# Child Spacing and Mothers' Careers – An IV Approach

**VERY PRELIMINARY – PLEASE DO NOT QUOTE!**


## Abstract

Although previous research has shown that there is a motherhood penalty, little is known about whether and how women can mitigate the costs related to child birth. Using Danish register data, I investigate if increased spacing of births alleviates long run childbearing costs, measured as mothers' cumulative earnings, cumulative work-hours, and hourly wages at age 45, and if the effects of spacing vary by level of education. Since spacing may be endogenous to the studied outcomes, I use miscarriages between births as an instrumental variable. Overall, increased spacing has limited effects on the studied outcomes. A one year increase in spacing increases cumulated work-hours by approximately 360 hours for mothers with low education. However, this increase in work hours does not lead to any change in cumulative earnings or hourly wages at age 45. Danish family friendly policies may explain these limited effects of spacing.


## Introduction

Most Danish women bear more than one child during the course of their lives and a majority of Danish mothers work (Statistics Denmark 2012). Previous research shows that there is a motherhood penalty and that the labor market costs of a second child may be even greater than those of a first child (Anderson et al. 2003, Budig & England 2001, Loughran & Zissimopoulos 2009). Yet, little is known about whether and how women can mitigate the costs related to childbirth and childrearing. This paper investigates the effects of birth spacing on women's earnings and labor market outcomes. It examines whether is it better for the mother, from a cumulative earnings and labor market attachment perspective, to have her children close together rather than further apart. I focus on women who had their first birth in 1976, who gave birth to a total of two children in the period 1976-1986 and who had no additional births after 1986. I use Danish register data and data from The Danish National Patient Register and the analysis thus builds on very reliable information on labor market attachment (measured as number of hours worked), earnings and births.

There are few previous studies on the link between fertility spacing and mothers outcomes, and the studies that do consider it typically consider it only as a peripheral issue. Further, the results of these studies are inconclusive. For instance, Ross (1974) and Mincer and Polachek (1974) find that short spacing has positive effects on mothers' labor market outcomes. Peltola (2004) finds that close spacing is associated with a shorter time to labor force re-entry. However, women with short spacing are more likely to take up part-time work than women with longer birth intervals, resulting in lower earnings. Calhoun and Espenshade (1988) find that longer spacing is associated with a lower opportunity cost of children for white women, whereas the opposite holds for black women, possibly reflecting differences in socio-economic characteristics between these two groups. Cramer (1979) finds that mothers' hours of employment are negatively associated to very short (0-1 year) or very long (4-5 years) birth intervals, whereas Joesch (1994) finds no association between spacing and the timing of return to paid work after childbirth. Gough (20xx) finds that, on average, women with birth intervals of five or fewer years have lower cumulative work experience by mid-life, but their mid-life financial outcomes are not affected. Karimi (2014) finds that increased spacing of births leads to increases in long run labor market participation, labor income and wages, with a more pronounced effect for highly educated women.

The goal of this study is to establish the causal effect of spacing between births on cumulative earnings and cumulative labor force participation of Danish mothers. Furthermore, the study aims to investigate whether these effects vary by the mothers' level of education and type of employment. I use miscarriages between births to instrument for spacing to address the possible endogeneity problem.

**Theoretical considerations**

Taking care of children is time-intensive and consequently motherhood is often accompanied by a reduction in labor supply, at least during the child's first year of life. As children grow, taking care of them becomes less time consuming, thus allowing mothers to increase their labor supply. There are a number of theories that can formalize these ideas and give further insights into how and why the spacing of births may influence mothers' earnings and labor supply. However, neither of these theories presents clear cut predictions regarding the effects of spacing without introducing further assumptions.

First, in a job-search model (Mortensen 1986), the reservation wage (i.e. the lowest market wage that would induce an individual to accept a job offer) varies with an individual's value of time in alternative (non-work) states. Following Troske & Voicu (2010) I assume that a mother's value of non-work time, and hence her reservation wage, is higher the more children she has and the lower their ages. Hence, the probability of employment and the level of labor supply will be lowest for mothers with many, and young, children.

Second, Becker's (1962) model of human capital predicts that exits from the labor force, for instance due to childbirth, will result in depreciation of the human capital which in turn will result in lower earnings (or lower growth in earnings). The rate of depreciation is higher for individuals with larger amounts of job specific and / or general human capital. Thus, it may be more beneficial to concentrate all labor market interruptions for childrearing to the early years of one's career, when wages are relatively low. Therfore, the penalty induced by a career break can be expected to depend on a woman's level of education, type of employment and earnings. Previous studies have found that women with higher levels of education tend to have fewer, and more closely spaced, children, presumably to reduce time out of the labor force (Mincer & Polachek 1974, Ross 1974). However, the same result may not hold for a country like Denmark, where families have access to high quality low cost day care and where the benefits of a short, but intense, childrearing period may consequently be lower.

Besides these theories, there may be economies of scale in shorter spacing as children close in age may have more mutual interests and may benefit from the same parental activities, which in turn may allow the mother to invest more in her career. Moreover, the effects of spacing may vary over time. For instance, children that are closely spaced may for instance require more of the mother's time when they are young, but once they grow older they may keep each other company to a larger extent than children with larger age differences and hence require less of the mother's attention.

Overall, this discussion makes clear that the net effect of spacing on mothers' earnings and labor supply remain an empirical question. Moreover, the theories predict that the effects of spacing may vary with the mother's level of education and type of employment and therefore these factors should be considered in the empirical estimations. Additionally, the effects of spacing are likely to vary with the ages of the children.

**Methodological considerations**

As previously mentioned, most mothers in Denmark have more than one child. In general, mothers are likely to choose birth intervals in a rational manner and in doing so they are likely to take the consequences of their decision on their subsequent earnings and labor market attachment into consideration. Thus, OLS estimates of the effect of spacing on cumulative earnings and labor market attachment are likely to be biased. To circumvent the problem of potential bias in the OLS estimates, I use miscarriages between births as an instrumental variable (Heckman 2008).[1] As miscarriages between births are strongly correlated with spacing, but unlikely to have a direct effect on cumulative earnings or labor market attachment, this variables is likely to fulfill the requirements of an instrument.

Nevertheless, there are some potential problems with using miscarriages as an instrument. First, a woman who experiences a miscarriage runs a larger risk to suffer from depression (Armstrong 2002, Armstrong & Hutti 1998, Neugebauer et al. 1992) which may potentially affect her earnings negatively. However, previous studies show that these symptoms decrease over time and usually disappear by 12 months after the miscarriage (Thapar & Thapar 1992, Janssen et al. 1996). However, by focusing on cumulative outcomes over an extensive period of time (from 1976-2011), as well as hourly wages at age 45, I probably circumvent this problem to a large extent. In addition, women who have a healthy pregnancy after a miscarriage (as the mothers in my sample) have a lower risk for depressive symptoms (Swanson 2000, Theut et al. 1989). Importantly, a miscarriage would alter the woman's intended spacing of births and should therefore have, if anything, a negative effect on the outcomes and would consequently work against my finding a positive spacing effect.

Second, the risk of miscarriage increases with maternal age. According to the *American Pregnancy Association*, the risk of miscarrying is around 15 percent for women below the age of 35, but between 20 and 35 percent for women 35-45 years old. Although I can control for age in the empirical estimations, women with long birth intervals will be older at the second conception and may therefore run a larger risk of miscarrying. This problem may be circumvented by limiting the

[1] The length of a birth interval may of course also be shorter than originally intended. However, I cannot address this possibility empirically and therefore; this study examines the effects of different birth intervals on economic outcomes regardless of the underlying mechanisms determining these intervals.

sample to women who have their second child before they turn 35. As I will focus on women that had their first birth in 1976, when mothers' average age at first birth was 24.1 years (Statistics Denmark 2013), this limitation will most likely only exclude relatively few mothers from the estimations.

Third, certain characteristics of the mother for which I cannot control (e.g., drug use, alcohol abuse and smoking) are also correlated with the risk of miscarriage. Nevertheless, Buckles and Munnich (2012) show that controlling for such factors does not affect results when one estimates the effects of spacing on early child outcomes. In addition, I am able to control for some factors that are likely to be highly correlated to these characteristics (such as marital status at the time of birth and level of education). In order to circumvent problems related to unobserved characteristics of the mother, I exclude all mothers who experienced more than one miscarriage.

Other potential problems with using miscarriages as an instrument that have been discussed in the literature, such as i.e. misreporting, is avoided in my context since this study, in contrast to most previous studies, relies on register data. However, one limitation with my data is that only registered miscarriages are included. For a miscarriage to be registered in the Danish National Patient Registry from 1976, the woman must have been in contact with a hospital. In practice, this restriction means that very early miscarriages are unlikely to be reported in my data. As such early miscarriages have a quite limited effect on spacing, this limitation should not have a major influence on the results. Another potential problem is that the reported miscarriages may be of a more severe nature than other miscarriages (for instance, cases that occurred at later gestational ages or cases that involved medical complications). However, Karimi (2014) shows that the vast majority of registered miscarriages for the Swedish National Patient Registry (88 percent) regard cases without additional medical complications, and this result in particular holds for the early years of the period that she examines (1997-2005). As the Swedish and the Danish health systems are very similar, and as I use data from the 1970s (where the number of miscarriages treated at hospitals were relatively large), I expect that most miscarriages included in my sample are without complications.

## Data

In this study, data from the Danish National Patient Registry (DNPR) is combined with Danish register data. Hence, I avoid the measurement error that is likely to affect similar studies based on survey data. The DNPR covers all hospital visits in Denmark from 1976 and onwards and includes medical information associated with each visit (ICD-codes). Using these ICD-codes, I can identify all hospital visits associated with miscarriages. The project samples all women who had their first live birth in 1976. The women are followed through 1986, and all women who had at least one more child within this period remain in the sample. Information on any miscarriages and their timing is collected from the DNPR, in addition to data on live births and their timing.

Background data on mothers at the time of the first birth (or as early as possible) from Danish registers is merged with the data on miscarriages and births. The background data include information on the mother's civil status, educational background and age. The project samples women that had their first child in 1976, who gave birth to a total of two children in the period 1976-1986 and who had no additional births after 1986. The dataset includes information on miscarriages in the between-births period. As noted in the theoretical section, the effects of spacing may vary over time and therefore I focus on cumulative earnings and cumulative labor supply to capture the full effects of spacing. My outcomes of interest, earnings and labor supply, are measured by accumulating these factors over time. Thus, the first dependent variable of interest, cumulative earnings, is the log of gross earnings from 1976 until the end of the sample window in 2011. The second dependent variable of interest, cumulative work hours, cumulates the respondent's annual hours of work from the birth of the first child in 1976 until 2011 (measured in thousands of hours). The third dependent variable is the hourly wage at age 45. The fourth dependent variable is the effective wage, i.e. cumulative earnings divided by cumulative work hours. Wages and earnings are adjusted to 2013 Danish kroner using the consumer price index. The explanatory variable of interest is the interval between births, measured in number of months. Control variables include the mother's age, civil status at birth and at age 45, ethnicity and level of education.

Table 1 presents summary statistics for the mothers included in the sample. Notably, the average spacing for this sample was 48.21 months, that is, slightly more than four years, which is substantially longer than most previous figures reported in the literature.

**Table 1.** Summary statistics

| | mean | sd |
|---|---|---|
| *Log cumulative earnings 1976-2011* | 15.88 | 0.49 |
| *Cumulative hours 1976-2011 (thousands of hours)* | 36.34 | 4.92 |
| *Hourly wages at age 45(Danish kroner)* | 216.35 | 17.38 |
| *Effective wage* | 162.49 | 60.51 |
| *Spacing (months)* | 48.21 | 23.82 |
| *Age at first birth* | 23.38 | 3.44 |
| *Age at first birth, squared* | 558.64 | 169.35 |
| *Born in Denmark (per cent)* | 97.9 | 0 |
| *Born in developed country outside of Denmark* | 1.70 | 0.13 |
| *Born in developing country* | 0.40 | 0.06 |
| *Married / cohabiting at time of birth (per cent)* | 64.52 | 0 |
| *Not married at time of birth* | 35.48 | 47.85 |
| *Married at age 45 (per cent)* | 78.91 | 0 |
| *Divorced at age 45* | 15.84 | 36.51 |
| *Never married at age 45* | 5.25 | 22.31 |
| *Compulsory schooling (per cent)* | 34.56 | 0 |
| *Highschool* | 1.70 | 12.95 |
| *Erhvervsgymnasiale uddannelser* | 0.30 | 5.51 |
| *Erhvervsfaglige praktik- og hovedforløb* | 36.95 | 48.27 |
| *Short university education* | 3.61 | 18.65 |
| *Medium university education* | 20.36 | 40.27 |
| *Bachelor* | 0.06 | 2.53 |
| *Long university education* | 2.40 | 15.31 |
| *PhD* | 0.06 | 2.53 |
| Observations | 12,493 | |

**Estimation – Ordinary least squares**

I first estimate the effects of spacing on mothers' outcomes using OLS. I investigate the effects of spacing on the previously described dependent variables. The results are presented in table 2, and shows that spacing influences mothers' labor market outcomes positively, although the estimated coefficients are generally small. For the log of cumulative earnings, the coefficient is so small it becomes negligible and the same holds for cumulative hours: a one year increase in spacing causes a 120 hour increase in cumulative hours, corresponding to approximately four weeks of additional work over a 35 year period. An increase in spacing by one year would lead to an increase in the effective wage (defined as cumulative earnings divided by cumulative work hours) by 0.72 *kroner.*

As the average number of hours is slightly above 36,000, this would lead to an increase in earnings of approximately 26,000 *kroner* over the 35 year period. However, this result is not reflected in the coefficient for log cumulative earnings.

**Table 2.** OLS estimates of the effects of spacing on mothers' labor market outcomes.

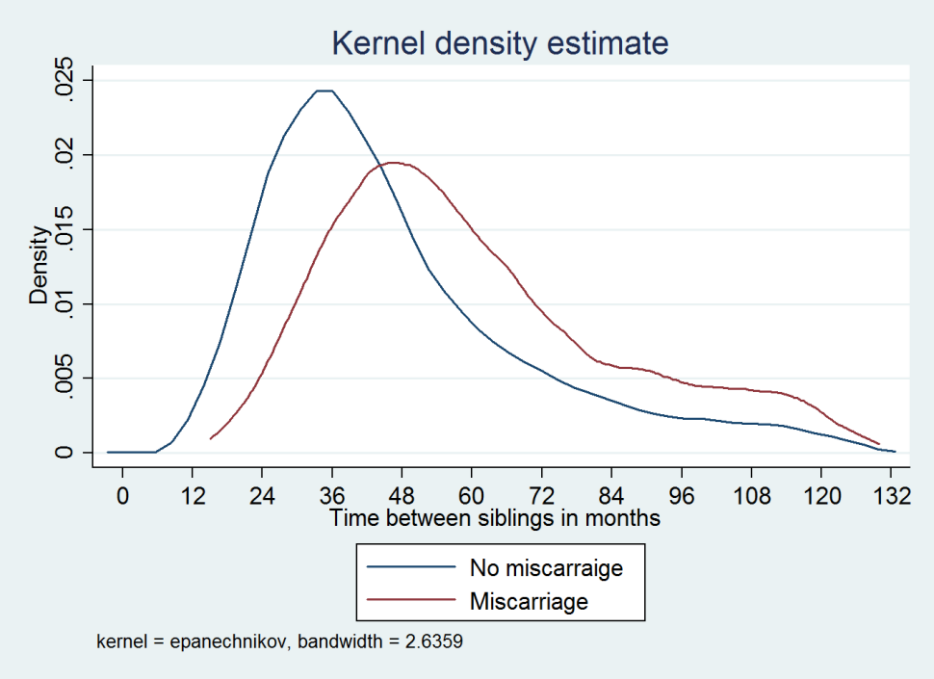
| | Log cumulative earnings | Cumulative hours | Hourly wages | Effective wage |
|---|---|---|---|---|
| *Spacing (months)* | 0.00* | 0.01*** | 0.00 | 0.06** |
| | 0.00 | 0.00 | 0.01 | 0.02 |
| *R-squared* | 0.12 | 0.12 | 0.22 | 0.24 |
| Observations | 14,371 | 13,364 | 15,420 | 14,373 |

* p<0.05, ** p<0.01, *** p<0.001

Note :The model includes controls for level of education, marital status at birth and at age 45, country of birth and age.

**IV-analysis**

If spacing is correlated with the error term, OLS will lead to biased estimates. This may happen if there are unobserved variables that influence both spacing and the mother's attachment to the labor market. For instance, if mother's with stronger preferences for market work also space their children with longer intervals, OLS models will overestimate the effects of spacing. I therefore now instrument for spacing using miscarriages between births as an instrumental variable. In order for miscarriage to be a valid instrument for child spacing, it must affect the interval between births. In addition, the instrument must not directly influence the outcome variables of interest (i.e. mothers' cumulative earnings and work hours and their hourly wages). The first assumption can easily be tested. Figure 1 shows kernel density estimates of the average spacing between siblings for mothers that did, and did not, experience a miscarriage between births. As expected, miscarriages have shifted the spacing density curve to the right and the figure thus shows that a miscarriage between births leads to an increase in spacing. The mean and median spacing for mothers that did experience a miscarriage are 46.7 months and 41 months, respectively, whereas the corresponding figures for mothers that experienced a miscarriage are 62.3 and 56 months. Thus, a miscarriage leads to an average increase in spacing of 15.6 months (1.3 years) for the women in my sample.




Whether a miscarriage influences the outcome variables of interest cannot formally be tested. However, in order to further asses the validity of the instrument, I investigate whether the probability of a miscarriage is correlated with the mothers' pre-determined characteristics in table 3. A result showing that there are no differences in observables between women who do, and who do not, experience a miscarriage supports the hypothesis that miscarriages occur at random and consequently such a result strengthens the credibility of the instrument.

Table 3 shows that no variables are significantly correlated with the probability of miscarrying after the first birth. Furthermore, a chi-2 test shows that the hypotheses that all β's equal zero cannot be rejected. I therefore conclude that women who do, and who do not, experience a miscarriage do not differ in their observed characteristics and that miscarriages between births therefore could potentially be a suitable instrument for spacing. I therefore continue the analysis using a miscarriage after the first birth as an instrument for spacing.

**Table 3. The probability of experiencing a miscarriage between the first and second birth.**

| | |
|---|---|
| *Age at first birth* | -0.07 |
| | 0.04 |
| *Age at first birth, squared* | 0.00 |
| | 0.00 |
| *Born in Denmark (per cent)* | *Reference* |
| *Developed country* | -0.03 |
| | 0.12 |
| *Developing country* | 0.26 |
| | 0.20 |
| *Married / coh. at birth* | *Reference* |
| *Not married at time of birth* | -0.01 |
| | 0.04 |
| *Compulsory schooling* | *Reference* |
| *Highschool* | -0.17 |
| | 0.13 |
| *Erhvervsgym.uddannelser* | -0.08 |
| | 0.28 |
| *Erhvervsf praktik forl.* | -0.04 |
| | 0.04 |
| *Short university education* | 0.10 |
| | 0.08 |
| *Medium university edu.* | 0.02 |
| | 0.04 |
| *Long university education* | 0.03 |
| | 0.10 |
| *PhD* | 0.28 |
| | 0.55 |
| *Constant* | -0.52 |
| | 0.52 |
| Observations | 15,216 |

Table 4 shows the first stage estimates for the four dependent variables of interest (in addition to the miscarriage-dummy, the first stage models also include controls for level of education, marital status at birth and at age 45, country of birth and age). The first stage estimates show that miscarriages have a significant effect on spacing. The F-statistic is large, hence showing that I do not need to worry about a week instrument (the results of the four models differ slightly because of slightly different sample sizes).

**Table 4.** First stage estimates, the effects of a miscarriage on spacing.

| | Log cumulative earnings | Cumulative hours (thousands) | Hourly wages | Effective wage |
|---|---|---|---|---|
| *Miscarriage* | 13.57*** | 13.59*** | 13.21*** | 13.56*** |
| | 0.77 | 0.79 | 0.74 | 0.77 |
| F-statistic | 46.04 | 44.60 | 48.55 | 46.02 |
| Observations | 14,195 | 13,194 | 15,230 | 14,197 |

Note :The model includes controls for level of education, marital status at birth and at age 45, country of birth and age.

Table 5 shows the corresponding second stage estimates.

**Table 5. Second stage estimates of the effects of spacing on mothers' labor market outcomes**

| | Log cumulative earnings | Cumulative hours (thousands) | Hourly wages | Effective wage |
|---|---|---|---|---|
| *Spacing (months)* | 0.001 | 0.025* | 0.003 | -0.100 |
| | 0.001 | 0.012 | 0.038 | 0.131 |
| R-squared | 0.119 | 0.113 | 0.219 | 0.238 |
| Observations | 14,195 | 13,194 | 15,230 | 14,197 |

Note :The model includes controls for level of education, marital status at birth and at age 45, country of birth and age.

In the IV-model, only the coefficient for cumulative hours is statistically significant and the coefficient is somewhat larger in magnitude than in the OLS model. Thus, a one year increase in spacing leads to a 300 hour increase in cumulative work hours (approximately seven to eight full-time weeks, corresponding to 0.8 percent of average cumulative work hours).

As previously mentioned, the effects of spacing may vary with the mother's level of education. In table 6, I therefore estimate separate models for women with low and high education, where low education is defined as below university, whereas high education is defined as some university training.

It is clear from the tables that the previously found result that spacing influences cumulative hours is entirely driven by mothers with low education. Thus, for mothers with high education, spacing has no influence on cumulative earnings, cumulative hours or hourly wages, whereas spacing influences cumulative hours positively for mothers with low education. More specifically, a one year increase in spacing leads to a 360 hour increase in cumulative work hours. However, this increase in cumulative work hours does not lead to any changes in cumulative earnings or hourly wages.

The very limited effects of child spacing on mothers' long run employment outcomes may be explained by the Danish family friendly policies that allow mothers to take time off due to parental leave and give them access to high quality low cost daycare, thus mitigating the overall costs of child care.

**Table 6. Second stage estimates of the effects of spacing on mothers' labor market outcomes, by education.**

| | Cumulative earnings, low | Cumulative hours, low | Hourly wages, low | Effective wage, low |
|---|---|---|---|---|
| | Low education | | | |
| *Spacing (months)* | 0.00 | 0.03* | 0.02 | -0.08 |
| | 0.00 | 0.01 | 0.05 | 0.15 |
| R-squared | 0.03 | 0.08 | 0.21 | 0.05 |
| Observations | 10428.00 | 9661.00 | 11142.00 | 10429.00 |
| | High education | | | |
| *Spacing (months)* | -0.00 | 0.01 | -0.03 | -0.13 |
| | 0.00 | 0.02 | 0.07 | 0.27 |
| R-squared | 0.11 | 0.16 | 0.20 | 0.21 |
| Observations | 3767.00 | 3533.00 | 4088.00 | 3768.00 |

Note :The model includes controls for level of education, marital status at birth and at age 45, country of birth and age.

**Conclusion**

Previous research has found that there is a motherhood penalty and that postponing births is one way of mitigating the costs related to childbirth. However, less is known about other ways in which mothers may alleviate the costs of childbirth. This study builds on Danish register data and data from the Danish national patient registry to investigate the long-run effects of child spacing on mothers' labor market outcomes. We use three measures for mothers' long-run labor market outcomes: cumulative earnings, cumulative work hours (both measured from 1976-2011) and hourly wages at age 45. Since both spacing and long-run labor market outcomes may be determined by unobserved variables, I use a miscarriage occurring after the first birth as an instrument for spacing.

The (very preliminary) results show that spacing has a limited effect on mothers' long run labor market outcomes: an additional year of spacing increases cumulated work hours by approximately 300 hours (an increase of less than one per cent, evaluated at mean cumulative work hours). However, this increase in work hours is not accompanied by any change in either cumulated earnings or hourly wages at age 45.

When estimating the effects of spacing separately for mothers with high (some university) and low (no university) levels of education, I find that the effect of spacing on cumulative hours is completely driven by mothers with low education. For mothers with high education, spacing has no effect on any of the studied outcomes.

Danish family friendly policies, such as paid parental leave and publicly subsidized high-quality daycare, were introduced in the 1960s and early 1970s and moved a large share of the costs related to raising children from the family to society. The overall lower costs of children may have made spacing less of a factor for mothers in Denmark, compared to many other countries.

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