn 20 years old. This is especially relevant for December borns, and is a likely explanation for why the drop in completion rates is so large for December borns. However, the negative trend in completion rates prior to December cannot be explained by children delaying school start, as very few children born in November or earlier in the year delay school start.<sup>20</sup>

When I investigate different socioeconomic groups separately in Models 4a and b for boys and 5a and b for girls, there is little evidence for different birth month effects on high school graduation at age 19 across subgroups. This is illustrated in Figures 3.2 and 3.3. In contrast to

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<sup>18</sup> Markussen et. al (2008).

<sup>19</sup> Pupils failing in compulsory school, have the opportunity to add an extra year of schooling between compulsory school and high school.

<sup>20</sup> In regressions not reported here, the birth month effects of having graduated at age 20 are somewhat smaller than those reported here, but the negative trend is similar.

the analysis on GPA, birth month effects are somewhat stronger for advantaged pupils, but the difference to the less advantaged is not statistically significant.

Note that birth month effects on having completed high school by age 19 are estimated on older cohorts than on GPA. Significant differences in birth month effects on GPA between socioeconomic groups that are not present for high school completion may therefore reflect that the importance of socioeconomic status on birth month effects either changes over time as individuals age, or that socioeconomic status has a stronger impact on birth month effects for younger cohorts.

iii. Educational achievement II: College enrollment at age 25:

In Table 4 I investigate relative age effects on enrollment into college. In Models 1a and b we can see that for both boys and girls those born late in the year have a significantly lower probability of having enrolled into college at age 25 than their older peers. This is illustrated in Figure 4.1. A notable exception is those born early in spring, especially April borns, who have a higher enrollment rate than their older peers. In Models 2a and b we can see that when dropping covariates from the model, the April effect is even more pronounced, although not significantly different. This suggests that there is some positive selection of parental characteristics associated with April borns in these cohorts. Note also that this is consistent with the small deviations in parent characteristics revealed in Figure 1. The remaining coefficients suggest a negative birth month effect on college enrollment, and it seems to be similar for boys and girls: More than 2 percent more April borns than December borns enroll into college by age 25, which constitutes around 8 percent of the average enrollment rates. In Models 3a and b we can see that when adding mother fixed effects to the model the birth month effect on college enrollment disappears for both girls and boys.

Models 4a and b demonstrate that the birth month effect is mostly generated by less advantaged children. This is also illustrated in Figures 4.2 and 4.3. The difference between April borns and December borns constitutes 12 percent of the average enrollment rates for less advantages children. Since most college graduates enroll into college before 25 years of age, these estimates suggest that individuals born late in the year have a significantly lower probability of ever enrolling into college.<sup>21</sup> Note also that the April effect from Table 4, Models 1a and b is generated only by less advantaged girls.

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<sup>21</sup> In regressions not reported here, I find a similar pattern in birth month effects when observing college enrollment at age 30.

Summing up, analyses on educational achievement suggest that children born late in the year are delayed in completing high school, and less likely to ever enroll into college than those born early in the year. The birth month effect on educational achievement is similar for boys and girls, but mostly pronounced among those from less advantaged families. A possible reason is that parental support in more advantaged families offset a negative long term effect of being relatively young in class.

iv. Earnings at age 30.

In Table 5 I investigate the effect of relative age on earnings at age 30. Individuals without earnings are excluded from the sample. In Model 1a we can see a clear trend that men born late in the year have substantially lower earnings than men born early in the year: Men born in December have on average 3.8 percent lower earnings than January borns.<sup>22</sup> In Model 1b we can see that for women there is no relationship between birth month and earnings. See Figure 5.1 for an illustration. Models 2a and 3a demonstrate that the significant birth month coefficients for men are robust to exclusion of covariates and to the inclusion of mother fixed effects.

As for educational achievement, individuals having delayed enrollment into school lag one year behind their cohort peers. One year less labor market experience is likely to have a significant impact on earnings, particularly as early in the career as at age 30. Since deferment mainly applies to individuals born late in the year, it is particularly the December estimates that would be affected by late school enrollment. However, the birth month effect is close to linear and does not only apply to individuals born late in the year, which suggests that delayed school enrollment and less labor market experience is not the sole explanation for the birth month effect. Furthermore, even for December borns, the mark down on average earnings due to delayed school enrollment should reflect that only a certain proportion of the whole cohort is lagging behind in their career path. The wage growth due to an additional year of labor market experience or the percentage being deferred would be unreasonably high to explain close to an average of 4 percent lower earnings for *all* December borns.<sup>23</sup> Models 4a and b

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<sup>22</sup> In regressions not reported here, I find a similar pattern when earnings are measured linearly rather than logarithmic. I also find a similar pattern if including those with no earnings in the sample.

<sup>23</sup> If, for example, one year labor market experience increases wages by 3 percent, and 30 percent of December borns have one year less labor market experience, deferment alone would reduce average earnings for December borns by 0.9 percent, by far not enough to explain the 4 percent lower earnings for December borns. Also, when taking into account that some January borns have an additional year of labor market experience, it is clear that non-compliance with enrollment regulations alone cannot explain the negative birth month trend in earnings.

divide the sample according to socioeconomic status. The results demonstrate that the negative birth month effect on earnings for men is especially pronounced for those from less advantaged families. In Model 5a and b we can see that there is no similar pattern for women.

## 6. Conclusion

There is a strong and close to linear effect of birth month on GPA: The oldest pupils in class perform significantly better than their younger peers. The result is robust to exclusion of background characteristics and to adding mother fixed effects. Observing longer term outcomes, I find that children born late in the year, especially boys, have a significantly lower probability than their older peers in achieving a high school degree by age 19, and are less likely to ever enroll into college. Finally, I find that individuals born late in the year, in particular men, have significantly lower earnings at age 30 than those born early in the year. The birth month effect on earnings for men remains when controlling for mother fixed effects. Generally, the effects seem to be more pronounced for less advantaged children.

Although birth month effects may reflect that the relatively young lag behind simply due to the absolute age difference at time of observation, there are at least three reasons why the birth month effect should still cause concern: First, for educational achievement the relatively youngest cannot lag marginally behind in order to compensate for absolute age differences: Graduation from high school and enrollment into college do not occur continuously, and those lagging behind will lag a full year behind. For GPA it is similarly not possible to “lag behind” since final grades are achieved only once. Second, also when observing final educational achievement I find that those born late in the year have a significantly lower probability of ever enrolling into college than those born during spring. Third, although the absolute age difference is similar for children from higher and lower socioeconomic strata, I find significant differences between these groups of children, where those less advantaged also suffer most from being youngest in class.

Persisting effects on educational achievement and earnings at age 30 of relative age differences within one cohort suggest that the strict enrollment regulations systematically discriminate against those youngest within one cohort. Given the Norwegian schooling system’s strong focus on integration and promotion of equal opportunities for all children regardless of socioeconomic status, it should be especially noted that these persisting effects of relative age in class seem to be stronger for disadvantaged children.

Non-compliance with enrollment regulations in flexible education systems as e.g. the US, have been shown to reinforce inequality between socioeconomic strata by positive selection

into deferment: Red-shirting (late enrollment) is by far most common in affluent communities, where parents are more aware of the advantage of being relatively old in class. As pointed out by Bedard and Dhuey (2006), such enrollment practices imply that disadvantaged children constitute a proportionally larger share of the youngest in class, hence being at two substantial disadvantages. On the other hand, in countries with more rigid enrollment regulations, as in Norway, the practice of expert assessment on maturity and abilities generates a negative selection into deferment.<sup>24</sup> If the drawback of being youngest in class is not only due to absolute age differences but also has a direct effect e.g. on self-confidence of being a low performer compared to relatively more mature peers, then reducing within-class variation in abilities may eliminate some of the negative birth month effect for the relatively younger pupils. Relaxing the enrollment regulations by allowing more of the most immature children to delay school start by one year may therefore be an appropriate step to reduce the performance gap within cohorts and in class.

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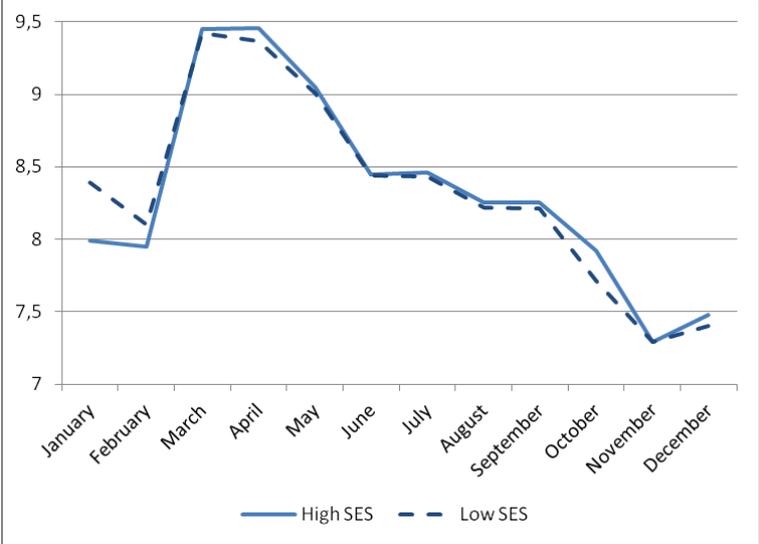
<sup>24</sup> Early enrollers score on average 25 percent better on GPA than deferred children.

## References:

- Bedard, K. and E. Duhey. 2006. "The Persistence of Early Childhood Maturity: International Evidence of Long-Run Age Effects", *The Quarterly Journal of Economics* 121(4): 1437-1472.
- Black, S., P. Devereux and K. Salvanes. 2012. "Too Young to Leave the Nest? The Effects of School Starting Age", forthcoming in *Review of Economics and Statistics*.
- Buckles, K. and D. Hungerman. 2008. "Season of Birth: Old Questions, New Answers", NBER working paper no. W14573.
- Byrghagen, Falch and Strøm. 2006. "Frafall i videregående opplæring: Betydning av grunnskolekarakterer, studieretning og fylke", SØF-rapport nr. 8/06.
- Cascio, E. and D. Schanzenbach. 2007. "First in the Class? The Education Production Function", NBER working paper no. W13663.
- Crawford, C., L. Dearden and E. Greaves. 2011. "Does When You are Born Matter? The Impact of Month of Birth on Children's Cognitive and Non-Cognitive Skills in England", IFS Briefing Note: BN 122, Institute of Fiscal Studies/Nuffield Foundation.
- Crawford, C., L. Dearden and C. Meghir. 2007. "When you are born matters: the impact of date of birth on child cognitive outcomes in England." CEEDP 93, London School of Economics and Political Science.
- Dobkins, C. and F. Ferreira. 2010. "Do School Entry Laws Affect Educational Attainment and Labor Market Outcomes?" *Economics of education review* 29(1): 40-54.
- Elder, T. and D. Lubotsky. 2009. "Kindergarten Entrance Age and Children's Achievement: Impacts of State Policies, Family Background and Peers", *Journal of Human Resources* 44(3): 641-683.
- Fredriksson, P. and B. Öckert. 2006. "Is Early Learning Really More Productive? The Effect of School Starting Age on School and Labor Market Performance", IFAU Working Paper 2006/12.
- Fertig, M. and J. Kluge. 2005. "The Effect of Age at School Entry on Educational Attainment in Germany", IZA discussion paper no 1507.
- Fiva, J. and L. J. Kirkebøen. 2011. "Information Shocks and the Dynamics of the Housing Market", *Scandinavian Journal of Economics* 113(3): 525-552.
- Heckman, J. 2006. "Skill Formation and the Economics of Investing in Disadvantaged Children", *Science*, Vol 312(5782): 1900-1902.
- Jürges, H. and K. Schneider. 2007. "What Can Go Wrong Will Go Wrong: Birthday Effects and Early Tracking in the German School System", CESifo Working Paper No. 2055.
- Kawaguchi, D. 2011. "The Effect of Age at School Entry on Education and Income", *Journal of the Japanese and International Economies* 25(2): 64-80.
- Markussen, E., M. W. Frøseth, B. Lødding and N. Sandberg. 2008. "Bortvalg og kompetanse", Rapport 13/2008. NIFU STEP
- Puhani, P. A. and A. M. Weber. 2007a. "Does the Early Bird Catch the Worm? Instrumental Variable Estimates of Early Educational Effects of Age of School Entry in Germany", *Empirical Economics* 32: 359-386.
- Puhani, P. A. and A. M. Weber. 2007b. "Persistence of the School Entry Age Effect in a System of Flexible Tracking", Institute for the Study of Labor Discussion Paper No. 2965.
- Strøm, B. 2004. "Student Achievement and Birthday Effects", working paper, Department of Economics, NTNU.

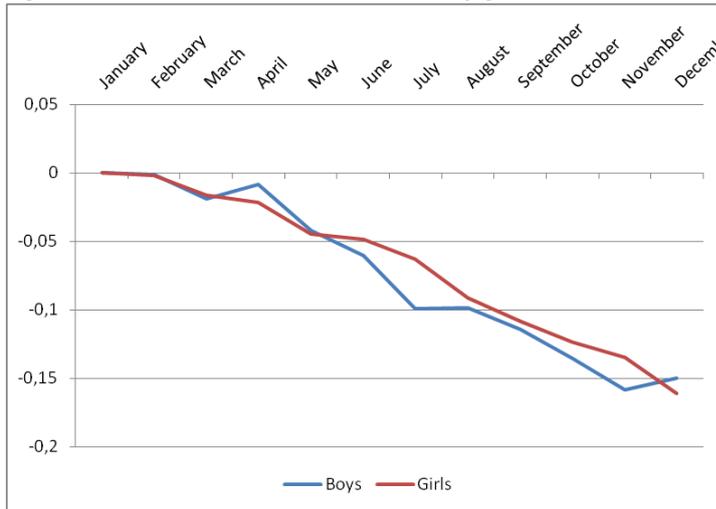
**Figures and tables:**

**Fig. 1: Distribution of month giving birth by socioeconomic status.**



Note: Sample consists of mothers of children born between 1980 and 1984. Socioeconomic status (SES) is defined as having completed high school or not.

**Fig. 2.1: Birth month effects on GPA by gender.**



Notes:

Standard error regression coefficients:

Boys: 0.009.

Girls: 0.009.

Summary statistics outcome variable:

Boys: Mean = 3.913, st.dev. = 0.792.

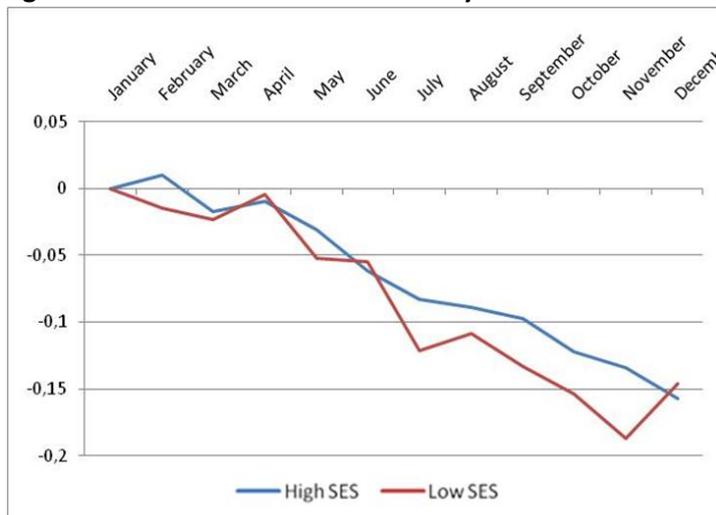
Girls: Mean = 4.274, st.dev. = 0.746.

# observations:

Boys = 141 201

Girls = 137 401

**Fig. 2.2: Birth month effects on GPA by socioeconomic status (SES). Boys.**



Notes:

Standard error regression coefficients:

Low SES: 0.014.

High SES: 0.013.

Summary statistics outcome variable:

Low SES: Mean = 3.674, st.dev. = 0.767.

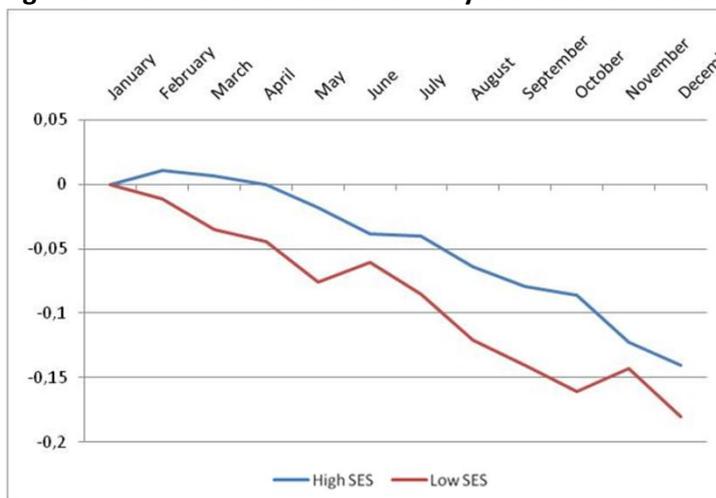
High SES: Mean = 4.153, st.dev. = 0.733.

# observations:

Low SES = 65 661

High SES = 72 616

**Fig. 2.3: Birth month effects on GPA by socioeconomic status (SES). Girls.**



Notes:

Standard error regression coefficients:

Low SES: 0.014.

High SES: 0.012.

Summary statistics outcome variable:

Low SES: Mean = 4.020, st.dev. = 0.744.

High SES: Mean = 4.511, st.dev. = 0.661.

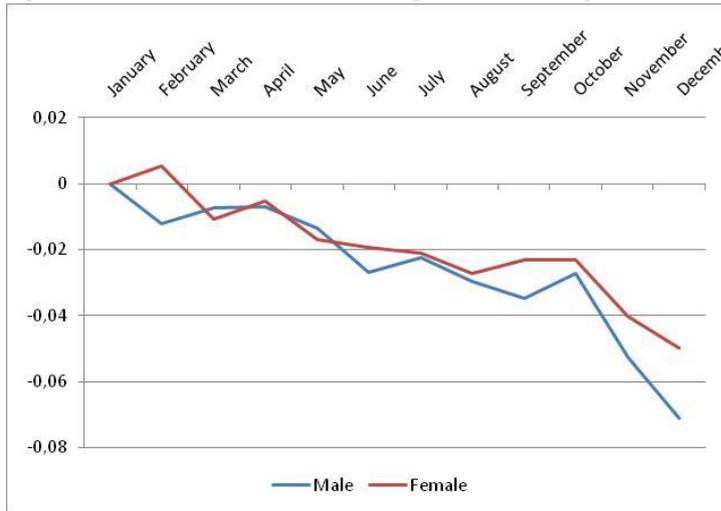
# observations:

Low SES = 64 802

High SES = 69 817

Notes: Cohorts 1986-1991. Reported standard error is approximately constant across birth month coefficients. Socioeconomic status (SES) is defined as mother having completed high school or not.

**Fig. 3.1: Birth month effects on high school completion at age 19 by gender.**



Notes:

Standard error regression coefficients:

Boys: 0.007.

Girls: 0.007.

Summary statistics outcome variable:

Boys: Mean = 0.418.

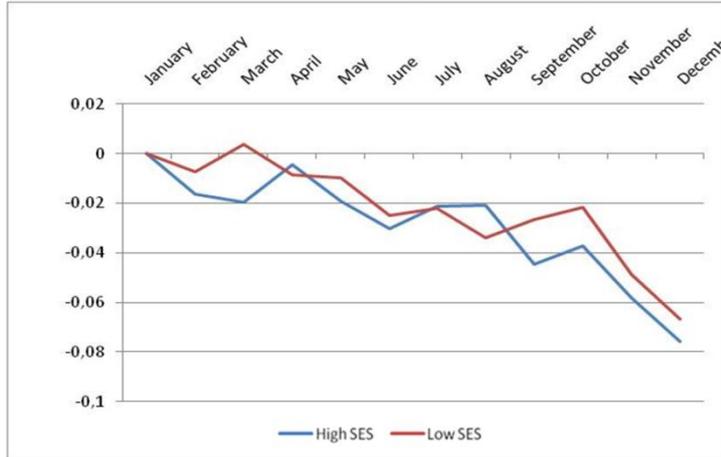
Girls: Mean = 0.594.

# observations:

Boys = 114 891

Girls = 108 693

**Fig. 3.2: Birth month effects on high school completion at age 19 by socioeconomic status (SES). Boys.**



Notes:

Standard error regression coefficients:

Low SES = 0.009.

High SES = 0.011.

Summary statistics outcome variable:

Low SES: Mean = 0.322.

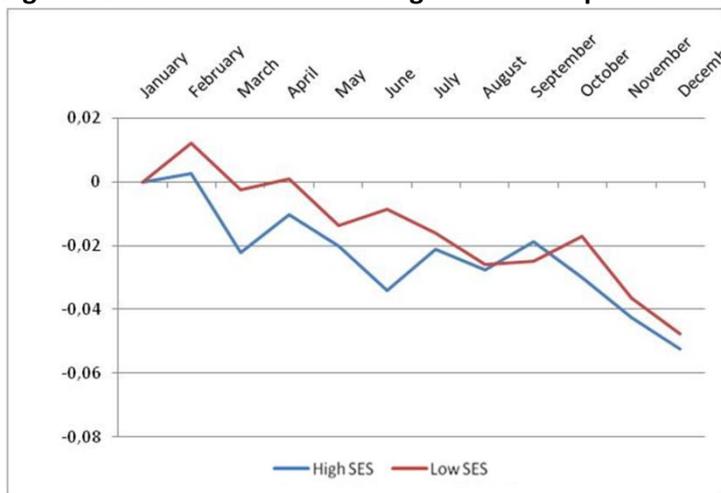
High SES: Mean = 0.547.

# observations:

Low SES = 63 619

High SES = 48 679

**Fig. 3.3: Birth month effects on high school completion at age 19 by socioeconomic status (SES). Girls.**



Notes:

Standard error regression coefficients:

Low SES = 0.010.

High SES = 0.010.

Summary statistics outcome variable:

Low SES: Mean = 0.518.

High SES: Mean = 0.701.

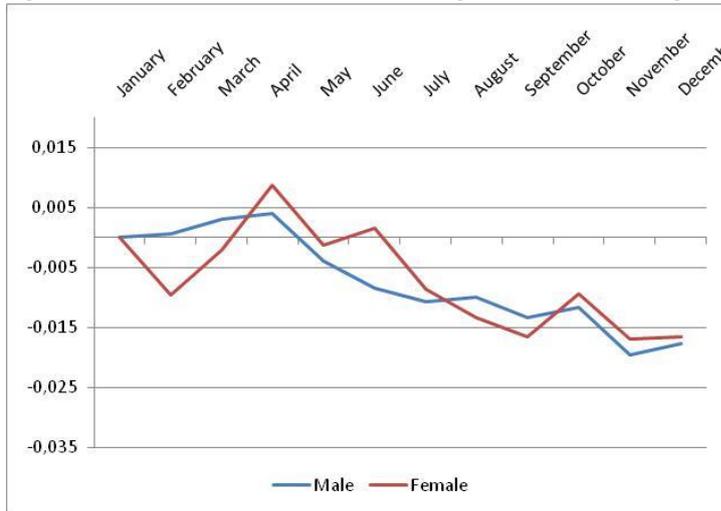
# observations:

Low SES = 60 512

High SES = 45 849

Notes: Cohorts 1980-1984. Reported standard error is approximately constant across birth month coefficients. Socioeconomic status (SES) is defined as mother having completed high school or not. Outcome is observed at year end.

**Fig. 4.1: Birth month effects on having enrolled in college at age 25 by gender.**



Notes:

Standard error regression coefficients:

Boys = 0.006.

Girls = 0.006.

Summary statistics outcome variable:

Boys: Mean = 0.248.

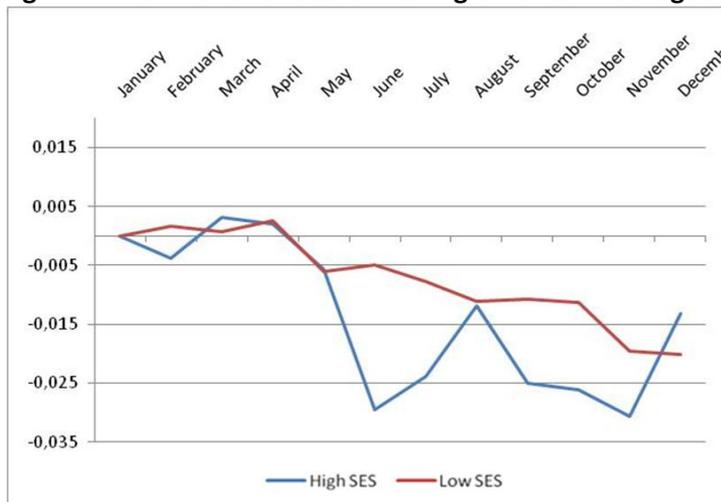
Girls: Mean = 0.327.

# observations:

Boys = 143 876

Girls = 137 187

**Fig. 4.2: Birth month effects on having enrolled in college at age 25 by socioeconomic status (SES). Boys.**



Notes:

Standard error regression coefficients:

Low SES = 0.006.

High SES = 0.013.

Summary statistics outcome variable:

Low SES: Mean = 0.189.

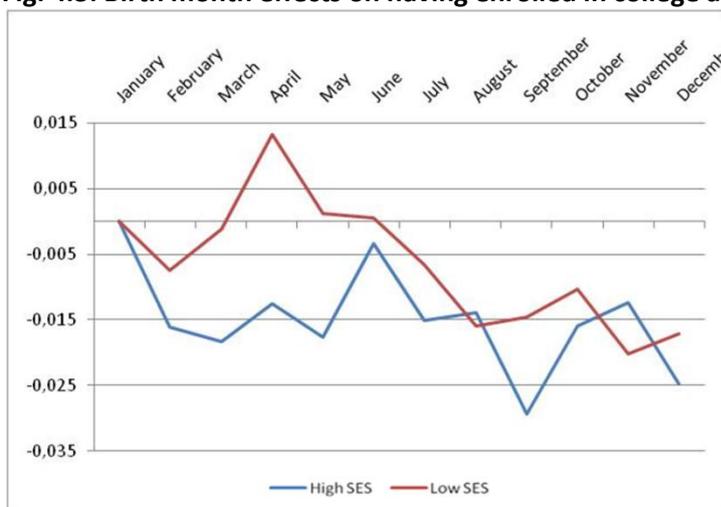
High SES: Mean = 0.459.

# observations:

Low SES = 103 626

High SES = 30 960

**Fig. 4.3: Birth month effects on having enrolled in college at age 25 by socioeconomic status (SES). Girls.**



Notes:

Standard error regression coefficients:

Low SES = 0.007.

High SES = 0.014.

Summary statistics outcome variable:

Low SES: Mean = 0.260.

High SES: Mean = 0.572.

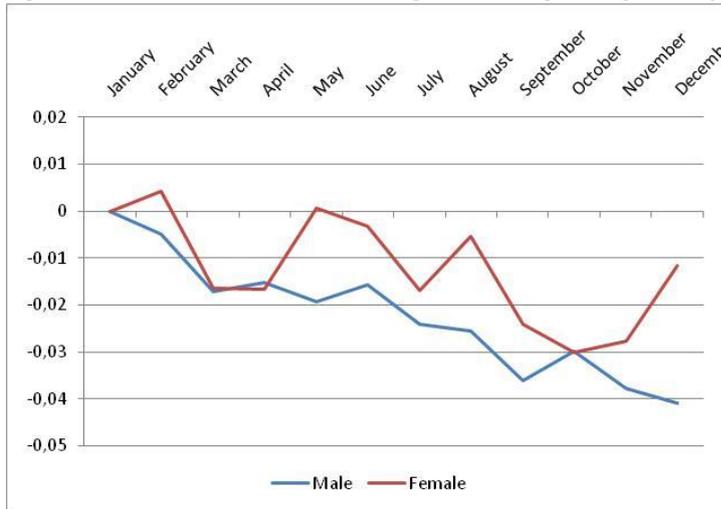
# observations:

Low SES = 99 163

High SES = 29 334

Notes: Cohorts 1969-1973. Reported standard error is approximately constant across birth month coefficients. Socioeconomic status (SES) is defined as mother having completed high school or not. Outcome is observed at year end.

**Fig. 5.1: Birth month effects on log of earnings at age 30 by gender.**



Notes:

Standard error regression coefficients:

Boys = 0.010.

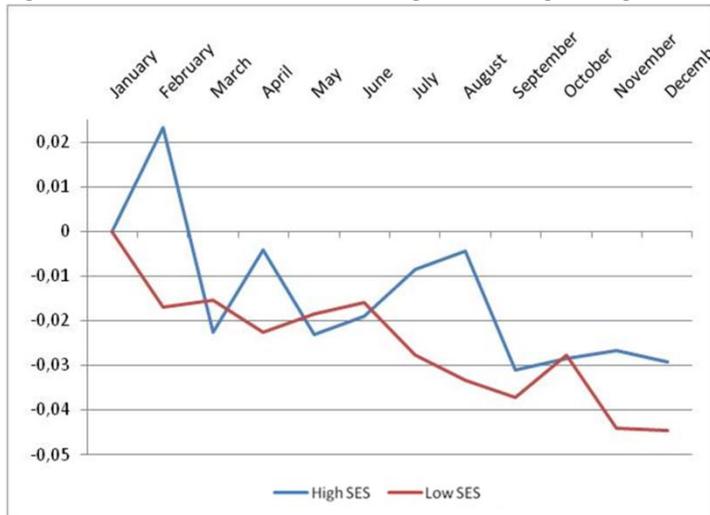
Girls = 0.012.

# observations:

Boys = 139 973

Girls = 128 350

**Fig. 5.2: Birth month effects on log of earnings at age 30 by socioeconomic status (SES). Boys.**



Notes:

Standard error regression coefficients:

Low SES = 0.011.

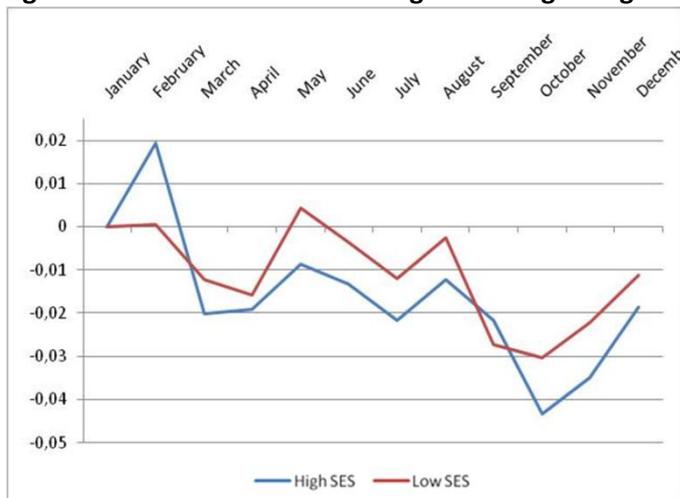
High SES = 0.021.

# observations:

Low SES = 97 673

High SES = 33 523

**Fig. 5.3: Birth month effects on log of earnings at age 30 by socioeconomic status (SES). Girls.**



Notes:

Standard error regression coefficients:

Low SES = 0.015.

High SES = 0.025.

# observations:

Low SES = 89 707

High SES = 30 815

Notes: Cohorts 1969-1973. Reported standard error is approximately constant across birth month coefficients. Socioeconomic status (SES) is defined as mother having completed high school or not. Outcome is measured as annual earnings the year the individual turns 30 years.

**Table 1: Sample selection criteria and timing of observation of background characteristics.**

<b>Outcome variable</b>	<b>Cohorts observed</b>	<b>Age (year) when background characteristics are observed</b>
Grade point average (16 yrs)	1986-1991	10 years old (1996-2001)
High school graduation (19 yrs)	1980-1984	19 years old (1999-2003)
College attendance (25 yrs)	1969-1973	25 years old (1994-1998)
Earnings (30 yrs)	1969-1973	30 years old (1999-2003)

Note: 617 (0.02 percent) pupils are born in 1985 or 1992 due to early or late enrollment, see footnote 13.

**Table 2: Birth month effects on GPA, by gender and socioeconomic status (SES)**

Subsample:	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b	Model 5a	Model 5b
	Boys	Girls	Boys	Girls	Boys	Girls	Boys Low SES	Boys High SES	Girls Low SES	Girls High SES
	Figure 2.1						Figure 2.2		Figure 2.3	
February	-0.0010	-0.0017	-0.0009	-0.0002	-0.0300	-0.0154	-0.0149	0.0101	-0.0114	0.0107
March	-0.0186*	-0.0166+	-0.0227*	-0.0139	-0.0391+	-0.0250	-0.0233+	-0.0173	-0.0349*	0.0068
April	-0.0084	-0.0218*	-0.0081	-0.0149	-0.0524**	-0.0434*	-0.0040	-0.0097	-0.0443**	-0.0001
May	-0.0417**	-0.0444**	-0.0393**	-0.0419**	-0.0570**	-0.0570**	-0.0525**	-0.0306*	-0.0759**	-0.0178
June	-0.0603**	-0.0487**	-0.0579**	-0.0489**	-0.0732**	-0.0877**	-0.0549**	-0.0620**	-0.0604**	-0.0380**
July	-0.0993**	-0.0629**	-0.1071**	-0.0637**	-0.1215**	-0.0842**	-0.1215**	-0.0832**	-0.0850**	-0.0402**
August	-0.0983**	-0.0913**	-0.0961**	-0.0875**	-0.1063**	-0.1022**	-0.1085**	-0.0892**	-0.1210**	-0.0637**
September	-0.1145**	-0.1081**	-0.1165**	-0.1025**	-0.1093**	-0.0871**	-0.1334**	-0.0971**	-0.1404**	-0.0792**
October	-0.1356**	-0.1236**	-0.1389**	-0.1138**	-0.1398**	-0.1363**	-0.1539**	-0.1226**	-0.1612**	-0.0863**
November	-0.1582**	-0.1350**	-0.1578**	-0.1274**	-0.1468**	-0.1032**	-0.1870**	-0.1339**	-0.1433**	-0.1222**
December	-0.1498**	-0.1613**	-0.1508**	-0.1533**	-0.1595**	-0.1583**	-0.1464**	-0.1574**	-0.1803**	-0.1402**
Standard error	0.0094	0.0090	0.0104	0.0099	0.0206	0.0200	0.0144	0.0126	0.0140	0.0116
Controls	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Sibling FE	No	No	No	No	Yes	Yes	No	No	No	No
Observations	141 201	137 401	141 201	137 401	141 201	137 401	65 661	72 616	64 802	69 817
Adjusted R <sup>2</sup>	0.185	0.182	0.008	0.006	0.575	0.582	0.063	0.132	0.057	0.124
Outcome variable:										
Mean	3.913	4.274	3.913	4.274	3.913	4.274	3.647	4.153	4.020	4.511
Standard dev.	0.792	0.746	0.792	0.746	0.792	0.746	0.767	0.733	0.744	0.661

Notes: Cohorts 1986-1991. \*\*, \* and + denote significance at 1, 5 and 10 percent level. Reported standard error is approximately constant across birth month coefficients. Socioeconomic status (SES) is defined as mother having completed high school or not.

**Table 3: Birth month effects on having completed high school at age 19, by gender and socioeconomic status (SES).**

Subsample:	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b	Model 5a	Model 5b
	Boys	Girls	Boys	Girls	Boys	Girls	Boys		Girls	
							Low SES	High SES	Low SES	High SES
	Figure 3.1						Figure 3.2		Figure 3.3	
February	-0.0122+	0.0054	-0.0118	0.0100	-0.0126	-0.0147	-0.0073	-0.0164	0.0122	0.0028
March	-0.0075	-0.0109	-0.0074	-0.0093	-0.0368+	-0.0304	0.0037	-0.0195+	-0.0024	-0.0221*
April	-0.0069	-0.0053	-0.0037	0.0000	-0.0311	-0.0215	-0.0087	-0.0046	0.0010	-0.0103
May	-0.0134*	-0.0170*	-0.0099	-0.0125+	-0.0710**	0.0196	-0.0100	-0.0191+	-0.0137	-0.0201+
June	-0.0268**	-0.0195**	-0.0300**	-0.0150*	-0.0516*	-0.0094	-0.0251**	-0.0303**	-0.0084	-0.0341**
July	-0.0223**	-0.0210**	-0.0204**	-0.0197**	-0.0671**	-0.0343	-0.0221*	-0.0212*	-0.0162+	-0.0210*
August	-0.0295**	-0.0274**	-0.0301**	-0.0230**	-0.0446*	-0.0091	-0.0341**	-0.0209+	-0.0259**	-0.0276**
September	-0.0349**	-0.0231**	-0.0360**	-0.0194**	-0.0663**	0.0176	-0.0266**	-0.0447**	-0.0248*	-0.0189+
October	-0.0272**	-0.0230**	-0.0274**	-0.0173*	-0.0622**	-0.0359	-0.0215*	-0.0372**	-0.0170+	-0.0301**
November	-0.0525**	-0.0401**	-0.0518**	-0.0368**	-0.0659**	-0.0473*	-0.0486**	-0.0581**	-0.0363**	-0.0427**
December	-0.0712**	-0.0499**	-0.0719**	-0.0467**	-0.0750**	-0.0205	-0.0666**	-0.0758**	-0.0476**	-0.0525**
Standard error	0.0068	0.0071	0.0072	0.0074	0.0210	0.0221	0.0089	0.0107	0.0098	0.0104
Controls	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Sibling FE	No	No	No	No	Yes	Yes	No	No	No	No
Observations	114 891	108 693	114 891	108 693	114 891	108 693	63 619	48 679	60 512	45 849
Adjusted R <sup>2</sup>	0.114	0.071	0.003	0.002	0.333	0.318	0.047	0.089	0.037	0.043
Outcome variable:										
Mean	0.418	0.594	0.418	0.594	0.418	0.594	0.322	0.547	0.518	0.701

Notes: Cohorts 1980-1984. \*\*, \* and + denote significance at 1, 5 and 10 percent level. Reported standard error is approximately constant across birth month coefficients. Socioeconomic status (SES) is defined as mother having completed high school or not.

**Table 4: Birth month effects on having enrolled in college at age 25, by gender and socioeconomic status (SES).**

Subsample:	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b	Model 5a	Model 5b
	Boys	Girls	Boys	Girls	Boys	Girls	Boys		Girls	
							Low SES	High SES	Low SES	High SES
	Figure 4.1						Figure 4.2		Figure 4.3	
February	0.0006	-0.0095	-0.0005	-0.0107+	0.0049	-0.0048	0.0016	-0.0038	-0.0075	-0.0161
March	0.0030	-0.0021	0.0066	0.0027	0.0090	-0.0061	0.0008	0.0032	-0.0011	-0.0184
April	0.0040	0.0087	0.0103+	0.0162**	0.0093	0.0124	0.0025	0.0020	0.0133*	-0.0125
May	-0.0039	-0.0012	0.0019	0.0062	0.0139	0.0171	-0.0060	-0.0056	0.0012	-0.0177
June	-0.0084	0.0016	-0.0076	0.0087	-0.0023	-0.0141	-0.0050	-0.0295*	0.0005	-0.0034
July	-0.0107*	-0.0086	-0.0096+	-0.0050	0.0001	-0.0142	-0.0077	-0.0239+	-0.0066	-0.0151
August	-0.0100+	-0.0133*	-0.0088	-0.0088	0.0028	0.0136	-0.0111+	-0.0118	-0.0160*	-0.0139
September	-0.0133*	-0.0165**	-0.0123*	-0.0138*	0.0048	-0.0247	-0.0107+	-0.0251+	-0.0146*	-0.0294*
October	-0.0116*	-0.0094	-0.0089	-0.0019	-0.0010	0.0078	-0.0113+	-0.0261+	-0.0104	-0.0159
November	-0.0196**	-0.0170**	-0.0153**	-0.0104	0.0023	-0.0253	-0.0196**	-0.0307*	-0.0202**	-0.0123
December	-0.0176**	-0.0165**	-0.0153**	-0.0122+	0.0112	-0.0088	-0.0201**	-0.0132	-0.0171*	-0.0247+
Standard error	0.0052	0.0058	0.0056	0.0062	0.0139	0.0153	0.0058	0.0134	0.0067	0.0136
Controls	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Sibling FE	No	No	No	No	Yes	Yes	No	No	No	No
Observations	143 876	137 187	143 876	137 187	143 876	137 187	103 626	30 960	99 163	29 334
Adjusted R <sup>2</sup>	0.122	0.127	0.001	0.003	0.389	0.410	0.048	0.087	0.044	0.092
Outcome variable:										
Mean	0.248	0.327	0.248	0.327	0.248	0.327	0.189	0.459	0.260	0.572

Notes: Cohorts 1969-1973. \*\*, \* and + denote significance at 1, 5 and 10 percent level. Reported standard error is approximately constant across birth month coefficients. Socioeconomic status (SES) is defined as mother having completed high school or not.

**Table 5: Birth month effects on log of earnings at age 30, by gender and socioeconomic status (SES).**

Subsample:	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b	Model 4a	Model 4b	Model 5a	Model 5b
	Boys	Girls	Boys	Girls	Boys	Girls	Boys		Girls	
							Low SES	High SES	Low SES	High SES
	Figure 5.1						Figure 5.2		Figure 5.3	
February	-0.0050	0.0042	-0.0045	0.0042	0.0183	0.0165	-0.0169	0.0232	0.0005	0.0193
March	-0.0171+	-0.0165	-0.0139	-0.0116	-0.0664*	0.0028	-0.0153	-0.0225	-0.0121	-0.0201
April	-0.0152	-0.0166	-0.0118	-0.0092	-0.0120	0.0168	-0.0225*	-0.0040	-0.0159	-0.0190
May	-0.0192*	0.0007	-0.0162+	0.0073	-0.0593*	0.0793*	-0.0185+	-0.0232	0.0044	-0.0086
June	-0.0158	-0.0031	-0.0131	0.0031	-0.0125	-0.0122	-0.0158	-0.0189	-0.0036	-0.0133
July	-0.0241*	-0.0170	-0.0209*	-0.0130	-0.0621*	0.0237	-0.0276*	-0.0086	-0.0120	-0.0217
August	-0.0256**	-0.0054	-0.0228*	-0.0003	-0.0347	-0.0069	-0.0334**	-0.0043	-0.0026	-0.0122
September	-0.0362**	-0.0242+	-0.0334**	-0.0195	-0.0228	0.0037	-0.0371**	-0.0311	-0.0272+	-0.0216
October	-0.0299**	-0.0300*	-0.0265**	-0.0228+	-0.0644*	-0.0304	-0.0278*	-0.0284	-0.0303*	-0.0434+
November	-0.0378**	-0.0277*	-0.0337**	-0.0200	-0.0564*	0.0227	-0.0442**	-0.0266	-0.0221	-0.0349
December	-0.0409**	-0.0116	-0.0361**	-0.0066	-0.0322	0.0279	-0.0446**	-0.0293	-0.0113	-0.0185
Standard error	0.0097	0.0123	0.0097	0.0125	0.0274	0.0387	0.0113	0.0207	0.0148	0.0248
Controls	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Sibling FE	No	No	No	No	Yes	Yes	No	No	No	No
Observations	139 973	128 350	139 973	128 350	139 973	128 350	97 673	33 523	89 707	30 815
Adjusted R <sup>2</sup>	0.017	0.031	0.008	0.013	0.231	0.135	0.018	0.010	0.025	0.021

Notes: Cohorts 1969-1973. \*\*, \* and + denote significance at 1, 5 and 10 percent level. Reported standard error is approximately constant across birth month coefficients. Socioeconomic status (SES) is defined as mother having completed high school or not.

## Appendix

**Table A1: Non-compliance with enrollment regulations (early/late enrollment) by birth year, gender and birth month. Percent.**

	Boys		Girls		Boys				Girls			
	Early	Late	Early	Late	Early		Late		Early		Late	
					Jan.	Dec.	Jan.	Dec.	Jan.	Dec.	Jan.	Dec.
1969	1.53	4.79	2.51	2.89	10.43	0.00	0.79	25.03	15.94	0.04	0.40	15.17
1970	1.54	4.51	2.53	2.66	9.28	0.04	0.78	22.98	15.80	0.00	0.43	14.44
1971	1.30	3.87	2.10	2.28	9.22	0.00	0.50	22.27	13.72	0.04	0.67	13.91
1972	1.15	3.68	2.10	2.03	7.85	0.00	0.44	21.85	13.70	0.04	0.39	12.42
1973	1.06	2.46	2.12	1.27	6.80	0.04	0.52	15.22	13.91	0.14	0.48	7.35
1980	0.93	2.15	1.95	1.28	6.52	0.00	0.29	11.75	12.70	0.00	0.41	6.87
1981	1.03	2.07	1.98	1.06	6.81	0.00	0.43	11.07	13.67	0.00	0.20	5.04
1982	0.90	2.04	2.00	1.11	6.50	0.00	0.81	10.87	12.58	0.00	0.56	5.90
1983	0.88	2.11	1.98	1.11	6.49	0.00	0.54	11.00	13.01	0.00	0.31	5.51
1984	0.83	2.08	1.82	1.14	5.43	0.00	0.24	10.69	12.36	0.17	0.26	5.17
1986	0.77	1.63	1.69	0.85	5.17	0.00	0.47	9.84	11.57	0.00	0.05	4.55
1987	0.75	1.79	1.53	0.98	4.12	0.19	0.29	10.05	9.60	0.19	0.19	4.52
1988	0.62	1.58	1.02	0.81	3.78	0.18	0.26	9.24	6.80	0.00	0.31	3.97
1989	0.40	1.28	0.89	0.59	2.56	0.00	0.13	7.86	6.26	0.05	0.18	3.16
1990	0.57	1.56	1.03	0.92	2.90	0.26	0.35	7.84	6.02	0.39	0.25	4.48
1991	0.09	1.55	0.32	0.94	0.72	0.00	0.23	9.48	1.77	0.04	0.16	5.68

Notes: Numbers refer to the percentage boys/girls born a given year (and month) that enrolled in school one year earlier or later than according to the administrative statutes. Source: Statistics Norway.