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ABSTRACT

Motherhood on Campus: Timing Childbirth during University Studies*

This paper examines the relationship between the timing of childbirth and the motherhood penalty among high-skilled Danish women. Earlier studies typically find that delaying first childbirth increases female earnings. However, postponing the first birth may also have negative fertility consequences, as it often leads to greater difficulties in conceiving. If women have their first childbirth early, before entering the labor market, this can potentially result in both positive and negative effects on their labor market outcomes. Positive effects may arise if student-mothers signal to employers that they will take up less future maternity and parental leave once they enter the labor market. Negative effects may occur if student-mothers face a delayed entry into the labor market or if they signal a preference for higher fertility compared to students without children. Using a sibling fixed effects design, we find that student-mothers have higher drop-out rates than non-student-mothers at both universities and university colleges. However, for those women completing their education, student-mothers from university colleges experience a considerably higher growth rate in earnings after labor market entry compared to non-student-mothers, and by the age of 40, they have surpassed non-student-mothers in earnings. In contrast, university student-mothers do not fully catch up with non-student-mothers by age 40, although they, on average, enter the labor market at a higher earnings level compared to non-student-mothers.

JEL Classification: J13, J31, D82

Keywords: wage differentials, female wages, parental leave, signaling, motherhood penalty

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1. Introduction

The Nordic countries are usually seen as the most gender-equal societies in the world. According to the 2023 EU Gender Equality Index, Sweden and Denmark rank no. 1 and 4, respectively, Finland ranks no. 8, while Norway and Iceland, which are not EU members, rank high in other gender equality indices. Despite these observations, large gender gaps persist in the labor market, also in the Nordic countries (Albrecht et al., 2018; Blau & Kahn, 2006, 2017). The gender gap in the labor market in many countries, including Denmark, has often been found to be largely a *motherhood gap* in the sense that mothers tend to incur a child penalty while fathers may experience a child premium. Shortly after the birth of their first child, mothers experience a large decrease in earnings while the same is not seen for fathers (Kleven et al., 2019; Lundborg et al., 2017, 2024; Simonsen & Skipper, 2006).[1] New evidence even suggests a *grand*motherhood gap in earnings, due to decreases in grandmothers' labor supply after the arrival of the first grandchild (Gørtz et al., 2025).

The impact of having children, especially the first one, often depends on the timing in relation to a woman's career. Numerous studies have shown, for example, that teen mothers have much poorer labor market prospects compared to other women (Diaz & Fiel, 2016; Hotz et al., 2005; Johansen et al., 2024; Ribar, 1994). This tendency is also observed for women who are early in their careers when they become mothers for the first time. In the US, mothers who delay their first birth until they have established a strong foothold in the labor market earn higher earnings compared to women who have their first child early in the career. These results persist after controlling for background characteristics (Miller, 2011).

Yet, the decision to postpone the first childbirth may also have negative consequences. Women who delay the first pregnancy until their thirties may face unexpected fertility challenges, resulting in costly fertility treatments both from an economic and mental health perspective. From a macro perspective, this delay in childbirth leads to demographic challenges and increased healthcare expenditures related to fertility treatments. The existing literature is not clear about when (and for whom) the individual gains from postponing the first childbirth are present, except that teen births are generally associated with worse outcomes. For example, we

[1] The decrease in earnings seems to persist for around 10 years, and the drop in earnings is estimated to be around 30 percent in the short run. In the longer run, some studies find persistent effects of around 12-20 percent, while e.g. Lundborg et al. (2024) find that the child penalty fades out and disappears after 10 years.

have very little knowledge about the effects of the timing of births for highly skilled women, and whether these women could benefit from having their first child while being a student.

This paper extends the existing literature by examining the potential impact on high-skilled women's future careers of having children at a relatively early age, i.e., before they enter the labor market. More specifically, we ask the question: Is the nature of the motherhood penalty different for high-skilled women who become mothers while studying, than for high-skilled women who postpone motherhood until after they have entered the labor market? [2]

We extend the analysis in previous studies from mothers versus non-mothers (e.g., Miller, 2011) to the rapidly increasing group of high-skilled mothers. Based on register data of the full Danish population, we collect a sample of all women who were admitted to university colleges or universities during the period from 1981 to 2012 and follow them during their studies and their labor market careers until at least the age of 40. Among these female students, about 18 percent have their first child while they are studying, and 22 percent of student-mothers have more than one child while studying. In Denmark, the institutional settings support motherhood for students. Students are entitled to tuition-free education, public support (student grants) while studying, and they are eligible for an extra year of student grants when becoming parents. Hence, financial uncertainties often related to childbirth during studies are not as prevalent in the Danish case as in many other countries, making Denmark a good candidate for studying the effects of having children while being a student.

Our analyses are threefold. First, we focus on the effects of childbearing on the risk of dropping out of a university or university college, and for a subgroup of students, we study the effects on grade point averages. Henceforth, we will jointly refer to university colleges and universities as *'university studies'*. Second, we investigate the effects on earnings potential for those who do not drop out of their university studies. Third, we decompose estimated effects for students in university colleges and universities, respectively. This decomposition analysis adds new information about timing effects for women studying different types of higher education.

[2] The study by Bütikofer et al. (2018) also focuses on fertility of high-skilled women and include descriptive analyses of effects on earnings from the timing of births. They find that child penalties are sensitive to the timing of fertility, but their study differs from ours in important ways: they investigate only fertility timing after graduation, and they use a very selected sample of top 20 percent high earning women in four top graduate degree programs (MBA, law, medicine, and STEM).

The results from our OLS and sibling fixed effects analyses show that early childbearing negatively affects educational outcomes: student-mothers are significantly more likely to drop out of their formal education and achieve lower grades compared to non-student-mothers, but at the same time their labor market outcomes seem significantly better at age 40 than those of non-student-mothers. For those who *complete* their university studies, student-mothers tend to perform well in the labor market. They tend to catch up, and for some groups, even surpass women who become mothers after entering the labor market. Overall, descriptive figures show that student-mothers' annual earnings are higher by the age of 40 compared to non-student-mothers. This positive effect is driven by two separate factors. First, the share of student-mothers at universities is higher than at university colleges, and student-mothers with a university degree have considerably higher earnings than women with a university college degree. Second, student-mothers at university colleges surpass their female peers who postpone their first birth until they have entered the labor market (student-mothers at universities do not fully catch up with their non-student-mother peers by the age of 40). A decomposition analysis further reveals that university college student-mothers experience stronger earnings growth after entering the labor market, whereas university student-mothers do not have a steeper earnings profile post-entry but appear to send strong positive signals, leading to higher starting salaries compared to non-student-mothers. Lastly, our results also indicate that student-mothers tend to have a significantly higher fertility than non-student-mothers. Student-mothers on average have their first child at the age of 26, whereas non-student-mothers have their first child at the age of 31. By the age of 40, student-mothers on average have 2.2 children, and non-student-mothers 1.7 children. This may, of course, reflect different fertility preferences between the two groups. However, it may also reflect that student-mothers, who start their fertility earlier than non-student-mothers, can more easily fulfill their fertility preferences than women who postpone their first birth until after entering the labor market.

Our paper contributes to the literature on timing of childbirth and women's labor market prospects in several ways. First, we extend the existing literature by focusing on the effects of childbirth timing among highly educated women. Second, we decompose the career trajectories of student-mothers and non-student-mothers and provide new evidence on the relative importance of human capital depreciation, delayed labor market entry, returns to experience, and signaling effects. Third, we explore these dynamics within the unique framework of Denmark's welfare system, where financial constraints typically associated with having children during studies are mitigated. This context offers valuable new insights into how

supportive welfare policies can shape the career outcomes of student-mothers. Ultimately, our findings have important implications for both women making childbearing decisions and policymakers shaping family and labor market policies.

The rest of the paper unfolds as follows. In Section 2, we review the existing literature on childbirth timing and the motherhood penalty, and we present the framework for our analyses. Section 3 briefly describes the Danish institutional settings, focusing on the student grant scheme and welfare schemes relevant for students and parents. Sections 4 and 5 present the estimation strategy and the data used in the empirical analysis. Our results are presented in Section 6. Finally, Section 7 concludes.

2. Timing of Childbirth and the Motherhood Penalty

According to the classical human capital theory, mothers tend to earn less than fathers because mothers accumulate less labor market experience due to maternity leave periods (Becker, 1962; Rosen, 1976). Several studies have documented a negative impact on female careers from taking maternity and parental leave (Albrecht et al., 2018; Andersen, 2018; Corekcioglu et al., 2021; Datta Gupta & Smith, 2002; Ejrnæs & Kunze, 2013; Miller, 2011; Simonsen & Skipper, 2006; Waldfogel, 1998). In addition, the return to labor market experience after the birth of the first child, i.e., the wage growth over the career, also tends to be smaller for mothers compared to fathers. This may again be explained by the classical Becker theory if, after the birth of the first child, women specialize in home production and allocate less effort to the labor market than their male peers (Becker, 1965).

The human capital explanation of the gender gap can be supplemented by other mechanisms such as statistical discrimination, gender stereotypical beliefs, and expectations in promotion processes (Bjerk, 2008; Gibbons & Waldman, 1999; Landers et al., 1996; Lazear & Rosen, 1990). These theories and signaling models suggest that unobserved skills, effort, ability, and motivation are important for promotions and, thereby, wages for high-skilled workers. The signals in the early career are particularly important for the future career. Thus, having children early in the career is expected to be more harmful to earnings potential and career development than having children later, because it is important to signal high ambitions, ability, and effort as soon as you enter the labor market.

It is particularly difficult for teenage mothers to signal high ambitions. Pregnancy often causes that these young mothers drop out of school. The literature on teenage mothers thus typically finds that their education, labor market prospects, and earnings are considerably worse due to their teenage motherhood, even after controlling for potential endogeneity issues (Diaz & Fiel, 2016; Holmlund, 2005; Hotz et al., 2005; Johansen et al., 2024). Teenage mothers tend to be a highly negatively selected group, and they do not constitute a reasonable comparison group for more general analyses. Therefore, we turn our attention to studies of relatively older mothers.

The greater part of the empirical evidence on motherhood after the teenage years suggests that postponed motherhood can be beneficial for mothers' outcomes. Much of this literature is correlational. Studies aiming to estimate causal relationships give more mixed results. Wilde et al. (2010) and Miller (2011) for the US, Mølland (2016) for Norway, and Fitzenberger et al. (2016) for Germany find positive effects of postponing motherhood. A new study by Gallen et al. (2023) using information on long-acting reversible contraceptives finds a negative effect from an unplanned pregnancy. Karimi (2014) for Sweden and Rosenbaum (2020) for Denmark find no persistent effect or even negative effects from postponing first birth.

The study by Karimi (2014) uses Swedish register data and finds a negative effect of delaying first birth on both wages and income, partly due to a tighter spacing of childbirths when the first birth is delayed. This implies that late mothers often experience a period with many transitions in and out of the labor market, or alternatively, a longer consecutive parental leave, compared to mothers who have their children earlier. Karimi's study highlights the importance of the institutional settings as Sweden has implemented very long maternity and parental leave schemes in recent decades, along with economic incentives to reduce spacing between childbirths (the so-called 'speed premium'). Denmark has overall comparable institutional settings to Sweden, and Rosenbaum (2020) finds similar results to Karimi in a Danish context. Rosenbaum's study includes the entire population of mothers who gave birth during the period 1984-2014. For mothers younger than 25 years at the first childbirth, he finds only a short-term decline in their wages. Rosenbaum thus finds support for a catch-up effect for the young mothers' wages, implying that there are no long-run negative causal effects of having the first

child before the age of 25. Rosenbaum attributes these findings to Denmark's generous welfare system.[3]

The study by Miller (2011) compares mothers to non-mothers at a given age and outlines four potential effects on earnings due to motherhood:

(1) *forgone earnings* during leave periods when the mother is absent from work.

(2) *forgone human capital accumulation* (experience) during the leave period, resulting in forgone earnings throughout life due to lost human capital while absent from work during parental leave.

(3) *a fixed cost of motherhood,* capturing the loss of earnings potential during absence periods (due to human capital depreciation or negative productivity signals to employers), which may be larger the younger the woman is at first childbirth.

(4) *reduced return to labor market experience* during the rest of the working life (flatter wage profiles due to less effort and productivity or due to employers' (statistical) discrimination against mothers).

In the rest of the paper, we will often refer to these four potential effects on earnings as the *'Miller effects'*. Based on US data (NLSY79), Miller (2011) finds that motherhood is associated with a downward shift in the wage profile and a flattening of the wage profile slope. The flattening effect is larger the lower the age at first childbirth. Miller further documents that the effects of postponing motherhood depend on the type of education and occupation. If women are aware of such effects when making their educational choices, educational levels are likely endogenous, as discussed by Polachek (1979).

Herr (2016) utilizes data similar to those investigated by Miller (2011) and finds that postponement of the first childbirth may not always increase later earnings. Herr argues that 'career age' (number of years after entering the labor market) is a more relevant measure for the age at first birth than the actual age of the mother. She finds that women who have their

[3] In Rosenbaum's study, the average age at the first childbirth for mothers with an early childbirth is 22 years. His study is not about teenage mothers.

first child before they enter the labor market may end up having higher wages and income compared to women who have their first birth after entering the labor market. For the latter group, a higher 'career age' is associated with a smaller child penalty. Herr's results indicate that women who give birth before vs. after starting their labor market career have different unobserved characteristics. For Germany, Brandt and Spangenberg (2022) also show that women, who have their first child before completing their education, experience a significantly larger probability of ending up in leadership positions ten years after graduating. The authors argue that the explanation lies in signaling and the fact that student-mothers have fewer career interruptions compared to women who become mothers after entering the labor market.

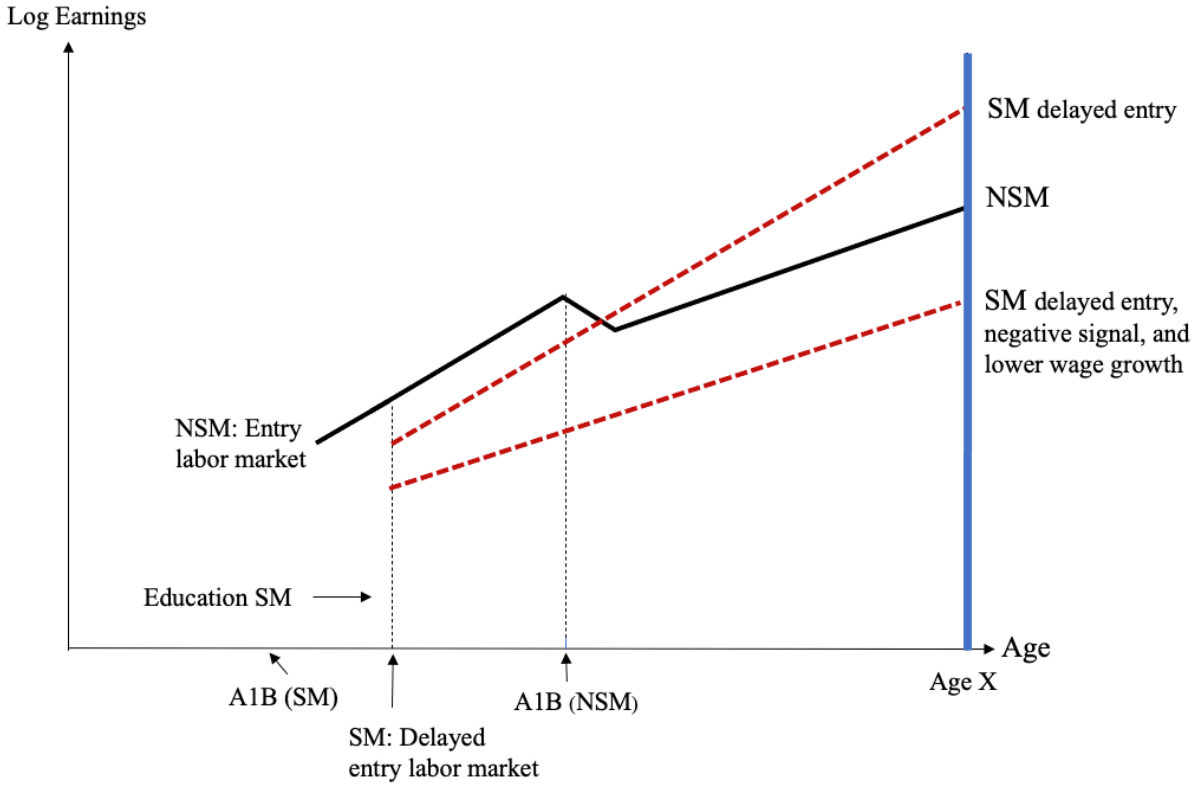
An obvious concern in relation to the studies by Brandt and Spangenberg (2022) and Herr (2016) is endogeneity in the decision to have children before entering the labor market. 'Early' childbirth is likely endogenous to the labor market career and subsequent earnings. Some studies use instruments for addressing timing of births, e.g., miscarriage, stillbirth, failed contraception, or other health indicators, as discussed by Bratti (2023). However, the literature has not converged on a perfect solution to the endogeneity problem. Miller (2011) uses failed contraception and miscarriages as instruments for the timing of first birth, whereas Karimi (2014) and Rosenbaum (2020) combine individual or family fixed effect estimations with miscarriages as an identification strategy. Fixed effect analyses on panel data can address aspects of endogeneity that are rooted in family characteristics. As further outlined in Section 4, we employ the fixed effects strategy in our analyses, as we have detailed information on the sisters of student-mothers.

We extend the work by Miller (2011), Herr (2016), and Brandt and Spangenberg (2022) by analyzing impacts of having the first child while enrolled in higher education, i.e., before entering the labor market. We focus on two groups of high-skilled women who are admitted to a university or a university college: i) student-mothers, those who give birth to their first child while enrolled in university studies; and ii) non-student-mothers, women who have their first birth after completing university studies. Our benchmark group is non-student-mothers, i.e., women who give birth to their first child *after* entering the labor market.

For student-mothers, we introduce two modifications to Miller's model, as illustrated in Figure 1. These modifications are necessary because student-mothers, unlike non-student-mothers, do

not incur an immediate income loss from having their first child.[4] For simplicity, in Figure 1, we ignore scenarios where student-mothers are working during their studies and subsequent births after the first child.

Figure 1. Potential Earnings Profiles for Student-Mothers (SM) compared to Non-Student-Mothers (NSM)



Notes: This figure shows the potential earnings trajectory for student-mothers (SM) in comparison to non-student-mothers (NSM) until a given age X. 'A1B' represents the age at first birth. The solid black line shows the earnings profile for NSM from when they enter the labor market. The red dashed lines indicate the potential earnings profile for SM from when they enter the labor market. The upper dashed line incorporates the effect of delayed entrance, while the lower dashed line incorporates the effects of delayed entrance, negative signaling, and lower wage growth. The effects of potential student jobs and subsequent births after the first birth are ignored.

Being a student-mother typically leads to delayed labor market entry, resulting in lost earnings and human capital accumulation due to less experience and on-the-job training compared to non-student-mothers. In Figure 1, this is illustrated with an earning profile for student-mothers similar to that of non-student-mothers, but with delayed entrance. However, a negative (or

[4] The student mother receives 12 months of additional student grants (each grant is the same amount as for other students) and she may also receive other subsidies for low-income groups (e.g. housing subsidy and childcare subsidy). See Section 3 for details on the institutional settings.

positive) signaling effect and a lower (or higher) wage growth may be present for student-mothers. Employers might view their delayed entrance and choice of having a child while studying as a signal of preferences for high fertility and lower labor market preferences. Furthermore, the educational success of student-mothers may be impacted by the challenges of balancing education and parenthood, which could be reflected in higher drop-out rates and lower grades. Additionally, student-mothers might tend to self-select into part-time or less competitive jobs.[5] The combination of these factors could contribute to a lower starting wage and a less steep earnings profile for student-mothers compared to non-student-mothers. Alternatively, being a student-mother may signal *high productivity* to a potential employer by demonstrating the ability to complete a degree while caring for a baby, and potentially having *fewer childbirths* later in life, ceteris paribus, thus leading to less long-term absence from the workplace due to childbirth. If the positive effects dominate, we will observe that student-mothers catch up with non-student-mothers later in their careers (not illustrated in Figure 1).

We test whether any positive effects from being a student-mother dominate the possible negative effects of early childbirth on delayed entrance, starting wages and reduced grade point averages. Thus, we will investigate whether i) student-mothers have lower GPAs and higher drop-out rates than non-student-mothers; and ii) student-mothers experience a lower starting salary and/or flatter earnings profile than non-student-mothers. We will also decompose the estimated effects on career trajectory and more formally test how much can be explained by the four mechanisms described by Miller (2011), referred to as the 'Miller effects', and/or any additional effects as illustrated in Figure 1.

3. Institutional Settings

Fertility choices, particularly regarding the timing of the first childbirth, can be significantly influenced by the welfare regime. The welfare regime can, for example, affect individuals' decisions to have a child while being a student by providing specific benefits for students. Denmark, as one of the Nordic countries, adheres to the universal welfare state model, where benefits such as healthcare, education, and social assistance are free for all Danish citizens. These benefits also include generous family-friendly policies intended to help balance work

[5] We are not able to disentangle effects of low(er) grades from the choice of working part-time, in less competitive jobs, and/or receiving a lower starting wage.

and family life, such as long parental leave and highly subsidized childcare available for all families 6-12 months after childbirth. Furthermore, all parents are eligible for supplementary child benefits until their child is 18 years old.

The Danish education system is very generous. All students are entitled to tuition-free education as well as public support (study grants) during their studies. Danish students who do not live with their parents receive approximately 990 dollars (in 2024) each month in study grants. Besides study grants, students also have the right to take up inexpensive student loans (up to approximately 500 dollars each month).

If students become parents, they are eligible for extra grants ('birth grants') and receive an additional year to complete their education. At the time of our study, student-mothers were eligible for 12 months of birth grants, whereas student-fathers were eligible for 6 months of birth grants. These extra grants could be received as monthly leave benefits, in twofold (in 6 months), or combined with normal study grants for 12 months.[6] Furthermore, if the student-parent shares a residential address with the child, the parent can take out additional student loans of up to approximately 250 dollars each month. Additionally, it was uncomplicated to prolong studies. Although there was a maximum number of years for study grants, students could, in principle, study for many more years than the grants covered. Thus, prolonging studies due to having children would not be a restriction. It is possible that some students might prolong their studies by having a child to continue receiving study grants (and birth grants) when they had already planned to drop out. We cannot identify such behavior, so we limit our main analysis of labor market outcomes to those who complete their university studies.

Overall, the opportunity costs for early childbearing while still enrolled in education are relatively low compared to many other countries (Waldfogel, 1998).

4. Empirical Framework

To explore the relation between the timing of childbirth and the motherhood penalty among high-skilled Danish women, we conduct several empirical analyses. First, we investigate the

[6] On August 2nd, 2022, a new parental leave reform was implemented, which also changed the rules for students. As our study investigates student-mothers under the old grant scheme, our focus is solely on that scheme.

risk of *not completing* university studies if having a child while studying. We also investigate the effects on grades from bachelor's theses (university college students) or master's theses (university students) for a subgroup of students.[7] Second, for those who *complete* their education, we investigate the impact of being a student-mother on earnings and wage rates. Third, we introduce a decomposition exercise of the earnings potential at age 40 for student-mothers and non-student-mothers to better understand the effects of being a student-mother compared to women who choose to have their first child after completing their education.

Our starting point for the analyses is linear regressions (the linear probability model or ordinary least square (OLS) model). Except for the decomposition exercise and a few cases where the samples become too small, we supplement with sibling fixed effects analyses to account for the fact that timing of childbirth may not be random. If the timing of children is not random, our initial linear regression results could be biased by the self-selection of women who choose to have a child while studying. In the sibling fixed effects design, we compare closely spaced sisters. By controlling for common family characteristics among sisters, we aim to address (most of) the endogeneity of childbirth timing and thus obtain causal effects on earnings from having children while being a student. The linear regression methods are detailed in Section 4.1, the sibling fixed effects design in Section 4.2, and the decomposition method is explained in Section 4.3.

4.1 Linear Regressions

Educational Success

Student-mothers may be a selected group of students, and for this reason, our starting point is to examine student-mothers prior to their labor market entry. First, we explore whether student-mothers are less likely to complete a formal education than non-student-mothers. To assess the drop-out risk of being a student-mother, we use a linear probability model, ignoring any potential endogeneity and selection bias related to both the timing and the choice of having children. Second, we investigate effects on grade point averages (GPA) for the subgroup of students for whom grades are available. To address the drop-out-risk of student-mothers attending university studies, we include all women at university studies who are categorized as student-mothers or non-student-mothers.

[7] The Danish registers do not yet contain information on grades for all study programs or universities.

We use a linear probability model and estimate

$$Y_i = \beta_0 + \beta_1 SM_i + \gamma X_i + \theta T_i + u_i, \quad (1)$$

where Y_i =1 if the individual has *not completed* a university college bachelor or a university master's degree by age 35, and Y_i =0 if completed. SM_i is an indicator for being a student-mother, i.e., having the first child while studying. X_i is a vector of background characteristics including type of education (Arts & Humanities, Social Science etc.), GPA from high school, parents' years of education, work experience (number of years) as a student, and whether the woman gives birth to more than one child while being a student. T_i indicates birth cohort dummies to account for any potential time effects. We define this model as our base model.[8] To explore potential different effects of background characteristics across the groups of women, the background characteristics and cohort indicators are interacted with the SM_i indicator in some specifications (defined as the interaction model).

When investigating the association between being a student-mother and grades, we use the same specification as in Equation 1. However, we now replace the previous dependent variable with a continuous variable that captures the grade from the bachelor's thesis for students at university college, and the grade from the master's thesis for university students.

Labor Market Outcomes

In the second part of the empirical analysis, we examine the career trajectories after entering the labor market. We focus on women who *complete* a formal education and exclude those who do not complete a university college bachelor or a university master's degree by the age of 35. This positive selection avoids including women who may have become student-mothers solely to prolong their studies before dropping out.[9]

[8] We have further estimated Equation (1) with an additional indicator for the type of university studies (university college vs. university). However, including this indicator does not change our results in any substantial way and we therefore only report results from specifications not including this indicator variable.

[9] Table A9 in the appendix shows the results based on *all* women, i.e., both those who complete a formal education by age 35 and those who do not. The estimated coefficients for student-mothers in Table A9 decrease slightly but remain positive and significant. Thus, due to our positive selection, the reported results in our main tables should be considered as an upper bound of the effects of being a student-mother on labor market outcomes.

We use a similar specification as in Equation 1 to investigate the impact of being a student-mother on labor market outcomes. As the sample for these estimations consists only of non-dropouts from university studies, we add extra control variables to the specification in Equation 1. Specifically, we include the type of completed education (6 indicators, e.g., Arts & Humanities, Social Science etc.), the number of years of experience in the labor market at age 40, and the accumulated number of years being absent from the labor market since labor market entry. Absence is measured at age 40 and captures a combination of parental leave, unemployment, and other reasons.[10] Thus, absence measures the amount of time the woman could potentially be working but is not registered as working. Additionally, we include the squared value of the experience and absence variables and control for the total number of children by age 40. We investigate three labor market outcomes: i) the (log) annual earnings; ii) the (log) hourly wage rate at age 40; and iii) the growth in annual earnings between ages 36 and 40 (average values for the three-year periods 35-37 and 39-41). The variables are described further in Section 5.1.

4.2 Sibling Fixed Effects

To address the risk that non-random timing of childbirth biases results in our linear regressions, we employ a sibling-fixed effect design to derive causal effects from being a student-mother. We create a sample consisting of sisters who fulfill the sample selection criteria (described further in Section 5). The main identifying assumption of the sibling fixed effects design is that all family-specific confounding variables - both observed and unobserved - are shared among sisters. Thus, if these factors are constant over time, influences from parents' endowments, rearing talent, biological aspects, and shared environmental factors are automatically adjusted for when comparing within sister pairs.

The sibling fixed effects strategy involves calculating the averages of the characteristics of two sisters within the same family and then subtracting these averages from the individual levels in Equation 1. Any observable and unobservable family characteristics that are common to all

[10] Number of years absent from the labor market after leaving the education system is calculated as [Age] – [Age when completing education] – [Experience]. Information on exact experience is based on data from the ATP pension registers, where information is available on contributions to the mandatory ATP scheme. ATP payments are closely related to work experience.

sisters are thus differenced away, and we thereby isolate the impact of the timing of the first childbearing on labor market outcomes.

Identifying the causal effect of being a student-mother on educational and labor market outcomes is challenging. Controlling for shared environmental factors and parental characteristics and skills in the sibling fixed effects design substantially reduces the potential endogeneity bias when estimating the effect of being a student-mother. However, this strategy also have its shortcomings as discussed by e.g. Fletcher and Lehrer (2011), Fletcher (2013), and Halpern-Manners et al. (2020). The sibling fixed effect approach may, for example, not fully account for differences in genetic factors between siblings. For instance, variations in innate abilities or traits like motivation and resilience can differ and may influence both the timing of childbirth and labor market outcomes. Additionally, there may be differences in early endowments, such as birth-order effects or variation in parental investment between siblings, as well as spillover effects in fertility choices between sisters. In our sibling fixed effect design, we thus control for birth order, as several studies find that earlier-born children generally perform better (e.g. Black et al., 2005, 2011; and Houmark, 2023). Ideally, restricting the sample to twins and applying a within-twin approach would minimize the genetic differences between sisters and the potential differential investments from parents. However, even within twin pairs, unobserved differences influenced by environmental factors may still exist (Lundborg et al., 2016). In our analysis, there are too few twin pairs meeting our sample criteria to estimate meaningful results.

Another concern is external validity. The sibling fixed effects results are limited to i) women who have sisters and ii) women who have sisters that meet the sample criteria. For instance, if one of the siblings drops out of education, the pair cannot be used for estimations in the analyses of labor market outcomes. As a result, the sibling fixed effects design is based on a subsample of our initial data, which may limit the generalizability of the findings to the broader population of highly educated women. However, descriptive statistics on the sibling sample show that this group is largely comparable to the full sample, see Appendix Tables A1 and A2.

To address endogeneity concerns regarding the timing of childbirth, instead of using panel fixed effects, some studies use instrumental variables such as miscarriages, stillbirths, or failed contraception. However, these health-related instruments can be criticized for not being exogenous to labor market careers, as they might directly affect labor market decisions (Bratti,

2023) or influence investments in the following pregnancy (Bütikofer et al., 2024). An alternative to these instruments is the success of fertility treatments, such as IVF treatments (Lundborg et al., 2017, 2024). However, IVF is typically considered when a couple has difficulties conceiving naturally. Given that our sample consists of relatively young women, IVF is not an option they would frequently consider. Therefore, in the current study, the sibling fixed effects design stands out as the most appropriate method for dealing with the endogeneity of the timing of children.

4.3 Decomposition of Earnings Potential at Age 40

To identify differential effects at the age of 40 for student-mothers and non-student-mothers (as illustrated in Figure 1), we decompose the estimated differences in (log) annual earnings between these two groups. The decomposition is inspired by the Oaxaca-Blinder approach (Blinder, 1973; Oaxaca, 1973). We decompose earnings for the combined sample of student-mothers and non-student-mothers into two parts: one based on women's characteristics, and another based on the different returns to these characteristics for student-mothers vs. non-student-mothers.

We define $\overline{\ln y}_{40}^{j}$ as the average log annual earnings at age 40 for group *j,* where *j* = SM and NSM. The difference in average log annual earnings at age 40 between SM and NSM can be decomposed as:[11]

$$(2) \qquad \overline{\ln y}_{40}^{SM} - \overline{\ln y}_{40}^{NSM} = \bar{X}_{SM_{40}} \cdot \hat{\beta}_{SM} - \bar{X}_{NSM_{40}} \cdot \hat{\beta}_{NSM} = \left(\bar{X}_{SM_{40}} - \bar{X}_{NSM_{40}}\right) \hat{\beta}_{SM} + \bar{X}_{NSM_{40}} \left(\hat{\beta}_{SM} - \hat{\beta}_{NSM}\right),$$

where the first term represents differences in characteristics (X) evaluated at SM 'prices' (coefficients), and the second term represents differences in 'prices' (the return to X) evaluated at NSM characteristics. Based on this decomposition, we identify the effects described in Section 2 (i.e., the four 'Miller effects' and additional effects related to being a student-mother)

[11] Alternatively, the decomposition might use non-student-mother coefficients as weights in the first term ('characteristics') and student-mother characteristics as weights in the second term ('prices'). The results are not sensitive to which type of decomposition we use.

by comparing the difference in average log earnings for student-mothers and non-student-mothers at age 40. A more detailed description of the calculations is given in Appendix B.

5. Data

The empirical analysis is based on administrative register data from Statistics Denmark. The register data covers the full population, and most of the registers contain information from 1980 and onwards. The data combines individual-specific information on demographics, school performance, educational attainment, labor market information, and income. A unique personal identifier enables us to connect data from different registers and link individuals with their family members and employers. Furthermore, the longitudinal nature of the data makes it possible to follow individuals over time and explore how their career and family life evolves.

For our analysis, we select all women who are enrolled in their first education – either at a university college (*professional bachelor's degree* or *medium higher education)* or university (*long higher education*) – during the period 1981-2001, and who were 25 years old or younger at the start of their first formal education. We exclude all women who have children before starting their first formal education or who never have a child during our sampling period.[12]

Table 1 provides an overview of the selection of cohorts and the reduction in the sample size for each selection criterion. The sample restrictions result in a sample of 153,563 unique women who enroll in their first college or university education before the age of 25 (referred to as Sample 1), and a subsample of Sample 1 consisting of 128,310 individuals who *complete* a university college or university degree before the age of 35 (referred to as Sample 2).[13]

We have information on the date a child is born and the date a person completes formal education. Based on this information, we split Sample 1 into two groups: i) student-mothers, i.e., women who have their first child while still under education; and ii) non-student-mothers, i.e., women who have the first child after completing formal education. The distribution of

[12] We define women who are not observed to have children in our sample period as non-mothers (NM). Since we only include women who are observed until they are at least 40 years old, this means that for the youngest cohorts, some of our non-mothers may end up having children after they reach the age of 40. However, in 2022, only 2.8 percent of first-time mothers were 40+ years old (Statistics Denmark, 2023).

[13] In some figures, we also include non-mothers. In those cases, the number of observations in Sample 1 is 174,869 and 149,112 observations in Sample 2.

women across the two motherhood categories is presented in Table 2. Sample 2 is used for the analyses of labor market outcomes. According to Table 2, 17 percent of Sample 2 are student-mothers, while 83 percent have their first child after entering the labor market.

Table 1. Sample Restrictions

Restriction	**No. Individuals**
Women who enroll at their first university college or university education in the period 1981-2001	230,639
Exclude immigrant women	221,098
Only women who are observed each year until they are at least 41 (40 for youngest cohort) years old in 2021 (panel)	182,329
Sample 1: Delete women who have a child before they enroll in their first education or who never get a child in our sample period	153,563
Sample 2: Only women who complete a university college or university degree before the age of 35 (i.e., do not drop-out of university studies)	128,310

Table 2. Number of Student-Mothers and Non-Student-Mothers

	Sample 1		**Sample 2**	
	Frequency	*Percent*	*Frequency*	*Percent*
Student-Mothers (SM)	27,523	18	21,760	17
Non-Student-Mothers (NSM)	126,040	82	106,550	83
Total	153,563	100	128,310	100

5.1 Variables of Interest

First, we explore educational success, specifically whether student-mothers are less likely to complete a formal education than non-student-mothers. Using the educational register, our main outcome is an indicator for whether a woman completes a university college or university degree before the age of 35. Additionally, for a subgroup, we investigate grade point averages (GPA) from bachelor's or master's theses.

Second, we investigate the career trajectories of student-mothers and non-student-mothers. The two key variables for exploring career trajectories in this study are labor market experience and absence from the labor market. Using data from various social and labor market registers, we calculate the number of years each woman is in and/or out of employment after entering the labor market. We define absence from the labor market as time spent on maternity or parental leave, sick leave, unemployment, or receiving social disability pensions. Our three outcomes of interest are: 1) the average (log) annual earnings during the ages 39-41; 2) the average (log) hourly wage rate during the ages 39-41; and 3) the average percentage growth in annual earnings over a 4-year period from ages 35-37 to ages 39-41. Appendix Figures A1 and A2 show the distributions of these three earnings variables. The outcome variables capture the earnings potential of student-mothers and non-student-mothers at the age of 40. Ideally, we would have measured these outcomes at the age of 50, when all the women had completed their fertility, but this was not possible due to data limitations.[14] If we find that student-mothers catch up with non-student-mothers already at the age of 40, we provide a conservative estimate of the earnings potential for student-mothers. To accurately measure earnings potential, we use 3-year averages of wages and earnings, including only those years when an individual is employed full-time for all 12 months.[15] For some women, the 3-year average may therefore be based on only one or two years to avoid excluding too many observations.

5.2 Descriptive Statistics

In Table 3, we present mean values for the main control variables used in the empirical analyses.[16] Sample 1 includes both dropouts and women who complete their formal education, whereas Sample 2 only includes women who complete their formal education. Results for Sample 1 (Sample 2) are presented separately for student-mothers in Column 1 (Column 4), and for non-student-mothers in Column 2 (Column 5). Mean differences between the two groups are presented in Column 3 (Column 6).

[14] For the early cohorts, which we observe until age 50, we also estimate age-50-outcomes. However, these results are not considered our main results due to the heavily reduced sample size.

[15] Earnings are based on annual observations in the registers. To measure earnings potential most accurately, we only include individuals who are employed full-time for all 12 months of the year. Including years without full-time employment for all 12 months would risk incorporating reduced earnings for mothers who, for example, gave birth in October and subsequently took six months of leave, resulting in lower earnings in both the year of childbirth and the following year.

[16] A similar table presenting descriptive statistics for the outcome variables is included as Table 4.

Table 3. Descriptive Statistics of Main Control Variables by Motherhood Type (Sample 1 and Sample 2)

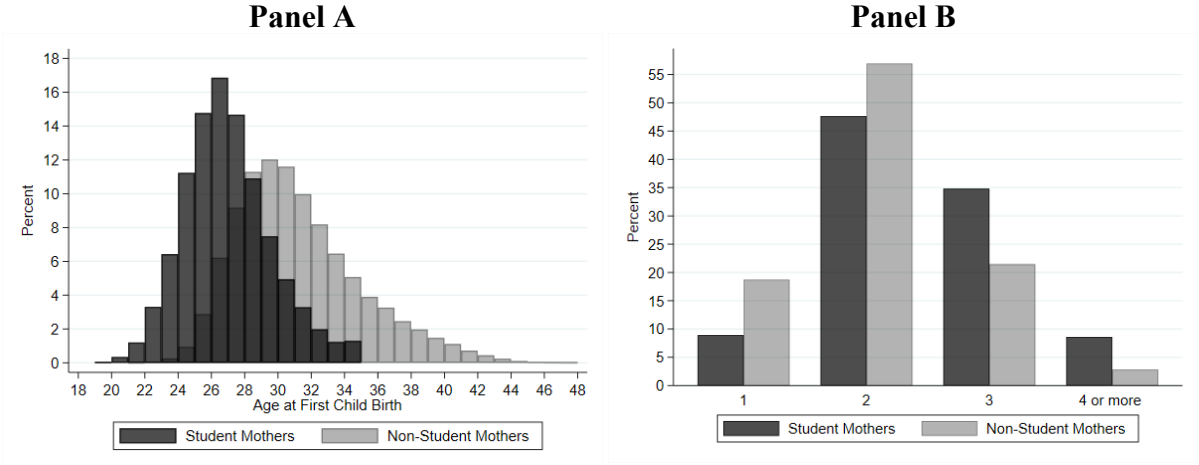
	Sample 1			Sample 2		
	Student-Mothers	Non-Student-Mothers	Difference	Student-Mothers	Non-Student-Mothers	Difference
	(1)	(2)	(3)	(4)	(5)	(6)
Birth Year	1971.19	1971.44	-0.25***	1971.17	1971.42	-0.25***
	(5.60)	(5.42)		(5.62)	(5.44)	
Mother's Age at First Birth	26.49	30.73	-4.24***	26.24	30.66	-4.42***
	(2.65)	(3.78)		(2.40)	(3.70)	
No. of Children	2.24	1.67	0.57***	2.29	1.69	0.60***
	(0.77)	(0.89)		(0.75)	(0.88)	
GPA High School	7.46	7.09	0.37***	7.49	7.11	0.38***
	(2.19)	(2.15)		(2.18)	(2.16)	
Married or Cohabiting (0/1)	0.89	0.89	0.00	0.89	0.90	-0.01
	(0.32)	(0.31)		(0.31)	(0.30)	
Work Exp. (Years) as Student at Age 40	2.73	2.58	0.15***	2.91	2.70	0.21***
	(2.18)	(1.93)		(2.10)	(1.88)	
Exp. after Labor Market Entry (Years) at Age 40	8.65	11.23	-2.58***	9.01	11.44	-2.43***
	(3.57)	(3.49)		(3.19)	(3.09)	
Absence after Labor Market Entry (Years) at Age 40	2.96	2.54	0.41***	1.87	1.98	-0.11***
	(3.67)	(3.04)		(2.07)	(2.15)	
Public Sector (0/1)	0.60	0.57	0.03***	0.66	0.62	0.04***
	(0.49)	(0.50)		(0.47)	(0.49)	
Parents' Education						
Father's Education	13.58	13.26	0.32***	13.60	13.27	0.33***
	(3.00)	(2.92)		(3.00)	(2.92)	
Mother's Education	13.25	12.90	0.35***	13.29	12.93	0.36***
	(2.92)	(2.85)		(2.92)	(2.85)	
No. of Observations	27,523	126,040		21,760	106,550	

Notes: Means and standard deviations for student-mothers (Column 1 and Column 4), and non-student-mothers (Column 2 and Column 5). Column 3 (Column 6) presents the difference between Column 1 (Column 4) and Column 2 (Column 5) along with the statistical significance from a single t-test for equal means between the two groups. Sample 1 refers both to women who drop out of their education and those who complete their education, whereas Sample 2 only consists of women who complete their formal education before turning 35. All variables are measured at age 35 unless otherwise indicated. Significance levels are indicated as *** p<0.01, ** p<0.05 and * p<0.10.

On average, the women included in Sample 1 (Column 1-3), were born in 1971, and student-mothers had their first child around the age of 26, whereas non-student-mothers were around the age of 31. Panel A of Figure 3 shows that the age at first birth varies a lot across student-mothers and non-student-mothers (age range from about 20 to 35 years vs. age range from 25 to 44 years). By the age of 35, student-mothers on average have 2.2 children, whereas non-student-mothers have 1.7 children.

The pattern of student-mothers having more children than non-student-mothers remains when investigating fertility at age 40 (Figure 3, Panel B). Approximately 43 (24) percent of student-mothers (non-student-mothers) have 3 or more children by the age of 40. This difference could indicate a preference for larger families among student-mothers or reflect fertility problems for non-student-mothers who have their first child at a later age and therefore potentially face more difficulties in getting pregnant.

Figure 3. Age at First Childbirth (Panel A) and Number of Children at Age 40 (Panel B) Separately for Student-Mothers and Non-Student-Mothers

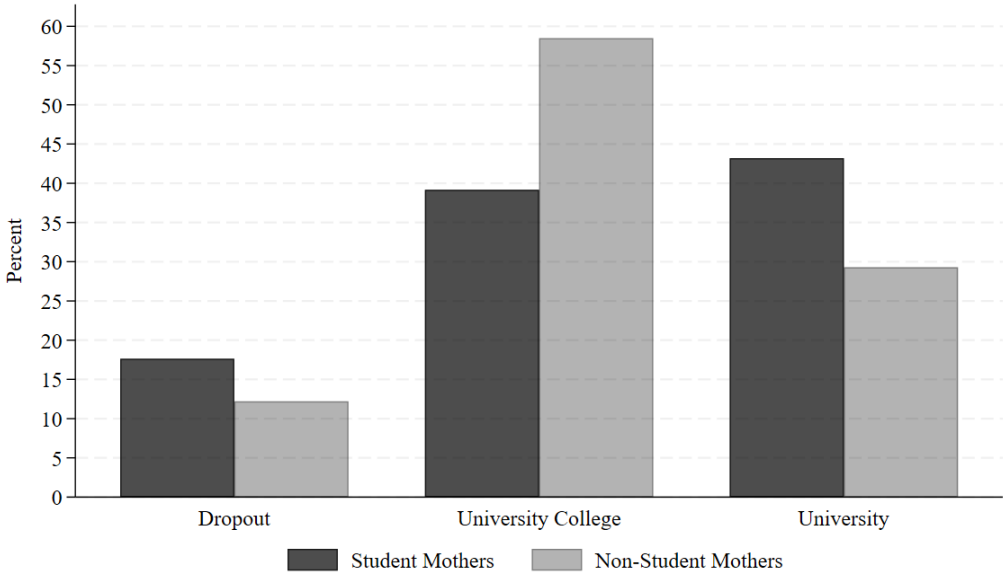


Notes: The figures are based on Sample 1, i.e., both women who drop out of their education and women who complete their education.

When comparing GPAs from high school and parents' education levels across the two types of motherhood, we observe notable differences. Student-mothers tend to have higher GPAs from high school and come from families with higher levels of education compared to non-student-mothers. This finding indicates that student-mothers are far from the stereotype of vulnerable teenage mothers, despite dropping out of their education more frequently than non-student-mothers (see Figure 4). Around 18 percent of student-mothers drop out of their education

compared to 12 percent of non-student-mothers. Drop-out is defined as not having completed university college or university education (master's degree) by the age of 35. While average drop-out rates are higher among student-mothers, those who complete their education tend to attain higher levels of education, as also shown in Figure 4: among non-student-mothers, 59 percent have a university college as their highest level of education, while 29 percent have a master's degree. By comparison, 39 percent of student-mothers have completed a university college education, and 43 percent have a university master's degree. Further, we find that student-mothers more often study humanities, social sciences, or education (preschool and schoolteachers), as shown in Appendix Figure A3.

Figure 4. Highest Completed Education Level at Age 35 by Motherhood Type



Note: Highest completed education level at age 35 for student-mothers and non-student-mothers. It is based on Sample 1, i.e., both women who drop out of their education and women who complete their education. Drop-out is defined as not having completed university college or university education (master's degree) by the age of 35.

Table 3 Column 4-6 focus on the women who complete their formal education, i.e. Sample 2. The descriptive statistics confirm that student-mothers appear to be a positively selected group compared to non-student-mothers.[17] At the age of 40, non-student-mothers on average have slightly more time out of employment compared to student-mothers. However, non-student-mothers entered the labor market earlier than student-mothers, resulting in more work

[17] Compared to non-mothers, student-mothers are even more positively selected (not shown in Table 3). The share of women on social disability pensions and those unemployed is higher for non-mothers compared to women who end up having children, even when focusing only on women who enroll in higher education.

experience by the age of 40. Student-mothers are more often employed in the public sector (66 percent) than non-student-mothers (62 percent). This may reflect that public sector jobs typically offer more family-friendly schemes, such as care days, parental leave compensation, etc. (Nielsen et al., 2004).

Table 4 reports descriptive statistics for our outcome variables by motherhood type. Column 1-3 provides mean values for student-mothers (Column 1) and non-student-mothers (Column 2) for Sample 1, whereas Column 4-6 provides mean values for student-mothers (Column 4) and non-student-mothers (Column 5) for Sample 2.[18] According to Table 4, student-mothers who complete their education (Sample 2) on average catch up with the non-student-mothers by the age of 40. This is observed both in terms of hourly wage rates and annual labor market earnings, and, interestingly, also holds for the sample including dropouts (Sample 1). Additionally, the growth rates in earnings from ages 35-37 to ages 39-41 are higher for student-mothers. This finding is confirmed in Figure 5, which shows the raw annual earnings profiles (in DKK) for student-mothers, non-student-mothers, and non-mothers.

Figure 5 clearly shows that non-student-mothers on average have higher annual earnings upon entering the labor market compared to student-mothers. However, by the late thirties, student-mothers have caught up and even surpassed the earnings of non-student-mothers. This can be attributed to student-mothers experiencing a higher growth in annual earnings during their thirties. Meanwhile, many non-student-mothers are having their first child during this period, which influences their earnings trajectory. In Appendix Figure A4, the sample is split by university college and university educations. For those holding university master's degrees, the raw numbers show that student-mothers do not seem to catch up with their non-student-mother peers by the age of 40. However, student-mothers with a university college degree do catch up by the age of 40.

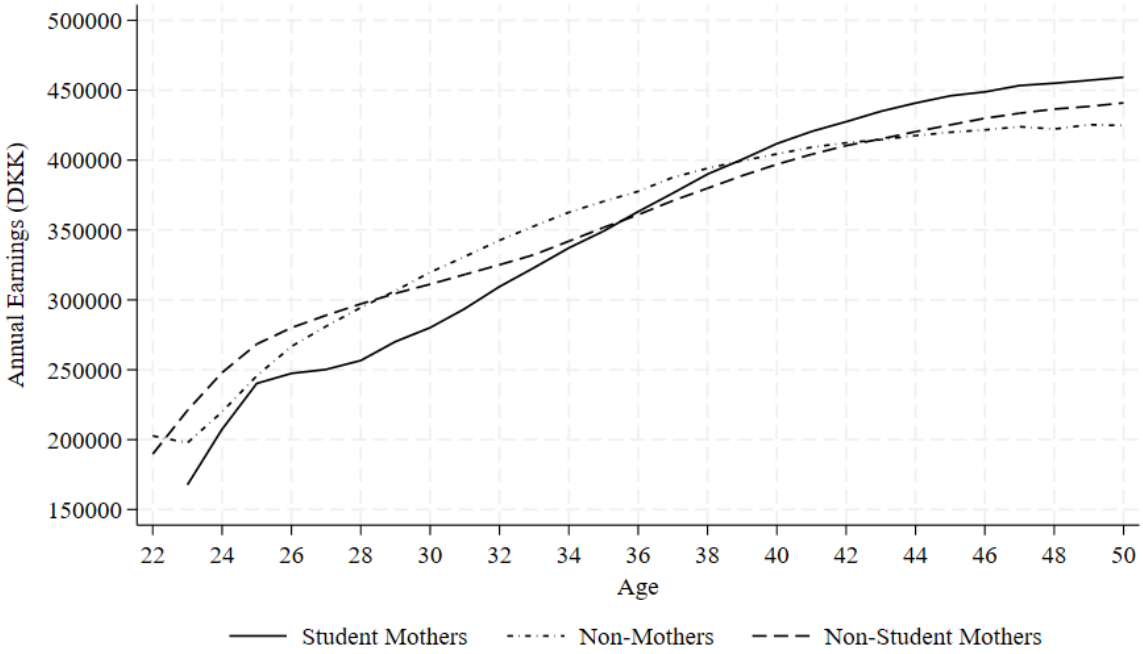
[18] In Appendix Tables A1- A2, we present the descriptive statistics by motherhood type for our sibling sample. Overall, the sibling sample is very comparable with our full sample.

Table 4. Descriptive Statistics for Outcome Variables by Motherhood Type (Sample 1 and Sample 2)

	Sample 1			Sample 2		
	Student-Mothers	**Non-Student-Mothers**	**Difference**	**Student-Mothers**	**Non-Student-Mothers**	**Difference**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dropout	0.18	0.12	0.06***	-	-	-
	(0.38)	(0.33)				
No. of Observations	27,523	126,040				
Average Annual Earnings at Age 40 (39-41)	441.798	429.381	12,417***	450,595	433,780	16,815***
	(119,740)	(122,838)		(119,395)	(122,561)	
No. of Observations	21,878	102,359		18,662	91,398	
Average Annual Hourly Wage at Age 40 (39-41)	241,50	239,24	2.26***	246.46	241.84	4.62***
	(70.13)	(76,62)		(70.29)	(67.21)	
No. of Observations	16,364	77,512		13,913	68,916	
Growth (%) in Average Annual Earnings from Age 36 to 40 (35-37 to 39-41)	13.50	9.52	3.99***	13.44	9.56	3.88***
	(21,14)	(20.44)		(16.39)	(20.63)	
No. of Observations	18,128	87,128		15,898	78,679	

Notes: Means and standard deviations for student-mothers (Column 1 and Column 4), and non-student-mothers (Column 2 and Column 5) for Sample 1 (Column 1-3) and Sample 2 (Column 4-6). Column 3 (Column 6) presents the difference between Column 1 (Column 4) and Column 2 (Column 5) and the statistical significance from a single t-test for equal means between the two groups. Sample 1 refers both to women who drop out of their education and those who complete their education, whereas Sample 2 only consists of women who complete their formal education before turning 35. All variables are measured at age 35 unless otherwise indicated. Since we restrict the outcome variables related to the labor market to individuals where we observe at least one observation with full time employment (i.e., where the person is not fully or partly on leave, unemployed etc.) in the three-year windows 35-37 and 39-41, there are fewer observations for the outcome variables. Labor market outcome variables are measured in fixed 2015-prices. Significance levels are indicated as *** $p<0.01$, ** $p<0.05$ and * $p<0.10$.

Figure 5. Earnings profiles for Student-Mothers, Non-Student-Mothers and Non-Mothers after Entering the Labor Market (Sample 2)



Notes: Raw annual earnings profiles for student-mothers, non-mothers and non-student-mothers after entering the labor market. It is based on Sample 2, i.e., women who complete their formal education before turning 35. Non-mothers are women who are not observed to have children in our sample period. The total number of observations is 149,112 including non-mothers.

6. Results

Women who have their first child while still studying could potentially face challenges related to completing their education and in devoting (enough) time to studying. They might therefore end up with lower grades due to the time needed for childcare and are potentially at a higher risk of dropping out. Therefore, we first explore whether student-mothers are less likely to complete their education and whether they have lower grades compared to non-student-mothers. These findings are presented in Section 6.1.

Second, in Section 6.2, we investigate the labor market potential for those who complete their education. We then consider heterogeneous effects based on the type of education and the timing of the first child in Sections 6.3 and 6.4. Finally, we complete the empirical analyses in Section 6.5 by decomposing earnings differences between student-mothers and non-student-mothers to better understand the drivers of these differences.

6.1. Educational Outcomes: Drop-out Risk and Grades

In this section, we test whether student-mothers have lower GPAs and higher drop-out rates than non-student-mothers after controlling for differences in background characteristics. Table 5 presents the results of the OLS and sibling fixed effects (FE) analyses for both the base and interaction model. In the interaction model, the type of motherhood is interacted with GPA and work experience as a student.

The OLS results reflect correlations rather than causal relationships. However, as shown in Table 5, the sibling FE estimates are very similar to the OLS estimates, suggesting that unobserved family background characteristics are not driving the OLS findings. Some of the coefficients in the sibling FE estimates are less statistically significant, which may partly be due to the smaller sample size in these estimations.[19]

Consistent with our proposition, the results show that student-mothers are more likely to drop out compared to non-student-mothers**.** In fact, student-mothers have a 6.3 percentage points higher drop-out rate compared to non-student-mothers in the base model and a slightly lower drop-out rate in the interaction model. Interestingly, work experience as a student has a significantly negative impact on drop-out rates, and this effect is more pronounced for student-mothers according to the interaction model. Similarly, and perhaps surprisingly, having more than one child while being a student appears to reduce the drop-out rate by 16 percentage points. One potential explanation for this finding could be that having more than one child while being a student creates a stronger motivation to complete the studies in order to secure better long-term financial stability for the family. The added responsibilities and financial pressure from having multiple children may push students to focus on finishing their education to improve their future career prospects.

[19] The OLS results based on the much smaller sibling sample are shown in Appendix Table A3. Overall, the OLS results based on the sibling sample are similar to the general OLS and sibling fixed effects estimates. Furthermore, Appendix Table A4 shows similar results as those in Table 5, when estimating without background controls.

Table 5. Estimation of Drop-out Risk from University College or University

	Base Model		Interaction Model			
			OLS		Sibling FE	
	OLS	**Sibling FE**	Main Effect	SM Interaction	Main Effect	SM Interaction
Student-Mother (0/1)	0.063***	0.063***	0.033***		0.057*	
	(0.002)	(0.008)	(0.009)		(0.031)	
GPA High School	-0.021***	-0.017***	-0.022***	0.004***	-0.016***	-0.003
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
Work Experience Student, Years	-0.028***	-0.041***	-0.026***	-0.008**	-0.041***	0.001
	(0.001)	(0.004)	(0.001)	(0.003)	(0.004)	(0.010)
Work Experience Student, Squared	0.003***	0.004***	0.003***	0.001**	0.004***	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
More than 1 Child as Student (0/1)	-0.170***	-0.158***	-0.174***	-	-0.160***	-
	(0.003)	(0.012)	(0.003)		(0.012)	
Additional Controls	Yes	Yes	Yes		Yes	
No. of Observations	153,563	24,039	153,563		24,039	
R-Squared	0.344	0.657	0.345		0.65	

Notes: Regression results using OLS and sibling fixed effects (FE) for the base model (Eq. 1) and the interaction model, which adds interactions of the student-mother indicator (SM_i) with background characteristics and cohort indicators to the base model. The regressions are based on Sample 1, i.e., women who drop out of their education and women who complete their education. Drop-out is defined as not having completed university college or university education (master's degree) by the age of 35. The sibling FE estimations are based on a subsample of Sample 1. Additional controls include type of education, parents' years of education, and birth cohort dummies. The sibling FE estimations also include a variable for birth order, with standard errors clustered at the sibling level. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

We also consider the possibility that GPAs might be affected by having the first child while being a student. Balancing having children and studies can reduce the time available for studying, attending lectures, and completing coursework. This constraint on time can directly impact the quality of student-mothers' academic efforts, potentially resulting in lower grades. For a sub-sample of the most recent students in our sample (slightly fewer than 10,000 students), the grades from bachelor's and master's theses are available in Statistics Denmark's registers.[20] Appendix Table A5 report the average GPAs split by motherhood type for this sub-sample and shows that student-mothers have slightly lower grades compared to non-student-mothers.

Table 6. OLS Estimation of Grades from Bachelor Thesis (University College) or Master Thesis (University) for a Sub-Sample of Students

		Interaction Model	
	Base Model	Main Effect	SM Interaction
Student Mother (0/1)	-0.169**	-0.197	
	(0.078)	(0.327)	
GPA High School	0.364***	0.355***	0.039
	(0.015)	(0.017)	(0.034)
Work Experience Student, Years	0.296***	0.307***	-0.062
	(0.046)	(0.054)	(0.102)
Work Experience Student, Squared	-0.014**	-0.013**	-0.001
	(0.005)	(0.006)	(0.011)
More than 1 Child as Student (0/1)	0.123	0.108	
	(0.146)	(0.146)	
Additional Controls	Yes	Yes	
No. of Observations	9,017	9,017	
R-Squared	0.095	0.096	

Notes: OLS regression results for the base model (Eq. 1) and the interaction model, which adds interactions of the student-mother indicator (SM_i) with background characteristics and cohort indicators to the base model. The regressions are based on Sample 1, i.e., both women who drop out of their education and women who complete their education. The sample is further reduced to individuals who have information about their grades from their bachelor or master's thesis. Additional controls include type of education, parents' years of education, and birth cohort dummies. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

For the subgroup with information on thesis grades, Table 6 presents OLS results for the base and interaction model using thesis grades as the dependent variable. During the sample period,

[20] The reporting of grades from university or university college is not mandatory for the education institutions. Since 2004, some university colleges have reported grades for certain study programs such as pre-school teacher (*pædagog*) and schoolteachers. A few universities (Aarhus, Odense, Roskilde, and Copenhagen) have reported grades for some study programs since 2011.

the Danish grading system ranged from -3 to 12. The base model shows that student-mothers receive lower grades on their bachelor's or master's thesis. Having more than one child as a student does not show any significant impact on grades. Work experience as a student is associated with an overall positive effect on grades for both student-mothers and non-student-mothers. The interaction model does not show significant associations between being a student-mother and having lower grades, but the coefficient estimate is similar in size to that in the base model. Overall, there is likely a negative effect on grades from being a student-mother, and the risk of dropping-out is higher for student-mothers.

6.2. Labor Market Outcomes: Earnings Potential

After leaving the education system with a completed bachelor's or master's degree, the important empirical question is whether student-mothers catch up with their non-student-mother peers. According to Figure 5, the average student-mother enters the labor market more than two years later and initially has lower annual earnings compared to non-student-mothers. In their late thirties, student-mothers' earnings catch up with those of non-student-mothers. However, as shown in Appendix Figure A4, when splitting the sample into university and university college students, only the latter group of student-mothers fully catch up with their non-student-mother peers in terms of raw earnings at age 40. These findings can potentially be explained by differences in background characteristics. Student-mothers are a positively selected group, particularly in terms of parental background (see Table 3). To account for these observed background characteristics when investigating labor market outcomes, we employ OLS regressions based on the base model (Eq. 1) and analyze annual earnings at age 40, hourly wage rates at age 40, and the growth in annual earnings between ages 36 and 40. To account for unobserved family background characteristics, we utilize sibling fixed effects estimations. For completeness, we also include OLS regressions for the smaller sibling sample. The results from these analyses are presented in Table 7.

Table 7 shows that, after controlling for background characteristics in the OLS regressions, student-mothers perform well in the labor market and even better than their non-student-mother peers.[21] The indicator for being a student-mother (with non-student-mothers as the comparison

[21] Results when not controlling for background characteristics are provided in Table A4. The estimated coefficients are – as expected – larger in size in this case, but else in line with the results when including controls.

group) is significantly positive for log annual earnings and wage growth between the ages of 36 and 40, and positive but insignificant for the log hourly wage rate. While these results do not imply causality, comparing the OLS estimates with those from the sibling sample and the sibling fixed effects model reveals no systematic differences. In the sibling FE model, student-mothers' annual earnings at age 40 are approximately 2.2 percent higher and they experience about 2.4 percent higher wage growth compared to non-student-mothers. Since the student-mother indicator accounts for the negative impact of delayed entry into the labor market, the results in Table 7 show that student-mothers are able to catch up and even surpass their non-student-mother peers, despite entering the labor market about 2.5 years later. It could be argued that measuring labor market outcomes at age 40 is too early, as earnings profiles for student-mothers and non-student-mothers may continue to diverge beyond this age. For a smaller subsample, we thus follow individuals until the age of 50 and find even stronger labor market effects for student-mothers across all three outcomes, see Appendix Table A6. However, due to the limited sample size, we refer to the age-40 outcomes as our main results.

As expected, the results in Table 7 show a positive but decreasing return to experience, with an annual increase of around 4 percent in the first years after entering the labor market. In contrast, the absence variable, which measures the number of years a woman is out of employment after labor market entry due to maternity or parental leave, sick leave, unemployment, or social disability pensions, has a negative impact. One year of absence reduces annual earnings and hourly wage rates by about 6-8 percent. Having more than one child by the age of 40 is naturally correlated with the absence variable. However, when controlling for the effect of absence and differencing out family characteristics, having more than one child by age 40 appears to have no negative impact on the earnings potential. In fact, having more than one child by the age of 40 is positively correlated with observed wage growth between the ages of 36 and 40.

The specifications in Table 7 assume identical coefficients for the return to labor market experience and absence for student-mothers and non-student-mothers. However, these two groups may have different returns to labor market experience and absence. In Table 8 (and

In separate regressions, we also control for partner characteristics. However, results do not change much. Therefore, we only report the specification where we simply control for own background characteristics. Results with partner characteristics are available upon request.

Appendix Tables A7 and A8), we re-estimate the specifications, using the interaction model, allowing for variation in the slopes of the career profile for the two groups of mothers.

In the more flexible interaction model, the student-mother indicator turns negative, indicating that student-mothers begin at a lower earnings level but experience a significantly steeper growth in annual earnings compared to non-student-mothers. This reflects that student-mothers, on average, enter the labor market with a delay of more than 2.5 years, as also shown in Table 4. Student-mothers also have significantly higher returns to their high school GPAs, indicating that these women are not disadvantaged. Turning to the sibling fixed effects estimations, the results appear to be fairly similar to OLS results. However, the coefficient for the student-mother indicator becomes insignificant, as do most of the interaction effects. This reduced significance may be partly due to the much smaller number of observations in the sibling fixed effects estimations. We find a large and significantly positive effect from high school GPAs and a larger return to experience compared to the OLS results. However, the return to experience is not significantly higher for student-mothers compared to non-student-mothers, as it is of about the same absolute size but with a greater dispersion.

These results are based on a relatively selected sample of women, as we condition on completing a university college or university education. Table A9 in the Appendix shows results for all women, including both those who complete a formal education by age 35 and those who do not. The estimated coefficients for student-mothers are slightly lower but remain positive and significant. The positive selection in our sample suggests that the results presented could be viewed as an upper bound on the estimated effects of being a student-mother on labor market outcomes. Nevertheless, when estimating the same outcome models - earnings, hourly wage rate, and wage growth up to the age of 40 - for the subsample of dropouts (see Appendix Table A10), the results indicate that even among this group, student-mothers appear to perform better than non-student-mothers.

Thus, the main interpretation is that being a student-mother does not necessarily harm labor market prospects. The results show that mothers who have their first child while studying are able to catch up with those who have their first child after entering the labor market in terms of labor market outcomes. However, the effects may vary depending on the type of education and the timing of the first child during the studies. We therefore explore heterogeneous effects based on the timing of the first child in Section 6.3 and the type of education in Section 6.4.

Table 7. Estimation of (Log) Annual Earnings and (Log) Hourly Wage Rate at Age 40, and Growth Rate from Ages 36 to 40

	Log Annual Earnings at Age 40			Log Hourly Wage Rate at Age 40			Growth in Annual Earnings between Ages 36 and 40		
	OLS	OLS (Sibling)	Sibling FE	OLS	OLS (Sibling)	Sibling FE	OLS	OLS (Sibling)	Sibling FE
Student Mother (0/1)	0.020***	0.022***	0.022***	0.003	0.006	0.007	2.441***	2.884***	2.393***
	(0.002)	(0.006)	(0.007)	(0.002)	(0.006)	(0.008)	(0.153)	(0.464)	(0.631)
GPA High School	0.020***	0.023***	0.026***	0.021***	0.023***	0.025***	0.250***	0.244***	0.320**
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.033)	(0.079)	(0.127)
Work Exp. After Labor Market Entry, Years	0.033***	0.036***	0.037***	0.033***	0.037***	0.043***	-1.355***	-1.519***	-1.772***
	(0.002)	(0.005)	(0.006)	(0.002)	(0.006)	(0.007)	(0.271)	(0.491)	(0.651)
Work Exp. After Labor Market Entry, Squared	-0.001***	-0.002***	-0.002***	-0.001***	-0.002***	-0.002***	0.040***	0.043**	0.059**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)	(0.021)	(0.028)
Absence from Labor Market, Years	-0.082***	-0.092***	-0.084***	-0.062***	-0.069***	-0.062***	-0.183	-0.726	-0.893
	(0.001)	(0.004)	(0.005)	(0.001)	(0.004)	(0.005)	(0.151)	(0.465)	(0.559)
Absence from Labor Market, Squared	0.006***	0.005***	0.006***	0.005***	0.005***	0.005***	0.052**	0.203**	0.202*
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.027)	(0.102)	(0.117)
More than 1 Child at Age 40 (0/1)	-0.003	-0.004	-0.010	0.010***	0.011*	0.001	1.867***	1.352***	2.007***
	(0.002)	(0.005)	(0.007)	(0.002)	(0.006)	(0.008)	(0.151)	(0.449)	(0.608)
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	110,060	13,720	13,720	82,829	9,897	9,897	94,577	10,388	10,388
R-Squared	0.383	0,370	0.720	0.321	0.321	0.702	0.031	0.066	0.535

Notes: Regression results for the base model (Eq. 1) using OLS and sibling fixed effects (FE). The regressions are based on Sample 2, i.e., women who complete their formal education before turning 35. The sibling FE estimations are based on a subsample of Sample 2. The outcomes at age 40 (and age 36) are based on average value for the years 39-41 (and 35-37) and includes only years with full-time work. Additional controls include work experience (years) as a student, type of completed education, parents' years of education, and birth cohort dummies. The sibling FE estimations also include a variable for birth order, with standard errors clustered at the sibling level. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

Table 8. Estimation of (Log) Annual Earnings at Age 40 (Interaction Model)

	OLS		OLS based on sibling sample		Sibling FE	
	Main Effect	SM Interaction	Main Effect	SM Interaction	Main Effect	SM Interaction
Student Mother (0/1)	-0.093***		-0.157**		-0.124	
	(0.024)		(0.068)		(0.087)	
GPA High School	0.020***	0.005***	0.021***	0.007***	0.025***	0.005
	(0.000)	(0.001)	(0.001)	(0.003)	(0.002)	(0.003)
Work Exp. Student, Years	-0.001	-0.010***	-0.007***	0.003	-0.013***	0.009
	(0.001)	(0.003)	(0.003)	(0.006)	(0.005)	(0.009)
Work Exp. Student, Squared	0.001***	0.001***	0.001***	0.000	0.001*	-0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Work Exp. After Labor Market Entry, Years	0.026***	0.012***	0.026***	0.025**	0.030***	0.011
	(0.002)	(0.0043)	(0.007)	(0.012)	(0.008)	(0.015)
Work Exp. After Labor Market Entry, Squared	-0.001***	-0.000*	-0.001***	-0.001*	-0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Absence from Labor Market, Years	-0.081***	-0.002	-0.088***	-0.015	-0.081***	-0.015*
	(0.002)	(0.004)	(0.004)	(0.009)	(0.005)	(0.012)
Absence from Labor Market, Squared	0.006***	0.001*	0.006***	0.003**	0.006***	0.003
	(0.000)	(0.0001)	(0.001)	(0.002)	(0.001)	(0.002)
More than 1 Child at Age 40 (0/1)	-0.002	0.009	-0.004	0.020	-0.013*	0.045*
	(0.002)	(0.007)	(0.006)	(0.020)	(0.007)	(0.026)
Additional Controls	Yes		Yes		Yes	
No. of Observations	110,060		13,720		13,720	
R-Squared	0.3866		0.373		0.721	

Notes: Regression results using OLS and sibling fixed effects (FE) for the interaction model, which adds interactions of the student-mother indicator (SM_i) with background characteristics and cohort indicators to the base model (Eq. 1). The regressions are based on Sample 2, i.e., women who complete their formal education before turning 35. The sibling FE estimations are based on a subsample of Sample 2. The outcomes at age 40 (and age 36) are based on average value for the years 39-41 (and 35-37) and includes only years with full-time work. Additional controls include type of completed education, parents' years of education, and birth cohort dummies. The sibling FE estimations also include a variable for birth order, with standard errors clustered at the sibling level. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

6.3. Heterogeneous Effects: Timing of First Child

Until now, our focus has solely been on comparing student-mothers with non-student-mothers. However, the timing of the first child *while* studying may be important for student-mothers' outcomes. The effects of motherhood may differ for students who become mothers during the first years of their bachelor's degree compared to those who have their first child close to completing their degree. Additionally, certain periods, such as those with intensive coursework or internships, may be more demanding for student-mothers.

In Table 9, we analyze the variation in having the first child one to five years before entering the labor market using the base model (Eq. 1). The results are presented for annual earnings at age 40, hourly wage at age 40, and earnings growth from ages 36-40. The estimates of the various timing indicators are related to the effect of having the first child one year before entering the labor market.

Table 9. Estimated Coefficients for Student-Mothers' Timing of First Child

	Log Annual Earnings, Age 40	Log Hourly Wage, Age 40	Earnings Growth, Age 36-40
Student-Mother (0/1)	0.014***	-0.007*	3.100***
	(0.004)	(0.004)	(0.305)
Timing of Firstborn Child before Entering the Labor Market			
5 Years	0.011*	0.003	0.001
	(0.006)	(0.006)	(0.505)
4 Years	-0.003	0.000	-0.396
	(0.005)	(0.005)	(0.415)
3 Years	0.006	0.014***	-1.221***
	(0.004)	(0.005)	(0.371)
2 Years	0.018***	0.029***	-0.978**
	(0.005)	(0.005)	(0.400)
1 Year	-	-	-
No. of Observations	110,060	82,829	94,577

Notes: OLS regression results for the base model (Eq. 1) but with additional dummy variables indicating the timing of the first birth for student-mothers. The regressions are based on Sample 2, i.e., women who complete their formal education before turning 35. The outcomes at age 40 (and age 36) are based on average value for the years 39-41 (and 35-37) and includes only years with full-time work. Controls include work experience (years) as a student, work experience (years) in the labor market at age 40, absence (years) from the labor market after labor market entry, type of completed education, parents' years of education, and birth cohort dummies. Full estimation results are available on request. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

The results in Table 9 do not reveal a clear pattern in terms of the timing of children. However, women who have their first child one year before entering the labor market tend to earn more at age 40 and experience more positive wage growth in their late thirties compared to non-student-mothers.

6.4. Heterogeneous Effects: Education Type

The results in Sections 6.1 and 6.2 might vary by educational programs. Some study programs may be more time-demanding than others or have more inflexible time-schedules due to laboratory work or internship periods. University programs, which often have flexible schedules with only a few weekly lectures (for example, Arts and Humanities), might be easier to balance with having a baby but could also be more demanding in terms of self-control and discipline, particularly when it comes to completing the final thesis.

Table 10 shows the coefficients for the student-mother (SM) indicator from OLS estimations based on the base model (Eq. 1), split by type of education. The upper part of the table focuses on the risk of dropping out, while the lower part examines labor market outcomes. Due to limited number of sibling pairs within these subgroups, we are not able to estimate sibling fixed effects and must rely on the OLS results, meaning the findings presented shows correlations rather than causality. However, as discussed in Sections 6.1 and 6.2, the OLS results for the entire sample are fairly similar to the sibling fixed effects estimations.

Student-mothers across all types of educations face a significantly higher risk of dropping out compared to non-student-mothers. This is particularly evident within ‘Arts & Humanities’. In contrast, the drop-out risk for student-mothers is lowest within ‘Education’ (e.g., schoolteachers). The results for labor market outcomes (lower part of Table 10) are consistent with our main results from Section 6.2. Being a student-mother has a significant positive impact on annual earnings and earnings growth across all education types when controlling for other background variables.

Table 10. Estimated Coefficient for Student-Mother Indicator by Type of Education

	Education	Arts & Human.	Soc. Science & Business	Nature & Tech	Health
Drop Out (0/1)[1)]	0.010***	0.126***	0.065***	0.074***	0.036***
	(0.002)	(0.008)	(0.007)	(0.009)	(0.003)
No. Observations	19,628	18,543	26,404	14,524	65,120
Log Annual Earnings at Age 40[2)]	0.026***	0.025***	0.018***	0.011*	0.031***
	(0.003)	(0.005)	(0.004)	(0.006)	(0.003)
Log Hourly Wage at Age 40[2)]	0.019***	0.012**	0.001	-0.006	0.008**
	(0.003)	(0.005)	(0.005)	(0.007)	(0.004)
Earnings Growth Age 36-40[2)]	1.542***	2.623***	2.508***	2.867***	2.550***
	(0.273)	(0.458)	(0.378)	(0.541)	(0.244)
No. of Observations					
Log Ann. Earnings[2)]	16,666	11,606	16,393	11,448	52,283
Log Hourly Wage [2)]	13,327	8,974	12,934	8,631	37,759
Earnings Growth [2)]	14,464	9,513	14,382	10,108	44,716

Notes: OLS regression results for the base model (Eq. 1) separately for the 6 types of education. The upper part [1)] is based on Sample 1, and controls include work experience (years) as a student, dummy for having more than one child while studying, parents' years of education, and birth cohort dummies. The lower part is based on Sample 2, and the outcomes at age 40 (and age 36) are based on average value for the years 39-41 (and 35-37) and includes only years with full-time work. Controls include work experience (years) as a student, work experience (years) in the labor market at age 40, absence (years) from the labor market after labor market entry, type of completed education, parents' years of education, and birth cohort dummies. The Category 'Other', which is a very heterogenous category, is not shown in the table. Significance levels are indicated as *** $p<0.01$, ** $p<0.05$, and * $p<0.10$.

University study programs at the master's level typically take more time to complete than university college programs, usually 5-6 years versus 3-4 years, respectively. Thus, the time to have a child while being a student also differs by the choice of education. We examine this further in Tables 11 and 12.

In Table 11, we re-estimate the simple OLS specification for drop-out rates separately for university college and university students. The results show that student-mothers at universities are significantly more likely to drop out compared to their non-student-mother peers, while student-mothers at university colleges face a smaller increase in drop-out risk. Thus, the drop-out risk varies depending on the length of education.

Table 11. Estimation of Drop-Out Risk for Student-Mothers by University College and University

	University College	University
Drop-Out	0.046***	0.110***
	(0.002)	(0.004)
No. of Observations	92,190	55,654

Notes: OLS regression results for the base model (Eq. 1) separately for university college and university programs. It is based on Sample 1, and controls include work experience (years) as a student, dummy for having more than one child while studying, parents' years of education, and birth cohort dummies. Full estimation results are available on request. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

For women who complete their education, the effects of being a student-mother on labor market outcomes from the interaction model are presented in Table 12. The results reveal notable differences in the earnings profile between student-mothers from universities and student-mothers from university colleges. For university students, the student-mother (SM) indicator remains positive and highly significant when allowing for different slopes in the earnings profile after entering the labor market, i.e., when including the interaction terms. This is not the case for university college students, where the SM indicator turns negative and insignificant. Regarding the return-to-work experience after entering the labor market, the results indicate that student-mothers from university colleges have a steeper earnings profile compared to their non-student-mother peers. University students have an even steeper earnings profile than university college students. However, for university students, there is no significant difference between student-mothers and non-student-mothers in terms of the steepness of their earnings profiles.

Generally, the positive coefficient for the SM indicator from our main results in Section 6.2 reflects that, at the age of 40, student-mothers tend to have higher earnings than non-student-mothers when controlling for various background characteristics. This positive SM effect comprises two effects. Firstly, there are considerably more university students who have their first child while still being students compared to university college students, and university students generally tend to have higher earnings at age 40. Secondly, when splitting estimations into subsamples of university students and university college students, we find that university college student-mothers have a steeper earnings profile than non-student-mothers after entering the labor market. As a result, university college student-mothers are able to catch up to and even surpass non-student-mothers at the age of 40, despite entering the labor market more than two years later than their non-student-mother peers. This early catch-up could be due to a

compressed earnings distribution and an earlier flattening of the earnings curve for university college graduates. Nevertheless, the results indicate that having a first child during studies does not necessarily lead to negative effects on future earnings for these graduates. For university student-mothers, although their labor market entry is also delayed by more than two years, they start at a higher earnings level than their non-student-mother peers when controlling for this delay. However, student-mothers with a university degree do not have a steeper earnings profile than non-student-mothers, and by age 40, they have not fully caught up with their non-student-mother peers from the university.

Table 12. Estimation of (Log) Annual Earnings at Age 40 (Interaction Model) By University College and University Students

	University College		**University**	
	Main Effect	SM Interaction	Main Effect	SM Interaction
Student Mother (0/1)	-0.031		0.072**	
	(0.032)		(0.033)	
GPA High School	0.004***	0.002	0.010***	-0.002*
	(0.000)	(0.001)	(0.001)	(0.001)
Work Experience Student, Years	0.015***	-0.011***	0.032***	-0.013***
	(0.001)	(0.003)	(0.002)	(0.003)
Work Experience Student, Squared	-0.000	0.001**	-0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Work Experience After Labor Market Entry, Years	0.012***	0.009*	0.031***	-0.006
	(0.003)	(0.006)	(0.003)	(0.006)
Work Experience After Labor Market Entry, Squared	0.000**	-0.000	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.000)
Absence from Labor Market, Years	-0.038***	0.001	-0.058***	0.008
	(0.002)	(0.004)	(0.003)	(0.005)
Absence from Labor Market, Squared	0.003***	0.000	0.005***	-0.000
	(0.000)	(0.001)	(0.001)	(0.001)
More than 1 Child at Age 40 (0/1)	-0.018***	0.000	-0.000	0.001
	(0.002)	(0.008)	(0.003)	(0.008)
Additional Controls	Yes		Yes	
Number of observations	70,532		39,528	
R-Squared	0.294		0.342	

Notes: OLS regression results separately for university college and university programs, using the interaction model, which adds interactions of the student-mother indicator (SMi) with background characteristics and cohort indicators to the base model (Eq. 1). The regressions are based on Sample 2, i.e., women who complete their formal education before turning 35. Annual earnings at age 40 is based on average value for the years 39-41 and includes only years with full-time work. Additional controls include type of completed education, parents' years of education, and birth cohort dummies. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

6.5. Annual Earnings at Age 40: Decomposition of Differences between Student-Mothers and Non-Student-Mothers

We now conduct a more detailed analysis based on the interaction model presented in Tables 8 and 12. We relate the findings to the varying effects of motherhood for student-mothers and non-student-mothers, as illustrated in Figure 1, as well as the effects of motherhood outlined by Miller (2011). Specifically, we decompose the difference in annual earnings at the age of 40 between student-mothers and non-student-mothers using an Oaxaca-Blinder-inspired framework, drawing on the OLS regression results in Tables 8 and 12.[22] A detailed description of the calculation of the various effects is provided in Appendix B, and the results from the decomposition exercise are presented in Table 13.

To briefly recap from Section 2, Miller (2011) identifies four channels through which motherhood affects women's earnings: (1) forgone earnings during leave periods, (2) reduced human capital accumulation, (3) a fixed cost of motherhood, and (4) flatter wage profiles due to lower returns on labor market experience post-childbirth. We do not include the 'Miller effect (1)' – loss of earnings during leave – in the decomposition, as it is not relevant when analyzing earnings differences at age 40. In Denmark, all mothers are eligible for various types of maternity leave compensation or full salary during the leave period, depending on the sector of employment and collective agreements. Therefore, the 'Miller effect (1)' is less relevant in the Danish context than in other settings.

In Column 1, the decomposition is performed for all students using the results from Table 8. In Columns 2 and 3, the decompositions are conducted separately for university college and university students, respectively, using the results from Table 12. On average, as indicated in the last row of Table 13, student-mothers earn 4.1 percent more than non-student-mothers at age 40. The positive difference in annual earnings is partly driven by student-mothers enrolled in university colleges and partly by the fact that a much larger group of university students become student-mothers. Given that university students, including university student-mothers, earn significantly more than university college students, this drives the positive gap of 4.1 percent observed in Column 1. Specifically, university college student-mothers earn 1.2 percent more than their non-student-mother peers at university colleges (Column 2), while

[22] Alternatively, we could have used the sibling fixed effects (FE) results, but since the OLS and sibling FE results are quantitatively similar and the OLS estimations are based on a much larger sample, we prefer the OLS results.

student-mothers enrolled in universities earn, on average, 4.5 percent less than their non-student-mother peers from universities (Column 3).

Table 13. Decomposition of Differences in log Annual Earnings at Age 40 for Student-Mothers and Non-Student-Mothers by All, University College and University

	All (1)	University College (2)	University (3)
(a) 'Miller effects (2), (3), (4)':			
Forgone human capital accumulation during absence periods	0.006*** (0.001)	0.003*** (0.000)	0.000 (0.001)
'Lower return' to absence periods after entering labor market	0.002 (0.003)	0.002 (0.004)	0.010*** (0.004)
(b) Delay effect: Loss of human capital accumulation due to delayed entrance into the labor market for SM	-0.090*** (0.010)	-0.041** (0.013)	-0.059*** (0.016)
(c) Different returns to labor market experience after completing education for SM compared to NSM	0.076*** (0.022)	0.067** (0.029)	0.007 (0.026)
(d) 'Signal effects': Earnings level for SM compared to NSM at entering labor market:			
'Signal Effect 1': SM-indicator minus delay effect	-0.005 (0.025)	0.016 (0.035)	0.147*** (0.037)
'Signal effect 2': Return to other variables fixed at entry into labor market	0.033*** (0.008)	-0.005 (0.008)	-0.051*** (0.014)
(e) Others[1)]	0.007** (0.035)	0.003 (0.048)	-0.099* (0.050)
Difference in average log earnings at age 40 for SM compared to NSM = Sum (a) to (e)	0.041*** (0.002)	0.012*** (0.002)	-0.045*** (0.003)

Notes: For a more detailed description of the calculation, see Appendix B. The regressions behind the decomposition are based on the flexible interaction models in Tables 8 and 12. Standard errors are calculated by bootstrapping in STATA. 'Others'[1)] captures the amount of student work experience, impact from parents' education, GPA from high school, type of education etc.

The combination of the 'Miller effects (2) to (4)' is equivalent to the 'classical child penalty effects' for mothers compared to non-mothers. These effects are marginally smaller for student-mothers compared to non-student-mothers. In our case, we are unable to distinguish Miller effect (3) from (2) and (4) as all the women in our sample become mothers. However, we can divide the effects into (i) forgone human capital accumulation during absence periods and (ii) 'lower return' to absence periods after labor market entry. We find that student-mothers

are less absent from the labor market (0.6 percent) and face a slightly smaller 'penalty' from being absent compared to non-student-mothers (0.2 percent, which is not significant in Column 1). One might have expected a larger difference between student-mothers and non-student-mothers because the latter group must catch up with respect to fertility. However, since student-mothers have higher overall fertility and tend to have more children after entering the labor market, the overall difference between student-mothers and non-student-mothers regarding this effect is small.

When the sample is split into university college students (Column 2) and university students (Column 3), differences between the two groups become evident. University student-mothers experience a smaller human capital penalty from periods of absence (1 percent) compared to their non-mother peers, while university college student-mothers incur a small positive gain (0.3 percent) from less forgone human capital accumulation after childbirth compared to their non-mother peers at university colleges.

On average, student-mothers enter the labor market more than two years later than non-student-mothers. This delayed entrance has a clear negative effect on annual earnings at age 40, resulting in non-student-mothers earning 9 percent more at age 40. Yet, the effect is counteracted by student-mothers' significantly higher return to experience after entering the labor market (7.6 percent). Columns 2 and 3 show that this effect is particularly important for university college students (6.7 percent). Instead, university student-mothers have a considerably higher starting salary, as reflected in the two 'signal effects'. 'Signal effect 1' of 14.7 percent represents the unexplained part from the regression (the SM indicator minus the impact from the delay effect), which may include positive signal effects for student-mothers – such as positive productivity signals to employers from being a student-mother etc. - compared to non-student-mothers. 'Signal effect 2' reflects the return to parents' educational background or GPA from high school, i.e., factors related to university student-mothers being a positively selected group of students. Perhaps due to this positive selection, university student-mothers have lower returns to these pre-labor market characteristics than non-student-mothers. For university college students, these signal effects appear to be of minor importance.

Thus, our results indicate that at the age of 40, student-mothers on average catch up with non-student-mothers. This is partly because student-mothers are more likely to obtain a university degree and earn higher wages than university college students, but also because student-

mothers achieve a higher return to experience, allowing them to catch up with their non-student-mother peers. However, when the sample is split into university and university college students, different mechanisms emerge for the two groups. Student-mothers at university colleges succeed in surpassing their non-student-mothers peers because they experience a steeper earnings growth than non-student-mothers, despite entering the labor market on average two years later than non-student mothers with a university college degree. In contrast, student mothers with a university degree are not fully able to surpass their non-mother peers with a university degree by the age of 40. Yet, an interesting result is that these student-mothers enter the labor market with a considerably higher salary than their non-student-mother peers, despite their delayed entrance. Due to data limitations, we are unable to determine whether student-mothers eventually achieve higher salaries than non-student-mothers with a university degree after the age of 40.

7. Conclusion

This paper investigates the impact of childbirth timing on educational and labor market outcomes. Specifically, we examine whether having a child while enrolled in university studies adversely affects women's probability of completing their studies and their subsequent labor market prospects. We investigate this question in the Danish context, where student-mothers do not face significant financial constraints when having children during their studies. Danish students benefit from tuition-free education and receive public support throughout their studies, which increases further if they become parents. Overall, family-friendly policies in Denmark are generous and designed to help balance work and family life.

Utilizing register data for the entire Danish population, we select women admitted into university colleges or universities and categorize them as either student-mothers or non-student-mothers, depending on whether they had their first child while studying or after entering the labor market. We follow these women until the age of 40 and identify the effects of having children before entering the labor market using OLS and sibling fixed effects strategies.

Our results suggest that having children while studying negatively affects educational outcomes. Both university college and university student-mothers are more likely to drop out

of their studies compared to their non-student-mother counterparts, with the effect being more pronounced for university student-mothers. Additionally, student-mothers tend to achieve lower grades in their bachelor's or master's thesis. However, student-mothers who drop-out of their education before the age of 35 actually tend to earn more at the age of 40, have higher hourly wages and earnings growth compared to students who drop-out from their education and have no children while being students.

For those who complete their education, the results are more complex. Overall, having a child while studying does not appear to negatively affect the earnings profile, despite an average delay in graduation by about 2.5 years. This delay implies that the accumulation of labor market-specific human capital starts later for student-mothers. Yet, student-mothers tend to catch up upon entering the labor market, and university college student-mothers even surpass women who become mothers after entering the labor market. Thus, by the age of 40, university college student-mothers' annual earnings are higher than those of non-student-mothers. Conversely, among university students, student-mothers do not fully catch up by age 40.

The earnings profile differs between university students and university college students. University college student-mothers exhibit stronger earnings growth after entering the labor market and thus end up with higher wages than their non-student-mother peers by age 40. University student-mothers do not have a steeper earnings profile after entering the labor market than their non-student-mother peers, but they seem to send strong positive signals, resulting in a higher starting salary than their non-student-mother peers when controlling for other background variables.

This paper aims to answer the question: Do student-mothers fare worse or better than non-student-mothers with respect to educational and labor market outcomes at the age of 40? Our results show that having a child while still being a student increases the risk of dropping out, especially for university students. University college student-mothers who *complete* their education catch up with their non-student-mother peers by age 40, while an earnings gap remains for university student-mothers compared to university students who postpone their first birth until after entering the labor market. Our main analysis concludes at the age of 40, leaving open the possibility that university student-mothers may catch up later in their careers. For the women followed until the age of 50, we find a continued positive effect of being a

student-mother on labor market outcomes. Furthermore, positive effects of being a student-mother on labor market outcomes are also found among our sample of dropouts.

These findings diverge from much of the existing literature, challenging the traditional findings that early motherhood has negative career effects. Our results suggest that under certain conditions, such as those provided by Denmark's generous welfare system, relatively early motherhood does not necessarily result in a significant long-run earnings penalty for high-skilled women, especially not for university college students.

While documenting that student-mothers overall fare as well as non-student-mothers in the labor market, we also observe that student-mothers tend to have higher fertility than non-student-mothers. Thus, considering fertility preferences, our results indicate that student-mothers may better fulfill their fertility preferences without being constrained by negative aging effects on fertility.

For employers, our results are relevant to consider in relation to hiring strategies for young (especially female) candidates. For policymakers, these findings highlight the importance of supportive educational and parental policies in mitigating motherhood penalties. Additionally, the results contribute to the ongoing debate about declining fertility rates in most Western societies, suggesting that both women and the society might benefit from considering earlier parenthood.

8. References

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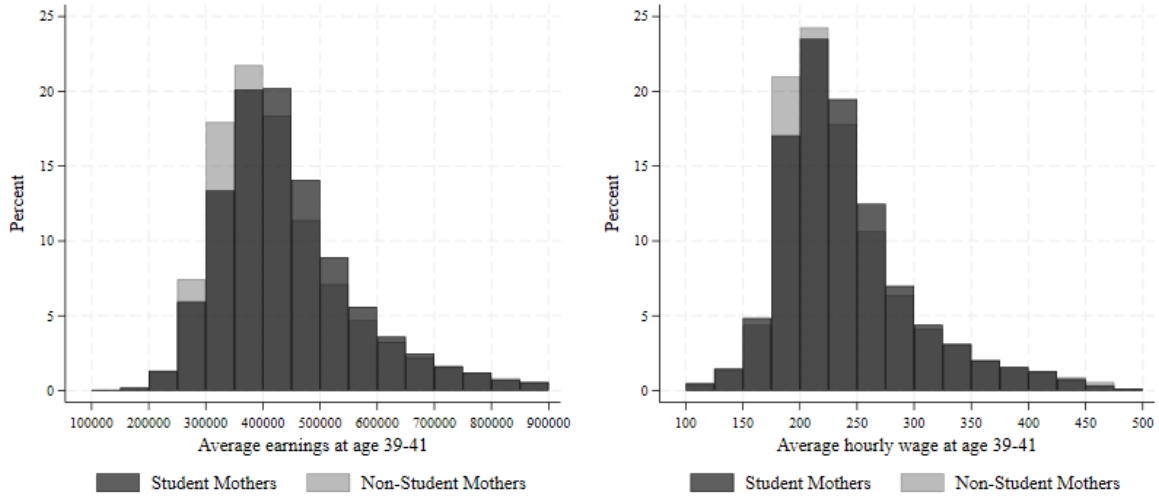
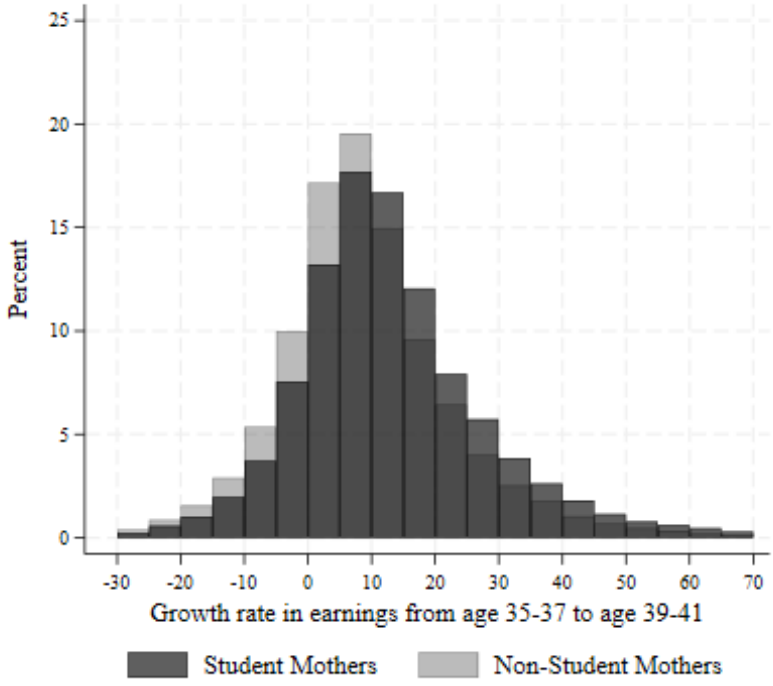
Appendix A – Figures and Tables

Figure A1. Annual Earnings and Hourly Wage Distributions at age 40 (39-41)



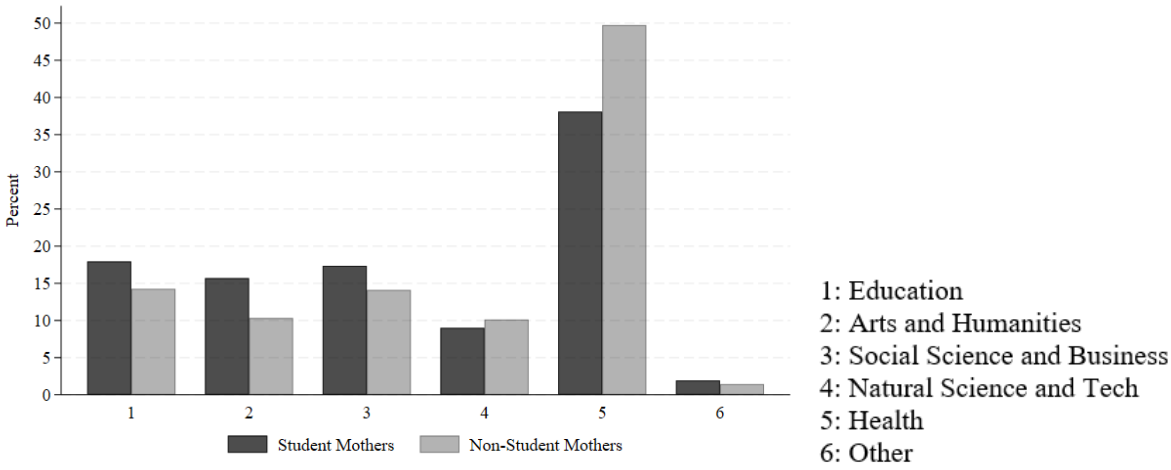
Notes: Based on Sample 2, which includes women who complete their formal education. Annual earnings and hourly wage at age 40 are based on average value for the years 39-41 and includes only years with full-time work.

Figure A2. Growth in Annual Earnings from 36-40 (35-37 to 39-41)



Notes: Based on Sample 2, which includes women who complete their formal education. The annual earnings at age 40 (age 36) are based on average value for the years 39-41 (35-37) and includes only years with full-time work.

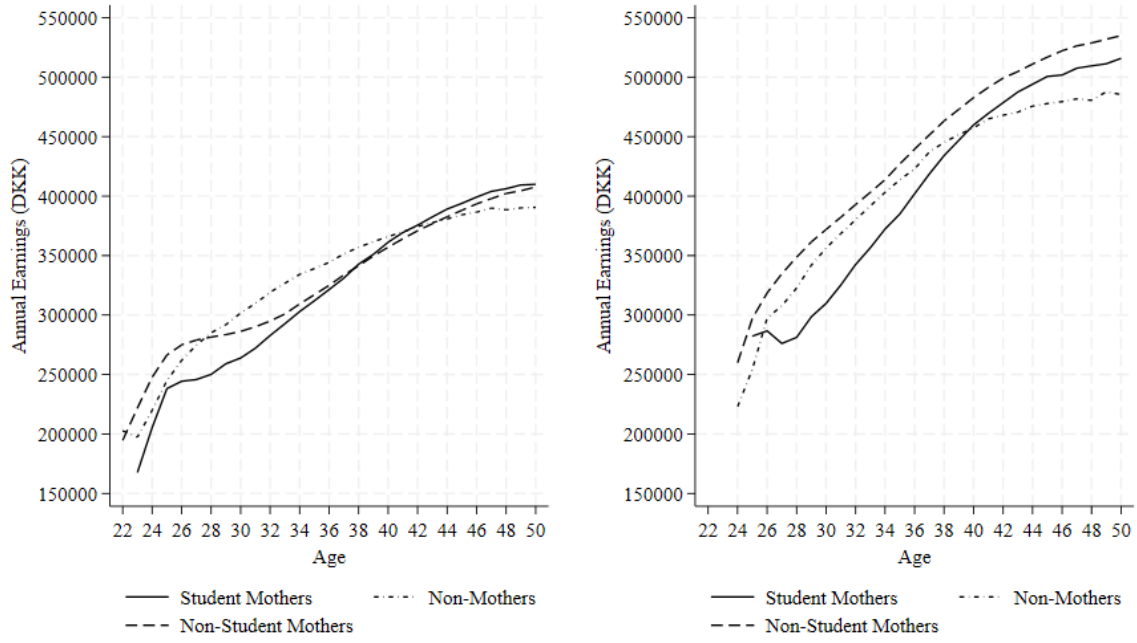
Figure A3. Type of Education at age 35 by Motherhood Type (Sample 2)



Notes: Type of education for the highest completed education level at age 35 for student-mothers and non-student-mothers. It is based on Sample 2, which includes women who complete their formal education.

Figure A4. Earnings profiles for Student-Mothers, Non-Student-Mothers and Non-Mothers after Entering the Labor Market by University College and University Education (Sample 2)

Panel A: University College **Panel B: University**



Notes: Raw annual earnings profiles for student-mothers, non-mothers, and non-student-mothers after entering the labor market, separated by university college (panel A) and university (panel B). Based on Sample 2, which includes women who complete their formal education before turning 35. Non-mothers are women who are not observed to have children during our sample period.

Table A1. Descriptive Statistics by Motherhood Type for Sample 1 (Sibling Sample)

	Student-Mothers (1)	Non-Student Mothers (2)	Difference (3)
Birth Year	1971.07	1971.42	-0.34***
	(5.04)	(4.87)	
Mother's Age at First Birth	26.61	30.79	-4.19***
	(2.59)	(3.75)	
No. Of Children	2.27	1.70	0.57***
	(0.76)	(0.90)	
GPA High School	7.81	7.36	0.46***
	(2.17)	(2.15)	
Married or Cohabiting (0/1)	0.90	0.89	0.01
	0.30)	(0.31)	
Work Exp. (Years) as Student, at Age 40	2.57	2.47	0.11***
	(2.02)	(1.85)	
Exp. after Labor Market Entry (Years), at Age 40	8.58	11.10	-2.52***
	(3.42)	(3.41)	
Father's Education	14.17	13.75	0.43***
	(3.10)	(3.03)	
Mother's Education	13.91	13.49	0.42***
	(2.80)	(2.79)	
Number of Siblings within the Family	1.53	1.55	-0.02**
	(0.56)	(0.56)	
Outcome Variable			
Drop-out (0/1)	0.15	0.10	0.05***
	(0.36)	0.29	
No. of Observations	4,360	19,679	

Notes: Means and standard deviations for student-mothers (Column 1), and non-student-mothers (Column 2). Column 3 presents the difference between Column 1 and Column 2 along with the respective significance from a single t-test for equal means between the two groups. Based on the subsample of siblings from Sample 1, i.e., both women who drop out of their education and those who complete their education. All variables are measured at age 35 unless otherwise indicated. Significance levels are indicated as *** $p<0.01$, ** $p<0.05$ and * $p<0.10$.

Table A2. Descriptive Statistics by Motherhood Type for Sample 2 (Sibling Sample)

	Student-Mothers (1)	Non-Student Mothers (2)	Difference (3)
Birth Year	1971.12	1971.49	-0.37***
	(5.06)	(4.87)	
Mother's Age at First Birth	26.34	30.69	-4.35***
	(2.36)	(3.65)	
No. Of Children	2.33	1.74	0.59***
	(0.75)	(0.89)	
GPA High School	7.89	7.40	0.49***
	(2.14)	(2.16)	
Married or Cohabiting (0/1)	0.91	0.90	0.01**
	(0.29)	(0.30)	
Work Exp. (Years) as Student, at Age 40	2.72	2.54	0.18***
	(1.97)	(1.80)	
Exp. after Labor Market Entry (Years), at Age 40	8.79	11.17	-0.15***
	(3.20)	(3.22)	
Absence after Labor Market Entry (Years) at Age 40	1.98	2.13	-0.15***
	(2.21)	(2.40)	
Public Sector (0/1)	0.65	0.61	0.04**
	(0.48)	(0.49)	
Father's Education	14.17	13.75	0.42***
	(3.12)	(3.03)	
Mother's Education	13.91	13.49	0.38***
	(2.82)	(2.79)	
Number of Siblings within Family	1.53	1.55	-0.02**
	(0.57)	(0.56)	
No. Of Observations	3,332	16,125	
Outcome Variables			
Average Annual Earnings at Age 40 (39-41)	462676.68	443249.49	19427.19
	(122,521)	(124496)	
No. Of Observations	2,297	11,423	
Average Annual Hourly Wage at Age 40 (39-41)	251.47	245.05	6.42
	(62.42)	(64.90)	
No. Of Observations	1,610	8,287	
Growth (%) in Average Annual Earnings from Age 36 to 40 (35-37 to 39-41)	13.84	9.44	4.40
	(16.77)	(15.33)	
No. Of Observations	1,721	8,667	

Notes: Means and standard deviations for student-mothers (Column 1), and non-student-mothers (Column 2). Column 3 presents the difference between Column 1 and Column 2 along with the respective significance from a single t-test for equal means between the two groups. Based on the subsample of siblings from Sample 2, i.e., only women who complete their formal education before turning 35. All variables are measured at age 35 unless otherwise indicated. Since we restrict the outcome variables to individuals where we observe at least one observation with full time employment (i.e., where the person is not fully or partly on leave, unemployed etc.) in the three-year windows 35-37 and 39-41, there are fewer observations for the outcome variables. Outcome variables are measured in fixed 2015-prices. Significance levels are indicated as *** $p<0.01$, ** $p<0.05$ and * $p<0.10$.

Table A3. Estimation of Drop-out Risk from University College or University (Sibling Sample)

	Base Model		Interaction Model			
	OLS (Sibling)	**Sibling FE**	**OLS (Sibling)**		**Sibling FE**	
			Main Effect	SM Interaction	Main Effect	SM Interaction
Student-Mother (0/1)	0.063***	0.063***	0.052**		0.057*	
	(0.006)	(0.008)	(0.022)		(0.031)	
GPA High School	-0.017***	-0.017***	-0.017***	0.000	-0.016***	-0.003
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)
Work Experience Student, Years	-0.035***	-0.041***	-0.034***	-0.005	-0.041***	0.001
	(0.003)	(0.004)	(0.003)	(0.008)	(0.004)	(0.010)
Work Experience Student, Squared	0.004***	0.004***	0.003***	0.001	0.004***	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
More than 1 Child as Student (0/1)	-0.154***	-0.158***	-0.156***	-	-0.160***	-
	(0.007)	(0.012)	(0.008)		(0.012)	
Additional Controls	Yes	Yes	Yes		Yes	
No. of Observations	24,039	24,039	24,039		24,039	
R-Squared	0.300	0.657	0.301		0.65	

Notes: OLS regression results and sibling fixed effects (FE) results for the base model (Eq. 1) and the interaction model, which adds interactions of the student-mother indicator (SM_i) with background characteristics and cohort indicators to the base model. Based on the subsample of siblings from Sample 1, i.e., both women who drop out of their education and women who complete their education. Drop-out is defined as not having completed university college or university education (master's degree) by the age of 35. Additional controls include type of education, parents' years of education, and birth cohort dummies. The sibling FE estimations also include a variable for birth order, with standard errors clustered at the sibling level. Significance levels are indicated as *** $p<0.01$, ** $p<0.05$, and * $p<0.10$.

Table A4. Estimations *without* Control Variables for Outcomes Drop-out Risk (Sample 1) and (Log) Annual Earnings, Hourly Wage Rate at Age 40, and Earnings Growth Rate from Ages 36 to 40 (Sample 2)

	Sample 1		Sample 2					
	Drop-Out Risk		Log Annual Earnings at Age 40		Log Hourly Wage Rate at Age 40		Growth in Annual Earnings between Ages 36 and 40	
	OLS	Sibling FE	OLS	Sibling FE	OLS	Sibling FE	OLS	Sibling FE
Student Mother (0/1)	0.054***	0.050***	0.041***	0.039***	0.020**	0.020**	3.883***	3.486***
	(0.002)	(0.008)	(0.002)	(0.008)	(0.002)	(0.008)	(0.149)	(0.590)
Controls	No	No	No	No	No	No	No	No
No. of Observations	153,563	24,039	110,060	13,720	82,829	9,897	94,577	10,388
R-Squared	0.004	0.517	0.003	0.608	0.001	0.608	0.005	0.508

Notes: Student-mother indicator from the regression results for the base model (Eq. 1 *without controls*) using OLS and sibling fixed effects (FE). The estimations for drop-out risk is based on Sample 1, i.e., both women who drop out of their education and women who complete their education. Drop-out is defined as not having completed university college or university education (master's degree) by the age of 35. The sibling FE estimations are based on a subsample of Sample 1. The estimations for log annual earnings, log hourly wage and growth in annual earnings are based on Sample 2, i.e., women who complete their formal education before turning 35. The sibling FE estimations are based on a subsample of Sample 2. The outcomes at age 40 (and age 36) are based on average value for the years 39-41 (and 35-37) and includes only years with full-time work. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

Table A5. Average Grades from Bachelor Thesis (University College) or Master Thesis (University) for a Sub-Sample of Students

	Student-Mother	Non-Student-Mother	Difference
Average Grade	8.05	8.17	-0.12*
No. of Observations	2,091	6,926	

Notes: Based on a subsample of Sample 1, i.e. both women who drop out of their education and women who complete their education.

Table A6. Estimations of (Log) Annual Earnings and (Log) Hourly Wage Rate at age 50, and Earnings Growth Rate between ages 36-50

	Log Annual Earnings at Age 50		Log Hourly Wage Rate at Age 50		Growth in Annual Earnings between Ages 36 and 50	
	OLS	Sibling FE	OLS	Sibling FE	OLS	Sibling FE
Student Mother (0/1)	0.026*** (0.003)	0.041*** (0.014)	0.015*** (0.003)	0.024** (0.012)	2.909*** (0.411)	3.885** (1.953)
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	51,165	4,087	51,132	5,043	41,342	3,360
R-Squared	0.321	0.717	0.289	0.695	0.024	0.557

Notes: Regression results for the base model (Eq. 1) using OLS and sibling fixed effects (FE). Based on Sample 2, i.e., women who complete their formal education before turning 35. The sibling FE estimations are based on a subsample of Sample 2. The outcomes at age 50 (and age 36) are based on average value for the years 49-51 (and 35-37) and includes only years with full-time work. Additional controls include work experience (years) as a student, type of completed education, parents' years of education, and birth cohort dummies. The sibling FE estimations also include a variable for birth order, with standard errors clustered at the sibling level. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

Table A7. Estimation of (Log) Hourly Wage Rate at Age 40 (Interaction Model)

	OLS		OLS based on sibling sample		Sibling FE	
	Main Effect	SM Interaction	Main Effect	SM Interaction	Main Effect	SM Interaction
Student Mother (0/1)	-0.030		-0.113		-0.055	
	(0.030)		(0.079)		(0.095)	
GPA High School	0.020***	0.003***	0.023***	0.001	0.025***	0.000
	(0.000)	(0.001)	(0.001)	(0.003)	(0.002)	(0.004)
Work Experience Student, Years	-0.003***	-0.008***	-0.014***	0.002	-0.015***	0.007
	(0.001)	(0.003)	(0.003)	(0.010)	(0.005)	(0.013)
Work Experience Student, Squared	0.001***	0.001***	0.001***	0.000	0.001**	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)
Work Experience After Labor Market Entry, Years	0.030***	0.003	0.029***	0.018	0.039***	0.005
	(0.002)	(0.005)	(0.007)	(0.013)	(0.009)	(0.016)
Work Experience After Labor Market Entry, Squared	-0.001***	0.000	-0.001***	-0.001	-0.002***	0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
Absence from Labor Market, Years	-0.062***	0.001	-0.010	-0.015	-0.061***	-0.007
	(0.002)	(0.004)	(0.010)	(0.009)	(0.006)	(0.012)
Absence from Labor Market, Squared	0.005***	0.000	0.005***	0.003*	0.004***	0.002
	(0.000)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
More than 1 Child at Age 40 (0/1)	0.011***	-0.003	0.011*	0.019	0.001	0.018
	(0.002)	(0.008)	(0.006)	(0.024)	(0.008)	(0.029)
Additional Controls	Yes		Yes		Yes	
Number of Observations	82,829		9,897		9,897	
R-Squared	0.324		0.324		0.703	

Notes: OLS regression results and sibling fixed effects (FE) results for the interaction model, which adds interactions of the student-mother indicator (SM_i) with background characteristics and cohort indicators to the base model (Eq. 1). Based on Sample 2, i.e., women who complete their formal education before turning 35. The sibling FE estimations are based on a subsample of Sample 2. Hourly wage at age 40 is based on average value for the years 39-41 and includes only years with full-time work. Additional controls include type of completed education, parents' years of education, and birth cohort dummies. The sibling FE estimations also include a variable for birth order, with standard errors clustered at the sibling level. Significance levels are indicated as *** $p<0.01$, ** $p<0.05$, and * $p<0.10$.

Table A8. Estimation of Growth in Annual Earnings between Age 36 and Age 40 (Interaction Model)

	OLS		OLS based on sibling sample		Sibling FE	
	Main Effect	SM Interaction	Main Effect	SM Interaction	Main Effect	SM Interaction
Student Mother (0/1)	10.189***		8.614		10.930	
	(2.606)		(7.770)		(9.203)	
GPA High School	0.252***	-0.004	0.159*	0.396*	0.270**	0.156
	(0.038)	(0.075)	(0.085)	(0.206)	(0.134)	(0.285)
Work Experience Student, Years	0.776***	-0.145	0.840***	-0.443	-0.015***	-1.518*
	(0.116)	(0.214)	(0.244)	(0.595)	(0.005)	(0.788)
Work Experience Student, Squared	-0.066***	-0.018	-0.096***	0.025	0.001**	0.109
	(0.011)	(0.022)	(0.028)	(0.065)	(0.001)	(0.083)
Work Experience After Labor Market Entry, Years	-0.884***	-818*	-1.078*	-0.542	0.039***	-0.177
	(0.342)	(0.494)	(0.590)	(1.330)	(0.009)	(1.600)
Work Experience After Labor Market Entry, Squared	0.023	0.021	0.027	0.012	-0.002***	-0.022
	(0.016)	(0.023)	(0.024)	(0.063)	(0.000)	(0.078)
Absence from Labor Market, Years	-0.119	-0.324	-0.728	-0.453	-0.061***	-1.591
	(0.171)	(0.392)	(0.507)	(1.234)	(0.006)	(1.591)
Absence from Labor Market, Squared	0.061*	-0.023	0.212*	0.107	0.004***	0.050
	(0.028)	(0.087)	(0.109)	(0.317)	(0.001)	(0.367)
More than 1 Child at Age 40 (0/1)	1.960***	-0.003	1.582***	-3.531*	0.001	-0.486
	(0.159)	(0.008)	(0.462)	(1.920)	(0.008)	(2.428)
Additional Controls	Yes		Yes		Yes	
Number of Observations	94,577		10,388		10,388	
R-Squared	0.031		0.068		0.537	

Notes: OLS regression results and sibling fixed effects (FE) results for the interaction model, which adds interactions of the student-mother indicator (SM_i) with background characteristics and cohort indicators to the base model (Eq. 1). Based on Sample 2, i.e., women who complete their formal education before turning 35. The sibling FE estimations are based on a subsample of Sample 2. The earnings at age 40 (and age 36) are based on average value for the years 39-41 (and 35-37) and includes only years with full-time work. Additional controls include type of completed education, parents' years of education, and birth cohort dummies. The sibling FE estimations also include a variable for birth order, with standard errors clustered at the sibling level. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

Table A9. Estimation of (Log) Annual Earnings and Hourly Wage Rate at Age 40, and Earnings Growth Rate from Ages 36 to 40 (Sample 1, i.e. including drop-outs)

	Log Annual Earnings at Age 40		Log Hourly Wage Rate at Age 40		Growth in Annual Earnings between Ages 36 and 40	
	OLS	Sibling FE	OLS	Sibling FE	OLS	Sibling FE
Student Mother (0/1)	0.018***	0.022***	-0.003	0.007	2.561***	2.575***
	(0.002)	(0.007)	(0.002)	(0.008)	(0.178)	(0.583)
GPA High School	0.023***	0.026***	0.023***	0.026***	0.251***	0.307***
	(0.000)	(0.001)	(0.000)	(0.002)	(0.034)	(0.118)
Work Experience After Labor Market Entry, Years	0.029***	0.027***	0.027***	0.026***	-1.287***	-1.566***
	(0.001)	(0.005)	(0.002)	(0.006)	(0.203)	(0.577)
Work Experience After Labor Market Entry, Squared	-0.001***	-0.001***	-0.001***	-0.001***	0.038***	0.049**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.010)	(0.024)
Absence from Labor Market, Years	-0.068***	-0.068***	-0.056***	-0.054***	-0.049	-0.349
	(0.001)	(0.003)	(0.001)	(0.003)	(0.106)	(0.297)
Absence from Labor Market, Squared	0.003***	0.003***	0.003***	0.003***	0.035**	0.047
	(0.000)	(0.000)	(0.000)	(0.000)	(0.017)	(0.036)
More than 1 Child at Age 40 (0/1)	-0.004**	-0.010	0.010***	-0.002	1.930***	1.979***
	(0.002)	(0.007)	(0.002)	(0.008)	(0.146)	(0.548)
Additional Controls	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	124,237	16,361	93,876	11,844	105,650	12,173
R-Squared	0.340	0.703	0.285	0.685	0.029	0.540

Notes: Alternative estimation of Table 7 reporting regression results for the base model (Eq. 1) using OLS and sibling fixed effects (FE) based on Sample 1, i.e., both women who drop out of their education and women who complete their education. Drop-out is defined as not having completed university college or university education (master's degree) by the age of 35. The sibling FE estimations are based on a subsample of Sample 1. The outcomes at age 40 (and age 36) are based on average value for the years 39-41 (and 35-37) and includes only years with full-time work. Additional controls include work experience (years) as a student, type of completed education, parents' years of education, and birth cohort dummies. The sibling FE estimations also include a variable for birth order, with standard errors clustered at the sibling level. Significance levels are indicated as *** p<0.01, ** p<0.05, and * p<0.10.

Table A10. Estimations of (Log) Annual Earnings and (Log) Hourly Wage Rate, and Earnings Growth Rate (Only Drop-outs)

	Log Annual Earnings at Age 40	Log Hourly Wage Rate at Age 40	Growth in Annual Earnings between Ages 36 and 40
Student Mother (0/1)	0.067*** (0.006)	0.034*** (0.006)	3.418*** (0.850)
Additional Controls	Yes	Yes	Yes
No. of Observations	14,177	11,047	11,073
R-Squared	0.177	0.148	0.029

Notes: Regression results for the base model (Eq. 1) using OLS on a sample consisting only of drop-outs, i.e., women who do not complete a university college or university education (master's degree) by the age of 35. The outcomes at age 40 (and age 36) are based on average value for the years 39-41 (and 35-37) and includes only years with full-time work. Additional controls include work experience (years) as a student, type of completed education, parents' years of education, and birth cohort dummies. Significance levels are indicated as *** $p<0.01$, ** $p<0.05$, and * $p<0.10$.

Appendix B - Decomposition

Calculation of 'Miller effects' and additional effects for SM at age 40

The calculation of the different effects is based on the Oaxaca-Blinder decomposition:

$$\overline{\ln y}_{40}^{SM} - \overline{\ln y}_{40}^{NSM} = \left(\bar{X}_{SM_{40}} - \bar{X}_{NSM_{40}}\right)\hat{\beta}_{SM} + \bar{X}_{NSM_{40}}\left(\hat{\beta}_{SM} - \hat{\beta}_{NSM}\right).$$

	Differences in background variables: $A = \left(\bar{X}_{SM_{40}} - \bar{X}_{NSM_{40}}\right)\hat{\beta}_{SM}$	Differences in coefficients $B = \bar{X}_{NSM_{40}}\left(\hat{\beta}_{SM} - \hat{\beta}_{NSM}\right)$	A+B
Effect of absence after entering the labor market	Miller effects 2 and 3 $\left(\overline{ABSENCE}_{SM} - \overline{ABSENCE}_{NSM}\right) * \widehat{\beta}_{SM_{ABSENCE}}$ + $\left(\overline{ABSENCE}_{SM}^{sq} - \overline{ABSENCE}_{NSM}^{sq}\right) * \widehat{\beta}_{SM_{ABSENCE^{sq}}}$	Miller effect 4 $\overline{ABSENCE}_{NSM} * \left(\hat{\beta}_{SM_{ABSENCE}} - \hat{\beta}_{NSM_{ABSENCE}}\right)$ + $\overline{ABSENCE}_{NSM}^{sq} * \left(\hat{\beta}_{SM_{ABSENCE^{sq}}} - \hat{\beta}_{NSM_{ABSENCE^{sq}}}\right)$	Miller effects (2+3+4)
Delayed entrance for SM compared to NSM (loss of HC accumulation). This effect is included in the SM indicator, but we can identify it directly from estimations	$\overline{DELAY}_{SM} \cdot \hat{\beta}_{SM_{EXP}}$ + $\overline{DELAY}_{SM}^{sq} \cdot \hat{\beta}_{SM_{EXP^{sq}}}$	0	Delay effect for SM
Different slope on earnings profile (return to experience after labor market entry) compared to SM	0 (effect of different experience accumulation is included in Miller effect 2 and 3 and delayed entry effect)	$\overline{EXP}_{NSM}\left(\hat{\beta}_{SM_{EXP}} - \hat{\beta}_{NSM_{EXP}}\right)$ + $\overline{EXP}_{NSM}^{sq}\left(\hat{\beta}_{SM_{EXP^{sq}}} - \hat{\beta}_{NSM_{EXP^{sq}}}\right)$	Different returns to experience
Earnings at entry into labor market for SM compared to NSM		SM-indicator - Delay effect	'Signal effect 1'
		Different coefficients for variables which are fixed before entry in labor market evaluated at NSM characteristics.	'Signal effect 2'
Other (differences between SM and NSM for other characteristics: student work experience, impact from parents' education, GPA from high school, type of education etc.	Calculated as a residual	Calculated as a residual	Other effects