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The consequence of birth spacing for first- and second-born siblings' long-term income rank: A restrictive two-child family approach

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Abstract

Birth spacing between siblings may have long-lasting impacts on them. This paper focuses on how different birth-spacing intervals are associated with income rank during the ages 33 to 42 years. In order to disentangle birth spacing from birth order, while holding potential sibsize association constant, an interaction model is used on a restrictive subpopulation of two-child families born between 1960 and 1970. The results show clear differences between first- and second-born siblings. Increased birth spacing, up to 3 years, is positively associated with first-born siblings' income rank. Birth spacing has a negligible association with second-born siblings, at the common spacing intervals (less than 5 years). Having relatively high spacing intervals (over 5 years) is associated with somewhat lower income-rank than having mid-length intervals for both first- and second-born siblings.

Key words: birth spacing, income rank, population register data, Sweden

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1. Introduction

There are some circumstances beyond children's control that impact their ability to influence their life chances, thus influencing equality of opportunity. One such circumstance is family structure, since siblings themselves cannot choose their family structure (Roemer 1998). Therefore, if there is a relationship between family structure and socioeconomic outcomes, it is a factor that the individual cannot control. Previous research hypothesizes family size to be negatively associated with socioeconomic outcomes of siblings (e.g. Blake 1981). Studies of the association between birth order and socioeconomic outcomes indicate that being the first-born child is beneficial in terms of education (e.g. Härkönen 2014), earnings (e.g. Kantarevic & Mechoulan 2006), intelligence (Black et al. 2011) and cognitive development in childhood (e.g. Heiland 2011). However, scholars have criticized previous birth order studies for not using longitudinal data or for using non-representative samples: see Barclay (2014) for an overview. Another less-studied characteristic of family structure argued to impact siblings' socioeconomic outcomes is birth spacing: that is, the age difference between siblings (cf. Steelman et al. 2002). The few existing studies on this subject focus on the association between birth spacing and early childhood test scores (Buckles & Munnich 2012), between birth spacing and educational achievement (Powell & Steelman 1993; Pettersson & Skogman 2009), between birth spacing and sibling correlation in education and earnings (Conley & Glauber 2008) or for outcomes for three or more sibling groups (Barclay & Kolk 2017).

The empirical evidence of the association between birth spacing and adulthood outcomes would add to our understanding of family structure. This is because some of the hypothesized mechanisms for birth order effects, for instance differential parental investment, are predicted to be eased by longer birth-spacing intervals (e.g. Zajonc 1976). The consequences of birth spacing on adulthood outcomes also make up an under-researched topic in the literature, despite having policy relevance. For instance, the World Health Organization (WTO) recommends parents to wait at least 2 years before having another child (WHO 2005) because of the reported risk of adverse perinatal outcomes, thus raising the question of whether this recommendation holds for children's adulthood outcomes as well. Furthermore, many countries have recently started to reform their family policies (Blum 2014), which impacts individuals' fertility decisions (Neyer 2003), as well as the timing between two births. Therefore, there is a need for analysing whether there is an association between birth spacing and siblings' labour market outcome.

The purpose of this paper is therefore partly to fill this gap by disentangling the association of birth order and spacing on long-time income measured as rank averages of the income of individuals aged 33 to 42 years. By merging a number of Swedish administrative registers, covering the entire Swedish population, parents and their children have been identified (thus including sibling information as well). A rich set of longitudinal background and demographic information spanning over generations is at our disposal, where parental characteristics such as parental age, education and income can be substantiated. Thus, this study addresses the relationship between birth spacing and long-term income in a two-child family, which is the most common sibship size in Sweden. By adopting a two-child family strategy, the association of birth spacing on first- and second-born children is isolated while simultaneously factoring out any potential effect of sibship size, which to the best of my knowledge has not been analysed in earlier research. Moreover, this study analyses the association between both short and long birth spacing and adulthood outcome for first- and second-born siblings, thereby also analysing potential positive and negative impacts from different birth-spacing intervals.

This study focuses on long-time earned income rank. There are several advantages to this. First, income rank provides us with an income measure net of structural changes over time: inflation and cohort effects. Second, long-term earned income can be viewed as the ultimate indicator of individuals' socio-economic standing in the labour market, which to a large extent is determined by outcomes related to educational success, such as educational level (Glick & Miller 1956; Houthakker 1959; Psacharopoulos & Patrinos 2004), and cognitive and non-cognitive skills (Lindqvist & Vestman 2011). Income rank assigns each sibling a specific position within the social hierarchy (on a scale of one to 100), which is a relative measure constructed by comparing each sibling to all other individuals of the same age and gender on the Swedish labour market in a specific year. Thus, it is possible to both compare the siblings to each other and to other individuals. Previous research indicates the power of relative measurement, where the perception of having "more" or "less" than others in one's surroundings, is an important aspect of individuals' utility (e.g. Carlsson et al. 2007).

2. Why birth-spacing effects emerge between first- and second-born siblings

The few empirical birth-spacing studies, focusing on later child outcomes, have mainly been interested in estimating the birth-spacing gap (i.e., the difference that emerges between shorter or longer birth spacing between two siblings). Yet, it is interesting not only to estimate the birth-spacing gap but also to understand whether there is a different association between birth spacing and income rank for first- versus second-born siblings. Below, we will first discuss three broad explanations (not mutually exclusive) affecting how birth spacing can influence socioeconomic outcomes and give rise to a birth-spacing gap between siblings. Thereafter, six hypotheses will be formulated (illustrated in Figure 1) regarding the different association of birth-spacing intervals for first- and second-born siblings with the help of previous findings.

2.1 Resource dilution model and confluence model

The resource dilution model argues that the amount of parental investment to each child, such as time and money, dilutes as the sibship grows (Blake 1991). First-born children receive more resources from their parents since they are the only child in the family until their younger sibling is born. Therefore, the first-born sibling is predicted, on average, to obtain better outcomes. A longer birth-spacing gap between siblings increases during the time the first-born sibling is an only child (Steelman et al. 2002), thereby predicting better outcomes for the firstborn. The resource dilution model does not explicitly predict how different birth-spacing intervals impact second-born siblings. However, a consequence of shorter a birth-spacing interval is that it decreases during the time the first-born child is the only child in the household, and thus the difference in outcome between first- and second-born siblings becomes smaller than for long birth-spacing intervals. The confluence model, introduced by Zajonc and Markus (1975), postulates that family size and birth order influence the intellectual environment of a household. Let us take the example of the first-born child in order to clarify. Imagine a family that adjusts their daily activities and conversations to their only child's need, who enjoys a rich intellectual environment. Then, a second child arrives and the intellectual environment of the first child is impaired as the parents now have two children to consider. In a follow-up study, Zajonc (1976) develops the confluence model a step further by introducing birth spacing as an important factor in family structure. He argues that the firstborn benefits more from teaching the younger sibling than the younger sibling benefits from learning. The benefit from teaching increases with the spacing of the siblings, but only up to a certain point because of a diminishing rate of return. As a result, spacing might mediate the effect of birth order but also compensate for the negative effect of family size. Zajonc (1976: 227) writes: "In itself birth order is not an important variable. The model predicts that its effects are mediated entirely by age spacing between siblings [...] In principle, the negative effects of family size can also be overcome by age spacing between children."

The empirical literature on the association between birth spacing and children's educational or/and labour market outcome is limited and omits long-run income. The few studies that analyse this question tend to arrive at somewhat different results. Making use of the parental leave benefit reform implemented in Sweden in 1980, Pettersson and Skogman (2009) use a causal approach to investigate the effects of spacing on educational attainment. They find that having closely spaced children (less than 2 years apart) affects the older siblings' educational attainment negatively. Pettersson and Skogman (2009) explain their result by arguing that mothers who have closely spaced children might pay less attention to the older sibling both during the pregnancy and after the birth of the younger sibling. Furthermore, Powell and Steelman (1993) found that having a closely spaced sibling (less than 2 years) has a negative effect on academic performance. In other words, the greater the spacing between the siblings, the better the academic performance of the younger sibling. Thus, they argue that family resources are more constrained when siblings are closely spaced. However, when it comes to birth spacing and parents' time investment (compared to financial resources/investment), the direction seems to be the opposite. Using time-use data, Price (2008) finds that parents' time investment in the younger sibling decreases as the birth spacing between the siblings increases. In a later study, Price (2012) reports that parental time investment in childcare activities for first-born siblings increases as the spacing between the siblings increases. By using the randomness of miscarriages as an exogenous variation in the length of birth spacing between siblings, Buckles and Munnich (2012) indicate that larger spacing between sibling pairs increases test scores for the older sibling by 0.17 standard deviations. To sum up, there seems to be no agreement on how different birth intervals affect siblings' outcome, one reason might be due to insufficient sample size, which makes it impossible to break down birth-spacing intervals in smaller sizes.

2.2 Physiological effects

A second explanation related to birth spacing is the physiological effects of spacing. The most studied outcome in infant health is low birth weight; it is an indication of infant health and has been shown to have negative effects on adulthood outcomes, such as income (e.g. Behrman & Rosenzweig 2004; Bharadwaj et al., 2018). By conducting a meta-analysis of birth spacing and risk of adverse perinatal outcomes, Conde-Agudelo et al. (2006) find that birth spacing of less than 1.5 years and more than 5 years are associated with adverse infant health outcomes such as pre-term birth, low birth weight and foetal death. One plausible explanation for the association between short spacing and infant health outcomes is that the mother's nutritional status is worsened by close birth spacing (Winkvist et al. 1992). When it comes to why there is an association between long spacing and adverse infant health outcomes, there are no firm conclusions. However, one hypothesis is that it is an effect of a gradual decline in women's physiological reproductive capacities after delivery (Zhu et al. 1999). Thus, the physiological explanation would imply that birth spacing affects income rank through individuals' physiological abilities. In other words, different birth-spacing intervals give rise to adverse infant health outcomes, which decreases the future income of individuals.

2.3 Confrontation and bargaining skills

A third explanation is a difference in confrontation and bargaining skills between siblings. Psychological studies using longitudinal data indicate that parents experience less conflict with their second-born than with their first-born adolescents (e.g. Whiteman et al. 2003; Shanahan et al. 2007). For instance, when it comes to establishing norms such as size of allowance and boundaries such as time curfews, older siblings have to fight and bargain with their parents to a greater extent than their younger siblings. Once these norms and boundaries have been established, they work as a sort of precedent for younger siblings (Whiteman et al. 2007). Therefore, it is plausible to assume that when the spacing is shorter between siblings, the younger sibling can also take part in the bargaining and negotiating. As a result, when siblings are closely spaced, both of them might develop skills and strategies early in life that will prove important later when they enter the labour market.

2.4 Potential positive and negative impacts

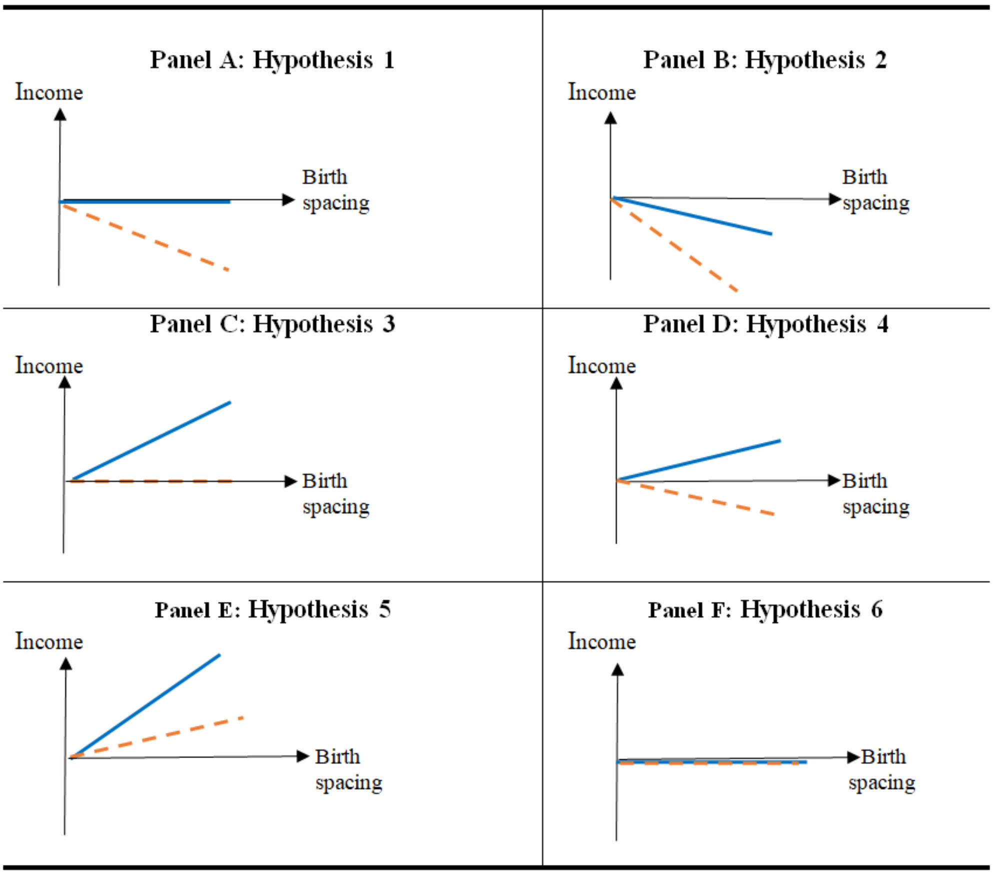
So far, the focus has been on the gap between siblings with different birth-spacing intervals, with the underlying assumption that the first-born sibling has an advantage over the second-born sibling in terms of various outcomes as found in most previous research (e.g. Kantarevic & Mechoulan 2006; Black et al. 2011; Heiland 2011; Härkönen 2014). However, it is also important to analyse which of the siblings benefits and which is hindered, not only relative to their sibling but also compared to other sibling pairs with different (shorter or longer) birth-spacing intervals, although there is limited empirical evidence shown in the literature.

In order to illustrate this, let us compare two of the above-mentioned studies, where birth spacing is assumed to have different effects on first- and second-born siblings, but the gap between siblings can empirically be the same. As Conde-Agudelo et al. (2006) argue, an overwhelming number of studies indicate an association between short birth spacing and adverse infant health outcomes for the younger sibling. This could be because close birth spacing worsens the mothers' nutritional status. This means that a short birth-spacing interval has a negative association for the younger sibling. *Hypothesis 1 (H1) is thus that birth-spacing intervals have a negative association for the second-born sibling while there is no association for the first-born sibling*; this is depicted in Panel A in Figure 1. However, the findings of Pettersson and Skogman (2009) indicted a negative effect of birth spacing on the older sibling. Therefore, it is plausible that both the older and younger siblings are affected negatively by birth spacing, but at different decreasing rates. *Hypothesis 2 (H2) is that birth-spacing intervals have a negative association for both first- and second-born siblings, but at different decreasing rates,* as depicted in Panel B in Figure 1.

Buckles and Munnich (2012) analyse short (less than 2 years) spacing effects for both older and younger siblings (however within different family sizes). Their findings indicate that spacing longer than 2 years has a beneficial effect on test scores for older siblings, compared to spacing shorter than 2 years. They do not find any spacing related test score effects for younger siblings. *Hypothesis 3 (H3) is that birth-spacing intervals have positive association for the first-born sibling while no association for the second-born sibling,* depicted in Panel C in Figure 1. However, Buckles and Munnich's data are limited in that it is not possible to break down birth spacing into smaller intervals in order to detect the exact shape of longer birth-spacing intervals between the siblings. This is noticeable in the insignificant coefficients and the large standard errors in their regression analyses. It is therefore plausible that the older sibling benefits from increased spacing while the younger loses, which is in line with the findings of Zhu et al. (1999) who hypothesize an association between long spacing and adverse infant health. *Hypothesis 4 (H4) is that birth-spacing intervals have positive association for the first-born sibling while having negative association for the second-born sibling*, depicted by Panel D in Figure 1.

Moreover, since this topic is under-researched, it could be hypothesized that both siblings benefit from increased birth spacing but at different increasing rates. *Hypothesis 5 (H5) is that birth-spacing intervals have positive association for both first-and second-born siblings, but at different decreasing rates,* depicted in Panel E in Figure 1. Nevertheless, birth spacing could also potentially have no association with income rank for the sibling pairs. *Hypothesis 6 (H6) is that birth-spacing intervals have no association for either first- or second-born siblings*, depicted by Panel F in Figure 1.

Figure 1: Potential positive and/or negative impact from birth spacing



Note: The bold blue line illustrates the effect for first-born siblings, and the dashed orange line illustrates the effect for second-born siblings. On the Y-axis is income rank, and the X-axis represents the length of birth spacing between sibling pairs. The figure illustrates that even if the gap between siblings might be equal, the effect on first- and second-born siblings can differ.

In all, the six scenarios above (Panel A to F in Figure 1) illustrate that while the gap between siblings is the same, the association of birth spacing can differ between first- and second-born children. Thus, there is a need for sufficient data to reject or confirm arguments about how short and long birth spacing impact labour market outcomes for both first- and second-born siblings, and whether there is any nonlinearity.

3. Data and method

By using Swedish administrative registers covering the entire population, we will examine income rank for siblings born between 1960 and 1970 in two-child families. Each individual in Sweden has a unique personal identification number, which is used universally for administrative processes. By using this identification number, four different administrative registers have been linked together. The first source is the multi-generational register, which includes all persons born from 1932 onwards (Statistics Sweden 2008). The register includes information about parents, making it possible to identify biological siblings. The second source is the 1970 census, from which the educational attainment of the siblings' parents was extracted. The third source is Statistics Sweden's *Integrated database for labour market research* (LISA), which covers the years from 1990 to 2012. From LISA, annual earned income and educational attainment coded in accordance with the *International Standard Classification of Education* (ISCED) are collected. The fourth source is the income and taxation registers 1968–1989 (Hjalmarsson et al. 2015). One advantage of using register data is that they do not suffer from retrospective biases. Moreover, register data studies can assess both exposure and outcome as a prospective study, since the data are collected yearly.

By focusing on two-child families, we are able to isolate the association of birth spacing on first- and second-born siblings and at the same time factor out potential effects of sibship size. Approximately 52 per cent of all Swedish children grow up in a two-child family, making two-child households the most common household composition in Sweden (Statistics Sweden 2017). The analytical population in this study was selected with a view to increasing the internal validity of the results and, as a consequence, the external validity decreases. The two-child families included only those in which the children have the same biological parents. In other words, families with adopted and stepchildren have been excluded from the sample. Furthermore, if the parents of the siblings have had children in an earlier relationship, the whole family was excluded. Two-child families with twins have also been excluded. These restrictions ensure that the siblings have had as similar nurturing environments as possible. It other words, it gives some guarantee that the analytical population captures families (more specific parents) whose resources (may it be time, money, or attention) are only devoted to the children in the same household and not to children in previous or future marriages/relationships (cf. Hofferth & Anderson 2004). Moreover, the sample is restricted to parents who lived in the same building (*fastighetsnummer*) as their children when both the first and second children were between 8 to 16 years old.[1] This is because the potential consequence of any marital disruption (whether due to divorce, separation, remarriage, step-parenthood, parent's death, etc.) af-

1 The reason for starting from the age of eight is due to data restriction. The residential building number (fastighetsnummer) is available starting in only 1968; the first sibling would then be 8 years old. It should be acknowledged that living in the same fastighetsnummer does not necessarily mean that all family members are living together—there is a theoretical possibility that the parents (or one of the siblings) could live in different apartments within the same building. However, the probability that two parents who have had children together would be living in the same residential building but in different apartments from the time their eldest child is 8 years old until their younger child is 16 years old should be assumed to be extremely low.

fects the cognitive and non-cognitive development of siblings differently since the children would be at different ages when the disruption occurred[2].

The analytical population, based on the selection criteria described above, can be described as a "closed" window, which means that in order to isolate potential birth-spacing associations from institutional settings, both siblings must have been born within the period from 1960 to 1970. The reason is due to data restriction: ensuring that siblings have similar nurturing environment requires that we must start at the year 1960, and capturing long-term income requires that we stop at the year 1970 (see below for a discussion). The advantage of using a closed-window sample is that all individuals grew up under a similar time period with similar institutional settings.

Birth-order studies based on non-panel survey data cannot generally choose the timing of when to measure outcomes. Thus, it is more likely that the first-born sibling would have an advantage in income and education outcomes, for example, since the firstborn would have had a head start on their younger siblings and thus would have had more time to acquire these outcomes. A strength of this study is that we can measure outcome at a certain *age* instead of a certain *year*. For instance, the income rank for siblings born in 1963 and 1967 is measured between years 1996–2005 and 2000–2009. This is particularly important since we are interested in measuring the income rank of siblings when they are at the *same age*. Therefore, we are eliminating any potential cohort effects since the income rank is constructed within each income year.

3.1 The variables included in the study

The dependent variable, *income rank*, is measured as each sibling's earned income rank between the ages of 33 and 42. Averaging over ages 33 to 42 has been shown to provide good estimates of life-cycle income for Swedish data (Böhlmark & Lindquist 2006), and has been adopted by several previous studies (e.g. Björklund et al. 2012; Shahbazian 2017). To be included, both siblings must have at least 6 years of valid income information in the registers.[3] Earned income includes all taxable incomes from employment, self-employment, pension, sickness benefits, and other taxable transfers. However, it does not include income from capital and it excludes non-taxable transfers. The income information has been transformed into ranks (on a scale from 1 to 100) based on individual earned income compared to all other individuals of the same age and gender in the Swedish labour market in a specific year. Thereafter, the average of the individual income ranks (between ages 33 and 42) has been calculated, in order to obtain the dependent variable. To take an example: Peter was 33 years old in 1995 and his income rank for that year is then calculated by comparing his earnings to the earnings of all individuals in Sweden

2 The overall number of siblings born in two child families between 1960 and 1970 is 277,520. After the restriction described above the number of siblings in the analytical population is 193,318.

3 A cutoff of 6 years of valid income information was chosen because individuals might have been studying or working abroad at ages 33 to 42. However, more than 90 per cent of the sample has 9 or more years' worth of valid income information. Sensitivity tests have been performed to see whether there is an overrepresentation of older or younger siblings in terms of the amount of available valid income information and it was found that the distribution is fairly equal.

aged 33 in 1995. We do not wish to compare a 33 year old to a 50 year old, for example, due to potential differences in the length of work experience. The same procedure has then been repeated until Peter was 42 years old. In a final step, the average of these income ranks is calculated and used as a measure of his income rank between 33 to 42 years of age. The rationale behind using income rank is to eliminate structural changes over time: inflation and cohort effects.

Birth spacing, the age difference between the older and the younger siblings in each family, is here measured in four-month intervals and is the main explanatory variable of the analyses. Birth spacing has been included as dummies, in order to capture any non-linear association.

In addition to birth spacing, the analyses are adjusted for several covariates that have a relationship between birth spacing and the siblings' income rank. Birth order of each sibling is adjusted for because of the prediction of resource dilution model, but also since previous research indicated a birth order effect on income (Björklund & Jäntti 2012).

Mother's and Father's age at birth of each sibling, measured in year dummies, is included since it can confound some of the association of shorter and longer birth spacing on income rank.[4] Moreover, since parents' physiological reproductive capacity decreases with the increase of age, this could impact children's health during the first few years of their lives that, in turn, is a significant predictor of adulthood outcomes (Currie & Hyson 1999; Knudsen et al. 2006). Furthermore, as birth spacing between siblings increases, parents are relatively older and therefore more likely to have matured in their parental role and/or to have acquired a higher position within society. Parents' age can thus also capture some of these associations, which would be more beneficial for second-born siblings than for first-born siblings.

Education level of both parents (measured in 1970) is also included, divided into i) primary and lower secondary school, ii) upper secondary school, iii) bachelor level, iv) master level and above. Parents' education level can be a proxy for parental characteristics, such as time preference and careful family planning, which affect children's lives and future outcomes. More highly educated parents might have different fertility patterns and, as a consequence, might have shorter birth spacing than parents with less education. Therefore, parents' education level might confound some of the associations of longer birth spacing on income rank between different families.

It is also possible that the *household disposable income* during each sibling's childhood confounds some of the association between birth spacing and income rank. This is because parents with children who are close in age have relatively scarce resources (compared to parents with children who are spaced further apart) to invest in each sibling during (or after) childhood (e.g. Powell & Steelman 1993). As a result, parents could choose different birth spacing depending on their earning potential. Therefore, the household disposable income for each sibling is calculated when they were between ages 8 to 16

4 For further discussion about the physiological effects of spacing, see Conde-Audelo et al. (2006) and Zhu et al. (1999).

years.[5] The variable is also measured in ranks, transformed in a similar fashion as the dependent variable, and contains the disposable income of both parents.[6]

Education level of each sibling is also included, which is hypothesized to work as a mediator between birth spacing and income rank, due to the high correlation between education and income. Education is measured as the individual's highest educational degree at age 42 and has been divided into four levels: i) primary and lower secondary school, ii) upper secondary school, iii) bachelor level, iv) master level and above.

3.2 The analytical strategy

The first step in the analysis was to disentangle the association of birth spacing from birth order; since our sample only includes two-child families, we do not need to worry about any potential sibship size effects. We are also interested in whether there are any differences in the association between birth spacing and income rank for first- vs. second-born siblings. We can plot the coefficient dummies and detect the exact shape of income ranks for our two groups: first- and second-born children. Buckles and Munnich (2012) have adopted an alternative approach by estimating separate models for older and younger siblings. However, having both siblings in the same model is a much more straightforward approach than estimating separate models.[7] By including both siblings in the same model, we are able to detect whether birth spacing really has an association, as Zajonc (1976) postulates. We therefore begin by estimating the following ordinary least square model:

$$\begin{aligned} Income\ rank_i \\ &= \alpha + \beta_1(First\ Born_i) + \gamma(Spacing\ Dummies_i) \\ &+ \theta(Spacing\ Dummies_i * First\ Born_i) + \varphi X_i + \varepsilon_i \end{aligned}$$

where i is an index for the individual. $\mathrm{Income\ rank_i}$ is the earned income rank of individual i. $\mathrm{First\ Born_i}$ indicates whether the individual i is the oldest sibling. $\mathrm{Spacing\ Dummies_j}$ is the birth spacing of each individual in relation to her sibling in the family j, divided into 20 dummies: the first dummy indicating spacing between 9 and 18 months is set as the reference category (which includes 12,116 cases). Thereafter, each dummy represents four-month intervals, and the two last dummies include all individuals with a birth spacing between 91 and 131 months.[8] $\mathrm{Spacing\ Dummies_j} * \mathrm{First\ Born_i}$ is a vector of the interaction between birth spacing and birth order, and ε_i is a disturbance term. One advantage of using an interaction model with birth order and 20 different birth-spacing dummies is that it would capture any non-linearity associations, thereby allowing short and long birth-spacing intervals to have different association with income rank for

5 A lower bound for household disposable income of 8 years was chosen based on the availability of data. Income information is available only as of 1968; in that year, the older sibling would have been 8 years old. For more information, see Shahbazian (2018).

6 For more information about disposable income between 1968 and 1989, see Hjalmarsson et al. (2015).

7 Models for first- and second-born siblings, respectively, following Buckles and Munnich (2012), have also been estimated, without altering the results below.

8 Birth spacing dummies of 3, 6, and 12 months have also been used without altering the results below.

both first- and second-born siblings. The following covariates are included stepwise in the model: Mother's and Father's age at birth, education level of both parents, household disposable income, and education level of the individual. Where X_i is a vector of the above characteristics of individual i, please see section *The Variables included in the study* for a rationale behind including these covariates.

3.3 *Descriptive statistics*

Table 1 shows the summary statistics based on the analytical population in this study. As can be seen, the siblings' income rank is slightly above average in the labour market: 58.27 for first-born siblings and 56.30 for the second born. First-born siblings have higher level of education than second-born siblings, which is in line with previous findings (e.g. Härkönen 2014)

Mothers' age at birth of their firstborn is lower compared to their age of the birth of their second-born child. The same pattern holds for fathers; however. fathers tend to be somewhat older when they become parents compared to mothers. Mothers tend to have lower level of education compared to fathers. For instance, 60 per cent of mothers have an education level equivalent to primary or lower secondary school, compared to 49 per cent for fathers. The mean age of mothers at the birth of their first-born children is 24.44 years of age and for second-born, 27.73 years. The corresponding mean values for fathers' age at the children's birth are 27.38 years and 30.67 years. The length of education for mothers and fathers is 9.25 and 9.73 years, respectively. Table 1 also shows the distribution of household income rank at ages 8 to 16 years for each sibling. The household income rank is higher during the second-born siblings' childhood compared to the firstborns'; the difference is 2.69 ranks, suggesting that parents had become more established in the labour market by the time they had their second child. Furthermore, the distribution of sex is fairly equal, even if there is a small over-representation of men: 51.38 per cent men and 48.62 per cent women.

Table 1 also shows the distribution of birth spacing across the 20 spacing dummies. The reference category (9–18 month spacing) contains 6.27 per cent of the analytical population (i.e. 12,116 observations). The distribution of birth spacing is left skewed; 64.12 per cent have a birth spacing of less than 43 months, and 91.09 per cent have a birth spacing of less than 63 months. The year of birth of each sibling is slightly concentrated around 1964–67, which is a consequence of the closed window approach discussed in above.

Table 1: Descriptive statistics

	Both siblings		First-born sibling		Second-born sibling	
	Mean / %	Nr	Mean / %	Nr	Mean / %	Nr
Earned income rank	57.28	193,318	58.27	96,659	56.30	96,659
Education:						
Primary & lower secondary	5.88 %	193,318	6.05 %	96,659	5.71 %	96,659
Upper secondary	51.11 %	193,318	49.32 %	96,659	52.90 %	96,659
Bachelor level	32.16 %	193,318	33.41 %	96,659	30.91 %	96,659
Master & above	10.85 %	193,318	11.22 %	96,659	10.48 %	96,659
Mother's age at birth						
Below age 20	5.47 %	193,318	10.21 %	96,659	0.74 %	96,659
Age 20	4.33 %	193,318	7.08 %	96,659	1.57 %	96,659
Age 21	5.69 %	193,318	8.25 %	96,659	3.12 %	96,659
Age 22	6.95 %	193,318	9.10 %	96,659	4.79 %	96,659
Age 23	8.00 %	193,318	9.77 %	96,659	6.24 %	96,659
Age 24	8.65 %	193,318	9.75 %	96,659	7.56 %	96,659
Age 25	9.03 %	193,318	9.57 %	96,659	8.49 %	96,659
Age 26	8.99 %	193,318	8.67 %	96,659	9.30 %	96,659
Age 27	8.18 %	193,318	6.88 %	96,659	9.48 %	96,659
Age 28	7.35 %	193,318	5.42 %	96,659	9.28 %	96,659
Age 29	6.24 %	193,318	4.19 %	96,659	8.29 %	96,659
Age 30	5.15 %	193,318	3.05 %	96,659	7.26 %	96,659
Age 31	4.01 %	193,318	2.26 %	96,659	5.76 %	96,659
Age 32	3.19 %	193,318	1.76 %	96,659	4.63 %	96,659
Age 33	2.34 %	193,318	1.18 %	96,659	3.49 %	96,659
Age 34	1.85 %	193,318	0.92 %	96,659	2.78 %	96,659
Age 35	1.36 %	193,318	0.65 %	96,659	2.08 %	96,659
Age 36	1.00 %	193,318	0.45 %	96,659	1.55 %	96,659
Age 37	0.76 %	193,318	0.35 %	96,659	1.17 %	96,659
Age 38	0.52 %	193,318	0.21 %	96,659	0.82 %	96,659
Age 39	0.37 %	193,318	0.12 %	96,659	0.62 %	96,659
Above age 39	0.57 %	193,318	0.16 %	96,659	0.98 %	96,659
Father's age at birth						
Below age 20	0.84 %	193,318	1.63 %	96,659	0.04 %	96,659
Age 20	1.42 %	193,318	2.68 %	96,659	0.16 %	96,659
Age 21	2.40 %	193,318	4.25 %	96,659	0.56 %	96,659
Age 22	3.66 %	193,318	5.96 %	96,659	1.36 %	96,659
Age 23	4.90 %	193,318	7.28 %	96,659	2.53 %	96,659
Age 24	6.01 %	193,318	8.01 %	96,659	4.01 %	96,659
Age 25	7.12 %	193,318	8.87 %	96,659	5.37 %	96,659
Age 26	7.89 %	193,318	9.20 %	96,659	6.59 %	96,659
Age 27	8.35 %	193,318	8.93 %	96,659	7.77 %	96,659
Age 28	8.15 %	193,318	7.97 %	96,659	8.32 %	96,659
Age 29	7.90 %	193,318	7.07 %	96,659	8.73 %	96,659
Age 30	7.15 %	193,318	5.81 %	96,659	8.50 %	96,659
Age 31	6.29 %	193,318	4.68 %	96,659	7.91 %	96,659
Age 32	5.43 %	193,318	3.75 %	96,659	7.12 %	96,659
Age 33	4.54 %	193,318	3.04 %	96,659	6.05 %	96,659
Age 34	3.75 %	193,318	2.41 %	96,659	5.08 %	96,659
Age 35	3.00 %	193,318	1.92 %	96,659	4.07 %	96,659
Age 36	2.43 %	193,318	1.54 %	96,659	3.33 %	96,659
Age 37	1.95 %	193,318	1.22 %	96,659	2.69 %	96,659
Age 38	1.56 %	193,318	0.94 %	96,659	2.18 %	96,659
Age 39	1.25 %	193,318	0.70 %	96,659	1.80 %	96,659
Above age 39	3.99 %	193,318	2.14 %	96,659	5.85 %	96,659

Table 1: Descriptive statistics (continued)

Mother's education:						
Primary & lower secondary	60.24 %	193,318	-	-	-	-
Upper secondary	29.97 %	193,318	-	-	-	-
Bachelor level	9.74 %	193,318	-	-	-	-
Master level & above	0.05 %	193,318	-	-	-	-
Father's education						
Primary & lower secondary	49.31 %	193,318	-	-	-	-
Upper secondary	38.95 %	193,318	-	-	-	-
Bachelor level	11.10 %	193,318	-	-	-	-
Master level & above	0.64 %	193,318	-	-	-	-
Household disposable rank	50.14	,193,318	48.80	96,659	51.49	96,659
Female	48.62 %	93,990	48.67 %	47,040	48.57 %	46,950
Spacing in months						
9–18	6.27 %	12,116	-	-	-	-
19–22	6.36 %	12,296	-	-	-	-
23–26	8.89 %	17,184	-	-	-	-
27–30	9.72 %	18,788	-	-	-	-
31–34	11.40 %	22,044	-	-	-	-
35–38	12.13 %	23,454	-	-	-	-
39–42	9.35 %	18,074	-	-	-	-
43–46	8.24 %	15,934	-	-	-	-
47–50	7.01 %	13,550	-	-	-	-
51–54	4.87 %	9,406	-	-	-	-
55–58	3.87 %	7,472	-	-	-	-
59–62	2.98 %	5,762	-	-	-	-
63–66	2.07 %	4,000	-	-	-	-
67–70	1.69 %	3,272	-	-	-	-
71–74	1.31 %	2,524	-	-	-	-
75–78	0.93 %	1,806	-	-	-	-
79–82	0.79 %	1,518	-	-	-	-
83–86	0.41 %	788	-	-	-	-
87–90	0.61 %	1,188	-	-	-	-
91–131	1.11 %	2,142	-	-	-	-
Year of birth						
1960	5.59 %	10,800	11.17 %	10,799	0.00 %	1
1961	6.33 %	12,246	12.22 %	11,807	0.45 %	439
1962	7.40 %	14,309	12.63 %	12,206	2.18 %	2,103
1963	9.42 %	18,201	13.27 %	12,822	5.56 %	5,379
1964	11.47 %	22,173	13.64 %	13,189	9.29 %	8,984
1965	12.58 %	24,310	13.40 %	12,956	11.75 %	11,354
1966	12.49 %	24,153	11.85 %	11,452	13.14 %	12,701
1967	11.22 %	21,681	8.00 %	7,730	14.43 %	13,951
1968	8.75 %	16,907	3.30 %	3,188	14.19 %	13,719
1969	7.50 %	14,499	0.53 %	508	14.47 %	13,991
1970	7.26 %	14,039	0.00 %	2	14.52 %	14,037

Note: Swedish administrative register data, compiled by the author.

4. Results

The results for the relationship between birth spacing and income rank are shown in Figure 2. By plotting the coefficients of the interaction terms from Model 3 to 7 (including the confounders and the mediator stepwise), the exact shape of the different birth-spacing intervals for both first- and second-born siblings will be examined. All analyses are performed by OLS regressions and the reference category is second-born siblings with birth spacing below 19 months. A full table of all the results is presented in Appendix A Table A1. Model 1 shows that first-born siblings have higher income ranks than their younger siblings. Model 2 includes the birth-spacing variables. Moving on to the results in Figure 2 Panel A, we can detect a nonlinear association between birth spacing and income rank for both first- and second-born siblings. However, potential confounders have not been adjusted for, which might bias the results.

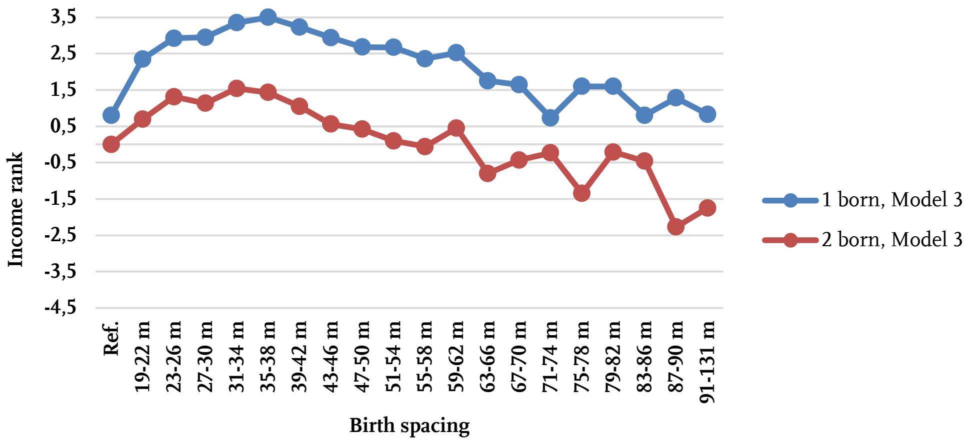
4.1 Including the confounders and the mediator

As discussed earlier, a potential confounder between birth spacing and future outcomes of siblings are the parents' age at the children's birth, since it is likely that as the parents' age increases, their physiological reproductive capacity decreases and, moreover, studies indicate that health problems after birth are significant predictors of adulthood outcomes (e.g. Currie & Hyson 1999). Panel B in Figure 2 shows the result from when parents' age at birth is included. The birth-spacing function for firstborns shifts slightly upwards; this is especially evident for the reference category. Thus, the difference in income rank for first- and second-born siblings, with spacing less than 19 months, has increased from 0.8 to 1.67 income ranks. One explanation behind this large shift in the reference category might be that close birth spacing worsens the mothers' nutritional status (Winkvist et al. 1992). When it comes to second-born siblings, we detect two distinctive changes. Firstly, birth spacing no longer has any association with income rank for more closely spaced intervals (up to 38 months), since it fluctuates around zero. Secondly, longer birth spacing seems to have a negative association with income rank for younger siblings' income rank.

Characteristics of parents can also potentially confound some of the effects of birth spacing on children's future outcomes (see, Rosenzweig 1986). Parental characteristics, such as time preference and careful family planning, might be associated with parental education. It is important to note that parental education would not explain the differences *within* the sibling pairs. However, it can explain some of the differences *between* sibling pairs, that is, between families. Panel C in Figure 3 shows how the birth-spacing functions change when the highest education level of both parents is included. There is one distinctive difference between models 4 and 5: longer spacing intervals for both first- and second-born siblings no longer have a steep decreasing gradient. In model 5, first-born siblings with longer spacing have now stabilized somewhat. Although a slight decreasing pattern is still evident for longer spaced second-born siblings (more than 50 months), the gradient is no longer as steep as in model 4 (without parents' education). It is interesting to note that there is no substantive change in short spacing intervals for the second-born sibling from parent's education.

Figure 2: Income rank across birth spacing intervals

Panel A: Estimates from model 3, *interaction terms*



Panel B: Estimates from models 3 and 4, controlling for *parent's age at birth*

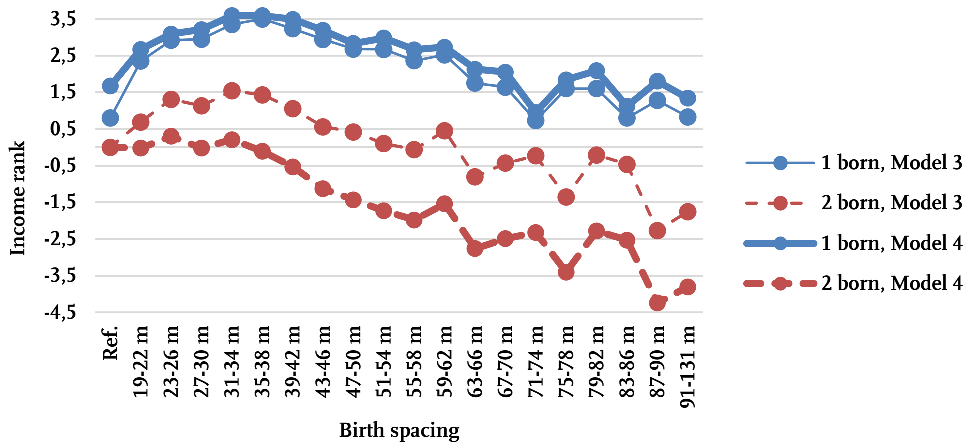
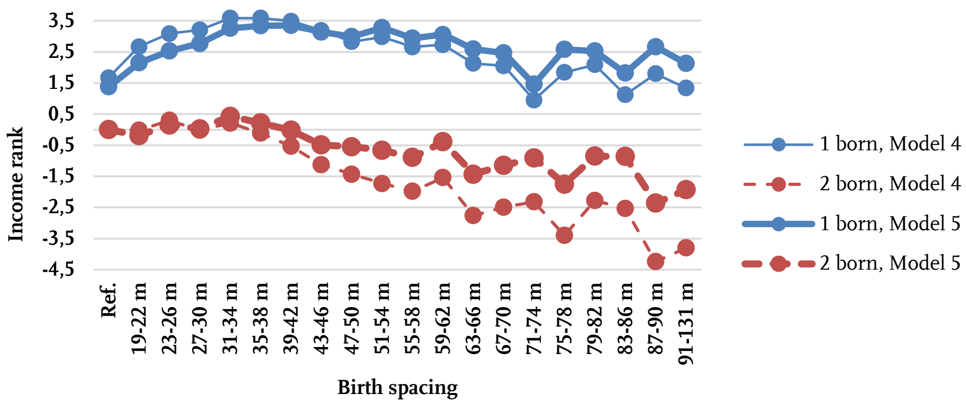


Figure 2: Income rank across birth spacing intervals (continued)

Panel C: Estimates from models 4 and 5, *parents' education*



Panel D: Estimates from models 5 and 6, *household income rank*

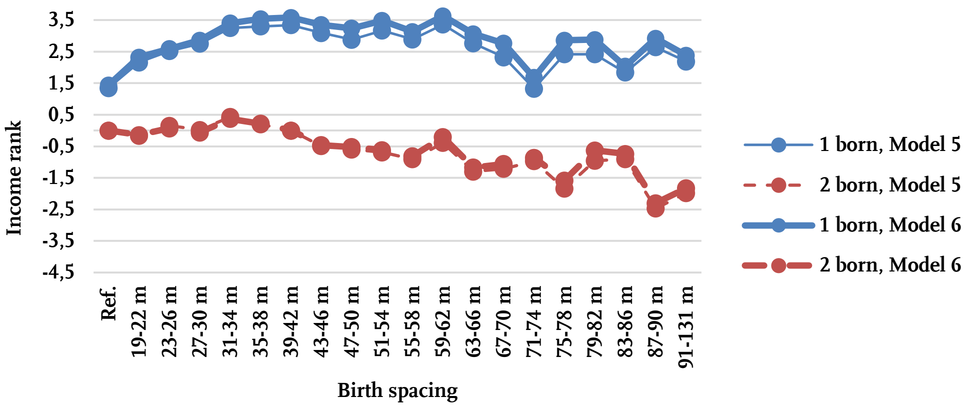
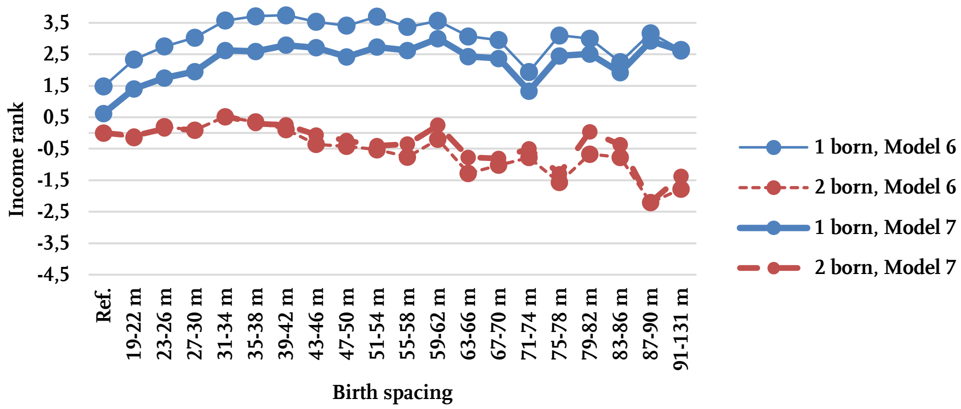


Figure 2: Income rank across birth spacing intervals (continued)

Panel E: Estimates from models 6 and 7, *education*



Note: The blue line illustrates how income rank changes for first-born siblings depending on the age difference between them and their younger sibling. The dashed orange line depicts the same thing but for the second-born siblings. On the Y-axis is income rank, while the X-axis represents the length of birth spacing between sibling pairs. The ref. category includes all siblings who have an age difference less than 19 months.

A third confounding factor of birth spacing on income rank can be argued to be the resources invested in each sibling during (or after) childhood. The total household income that can be invested in each sibling is potentially higher for the first- than second-born child since the firstborn is the only child in the household until the second child is born. Moreover, this difference in resources intensifies as the spacing between siblings increases. Panel D in Figure 2 shows the plotted coefficients for models 5 and 6 in Table A1, with and without disposable household income rank of siblings at ages 8 to 16. There is an increase in income rank for first-born siblings, but after around 46 months spacing, the increase in income rank has stabilized. This might be because, as the birth spacing between siblings increases, relatively more resources are available in the household to be invested entirely in the firstborn. However, with the arrival of the second child, the household's resources have to be divided between the two siblings. Turning our attention to the spacing function for second-born siblings, we see that it is almost identical to model 5, implying that the household income rank during childhood does not have any effect on them. The explanation behind this finding might be that during the entire childhood of the second born the resources are divided with the first-born sibling, independent of the birth spacing between the siblings.

Education is strongly correlated with income; as a result, education can be hypothesized to work as a mediator between birth spacing and income rank. Panel E in Figure 2 shows the plotted coefficients for models 6 and 7 in Table A1: how the birth spacing functions change when the length of education of each sibling is included. The results show that the income rank for first-borns decreases by approximately 1 income rank. However, for second-born siblings, education seems to have no association for short birth-spacing intervals (up to approximately 42 months) and a marginal association for longer birth spaced intervals (over 42 months). It is interesting that education mainly affects first-born siblings. Putting it differently, individuals' education reduces the magnitude of the gap between first- and second-born siblings. However, it does not alter how first- or second-born siblings are associated by different birth-spacing intervals (i.e., by the shape of the birth-spacing function). Nevertheless, if education mediates some of the association from birth spacing to income rank (as we have hypothesized in the section *potential positive and negative impacts*), then we should be interested in the association of spacing before including education in our model.

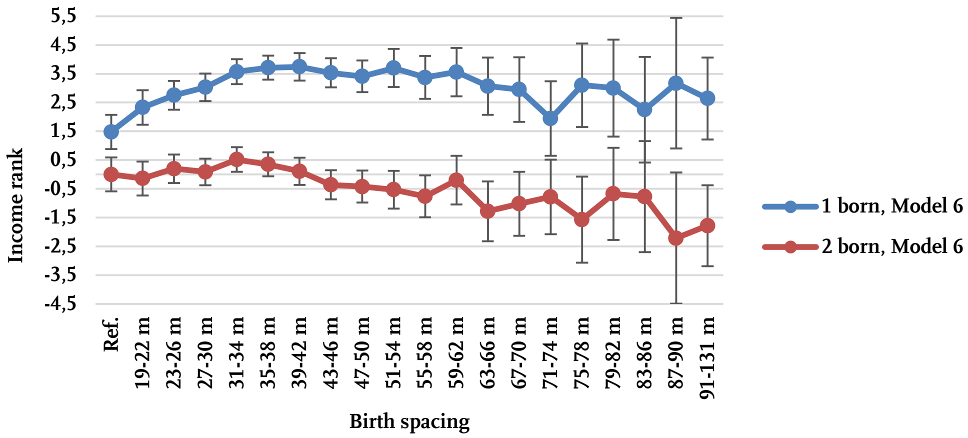
4.2 The association between birth spacing and long-term income rank

Figure 3 shows the results of birth spacing on income rank after including the confounders in the analysis. Starting with first-born siblings, we can clearly detect a first-born advantage of 1.44 income ranks, indicated by the shortest birth-spacing interval. As the birth spacing increases up to about 34 months, the income rank of the first-born siblings also increases, which implies that they are benefiting from the age difference between them and their younger siblings. However, between spacing intervals of 35 and 62 months, the income rank is almost flat, indicating that the increased age difference no longer has any additional benefits for first-born siblings. The pattern starts to fluctuate after birth-spacing intervals of 62 months, even if it still is positive. The first, second, and sixth hypothesis are therefore rejected, since first-born sibling's income rank shows increases across birth spacing.

Turning our attention towards second-born siblings, the pattern of the birth spacing is quite different for first-born siblings. Two somewhat different phases can be observed. Firstly, the estimated association between birth spacing and income rank for short spacing intervals (up to 34 months) seems to be negligible for second-born children, since the function fluctuates around zero. However, after 34 months a slight decreasing pattern emerges as birth spacing increases. It should be noted that 91.09 per cent of the analytical population have a birth spacing of less than 63 months, and the fluctuations is similar to random noise. As a result, the fifth hypothesis is not supported.

All in all, there seems to be some support for the fourth and especially third hypotheses. Although longer birth spacing is associated with somewhat lower income rank, the magnitude is not far from zero.

Figure 3: First- and second-born siblings income rank across birth-spacing intervals

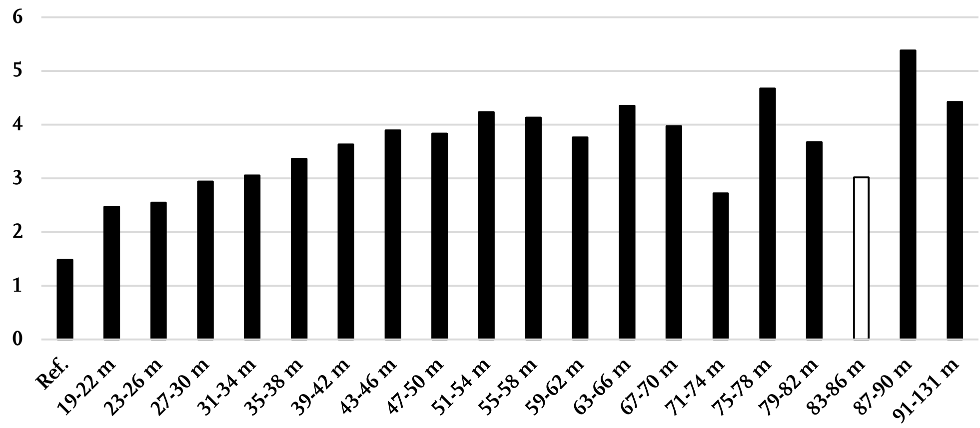


Note: The blue line illustrates how income rank changes for first-born siblings depending on the age difference between them and their younger sibling. The dashed orange line depicts the same thing but for the second-born siblings. On the Y-axis is income rank, while the X-axis represents the length of birth spacing between sibling pairs. The ref. category includes all siblings who have an age difference less than 19 months. The four vertical red lines indicate the different phases for first- and second-born siblings.

4.3 The income rank gap between siblings with different birth-spacing intervalls

So far, we have focused on the association between birth spacing for first- and second-born siblings and not the gap between them per se. Figure 4 shows the gap in income rank between first- and second-born siblings depending on the birth intervals, and indicate a clear gap in income rank as birth-spacing intervals increase. However, for birth spacing more than 54 months the income rank gap starts to fluctuate, although it is still positive. Siblings with birth spacing less than 19 months have the smallest income rank gap, 1.44, while the largest gap can be seen for siblings with a birth spacing between 87 and 90 months: 5.16 income ranks.

Figure 4: The gap in income rank between first- and second-born siblings with different birth-spacing intervals



Note: The bars illustrate the difference in income rank between first- and second-born siblings derived from Figure 3. On the Y-axis is income rank, while the X-axis represents the length of birth spacing between sibling pairs. The ref. category includes all siblings who have an age difference of less than 19 months. The black bar indicates that there is a significant difference (95 % level) in income rank gap between siblings, white bars indicate a non-significant gap.

5. Discussion

The paper adopts a restrictive two-child-family strategy in order to analyse the association between birth spacing and first- and second-born siblings' long-run income rank, which can be viewed as the ultimate indicator for socio-economic standing in the labour market. The analytical research strategy has been designed to cancel out the "nurture" differences between siblings as much as possible, by including only biological children of parents who have only two children (excluding step-siblings, adoptive siblings, and also twins).

The results show that when the association of birth spacing is disentangled from birth order, at the common spacing intervals (below 5 years), spacing has a negligible impact on second-born children. This result has the same pattern as Buckles and Munnich's (2012) results for test scores: age difference does not seem to have any effect on the younger siblings' test scores. However, as spacing between the siblings increases, the income rank of the second-borns starts to become slightly negative. This result goes against the predictions of confluence model, which states that as birth spacing increases, it would mediate the effect of birth order (Zajonc, 1976).

Moving on to first-born siblings, this study clearly indicates an association between increased birth spacing and lifetime income rank. Firstly, first-born children seem to suffer when a younger sibling is born when they are very young. However, as the spacing between the siblings increases, the first-borns' income rank also increases. This finding is similar to Price (2012), where he finds that parents' time investment in the oldest child increases as the age difference between the first and second-born children increases. The result for first-born siblings is in line with the resource dilution model, which predicts that with increased birth spacing the first-born sibling benefits from being the only child in the family. It can also be argued that as the age difference between siblings increases, the older siblings have more opportunity to discover solutions for themselves and learn from trial and error without the interference of a sibling close in age and/or the help of their parent(s). In this way, the children develop self-reliance and resourcefulness, which will serve them well later in life as these skills are in high demand in the labour market. Another explanation for the benefits of increased spacing might have for the first-born siblings is that, in adolescence, firstborns have to fight, negotiate and/or bargain for boundaries (without the backing of a sibling who is close in age). During this process of setting and defining boundaries with their parents, first-borns acquire another skill that can be quite productive in the labour market and result in higher income. Secondly, after approximately 3 years of spacing, income rank flattens out and for longer birth intervals (above 63 months) starts to fluctuate somewhat, which can be due to fewer cases in longer spacing dummies. One explanation behind the flattening out of income rank, might be that norm and boundaries set in the family, have become less enforced for the second-born children (Whiteman et al. 2003), and therefore the skills necessary in the labour market (such as negotiating, fighting and/or bargaining) have not been taught to the second child. All in all, the results seem to support the third hypothesis, since there is a positive association of birth spacing for first-born siblings and although longer birth spacing is associated with somewhat lower income rank for second-born siblings, the magnitude is not far from zero.

A relevant question at this stage is whether the gap in income rank of 1.44 to 5.16, depending on the birth-spacing intervals, is large or small. One way to evaluate these magnitudes is to translate one income rank into monetary terms. However, an increase of one income rank has different values depending on where on the income distribution the individual is. Comparing individuals at the 10, 50 and 90 percentile in the 2012 income distribution, an increase of one income rank is approximately equal to 90 (*700*), 300 (*2500*) and 600 (*5000*) euro (*SEK*) at a yearly basis.

Using prospective administrative data, which assess both exposure and outcome with a forward-looking perspective, increases the reliability of the results. However, administrative data also have its limitation. Individuals' opinions, attitudes, expectation etc., are not included, and thus pose a challenge for testing the importance of different mechanisms. Future research should focus on testing which mechanisms are more important. For instance, empirically evaluating the importance of confrontation and negotiation skill as a mechanism for the increasing association of income rank that can be seen for first-born siblings, but not second-born siblings.

Many countries have embarked on implementing extensive family policy reforms (Blum 2014). Many of these social policy reforms provide incentives, such as maternity regulations, parental-leave policy, childcare services, and child benefits, that influence parents' fertility decisions (Neyer 2003), both the timing and length between pregnancies. Focusing on whether and how these reforms change the interaction between siblings, and the life-chances of individuals is vital from an equality of opportunity perspective (Roemer 1998).

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References

Barclay, K.J. (2014). *The long-term impact of birth order on health and educational attainment*. Stockholm: Department of Sociology, Stockholm University.

Barclay, K.J. & Kolk, M. (2017) The long-term cognitive and socioeconomic consequences of birth intervals: a within-family sibling comparison using Swedish register data. *Demography*, 54, 2, 459-484. https://doi.org/10.1007/s13524-017-0550

Behrman, J. R., & Rosenzweig, M. R. (2004). Returns to birthweight. *Review of Economics and statistics*, 86, 2, 586-601. https://doi.org/10.1162/003465304323031139

Björklund, A., Jäntti, M. & Roemer J.E. (2012). Equality of opportunity and the distribution of long-run income in Sweden. *Social Choice and Welfare*, 39, 4, 675-696. https://doi.org/10.1007/s00355-011-0609-3

Bharadwaj, P., Lundborg, P., & Rooth, D.O. (2018). Birth weight in the long run. *Journal of Human Resources*, 53, 1, 189-231. https://doi.org/10.3368/jhr.53.1.0715-7235R

Black, S.E., Devereux, P.J. & Salvanes, K.G. (2011). Older and wiser? Birth order and IQ of young men. *CESifo Economic Studies*, 57, 1, 103-120. https://doi.org/10.1093/cesifo/ifq022

Blake, J. (1981). Family size and the quality of children. *Demography*, 18, 4, 421-442. https://doi.org/10.2307/2060941

Blum, S. (2014). No need to reinvent the wheel: family policy transfers in Germany and Austria. *Policy Studies*, 35, 4, 357-376. https://doi.org/10.1080/01442872.2013.875153

Buckles, K.S. & Munnich, E.L. (2012). Birth spacing and sibling outcomes. *Journal of Human Resources*, 74, 3, 613-642. https://doi.org/10.3368/jhr.47.3.613

Böhlmark, A. & Lindquist, M.J. (2006). Life-cycle variations in the association between current and lifetime income: Replication and extension for Sweden. *Journal of Labor Economics*, 24, 4, 879-896.
https://doi.org/10.1086/506489

Carlsson, F., Johansson-Stenman, O. & Martinsson, P. (2007). Do you enjoy having more than others? Survey evidence of positional goods. *Economics*, 74, 296, 586-598.
https://doi.org/10.1111/j.1468-0335.2006.00571

Conde-Anguelo A., Rosas-Bermudez, A. & Kafury-Goeta, A.C. (2006). Birth spacing and risk of adverse perinatal outcome: A meta-analysis. *Journal of the American Medical Association*, 295, 15, 1809-1823.
https://doi.org/10.1001/jama.295.15.1809

Conley, D. & Glauber, R. (2008). All in the family? Family composition, resources, and sibling similarity in socioeconomic status. *Research in Social Stratification and Mobility*, 26, 4, 297-306.
https://doi.org/10.1016/j.rssm.2008.08.003

Cunha, F. & Heckman, J.J. (2007). The technology of skill formation. *American Economic Review*, 97, 2, 31-47.
https://doi.org/10.3386/w12840

Currie, J. & Hyson, R. (1999). Is the impact of health shocks cushioned by socioeconomic status? The case of low birthweight. *American Economic Review*, 89, 2, 245-250.
https://doi.org/10.1257/aer.89.2.245

Fallesen, P. & Breen, R. (2016). Temporary life changes and the timing of divorce. *Demography*, 53, 5, 1377-1398.
https://doi.org/10.1007/s13524-016-0498-2

Glick, P.C., & Miller, H.P. (1956). Educational level and potential income. *American Sociological Review*, 21, 3, 307-312.

Heiland, F. (2011). Does the birth order affect the cognitive development of a child? *Applied Economics*, 41, 14, 1799-1818.
https://doi.org/10.1080/00036840601083220

Hjalmarsson, S., Mood, C. & Shahbazian, R. (2015). Kodbok för Inkomstvariabler 1968-89 (*In English: Codebook for income variables 1968-89*). The Swedish Institute for Social Research.

Hofferth, S.L. & Anderson, K.G. (2004). Are all dads equal? Biology versus marriage as a basis for parental investment. *Journal of Marriage and Family*, 65, 1, 213-232.
https://doi.org/10.1111/j.1741-3737.2003.00213.x

Houthakker, H. S. (1959). Education and income. *The Review of Economics and Statistics*, 41, 1, 24-28.
https://doi.org/10.2307/1925454

Härkönen, J. (2014). Birth order effects on educational attainment and educational transitions in West Germany. *European Sociological Review*, 30, 2, 166-179.
https://doi.org/10.1093/esr/jct027

Kantarevic, J. & Mechoulan, S. (2006). Birth order, educational attainment, and earnings: An investigation using the PSID. *The Journal of Human Resources*, 41, 4, 755-777.
https://doi.org/10.3368/jhr.XLI.4.755

Knudsen, E. I., Heckman, J. J., Cameron, J. L. & Shonkoff, J.-P. (2006). Economic, neurobiological, and behavioral perspectives on building America's future workforce. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 27, 10155-10162.
https://doi.org/10.1073/pnas.0600888103

Lindqvist, E., & Vestman, R. (2011). The labor market returns to cognitive and noncognitive ability: Evidence from the Swedish enlistment. *American Economic Journal: Applied Economics*, 3, 1, 101-28.
https://doi.org/10.1257/app.3.1.101

Neyer, G. (2003). Family policies and low fertility in Western Europe. *MPIDR Working Paper, WP 2003-021.* Max Planck Institute for Demographic Research, Rostock.

Psacharopoulos, G., & Patrinos, H.A. (2004). Returns to investment in education: a further update. *Education economics*, 12, 2, 111-134.
https://doi.org/10.1080/0964529042000239140

Pettersson-Lidbom, P. & Skogman Thoursie, P. (2009). Does child spacing affect children's outcomes? Evidence from a Swedish reform. *IFAU Working Paper 2009:7.*

Powell, B. & Steelman L.C. (1993). The educational benefits of being spaced out: Sibship density and educational progress. *American Sociological Review*, 58, 3, 367-381.
https://doi.org/10.2307/2095906

Price, J. (2008). Parent-child quality time: Does birth order matter? *Journal of Human Resources*, 43, 1, 240-265.
https://doi.org/10.3368/jhr.43.1.240

Price, J. (2012). The effect of parental time investments: Evidence from natural within-family variation. *NBER Working Paper.*

Roemer, J.E. (1998), *Equality of opportunity*, Harvard University Press, Cambridge MA.

Rosenzweig, M.R. (1986). Birth spacing and sibling inequality: Asymmetric information within the household. *International Economic Review*, 27, 1, 55-76.
https://doi.org/10.2307/2526607

Shahbazian, R. (2017). Is there any difference between having a brother or having a sister? The association between sex-composition and socioeconomic outcomes in Swedish two-and three-child families. *Journal of Family Studies.*
https://doi.org/10.1080/13229400.2017.1406392

Shahbazian, R. (2018). *Sibling configuration and adulthood outcomes: The case of two-child families.* Doctoral thesis. Stockholm: Swedish Institute for Social Science Research Series nr 100, Stockholm University.

Shanahan, L., McHale, S. M., Osgood, D. W., & Crouter, A. C. (2007). Conflict frequency with mothers and fathers from middle childhood to late adolescence: Within- and between-families comparisons. *Developmental Psychology*, 43, 3, 539-550.
https://doi.org/10.1037/0012-1649.43.3.539

Statistics Sweden (2008). Multi-generation register 2007 – A description of contents and quality.
http://www.scb.se/statistik

Statistics Sweden (2017). Statistical database.
http://www.statistikdatabasen.scb.se/pxweb/sv/ssd/START__LE__LE0102__LE0102C/LE0102T22/ [retrieved July 15, 2010]

Steelman, L. C., Powell, B., Werum, R., Carter, C. (2002). Reconsidering the effects of sibling configuration: Recent advances and challenges. *Annual Review of Sociology*, 28, 243–269.
https://doi.org/10.1146/annurev.soc.28.111301.093304

Whiteman, S.D., McHale, S.M. & Crouter, A.C. (2003). What parents learn from experience: The first child as a first draft? *Journal of Marriage and Family*, 65, 3, 608-621.
https://doi.org/10.1111/j.1741-3737.2003.00608.x

Winkvist, A., Rasmussen K.M., & Habicht, J.P (1992). A new definition of maternal depletion syndrome. *American Journal of Public Health*, 82, 5, 691-694.
https://doi.org/10.2105/ajph.82.5.691

WHO (2005). *Report of a WHO technical consultation on birth spacing*. Geneva, Switzerland: World Health Organization.

Zajonc, R.B. (1976). Family configuration and intelligence, *Science*, 192, 4236, 227-236.
https://doi.org/10.1126/science.192.4236.227

Zajonc, R. B. & Markus, H. (1975). Birth order and intellectual development. *Psychological Review*, 82, 1, 74-88.
https://doi.org/10.1037/h0076229

Zhu, B.P., Rolfs, R.T., Nangle, B.E. & Horal, J.M. (1999). Effect of the interval between pregnancies on perinatal outcomes. *New England Journal of Medicine*, 340, 589-594.
https://doi.org/10.1056/NEJM199902253400801

Appendix

Table A.1: Earned income, spacing and interaction terms

VARIABLES	(1) Model	(2) Model	(3) Model	(4) Model	(5) Model	(6) Model	(7) Model
First-born	1.97***	1.97***	0.80**	1.61***	1.35***	1.44***	0.59
	(0.10)	(0.10)	(0.39)	(0.39)	(0.39)	(0.39)	(0.38)
< 19 months spacing		*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*	*Ref.*
19-22 months spacing		1.12***	0.69	-0.04	-0.17	-0.14	-0.06
		(0.34)	(0.43)	(0.43)	(0.43)	(0.42)	(0.41)
23-26 months spacing		1.72***	1.31***	0.25	0.15	0.07	0.11
		(0.31)	(0.40)	(0.40)	(0.40)	(0.39)	(0.38)
27-30 months spacing		1.64***	1.13***	-0.08	0.02	-0.06	0.03
		(0.31)	(0.39)	(0.39)	(0.39)	(0.38)	(0.37)
31-34 months spacing		2.04***	1.54***	0.14	0.43	0.37	0.45
		(0.29)	(0.38)	(0.38)	(0.38)	(0.37)	(0.36)
35-38 months spacing		2.07***	1.43***	-0.18	0.20	0.22	0.25
		(0.29)	(0.37)	(0.38)	(0.37)	(0.37)	(0.36)
39-42 months spacing		1.74***	1.05***	-0.60	-0.01	-0.01	0.19
		(0.30)	(0.39)	(0.39)	(0.39)	(0.39)	(0.37)
43-46 months spacing		1.35***	0.56	-1.20***	-0.49	-0.46	-0.13
		(0.31)	(0.40)	(0.40)	(0.40)	(0.40)	(0.38)
47-50 months spacing		1.15***	0.42	-1.49***	-0.60	-0.52	-0.29
		(0.32)	(0.42)	(0.42)	(0.42)	(0.41)	(0.40)
51-54 months spacing		0.99***	0.10	-1.79***	-0.69	-0.62	-0.44
		(0.35)	(0.46)	(0.46)	(0.46)	(0.45)	(0.44)
55-58 months spacing		0.75**	-0.06	-2.02***	-0.91*	-0.81*	-0.37
		(0.38)	(0.49)	(0.49)	(0.49)	(0.48)	(0.47)
59-62 months spacing		1.09***	0.45	-1.57***	-0.39	-0.21	0.27
		(0.42)	(0.53)	(0.54)	(0.53)	(0.53)	(0.51)
63-66 months spacing		0.08	-0.80	-2.82***	-1.50**	-1.27**	-0.64
		(0.47)	(0.61)	(0.62)	(0.61)	(0.61)	(0.59)
67-70 months spacing		0.21	-0.43	-2.52***	-1.21*	-1.06	-0.72
		(0.50)	(0.65)	(0.66)	(0.65)	(0.64)	(0.63)
71-74 months spacing		-0.16	-0.23	-2.36***	-0.97	-0.86	-0.58
		(0.56)	(0.73)	(0.74)	(0.73)	(0.73)	(0.70)
75-78 months spacing		-0.28	-1.35	-3.44***	-1.84**	-1.58*	-1.33*
		(0.63)	(0.83)	(0.83)	(0.83)	(0.82)	(0.79)
79-82 months spacing		0.30	-0.21	-2.38***	-0.96	-0.63	0.06
		(0.69)	(0.88)	(0.89)	(0.88)	(0.87)	(0.84)
83-86 months spacing		-0.22	-0.46	-2.57**	-0.90	-0.74	-0.23
		(0.80)	(1.04)	(1.05)	(1.03)	(1.03)	(1.00)
87-90 months spacing		-0.89	-2.27*	-4.25***	-2.47**	-2.30*	-2.22*
		(0.91)	(1.21)	(1.22)	(1.21)	(1.20)	(1.18)
91-131 months spacing		-0.85	-1.75**	-3.83***	-1.98**	-1.83**	-1.37*
		(0.62)	(0.78)	(0.79)	(0.79)	(0.78)	(0.75)

Table A.1: Earned income, spacing and interaction terms (continued)

19-22 months spacing * first born	0.86	1.07*	0.98*	1.02*	0.87
	(0.55)	(0.55)	(0.55)	(0.55)	(0.54)
23-26 months spacing * first born	0.81	1.18**	1.02**	1.08**	0.95*
	(0.51)	(0.51)	(0.51)	(0.51)	(0.50)
27-30 months spacing * first born	1.02**	1.64***	1.38***	1.48***	1.20**
	(0.50)	(0.50)	(0.50)	(0.50)	(0.49)
31-34 months spacing * first born	1.01**	1.80***	1.47***	1.59***	1.48***
	(0.48)	(0.48)	(0.48)	(0.48)	(0.47)
35-38 months spacing * first born	1.27***	2.12***	1.75***	1.88***	1.62***
	(0.48)	(0.48)	(0.48)	(0.48)	(0.47)
39-42 months spacing * first born	1.38***	2.43***	1.99***	2.14***	1.87***
	(0.50)	(0.50)	(0.50)	(0.50)	(0.49)
43-46 months spacing * first born	1.58***	2.72***	2.23***	2.37***	2.09***
	(0.51)	(0.51)	(0.51)	(0.51)	(0.50)
47-50 months spacing * first born	1.46***	2.64***	2.13***	2.32***	2.08***
	(0.53)	(0.53)	(0.53)	(0.53)	(0.52)
51-54 months spacing * first born	1.77***	3.08***	2.51***	2.66***	2.44***
	(0.58)	(0.58)	(0.58)	(0.59)	(0.57)
55-58 months spacing * first born	1.62**	3.01***	2.40***	2.60***	2.32***
	(0.63)	(0.64)	(0.63)	(0.63)	(0.62)
59-62 months spacing * first born	1.27*	2.62***	2.01***	2.16***	2.04***
	(0.67)	(0.68)	(0.68)	(0.68)	(0.66)
63-66 months spacing * first born	1.75**	3.27***	2.61***	2.79***	2.51***
	(0.78)	(0.78)	(0.78)	(0.78)	(0.76)
67-70 months spacing * first born	1.27	2.89***	2.18***	2.38***	2.34***
	(0.84)	(0.84)	(0.84)	(0.84)	(0.82)
71-74 months spacing * first born	0.16	1.65*	0.95	1.10	1.09
	(0.95)	(0.96)	(0.95)	(0.96)	(0.93)
75-78 months spacing * first born	2.15**	3.62***	2.91***	3.00***	3.04***
	(1.05)	(1.05)	(1.05)	(1.05)	(1.03)
79-82 months spacing * first born	1.01	2.82**	2.03*	2.07*	1.74
	(1.17)	(1.18)	(1.17)	(1.18)	(1.14)
83-86 months spacing * first born	0.46	2.03	1.26	1.37	1.34
	(1.27)	(1.28)	(1.28)	(1.28)	(1.26)
87-90 months spacing * first born	2.75*	4.35***	3.55**	3.76**	4.40***
	(1.59)	(1.61)	(1.60)	(1.61)	(1.56)
91-131 months spacing * first born	1.78*	3.48***	2.60***	2.78***	3.13***
	(1.00)	(1.01)	(1.00)	(1.01)	(0.98)
Mothers age below age 20		*Ref.*	*Ref.*	*Ref.*	*Ref.*

Table A.1: Earned income, spacing and interaction terms (continued)

Mothers age 20	0.80**	0.46	0.40	0.26
	(0.34)	(0.34)	(0.34)	(0.33)
Mothers age 21	1.68***	1.14***	1.06***	0.72**
	(0.33)	(0.33)	(0.33)	(0.32)
Mothers age 22	2.98***	2.16***	2.03***	1.31***
	(0.33)	(0.33)	(0.32)	(0.31)
Mothers age 23	3.52***	2.40***	2.16***	1.37***
	(0.33)	(0.33)	(0.33)	(0.32)
Mothers age 24	4.46***	2.97***	2.74***	1.65***
	(0.34)	(0.34)	(0.34)	(0.33)
Mothers age 25	5.54***	3.68***	3.37***	2.01***
	(0.35)	(0.35)	(0.34)	(0.33)
Mothers age 26	6.65***	4.41***	3.99***	2.42***
	(0.35)	(0.35)	(0.35)	(0.34)
Mothers age 27	6.98***	4.46***	4.07***	2.45***
	(0.36)	(0.36)	(0.36)	(0.35)
Mothers age 28	7.69***	4.87***	4.40***	2.66***
	(0.38)	(0.38)	(0.37)	(0.36)
Mothers age 29	7.75***	4.64***	4.21***	2.27***
	(0.39)	(0.39)	(0.39)	(0.37)
Mothers age 30	8.15***	4.93***	4.46***	2.42***
	(0.41)	(0.41)	(0.41)	(0.39)
Mothers age 31	8.36***	4.99***	4.58***	2.50***
	(0.43)	(0.44)	(0.43)	(0.41)
Mothers age 32	8.35***	4.97***	4.54***	2.41***
	(0.46)	(0.46)	(0.45)	(0.44)
Mothers age 33	8.71***	5.22***	4.87***	2.59***
	(0.51)	(0.51)	(0.50)	(0.48)
Mothers age 34	9.65***	6.07***	5.68***	3.50***
	(0.54)	(0.54)	(0.53)	(0.51)
Mothers age 35	7.51***	4.12***	3.94***	1.71***
	(0.60)	(0.60)	(0.59)	(0.57)
Mothers age 36	8.81***	5.48***	5.35***	2.95***
	(0.66)	(0.66)	(0.65)	(0.62)
Mothers age 37	9.26***	5.83***	5.69***	3.27***
	(0.75)	(0.74)	(0.73)	(0.70)

Table A.1: Earned income, spacing and interaction terms (continued)

Mothers age 38	8.44***	4.88***	4.92***	2.40***
	(0.88)	(0.87)	(0.86)	(0.82)
Mothers age 39	9.35***	5.95***	6.08***	3.25***
	(1.00)	(0.99)	(0.98)	(0.93)
Mothers age above 39 years	6.62***	3.26***	3.83***	1.07
	(0.87)	(0.87)	(0.86)	(0.81)
Fathers age below age 20		*Ref.*	*Ref.*	*Ref.*
Fathers age 20	0.81	0.81	0.73	0.37
	(0.73)	(0.72)	(0.72)	(0.70)
Fathers age 21	0.72	0.84	0.77	0.10
	(0.67)	(0.67)	(0.66)	(0.64)
Fathers age 22	0.39	0.59	0.57	-0.06
	(0.65)	(0.65)	(0.64)	(0.63)
Fathers age 23	1.14*	1.38**	1.28**	0.64
	(0.64)	(0.64)	(0.63)	(0.62)
Fathers age 24	0.81	1.02	0.87	0.10
	(0.65)	(0.65)	(0.64)	(0.62)
Fathers age 25	0.85	1.02	0.89	-0.04
	(0.65)	(0.65)	(0.64)	(0.62)
Fathers age 26	1.18*	1.41**	1.27**	0.27
	(0.65)	(0.65)	(0.64)	(0.62)
Fathers age 27	1.53**	1.72***	1.60**	0.52
	(0.66)	(0.65)	(0.64)	(0.62)
Fathers age 28	1.16*	1.35**	1.25*	0.09
	(0.66)	(0.66)	(0.65)	(0.63)
Fathers age 29	1.19*	1.47**	1.42**	0.23
	(0.66)	(0.66)	(0.65)	(0.63)
Fathers age 30	1.01	1.36**	1.32**	0.08
	(0.67)	(0.67)	(0.66)	(0.64)
Fathers age 31	0.55	1.00	1.07	-0.16
	(0.67)	(0.67)	(0.66)	(0.64)
Fathers age 32	0.56	1.10	1.25*	-0.02
	(0.68)	(0.68)	(0.67)	(0.65)
Fathers age 33	0.41	1.06	1.32*	0.02
	(0.69)	(0.69)	(0.68)	(0.66)
Fathers age 34	-0.11	0.71	1.13	-0.11
	(0.70)	(0.70)	(0.69)	(0.67)
Fathers age 35	-0.54	0.34	0.78	-0.62
	(0.72)	(0.72)	(0.71)	(0.68)
Fathers age 36	-0.79	0.21	0.85	-0.44
	(0.74)	(0.73)	(0.72)	(0.70)
Fathers age 37	-0.73	0.27	0.88	-0.33
	(0.76)	(0.76)	(0.75)	(0.72)
Fathers age 38	-0.75	0.40	1.06	-0.25
	(0.79)	(0.79)	(0.78)	(0.75)
Fathers age 39	-1.53*	-0.24	0.62	-0.54
	(0.82)	(0.82)	(0.80)	(0.77)
Fathers age above 39 years	-2.91***	-1.54**	-0.36	-1.76**
	(0.73)	(0.73)	(0.72)	(0.69)

Table A.1: Earned income, spacing and interaction terms (continued)

Mother's education:							
Primary & lower secondary					*Ref.*	*Ref.*	*Ref.*
Upper secondary					1.65***	1.01***	0.06
					(0.14)	(0.13)	(0.13)
Bachelor level					4.24***	0.85***	-1.74***
					(0.24)	(0.24)	(0.23)
Master level & above					3.73	-0.20	-3.59
					(3.01)	(2.97)	(2.82)
Fathers' education:							
Primary & lower secondary					*Ref.*	*Ref.*	*Ref.*
Upper secondary					3.41***	2.06***	0.69***
					(0.13)	(0.13)	(0.12)
Bachelor level					7.09***	3.51***	0.01
					(0.23)	(0.23)	(0.22)
Master level & above					8.83***	4.64***	-0.56
					(0.82)	(0.82)	(0.77)
Household disposable rank						0.15***	0.12***
						(0.00)	(0.00)
Own Eduction							
Master level & above							*Ref.*
Bachelor level							-8.61***
							(0.19)
Upper secondary							-17.32***
							(0.19)
Primary & lower secondary							-25.88***
							(0.29)
Constant	56.3***	54.9***	55.5***	50.1***	48.4***	42.4***	61.3***
	(0.08)	(0.24)	(0.31)	(0.66)	(0.66)	(0.66)	(0.67)
Observations	193,318	193,318	193,318	193,318	193,318	193,318	193,318
R-squared	0.002	0.003	0.003	0.012	0.030	0.048	0.115
OLS	YES	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses. OLS estimates with family cluster.

Information in German

Deutscher Titel

Der Einfluss des Geburtsabstands von erst- und zweitgeborenen Geschwistern auf deren langfristigen Einkommensrang: Ein restriktiver Ansatz für Familien mit zwei Kindern

Zusammenfassung

Der Zeitabstand zwischen den Geburten von Geschwistern kann langfristige Folgen für diese haben. Diese wissenschaftliche Arbeit beschäftigt sich damit, wie unterschiedliche Abstände zwischen Geburten mit dem Einkommensrang im Alter zwischen 33 und 42 Jahren verbunden sind. Um den Geburtsabstand von der Geburtsreihenfolge zu trennen und die mögliche Geschwisteranzahl konstant zu halten, wird ein Interaktionsmodel für eine restriktive Subpopulation von Familien mit zwei Kindern, die zwischen 1960 und 1970 geboren wurden, verwendet. Die Ergebnisse dieser Studie zeigen deutliche Unterschiede zwischen erst- und zweitgeborenen Geschwistern. Ein größerer Geburtsabstand von bis zu 3 Jahren wirkt sich positiv auf den Einkommensrang der erstgeborenen Geschwister aus. Der Einfluss des Geburtsabstandes ist bei zweitgeborenen Geschwistern in den üblichen Abstandsintervallen (unter 5 Jahren) unerheblich. Relativ große Abstandsintervalle (über 5 Jahre) sind mit einem etwas niedrigeren Einkommensrang verbunden als Intervalle mittlerer Länge für sowohl erst- als auch zweitgeborene Geschwister.

Schlagwörter: Geburtenabstand, Einkommensrang, Daten des Bevölkerungsregisters, Schweden

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