Effects of fathers' parental leave uptake on continued childbearing in Estonia

Abstract

This study investigates the relationship between fathers' uptake of parental leave and progression to subsequent childbearing—specifically second and third births—in Estonia. Leveraging longitudinal register data covering couples with first or second born between 2003 and 2018, the study employs a mixture cure model that disentangles tempo effects (timing of birth) from quantum effects (the likelihood of having another child), an advancement over conventional survival analyses. A novel contribution is made by linking these register data with survey information on fathers' family orientation and gender role attitudes, alongside the use of birth interval between previous birth as a proxy for unobserved family-oriented characteristics, addressing potential selection issues that were often discussed in existing literature. The findings indicate that fathers' parental leave use is associated with faster transition to subsequent births. Furthermore, statistically significant positive quantum effects are observed for progression to the third child but not the second. Importantly, controlling for family orientation, through the proxy of length of duration between previous births, did not weaken these associations for the third birth — suggesting effects extend beyond selection of more family-oriented fathers. The study also found that the positive effects for the third births were driven by fathers who did not receive labour income during leave period, while no differences were observed between non-users fathers and fathers who took leave but received some labour income at the same time.

Introduction

Parental leave has become a central component of family policy in most low-fertility countries. All European Union member states offer some form of parental leave (European Commission, 2018), though the specific provisions — including duration, benefit levels, flexibility in sharing between parents, and eligibility criteria — may vary considerably. Parental leave policies are designed to achieve multiple objectives: facilitating the reconciliation of work and family life by enabling parents to temporarily exit and subsequently re-enter the workforce, maintaining a significant portion of income during absence from work due to childcare, promoting gender equality both in the labour market and within families, increasing fertility rates, and supporting early childhood development (Thévenon, 2011; Thomas et al., 2022).

In particular, fathers' use of parental leave has attracted significant scholarly interest over the last two decades, as fertility theories grounded on gender equity (Esping-Andersen & Billari, 2015; Goldscheider et al., 2015; McDonald, 2000a, 2013) suggest a positive relationship between fathers' involvement in the private sphere — household and childcare tasks — and fertility, mainly due to its contribution to family-life balance for mothers. The higher fertility rates and greater uptake of parental leave among fathers observed in Nordic countries during the 1990s and early 2000s, compared to other Western countries, have been cited as supporting evidence at the macro level (Duvander et al., 2020). At micro-level, a number of studies have found a positive link between fathers' leave uptake and subsequent childbearing, particularly for the second child (Duvander et al., 2010, 2019, 2020; Duvander & Andersson, 2006). However, these studies have been criticised for potential selection effects. The argument is that fathers who are more family-oriented would self-select into the group of leave users, and who would in any case, have a higher likelihood of having another child. This might have led to an overestimation of the effects of fathers' leave use. Some more recent studies have attempted to address this issue in order to make causal inferences by employing a quasi-experimental design (e.g., Duvander et al., 2020; Hart et al., 2022; Farré & González, 2019). These studies examined the effects of policy reforms, which either introduced or extended paternity leave or reserved a part of shared parental leave for fathers. Unlike earlier correlational studies, these quasi-experimental studies studies did not find significant effects of reforms, neither for Sweden (Duvander et al., 2020) nor for Norway (Hart et al., 2022). Furthermore, Farré and González (2019) found delays and decreases in continued childbearing in response to the introduction of paternity leave in Spain.

This study aims to investigate the link between fathers' uptake of parental leave and progression to second and third births in Estonia, utilising individual-level longitudinal register data. In 2004, Estonia switched to an earnings-related parental leave system with full compensation, a high ceiling rate, and a relatively long duration of paid benefits, ranking among the most generous internationally (Otto et al., 2021). Various aspects of the reform, such as its effects on mothers' employment rates (Võrk et al., 2009), progression to subsequent childbearing (Abdullayev & Puur, 2024; Puur et al., 2023), and fathers' uptake of leave (Karu & Kasearu, 2011), have been analysed to

some extent. However, the link between fathers' leave use and continued childbearing after the reform remains unexplored.

This study contributes to the existing literature in several ways. First, it expands the literature to a new context – Estonia – being the first work to explore this link among Eastern European countries. The majority of existing studies have focused on the Nordic countries (e.g., Cools et al., 2015; Duvander et al., 2019, 2020; Hart et al., 2022), with only a few studies on other countries (Farré & González, 2019; Regueiro-Ons et al., 2024; Lee, 2022). Second, the study makes a methodological contribution by employing a mixture cure model to investigate the relationship between fathers' leave uptake and progression to next birth This model is well-suited for this purpose as it allows to disentangle the timing and quantum effects of leave use by fathers on the event of next birth, an issue that previous studies have been unable to confidently address. Finally, this work contributes to the discussion on theories suggesting a positive impact of gender equity in the private sphere on fertility, as well as its policy implications for Estonia.

Theoretical background and previous findings

Empirical research examining the relationship between fathers' uptake of parental leave and fertility often takes its starting point in gender equity theories, including the Gender Revolution Theory (Goldscheider et al., 2015)). The theory provides a compelling framework suggesting that the fertility decline observed in most developed countries was largely due to an imbalance in work and family life for women following the marked rise in women's education and employment, while men remained resistant to increase their contribution to the private sphere (household labour). However, as the second phase of the gender revolution unfolds – fathers' greater involvement in housework and childcare – the double burden of paid and unpaid labour for women would be reduced, which in turn could reverse the fertility decline, thus suggesting a U-shaped relationship between gender equity and fertility (Esping-Andersen & Billari, 2015; McDonald, 2000a, 2000b).

There are different approaches to quantifying gender equity in the private domain in relation to fertility. A large body of research draws its evidence from the division of labour in housework and childcare tasks between men and women, as reported in surveys (Fanelli & Profeta, 2021; Miettinen et al., 2015; Neyer et al., 2013; Riederer et al., 2019). Other studies have focused on fathers' parental leave use as a proxy, assuming that fathers participate in housework and childcare tasks during the period of leave uptake (e.g., Duvander et al., 2010; Farré & González, 2019; Hart et al., 2022). Given the goal of this paper, the literature review focuses on studies that have examined the association between fathers' leave use and childbearing.

The Nordic countries were the first to introduce parental leave programs – Sweden in 1974 and Norway in 1978 – including a gender-neutrality aspect (about parental leave schemes in in Sweden and Norway, see Cools et al., 2015; Duvander et al., 2010; Duvander & Andersson, 2006). They were

also the first countries to reserve a portion of the leave specifically for fathers: Norway in 1993 and Sweden in 1995, with these portions being non-transferable to mothers. Thus, it is not surprising that the majority of empirical studies investigating the link between fathers' leave use and continued fertility have focused on this region. These studies have employed event history models. The specification of the main independent variable varied across studies. For example, Oláh (2003) distinguished only between users and non-users, while other studies incorporated information on the duration of leave — distinguishing short, moderate, and long leave (Duvander & Andersson, 2006; Duvander et al., 2010) — or differentiated between taking leave up to the legislated 'father's quota' versus exceeding it (Lappegård, 2010; Duvander et al., 2019). They found higher likelihood of transition to the second birth among leave users in all three countries examined (Sweden, Norway, and Iceland), while results regarding the transition to the third birth have been mixed (Duvander et al., 2010, 2019; Duvander & Andersson, 2006; Lappegård, 2010; Oláh, 2003). The positive effects of fathers' leave uptake on second births persisted across different study periods. For example, in Sweden, various periods were studied: 1968–1993 by Oláh (2003), 1988–1999 by both Duvander and Andersson (2006) and Duvander et al. (2010), and 1995–2009 by Duvander et al. (2019). However, the association weakened over time, as shown in these studies.

Regarding contextual differences, Duvander et al. (2010) found that the positive effects of leave sharing between parents on second births were stronger in Norway than in Sweden. The authors explained this finding by institutional and cultural factors. More specifically, the Swedish system was more gender egalitarian, and all parents permanently residing in Sweden were eligible to take parental leave, while the Norwegian system had stricter eligibility requirements — fathers' eligibility depended on mothers' eligibility, which required mothers to have been employed for six out of ten months prior to birth. In Norway, during the period of study, childcare cash benefits were also provided for up to 23 months when the child was one to two years old, incentivizing mothers to stay home longer after childbirth. "The dualism of the Norwegian family policy thereby present[ed] the possibility of gender equal parenthood more as an option than as a norm" (Duvander et al., 2010, p. 48), while in Sweden, it was more of a norm, with a higher percentage of fathers taking leave (more than 80% versus 60% in Norway). Therefore, fathers who took leave in Norway were a more selective group, so taking leave had a greater impact on the transition to a second child.

More recent comparative work by Duvander et al. (2019) also included Iceland, in addition to Sweden and Norway, and covered a more recent study period. The authors found the strongest effect of parental leave use on the risk of having a second child in Iceland, while in Sweden the association was the weakest. The authors also distinguished between different levels of leave use: 'up to quota', which included fathers who used leave but did not exceed the reserved portion, and 'more than quota', for those who went beyond the reserved amount. While a linear positive relationship between the level of leave use and the likelihood of a second birth — as one might intuitively expect — was found for Iceland, the association was inverse U-shaped in Norway, and there was no difference between "up to

quota" and "more than quota" users in Sweden. Due to the shorter duration of parental leave in Iceland, fathers who used more than the quota were considered by the authors to have much stronger gender-egalitarian views. Additionally, it is assumed that because the leave scheme was introduced later in Iceland — after strong gender-egalitarian ideas had already developed — the reform may have had a greater influence when it was first implemented. The modelling results for the interaction between period and leave use levels support this explanation, showing stronger effects during 2001–2004 compared to 2005–2009.

A 2006 Swedish study found that second-birth risks increased with the father's uptake of leave, but only up to a certain point (Duvander & Andersson, 2006). Couples in which the father took a moderately long leave — equivalent to 11–25% of his earned income in leave benefits — had the highest second-birth propensities. However, for the small group of fathers who took very extensive leave (over 25% of income from benefits), the second-birth intensity was reduced, falling even lower than that of fathers who took very brief leave. It is important to note that the length of leave was inferred from the portion of income received through parental leave benefits, meaning that those classified as extensive leave users were commonly low-income earners. In Norway, a 2010 study showed that couples where the father took leave had significantly higher second-birth intensities than couples in which only the mother took leave. No differences were found between those who took the designated 'father's leave' and those who exceeded it (Lappegård, 2010).

As noted above, the findings regarding third births were inconsistent across studies. While Duvander and Andersson (2006) and Duvander et al. (2010) did not find a statistically significant association between fathers' leave use and the transition to a third birth in Sweden, Duvander et al. (2019), studying a more recent period, found a negative association. For Norway, the association between fathers' leave use and third births differed between two studies, ranging from positive in Duvander et al. (2010) to negative in Lappegård's (2010) study, even though both covered roughly the same period. This difference may be due to Lappegård controlling for other policy-related factors, such as the availability of childcare and the timing of childcare cash benefits. Duvander et al. (2019) also found negative effects of parental leave use by fathers on the propensity to have a third child, while lowest likelihood was observed for couples where the father used leave up to the quota, same as in Sweden. Authors explained that the reason behind negative effects could be the fact that being on leave with two children is more demanding regarding childcare versus with one child. In Iceland, no statistically significant relationship was found between the father's leave use, including its length, and third-birth risk. The general conclusion is that while the results for second-birth risks were more consistent across these studies, third-birth intensities varied markedly and warrant further investigation. These works also show that the association between fathers' leave use and fertility differs between countries and by the parity of the child.

The studies discussed above have two major limitations. First, they did not disentangle the timing and quantum effects of fathers' leave use on progression to subsequent births. The authors

pointed out that, since the majority of couples with one child go on to have a second, the observed effects for the transition to the second birth were likely to reflect more timing or spacing effects rather than fertility quantum i.e., whether or not to have another child (Duvander & Andersson, 2006; Lappegård, 2010). However, the effects found for the transition to a third child could capture both timing and quantum effects, as only a minority of two-child parents have another child. Second, as noted by the authors, there is the issue that more family-oriented fathers might be both more likely to use parental leave and more likely to desire to have another child (e.g., Duvander et al., 2010, 2019, 2020; Duvander & Andersson, 2006). Therefore, the positive associations observed should not be interpreted as causal effects of fathers' experience of being on parental leave. Identifying causal relationships in this area is quite challenging. Since the majority of aforementioned studies use register data, they lack information on fathers' family orientation, which is likely to result in omitted variable bias[1]. Ideally, we would like to have such information, which would require a use of survey data, and control for it in the model.

Decroly (2024) tried to mitigate this issue in her study using German Family Panel (pairfam), which included information on fathers' gender role attitudes, i.e., their views regarding childcare, housework and their partners' labour market activity. She argued, based on existing literature (Puur et al., 2008), that fathers with more gender egalitarian views would be more likely to exhibit higher desire for another child. She used four variables to account for fathers' unobserved characteristics of family orientation. Findings regarding the effect of leave use by fathers on second child suggested positive effects, particularly in West Germany. However, findings from both univariate and multivariate analyses showed that fathers with more gender egalitarian views were less likely to have a second child, which did not align with the expectation.

A few more recent studies have adopted a quasi-experimental approach – either difference-in-difference (Cools et al., 2015; Duvander et al., 2020) or regression discontinuity approach (Hart et al., 2022; Farré & González, 2019). These studies focused on reforms that introduced a reserved month for fathers in Sweden and Norway (Duvander et al., 2020), two weeks of paternity leave in Spain (Farré & González, 2019), or extended existing leave by four weeks in Norway (Hart et al., 2022). None of the studies analysing the effects of reforms in Sweden and Norway found any significant impact on continued childbearing (Cools et al., 2015; Duvander et al., 2020; Hart et al., 2022), except for positive effects in one subpopulation – low income fathers – in progression to the third child for Sweden (Duvander et al., 2020). Duvander et al. (2020) explain that the reform in Sweden led to the greatest increase in leave uptake rates among low-income fathers, while other groups were already using leave extensively before the reform. This difference likely accounts for the positive effect observed for low-income fathers. However, it was also pointed out that the reforms studied often involved somewhat

[1] Although previous studies mention the term "selection", it should not be confused with "selection bias". The issue that previous studies faced is not about the underlying sample being analysed; rather, a case of omitted variable bias, which is likely affecting both fathers' leave uptake and progression to next child (Bendig & Hoke 2022).

minor changes, like few weeks of leave reserved for fathers. Furthermore, these studies mainly compared couples' childbearing behaviour who had a child just before and after the reforms, however it might take years for significant changes in behaviour to emerge. Such modeling approaches may fail to capture the total effects of leave sharing, as Hart et al. mentioned:

"It may very well be that there is a causal link between father involvement and family dynamics, but that the changes in father involvement induced by the reform are too small or local to invoke these causal mechanisms. As such, the reform effect is no perfect test of the effect of father involvement on family dynamics." (2022, p. 834)

Farré and González (2019) found negative effects on subsequent births from the introduction of two weeks of paternity leave in 2007 in Spain. The authors suggested that the negative effects of the reform may have resulted from two factors: (1) fathers' increased participation in the family led to higher labour force participation among mothers, which raised the opportunity costs associated with having another child; and (2) fathers reported a lower desire to have more children after the reform, based on survey data, possibly due to greater awareness of the costs of childrearing or a shift in preferences from quantity to quality of children (Becker and Lewis, 1973). A more recent study analyzing all fathers' quota extensions in Spain, starting from the 2007 reform, did not find significant effects of the same reform (Regueiro-Ons et al., 2024)[2]. However, the study did find significant positive effects for the extension of father-exclusive leave up to four weeks in 2017 on third and higher parities, while other reforms, such as the extension to five weeks in 2018 and to eight weeks in 2019, found no significant effects on any parity. The study utilised aggregate data, specifically the monthly number of births per 1000 women in childbearing age, using Bayesian structural time series modeling. It is important to note that aggregate-level evidence is generally considered weaker than micro-level evidence, as it can be susceptible to ecological fallacy or Simpson's paradox (Pollet et al., 2015).

A rare study outside Europe investigating a similar link was conducted by Lee (2022) for South Korea. Using a survey data, she employed both quantitative and qualitative methods in the study. The comparison of fertility intentions among fathers with varying experiences and intentions of leave use enabled the author to address the selectivity issues discussed above. Based on the quantitative analysis, the results showed that intention to have a second or third child was lower among fathers who had taken leave compared to fathers with no experience but who planned to take leave, suggesting a negative effect of fathers' leave-taking experience in South Korea. The effect was statistically significant only in the case of the transition to the third birth. Another finding was that fathers with both no experience of leave and no plan to take leave in the future compared to those with plan to take leave but no experience showed no difference in their intention to have a second child, which suggested an absence of selection effects based on differences in fathers' family orientation.

[2] The paper is a preprint and had not been gone through peer review process when cited.

However, this was not the case in the analysis of intention for the third child, where the plan to take leave was associated with higher likelihood of intending a third birth, suggesting a selection effect. Furthermore, findings from the qualitative analysis supported those of quantitative the analysis. There was not a single case where a father changed his mind to have another child after taking leave when he did not intend before leave use, while the opposite often occurred. Interviews with fathers suggested that experiencing the difficulties of childcare as a solo caregiver and lack of social and/or institutional childcare support were the main factors behind the shift toward a more negative outlook on having more children.

To summarise, empirical research on the effects of fathers' uptake of parental leave on continued childbearing is mixed. Differences in the results are likely partly due to methodological choices and partly due to contextual differences, such as social norms or institutional support. For instance, it has been suggested that the negative effects of fathers' leave use found in Spain and South Korea could be explained by a lack of adequate institutional support, such as the availability of public childcare services, no guaranteed return to work after leave, the replacement level of income during the leave, and other factors (Farré and González, 2019; Lee, 2022). These findings suggest that granting father exclusive leave while neglecting other policy measures may not be enough to reduce the work-family conflict for parents. However, it might increase fathers' awareness of the challenges of childcare and might raise the opportunity costs of having next child for mothers by strengthening their labour market attachment. Whether fathers' leave use, which is often induced by non-transferable quotas rather than voluntary choice, reduces the burden on mothers is also questionable, as recent study by Andresen and Nix (2025) shows. The authors showed that in Norway, fathers often took leave during summer holidays, or in periods when child was already in formal care, or while continuing to work part-time. Thus, they often did not take full responsibility for childcare while on leave.

In this study, we contribute to the literature by investigating the link between fathers' uptake of parental leave and the progression to second and third children in Estonia, following the introduction of a generous earnings-related parental leave scheme in 2004.

Estonian context

The parental leave scheme in Estonia underwent substantial changes in 2004 (Puur & Klesment, 2011), transitioning from low flat-rate benefits to earnings-related parental benefits. New Estonian parental leave scheme was evaluated as one of the most generous internationally (Otto et al., 2021), due to a combination of long duration of paid leave, job protection, full replacement of prior income, a high ceiling rate, and universal eligibility conditions. Parents taking leave would be fully reimbursed of their income prior to birth. If their earned income was below the minimum wage for that year, they would receive benefits equal to the minimum wage. If no income was earned, they would receive flat-rate benefits, which were set just below the minimum wage. The duration of paid parental

leave was initially set at 11 months when the reform was introduced, and was later extended to 14 months in 2006 and 18 months in 2008. The duration of job-protected leave remained unchanged at three years from the date of birth. In addition, a special feature known as the "speed premium" was introduced with the new leave design (Hoem, 1990, 1993). This provision allowed parents to renew parental leave benefits for the next child at the same amount as calculated for the previous child, given the next birth occurs within 30 months. It was also possible to work and receive income while receiving parental benefits, although at a reduced rate according to a specific formula.

According to Karu and Pall (2009), the 2004 parental leave reform in Estonia did not adequately incorporate gender equality, as flexibility for fathers to take leave was limited. First, fathers could use parental leave only after the child reached six months of age. This restriction was changed to 70 days starting in 2007, which appeared to stimulate higher take-up rates among fathers (Pall, 2024). Second, a father's quota – a non-transferable right for fathers to use parental benefits, which has been shown to significantly increase fathers' uptake of parental leave in Nordic countries (Duvander & Johansson, 2012; Lappegard, 2008) – was not introduced as part of the new leave scheme. A father's quota of 30 days was added much later, only in July 2020 (Pall, 2020).

The transition to a dual-earner society in Estonia has been relatively successful, as evidenced by female employment rates, which are among the highest in Europe – for example, 80.9% of women aged 20–64 were employed in 2023 (Eurostat, 2024). According to the European Institute for Gender Equality (EIGE, 2023; calculations based on EU LFS 2021), women's attainment of tertiary education and participation in training above age 15 are much higher than men's in Estonia, and even exceed the EU average. However, men remain overrepresented in decision-making positions and are more often employed full-time compared to women (EIGE, 2023; Statistical Office, 2024) and women are more likely to work part-time, similarly as in most OECD countries (OECD, 2022). Furthermore, Estonia has the highest gender pay gap among EU countries, at 21.3%, although this has decreased by 5% over the last decade (Eurostat, 2024; OECD, 2022).

On the other hand, the transition to "dual-carer" society in Estonia has been happening in much slower pace, while the extent to which shared parental leave has contributed to equal gender roles remains also questionable. After adopting an earnings-related parental leave scheme in 2004, Võrk et al. (2009) found that 100% compensation of earned income during leave motivated women to become employed and increase their wages before childbirth. However, some argue that generous leave durations may reinforce mothers' roles as primary caregivers, since fathers take comparatively little leave (Karu, 2012), and longer leaves taken by mothers can negatively affect their wages due to the motherhood penalty (Evertsson, 2016). Conversely, empirical studies suggest that fathers' leave use can reduce the motherhood penalty and help decrease the gender pay gap (Andersen, 2018; Johansson, 2010). In Estonia, mothers are not only the main users of parental leave, but also tend to take extended periods of leave. According to the 2010 Estonian Labour Force Survey (ELFS), 40% of women users were on leave for between two and three years, and 48% for one to two years; in total,

approximately 90% of all women users were on leave for more than a year (Ferraro & Jalakas, 2023). Using Oaxaca-Blinder decomposition on ELFS 2009–2019 data, Ferraro and Jalakas (2023) found that mothers earned 13.8% less than women without children, while fathers earned 4.5% more than men without children. These results indicate that the motherhood penalty and fatherhood premium explain a significant part of the gender wage gap in Estonia.

Kurowska's (2017) comparative study of Estonia and Lithuania suggested that the exceptionally low employment rates of mothers with toddlers (aged 0–2) in Estonia were due to unconditional parental benefits, as inactive women also received benefits equal to the minimum wage. However, employment rates among Estonian mothers with their youngest child aged 3–5 and 6–14 years were 80.1% and 90%, respectively, in 2021 (OECD, 2023), indicating that most mothers return to the labour market when parental leave ends. Moreover, employment rates for mothers with their youngest child aged 0–2 increased from 25% in 2013 to 46.7% in 2021 (Kurowska, 2017; OECD, 2023). The gradual increase in fathers' use of parental leave may have contributed to this trend. Fathers' share of leave use in Estonia rose slowly from 1–2% in 2004 to 9.9% in 2017, and, following the introduction of the fathers' quota in 2020, increased to 16.2% in 2021 (Pall, 2020; 2024). However, these numbers may be somewhat misleading. 72% of male benefit recipients also earned income from work while on leave, as it was permitted to work while receiving parental benefits, suggesting that many fathers receiving benefits may not be necessarily the primary caregivers (Pall, 2024). In contrast, the use of birth-related paternity leave by men increased substantially: 54% of men took paternity leave in 2018, 74% in 2021, and 90.6% in 2022 (Statistics Estonia, 2025, table TKS08). Similar patterns have been observed in Finland, where uptake of paternity leave is much higher than shared parental leave, likely reflecting the influence of gender roles — birth-related leave is less at odds with traditional gender norms than independent parental leave (Saarikallio-Torp & Miettinen, 2021).

Research hypotheses

Drawing on theoretical frameworks, evidence from previous studies, and the Estonian context, I formulate the following hypotheses.

The first hypothesis (H1) posits that couples in which the father takes parental leave will exhibit a higher likelihood of having a subsequent child and demonstrate a faster transition to the next birth compared to couples where the father does not take leave. Estonia's context is more similar to Nordic countries than to Spain or South Korea, as it features relatively easy access to formal childcare, high income compensation during leave, and guaranteed labour market re-entry, all of which facilitate a smoother transition to next child. As discussed in the literature, the asserted positive association may be driven not only by a more egalitarian division of childcare between parents, which makes it easier for mothers to combine work and parenting, but also by the possibility that fathers who take leave may be more family-oriented or have more egalitarian attitudes towards gender roles.

The second hypothesis (H2) expects that fathers who received labour income for some proportion of their leave period will exhibit a lower risk of progressing to the next birth and a longer interval between births compared to fathers who did not receive any labour income during their leave. This hypothesis is grounded in the notion that some fathers may have exploited the parental leave scheme's generosity, receiving both labour income and parental benefits simultaneously, thereby optimizing earnings rather than fully committing to childcare.

The third hypothesis (H3) predicts an inverse relationship between the length of the father's leave and the progression to a subsequent child, with the strongest positive effect observed for fathers who take a moderate length of leave, in terms of both tempo and quantum effects. This hypothesis is based on the notion that fathers taking moderate leave achieve the best balance between family participation and labour market involvement — contributing to childcare and household responsibilities without experiencing significant negative impacts on their careers. Taking leave for moderate durations may also reflect an arrangement where the father typically takes leave after the mother, who can then resume employment and experience lower opportunity costs. By contrast, if the father takes a long leave, it may signal other considerations that are not necessarily positively associated with subsequent childbearing (for instance, the mother's demanding job that does not allow for a longer absence from work).

The fourth hypothesis (H4) posits that the association between fathers' leave use and progression to the next child will be more pronounced for transition to third parity. This expectation arises from the prevailing two-child norm during the study period across European countries, including Estonia (Beaujouan & Berghammer, 2019; Sobotka & Beaujouan, 2014). In this context, transitions to higher-order parity are thought to reflect more individual preferences and family circumstances, including fathers' involvement in childcare.

Data and methods

I utilize register-based longitudinal datasets compiled by Statistics Estonia from multiple sources. Parental leave (PL) data for both parents are obtained from the Social Insurance Board and cover leave episodes initiated between 2004 and 2018. This dataset includes details such as the start and end dates of parental leave, benefit amounts paid, and pseudo-ID codes for linking with other datasets, etc. The second dataset, sourced from the Population Registers, provides childbearing histories of mothers, pseudo-ID codes of the other parent, and information on censoring events. Medical Birth Registers supply socio-demographic and economic characteristics of parents at the time of each birth, while social tax data, used to calculate labour income, are obtained from the Tax and Customs Board.

Additionally, two rounds of the Generations and Gender Survey (GGS) conducted in Estonia are utilised to integrate fathers' attitudinal characteristics, such as family orientation and gender role attitudes, with the register-based data. This linkage allows for supplementary analyses addressing potential selectivity issues discussed in the literature review. More detailed information about the

survey data, linkage procedures, and related tests will be provided in the "Additional analyses" section following the "Results" section.

The study population comprises couples who had their first or second child between 2003[3] and 2018. Their progression to the subsequent child is followed until January 1, 2024, allowing at least five years of observation per couple, except when censored earlier due to events such as parental death, divorce, emigration or the woman reaching age 45 (presumed end of childbearing). Given the study goal — to analyze the association between fathers' leave-taking behavior and the likelihood of having a subsequent child — I focus on more "stable" couples[4]. The event of interest is conception of the next child, inferred by subtracting nine months from the birth date. The observation window begins 19 months after the previous birth, which corresponds to the period when parental leave ends. Couples with multiple births are excluded.

To answer the research questions of the study, I employ mixture cure model – also known as split population models (Berkson & Gage, 1952; Boag, 1949). The advantage of this model over conventional survival models is its ability to distinguish the effects of the covariates on the propensity to have a next child from their effects on the timing of childbearing. It fits well to studies that investigate parity progression for one more reason. The mixture cure model assumes that a fraction of population will never experience the event (as we know that some couples never have the second or third child), while conventional survival models typically assumes everyone will eventually experience the event if followed long enough. The fraction that is not "suspectible" to event of interest is considered as cured, as the name of the model comes from cancer studies, based on which the model was first developed. Later the model was adopted to some other disciplines, including demography (e.g., Gray et al., 2010; Puur et al., 2023; Yamaguchi & Ferguson, 1995).

To address the research questions, I employ a mixture cure model, also known as a split population model (Berkson & Gage, 1952; Boag, 1949). Unlike conventional survival models, this model allows distinguishing the effect of covariates on the propensity to have a subsequent child (incidence) from their effect on the timing of childbearing (duration). This model is especially appropriate for parity progression studies because it accounts for a portion of the population that will never experience the event (i.e., some couples never have a second or third child), whereas traditional survival models assume eventual occurrence with sufficient follow-up. The "cured" fraction corresponds to those not susceptible to the event, borrowing its terminology from cancer research where the model was originally developed. Later the model was adopted to some other disciplines, including demography (e.g., Gray et al., 2010; Puur et al., 2023; Yamaguchi & Ferguson, 1995).

I estimate the model using the "cureregr" function in Stata 18 (Buxton, 2004/2013). The model consists of two submodels: (1) incidence, which estimates the probability of experiencing the event

[3] Parents of children born in 2003 were also entitled to receive parental leave benefits under the new regime.
[4] I exclude couples if fathers' information was not available and/or if mother's partnership status at the time of first (or second in transition to third child) was either single, widow, divorced or missing value.

(quantum), and (2) duration, which estimates timing effects of covariates. The incidence submodel specifies how covariate vector z is linked to π, the probability of being uncured or experiencing the event of next birth in this case, which is done via logit link:

$$logit[\pi(z)] = \log\left(\frac{\pi}{1-\pi}\right) = z'\gamma, \quad (1)$$

where γ is a vector of the coefficients. Therefore, we could interpret the coefficients from submodel as odds ratios by exponentiating (e^{γ}) them or probabilities using formula of $\pi = e^{z\gamma}/1 + e^{z\gamma}$ as in logistic regression. The survival probability function of mixture cure model is defined as following:

$$P(T > t) = S(t) = \pi S_u(t) + 1 - \pi, \quad (2)$$

where $S_u(t)$ is survival function of uncured (who has the next child) which is so-called duration submodel. It is defined as follows:

$$S_u(t) = S_u(t|x) = S_u\left(te^{-x'\beta}\right), \quad (3)$$

where x is a vector of covariates which can be either the same set of variables as in z vector or different (i.e., they consist of same set of variables in this study). Time to event of interest T follows accelerated failure time (AFT) model where T is affected by covariate vector of x with a link function of $\log(T) = x'\beta + \sigma\epsilon$. By exponentiating the coefficients of the x vector, we could interpret them as either having an accelerating if lower than 1 (decreasing birth interval) or a decelerating effect if higher than 1 (extending birth interval or postponing) on time to next birth. σ is scale parameter and ϵ is an error term which follows lognormal distribution. The parameters of the mixture cure model is estimated by maximizing the log-likelihood function (for more about cure models on, see Peng & Yu, 2021)

$$l(\theta) = log \prod_{i=1}^{n} [\pi(z_i) f_u(t_i|x_i)]^{\delta_i} [1 - \pi(z_i) + \pi(z_i) S_u(t_i|x_i)]^{1-\delta_i}. \quad (4)$$

The main explanatory variable is dichotomous: 1 if the father took parental leave, 0 otherwise. To examine whether fathers' behaviour regarding receiving labour income during leave — a potential indicator of commitment to childcare and housework — affects childbearing trajectories, I further categorise fathers who took leave based on whether they received labour income during leave. I create a monthly variable from fathers' monthly labour income and parental leave episodes within 19 months after birth, indicating combinations of leave status and income receipt. From this, I derive a variable

showing the proportion of leave duration with labour income for fathers who took leave, while non-users are marked as a separate group.

Two additional explanatory variables with a more detailed specification of fathers' parental leave use are then created, one measuring income receipt and the other measuring the duration of parental leave used by the father:

- The first has three categories: 0 ("Did not use" parental leave), 1 ("no labour income" – fathers who took leave and received no labour income during the entire leave), and 2 ("some labour income" – fathers who took leave and received labour income for at least some part of the leave or the whole duration).
- The second has three categories: 0 ("Did not use" parental leave), 1 ("<8 months" – fathers who used leave for a period of less than 8 months), 2 ("8> months" – fathers who used leave for a period of 8 months or more).

I fit three sets of models, one for each explanatory variable above, including identical individual-level controls: parents' age groups, education, income levels, ethnicity, marital status, area of residence, sex of previous child(ren), and previous child's birth year. Tables A1 and A2 (see Appendix) show descriptive statistics of transitions to the second and third parity, respectively. Controls are introduced in a stepwise manner: Model 1 (M1) includes only the main explanatory variable; Model 2 (M2) adds fathers' characteristics; Model 3 (M3) adds other controls.

Results

Fathers' leave uptake and transition to second and third births

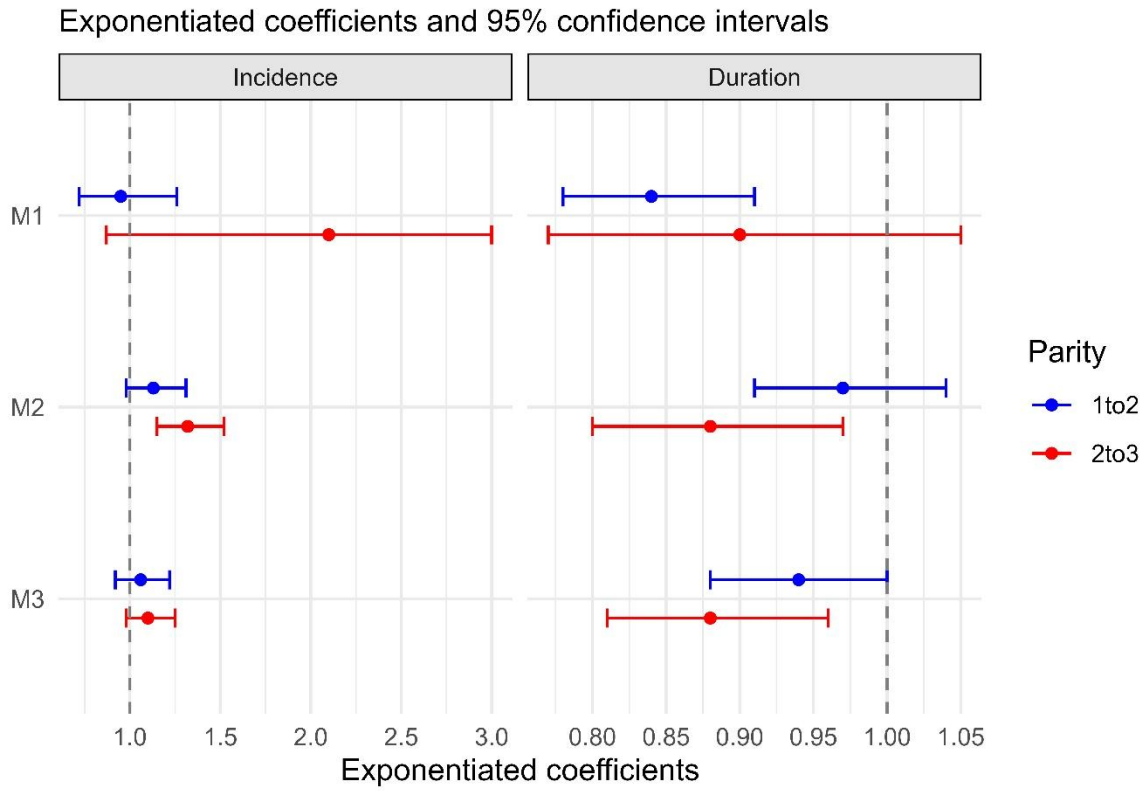
Figure 1 presents results from the two submodels of the mixture cure model — incidence and duration — estimated in a stepwise manner across three models (M1 to M3) for parity progression to both the second and third child. The gray dashed line at OR = 1 represents the reference category of fathers who did not take parental leave.

Focusing first on quantum effects from the incidence submodel, the adjusted models (M2 and M3) show a positive association between fathers' parental leave use and couples' propensity to have a subsequent child. For couples with one child, fathers who took leave have 1.13, in M2, and 1.06, in M3, times higher odds of progressing to a second child compared to non-users; however, the 95% confidence intervals include the reference value of 1, indicating no statistical significance. For the progression to the third child, the effects are stronger, with odds ratios of 1.32 in M2 and 1.10 in M3. The effect is statistically significant in M2 (which controls only for father's characteristics) but loses significance once mothers' characteristics and remaining controls are included in M3.

Turning to timing effects from the duration submodel, the exponentiated coefficients indicate the multiplicative effect of fathers' leave on the length of the birth interval to the next birth. The unadjusted model (M1) suggests that paternal leave use is associated with a 16% and 10% shorter

interval to the second and third child, respectively (exponentiated coefficients of 0.84 and 0.90). After controlling for fathers' characteristics in M2, the shortening effect on the interval to the second child becomes weaker and remains around 6% in M3 when all controls are included. For the third child, the reduction in birth interval remains consistent at approximately 12% in both adjusted models. The confidence intervals indicate statistically significant timing effects for the progression to third parity, whereas significance cannot be established for the second parity.

Figure 1: Exponentiated coefficients of fathers' uptake of parental leave for progression to second and third births (mixture cure model), Estonia, couples with children born between 2003 and 2018: dichotomous explanatory variable by uptake of leave



Source: Statistics Estonia, author's calculations

To summarise, Figure 1 indicates that the effects of fathers' parental leave uptake on progression to a subsequent child are primarily limited to tempo effects, a distinction made possible by the use of the mixture cure model. To illustrate the advantages of this modelling approach, I also estimated a conventional event history analysis (EHA) using the same data — a Cox proportional hazards model — similar to those used in several Nordic studies (e.g., Duvander & Andersson, 2006; Duvander et al., 2010, 2019), which reported positive effects of fathers' leave uptake on fertility, especially for the second parity. The results based on the Cox model, presented in Tables A3 and A4 of the Appendix, reveal statistically significant positive associations between fathers' parental leave use and progression to both the second and third child in Estonia. These results help clarify the conclusions that would be drawn if a conventional EHA were applied. Consistent with the findings

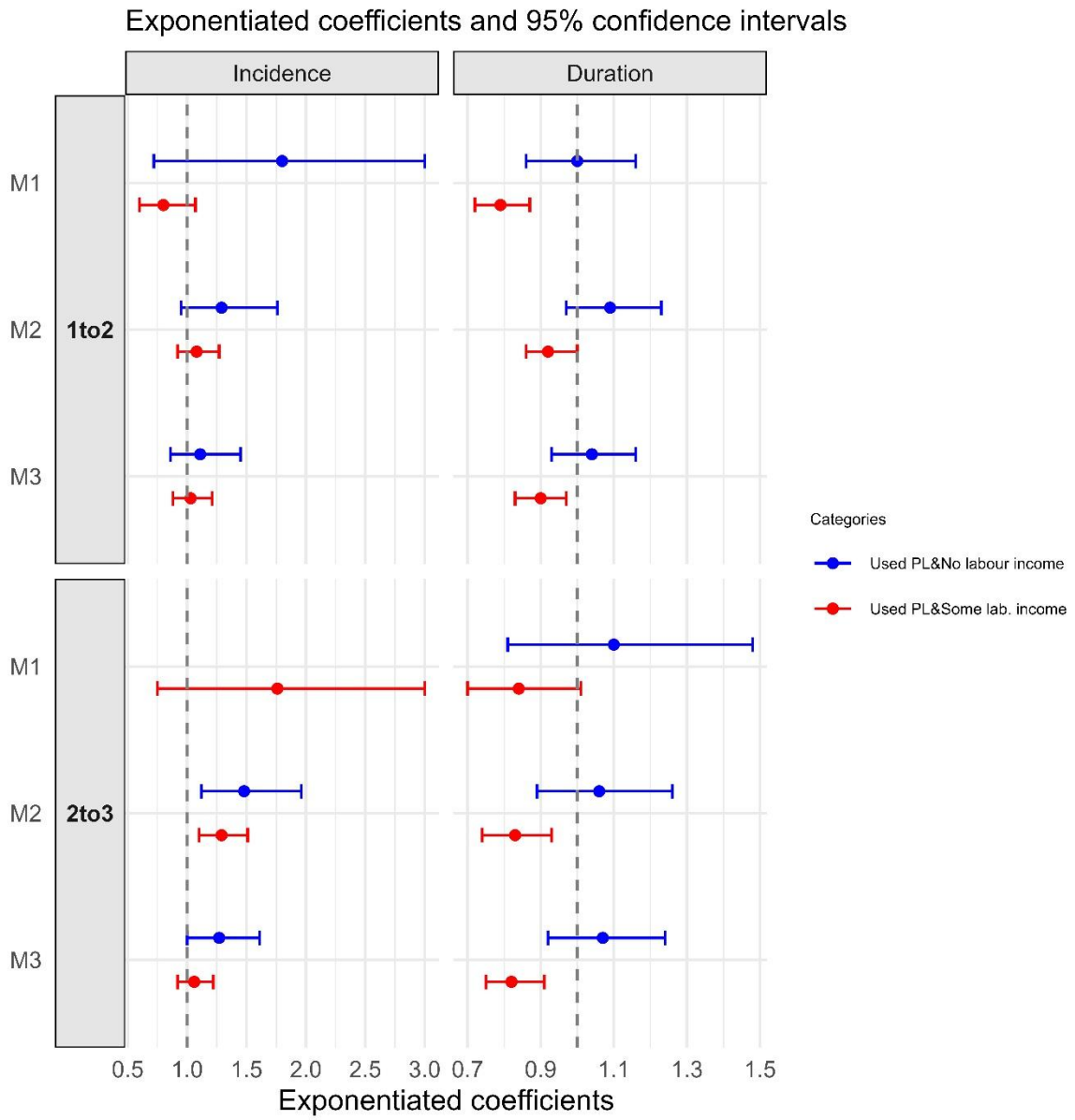
from Figure 1, effects of fathers' leave use from the Cox model are also stronger for progression to the third child.

Figure 2 displays results from the second set of models, where fathers who utilised parental leave are divided into two groups: those who did not receive any labour income during the leave period ("Used PL & No labour income") and those who received labour income for at least some part or entire period of the leave ("Used PL & Some lab. income"). For progression to the second birth, distinguishing leave users by income receipt yields no statistically significant effects in the incidence submodel; odds ratios for both groups do not differ significantly from non-users. The findings for progression to the third birth are more nuanced. In Model 2, both categories of leave users exhibit significantly higher odds of having a third child, mirroring the positive effects seen in Figure 1. However, in Model 3, with additional controls including maternal characteristics, the effect associated with income receipt loses statistical significance, while fathers who did not receive any labour income continue to show higher odds (OR = 1.27) with the lower bound of the confidence interval exactly at 1, indicating a result close to statistical significance. This suggests that fathers who fully dedicate themselves to childcare by not working concurrently may experience a quantum effect in progression to the third birth. Nonetheless, this finding could also reflect some unobserved characteristics — such as mother's need for a faster return to the labour market — that necessitate full paternal commitment at home.

Regarding timing effects, a different pattern emerges. The duration submodel demonstrates that mere uptake of parental leave is insufficient to fully explain the tempo of parity progression; rather, the pattern of income receipt during leave plays a critical role. For both second and third births, faster transitions are observed among fathers who earned labour income during part or all of their leave — corresponding to birth intervals shortened by 8–10% for second births and 17–18% for third births. By contrast, fathers who did not receive any income during leave show timing patterns statistically indistinguishable from non-users for both birth orders. This indicate weaker labour market attachment for fathers who fully suspend earnings or are even unemployed. In contrast, fathers who combine leave with some income appear to balance work and family roles efficiently, managing to support both without sacrifice. This interpretation is reinforced by an alternative categorisation of leave users by income receipt (not shown here), where significant acceleration effects were observed for fathers earning income during only part of the leave, particularly regarding the second births. These fathers might also have had jobs that allowed them to combine both roles.

Another important dimension of paternal leave uptake is its duration, as the family's experience may vary considerably depending on whether the father remains at home for a short period or for an extended time with a newborn child. Figure 3 summarizes findings from both submodels by

Figure 2: Exponentiated coefficients of fathers' uptake of parental leave for progression to second and third births (mixture cure model), Estonia, couples with children born between 2003 and 2018: by fathers' parental leave use and labour income receipt during leave

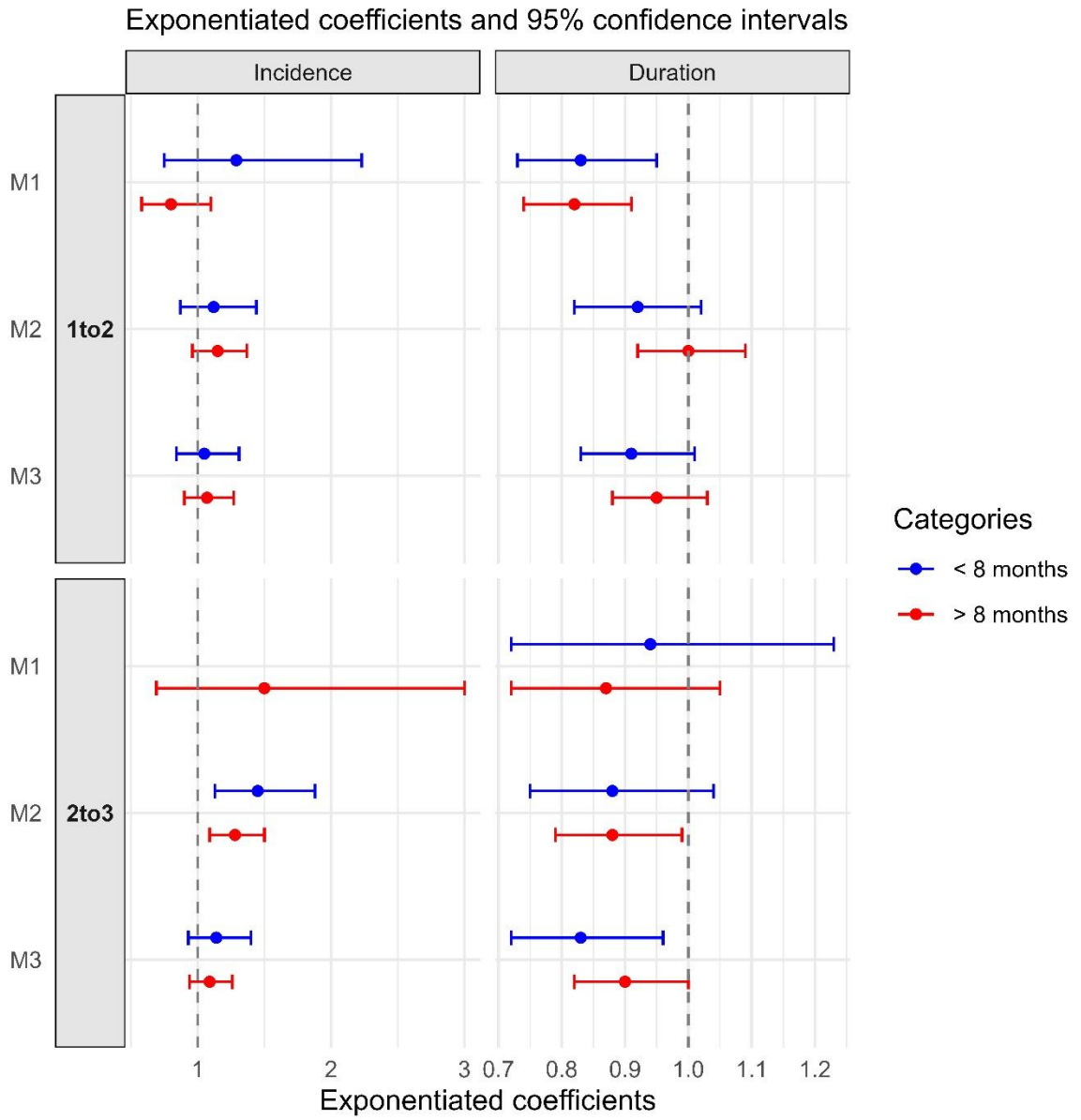


Source: Statistics Estonia, author's calculations

grouping leave length into moderate (less than 8 months) and long (more than 8 months) categories. Regarding quantum effects, leave duration is not significantly associated with progression to the second child, and no significant differences are observed among leave-taking for progression to the third child. Examining tempo effects, stronger acceleration is detected among fathers with moderate-length leave for both parities; however, statistically significant acceleration emerges only for the transition to the third birth. These results reinforce earlier interpretations that fathers who achieve a more balanced integration of work and family life — reflected by moderate leave duration — tend to experience faster transitions to subsequent childbearing. Further support for this interpretation is provided by additional analyses (not shown here) considering the interaction between leave length and

income receipt, which indicate that the faster transition is predominantly driven by fathers who took a moderate-length leave and received labour income during part of the leave period.

Figure 3: Exponentiated coefficients of fathers' uptake of parental leave for progression to second and third births (mixture cure model), Estonia, couples with children born between 2003 and 2018: by the length of parental leave



Source: Statistics Estonia, author's calculations

Additional analyses

Linked survey and register data

The relationship between fathers' parental leave uptake and continued childbearing, as described in earlier sections, may be confounded by attitudinal factors influencing both leave decisions and fertility

outcomes. Fathers with a stronger family orientation and/or more egalitarian views on gender roles may be more likely both to take parental leave and to have additional children. Failure to control for these attitudinal factors could bias the estimated effects of parental leave use on continued childbearing upwards. This possibility is partly supported by evidence from Lee's (2022) study in South Korea on progression to the third birth, although no such association was found for second parity. However, this issue cannot be directly addressed using register data, since registers do not contain information on attitudes.

To investigate whether family orientation or attitudes towards gender roles are associated with fathers' parental leave uptake in Estonia, I linked data from the Gender and Generations Survey (GGS) with the register dataset using pseudo-ID codes. Notably, our previous (Abdullayev & Puur, 2025) study suggested that income optimization, rather than characteristics possibly associated with attitudes, was the primary driver of fathers' leave uptake decisions in Estonia. The approach of linking survey and register data is novel in the context of parental leave research and has not been employed in prior studies examining the association between fathers' uptake of parental leave and fertility.

The Gender and Generations Survey is a cross-national panel survey on life course and family dynamics, collected in more than 20 countries — mainly European — since the early 2000s. In Estonia, the first round of GGS (GGS-I) was conducted in 2004–2005 and included individuals aged 21 to 80, while the second round (GGS-II) was collected in 2021–2022 covering ages 18 to 59 (Puur et al., 2024). The response rate was 70.2% in GGS-I, but dropped to 28.7% in GGS-II, due to the switch to web-based data collection, with sample sizes of 7,855 and 8,992, respectively. Since GGS-I data were collected near the beginning of our study period — covering births that occurred between 2003 and 2018 — it is more appropriate to link the register data with GGS-I, as attitudes towards family size and gender roles may change following parenthood. This approach provides information on attitudes prior to parental leave decisions, allowing for greater causal identification rather than post hoc measurement. Nonetheless, both GGS rounds were linked for testing purposes. The register dataset linked with GGS includes all birth orders, as restricting to specific parities reduces sample size considerably. Notably, the linked dataset with GGS-II is substantially larger than GGS-I (2,758 vs. 831 individuals).

Two variables from each GGS wave were constructed: (1) family orientation and (2) attitudes towards gender roles. For family orientation, questions about intended and ideal family size were used, with the following wording:

- GGS-I: "How many children would you like to have?"
- GGS-II: "For you personally, what would be the ideal number of children you would like to have or would have liked to have had?"

I constructed continuous variables based on these questions for both rounds.

An index of attitudes toward gender roles was created from multiple items. For GGS-II, five questions from the "Attitudes" module were used:

1. att07a – “On the whole, who would make better political leaders, men or women?”
2. att07b – “For whom is a university education more important, men or women?”
3. att07c – “For whom is a job more important, men or women?”
4. att07d – “For whom is looking for children more important, men or women?”
5. att07g – “Who are better at caring for small children more important, men or women?”

Response options ranged from 1 (“Men definitely”) to 5 (“Women definitely”). To ensure consistent directionality, scales for att07d and att07g were reversed before summation to create a continuous variable where higher values indicate more egalitarian views.

A similar index was constructed for GGS-I using a different set of questions, because the same questions used for GGS-II were not available, in the module “Reconciliation of work and family life.” Respondents indicated agreement with ten statements on a 5-point Likert scale, ranging from “Strongly agree” to “Strongly disagree”, such as:

1. D01A – “A man should earn money, a woman should look for after the home and family”
2. D01B – “For a man the job is more important than the family”
3. D01C – “Both a man and a woman should contribute to household income”
4. D01D – “Family life often suffers because men spend too much time on work”
5. D01E – “A woman should not sacrifice her career for her family to a greater extent than a man”
6. D01F – “Family life suffers when the woman has a full-time job”
7. D01G – “Having a job is the best way for a woman to be independent”
8. D01H – “If a woman earns more than her partner, it is not good for the relationship”
9. D01I – “Being a housewife is just as fulfilling as working for pay”
10. D01J – “When good jobs are scarce, men should have more right to a job than women”

Scales for selected items — D01C, D01D, D10E and D01G — were reversed to ensure consistency. For respondents with incomplete answers, scores were adjusted proportionally by multiplying the sum of valid items by 10/n for GGS-I or 5/n for GGS-II, where n is the number of valid responses.

The analysis began with t-tests assessing whether mean family orientation and gender role index scores differed by fathers’ parental leave uptake status. Results indicated that fathers who took leave had significantly higher mean intended or ideal family size in both GGS rounds. For gender role attitudes, leave-taking fathers had higher mean scores compared to non-users; this difference was statistically significant for GGS-I but not for GGS-II.

Subsequently, logistic regression models were fitted with fathers’ leave uptake as the dependent variable and each attitudinal variable as the main independent variable (modeled separately). Table 1 presents odds ratios with 95% confidence intervals for unadjusted and adjusted models, including versions with and without survey weights. In the GGS-I linked dataset, fathers intending one additional child had greater odds of taking parental leave (OR = 1.37-1.38 unadjusted; OR = 1.26 adjusted). Associations were somewhat weaker but still positive in GGS-II (ORs 1.15–1.18

unadjusted; 1.14–1.20 adjusted). However, statistical significance disappeared for the weighted GGS-II models, unlike in GGS-I. Gender role indices did not show statistically significant associations with leave uptake, though odds ratios were positive.

Table 1: Odds ratios from logistic regression, association between attitudinal variables and fathers' parental leave uptake, all birth orders born between 2003 and 2018, Estonia

	Unadjusted model			Adjusted model		
	Odds ratios	[95% conf. interval]		Odds ratios	[95% conf. interval]	
Linked dataset with GGS I						
Intended family size	1.37	1.12	1.69	1.26	0.99	1.61
Intended family size – weights included	1.38	1.16	1.66	1.26	1.02	1.56
Sample size		*753*			*753*	
Gender role index	1.09	1.02	1.16	1.06	0.98	1.15
Gender role index – weights included	1.09	1.03	1.15	1.06	0.99	1.14
Sample size		*597*			*597*	
Linked dataset with GGS II						
Ideal family size	1.18	1.01	1.37	1.20	1.02	1.43
Ideal family size – weights included	1.15	0.99	1.33	1.14	0.97	1.34
Sample size		*2214*			*2214*	
Gender role index	1.05	0.96	1.14	1.02	0.93	1.11
Gender role index – weights included	1.05	0.97	1.13	1.02	0.93	1.11
Sample size		*2532*			*2532*	

Source: Statistics Estonia, author's calculations
Adjusted models include controls for the father's income level, education, age, ethnicity, place of residence, and the child's birth year and birth order.

In summary, these findings suggest that the observed positive association between fathers' parental leave use and faster progression to subsequent births may partly reflect that fathers who take leave have higher intended or ideal family sizes, potentially biasing the estimates. Inclusion of attitudinal variables in main mixture cure models would ideally test whether the association weakens, but linked sample sizes were insufficient for credible register-based analyses, particularly for GGS-I.

Control for the length of the previous birth interval

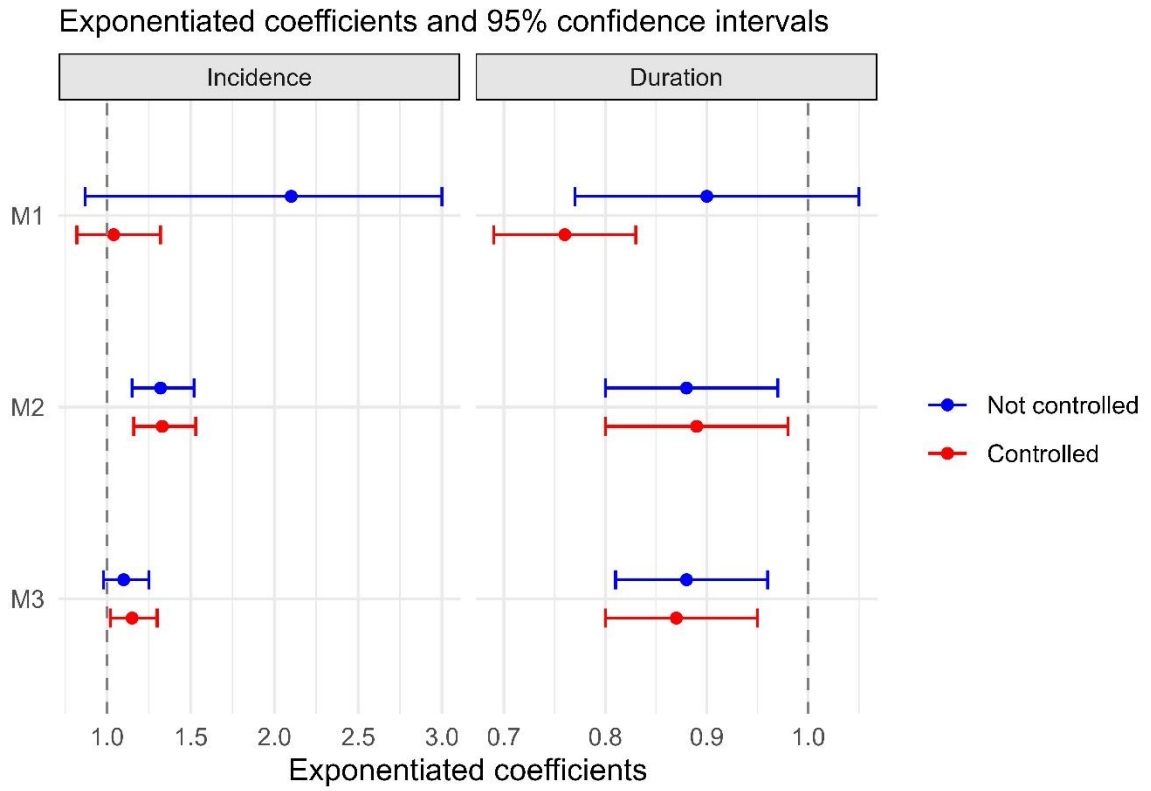
The previous section highlighted the importance of controlling for unobserved characteristics — such as family orientation — to obtain more robust estimates of the effect of fathers' parental leave uptake on continued childbearing. Since register-based data lack attitudinal information, an alternative

approach is to use proxy measures derived from available data. The interval between births can serve as a plausible proxy, based on the notion that individuals with larger family size ideals tend to progress more quickly to higher parity to achieve their desired number of children.

To validate this with assumption, I tested using GGS-I linked register data and found that shorter intervals between previous births are indeed associated with higher ideal family size among fathers. Furthermore, results from our previous study (Abdullayev & Puur, 2025) on determinants of fathers' leave uptake — based on a similar dataset but including all birth orders — showed that a shorter interval to the previous child was associated with a higher likelihood of parental leave use for the current child analysed. We interpreted the length of previous birth interval as a proxy indicator of the father's family orientation.

Building on this rationale, the length of the previous birth interval was included as a covariate in mixture cure models using the full register dataset. This allows for partial adjustment of unobserved family orientation in models estimating the effect of fathers' leave use on fertility. The analysis could be performed only for transition to the third birth, as at least two children are required to define an interval.

Figure 4: Exponentiated coefficients of fathers' uptake of parental leave for progression to the third birth (mixture cure model), Estonia, couples with children born between 2003 and 2018: comparison of models with and without controlling for duration to previous child



Source: Statistics Estonia, author's calculations

Figure 4 displays exponentiated coefficients and 95% confidence intervals from both mixture

cure submodels, comparing the effects of leave uptake on progression to third birth with and without controlling for birth interval. Notably, the results do not indicate attenuation of the effect of fathers' leave use on the transition to third birth; if anything, the estimate becomes statistically significant in Model 3 (the fully adjusted incidence submodel). These findings suggest that the positive association between fathers' leave use and faster transition — particularly for third births — remains robust even when accounting for potential selectivity related to fathers' family orientation.

Summary and discussion of findings

This study examined the relationship between fathers' uptake of parental leave and progression to subsequent births — specifically the second and third child — in Estonia, using longitudinal register data complemented by linked survey information on family orientation and gender role attitudes for supplementary analyses. The application of mixture cure models allowed to disentangle quantum effects (the propensity of having another child) from tempo effects (timing of childbirth), advancing the literature beyond conventional event history analyses that do not differentiate these processes. Furthermore, the possibility of linkage with the GGS survey and the use of a proxy for fathers' family orientation, as a novel approach applied to the full dataset, enabled partial addressing of the selectivity issues.

The first hypothesis (H1) — anticipating that couples with fathers who take parental leave would be more likely to progress to subsequent births and transition faster to the next child compared to non-users — was partly supported by the findings. Fathers' leave use was consistently associated with accelerated progression to both second and third births, with stronger effects for third births, while observed positive quantum effects were statistically significant only for the third birth. The positive quantum effects for progression to the third child suggest that fathers' leave use may reflect genuinely higher fertility intentions beyond merely faster timing. This observation is consistent with the fourth hypothesis (H4), predicting stronger associations between fathers' uptake of parental leave for third births due to greater variability in family preferences and circumstances beyond the two-child norm prevalent in contemporary Europe (Beaujouan & Berghammer, 2019; Sobotka & Beaujouan, 2014).

Positive effects of fathers' leave use on subsequent births reported by Nordic studies (Duvander & Andersson, 2006; Duvander et al., 2010, 2019) suggest that fathers' parental leave use facilitates domestic workload sharing and likely reduces barriers to continued childbearing by easing the reconciliation of work and family life for mothers. However, those studies could not distinguish whether their findings referred to tempo or quantum effects. Methodologically, the use of mixture cure models in our study addressed this issue. Our supplementary Cox model analyses aligned with previous Nordic studies, showing statistically significant positive effects of fathers' parental leave use on second and third births; however, mixture cure models revealed that the effects for the second births were limited to timing effects.

The second hypothesis (H2) posited that fathers who received labour income during some portion of their leave — interpreted as partially or wholly maintaining work engagement and potentially being less committed to caregiving — would be less likely to progress to a next child and would exhibit longer birth intervals than those receiving no labour income. Our findings support this expectation regarding quantum effects solely on third births: fathers who took leave without earning labor income tended to have higher odds of transitioning to the third birth. However, timing effects, contrary to H2, were especially pronounced among fathers who received labour income during leave, exhibiting shorter birth intervals compared to fathers not earning income during leave and non-users. This pattern suggests heterogeneity in paternal leave experiences, where fathers balancing work and childcare may facilitate quicker progression, possibly reflecting efficient management of competing demands. Furthermore, those not receiving income during leave might have had weaker labour market attachment or even been unemployed.

Hypothesis three (H3) suggested a negative relationship between leave length and subsequent childbearing, anticipating that moderate or somewhat shorter leave durations would associate with both quicker timing and positive effects on the propensity to have a next birth. Our analysis of leave duration revealed no significant differences in quantum effects for either birth order but showed accelerated timing among fathers with moderate leave length. Consistent with findings from Sweden (Duvander & Andersson, 2006), this supports the idea that moderate leave reflects an optimal equilibrium wherein fathers contribute to childcare without extensive career interruption — an arrangement that also allows mothers to return to the labour market earlier. Longer leaves may correspond to other family considerations, such as mothers' employment constraints necessitating greater fathers' involvement at home, and do not necessarily translate into enhanced fertility progression.

An important concern in the literature is potential confounding by fathers' family orientation, which may lead to omitted variable bias if not adequately controlled and likely an overestimation of the association between fathers' leave use and continued childbearing. Analysis based on the linkage between GGS survey and register data, including all birth orders, found that fathers taking leave had larger family size ideals, echoing concerns raised in prior research (Duvander et al., 2010; Lee, 2022). Controlling for these attitudinal factors ideally requires using survey data, as register data lack such information. While linked data availability for particular parities further limits sample size, preventing inclusion of those covariates as additional controls in mixture cure models, we used the length of birth interval between previous children as a proxy for fathers' family orientation. The validity of this proxy was supported by the GGS-linked dataset, which showed an association between fathers' higher intended family size and shorter birth intervals. Including the length of the previous birth interval did not attenuate — and even strengthened — the positive association between fathers' leave uptake and progression to third births. This finding suggests that the observed associations for third births are not solely driven by selection on family orientation.

In conclusion, this study contributes novel evidence from Estonia on the interplay of fathers' parental leave use and fertility, fitting into the broader context of mixed empirical evidence from Nordic countries, Spain, and South Korea. Unlike some quasi-experimental studies that found no significant effects of leave reforms on fertility in Nordic countries (Cools et al., 2015; Duvander et al., 2020; Hart et al., 2022) or negative effects in Spain (Farré & González, 2019) and South Korea (Lee, 2022), our findings suggest moderate positive effects, particularly for third births. Differences in context and study design likely explain these divergences. Estonia's generous earnings-related leave, high female employment, and absence of father's quotas during the study period represent a distinct policy and social environment influencing fathers' leave-taking behaviour — which was found to be largely affected by strategic economic optimisation (Abdullayev & Puur, 2025) — and fertility decisions. This was consistent with arguments about the importance of policy context (Farré & González, 2019; Lee, 2022), more complementary and family oriented policy designs might create a better environment for combining work and family life for parents.

Regarding limitations, it is possible that the proxy we used did not fully capture unobserved differences between fathers who used parental leave and those who did not. Furthermore, this approach was not appropriate for the analysis of second births. Future research avenues might include revisiting the relationship between fathers' uptake of parental leave and continued fertility, focusing on the situation after the introduction of the fathers' quota in 2020 in Estonia, particularly as reports suggest a jump in fathers' uptake rates thereafter (Pall, 2024). Additionally, further investigation into whether mothers returned to employment or stayed at home while fathers were on leave could improve understanding of how parental leave sharing and the work-family balance affect childbearing trajectories. Given the low share of fathers taking leave during the study period, more detailed analyses would result in very small subpopulations with current data. However, considering evidence of growing fathers' leave uptake in recent years in Estonia, such investigations become more feasible with more recent data.

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Appendix

Table A1: Estimated person-time (months), frequency and incidence rates for transition from first to second birth, couples with children born between 2003 and 2018, Estonia

Variables	Person-time (months)	%	Failures	Rate	[95% conf. interval]	
					Lower	Upper
Father's parental leave use						
Did not use	4417585	94.45	38964	0.00882	0.00873	0.00891
Used	259745	5.55	2646	0.01019	0.00980	0.01058
Father's parental leave use and labour income receipt						
Did not use	4419352	94.48	38980	0.00882	0.00873	0.00891
No labour income	76073	1.63	739	0.00971	0.00903	0.01044
Some labour income	181905	3.89	1891	0.01040	0.00993	0.01087
Father's parental leave use and duration of the leave						
Did not use	4417585	94.45	38964	0.00882	0.00873	0.00891
< 8 months	86898	1.86	906	0.01043	0.00976	0.01113
> 8 months	172847	3.70	1740	0.01007	0.00960	0.01055
First child's birth year						
2003	322057	6.89	2540	0.00789	0.00758	0.00820
2004	394173	8.43	3352	0.00850	0.00822	0.00880
2005	394576	8.44	3296	0.00835	0.00807	0.00864
2006	415058	8.87	3389	0.00817	0.00789	0.00844
2007	430985	9.21	3583	0.00831	0.00804	0.00859
2008	404778	8.65	3452	0.00853	0.00825	0.00882
2009	354320	7.58	3137	0.00885	0.00855	0.00917
2010	327769	7.01	2921	0.00891	0.00859	0.00924
2011	282930	6.05	2544	0.00899	0.00865	0.00935
2012	253113	5.41	2463	0.00973	0.00935	0.01012
2013	239855	5.13	2364	0.00986	0.00946	0.01026
2014	218524	4.67	2228	0.01020	0.00978	0.01063
2015	209155	4.47	2132	0.01019	0.00977	0.01064
2016	180440	3.86	1781	0.00987	0.00942	0.01034
2017	151426	3.24	1455	0.00961	0.00912	0.01012
2018	98171	2.10	973	0.00991	0.00930	0.01055
Father's characteristics						
Father's income level						
No income	643781	13.76	4552	0.00707	0.00687	0.00728
Q1	1057334	22.61	9069	0.00858	0.00840	0.00876
Q2	1069803	22.87	9588	0.00896	0.00878	0.00914
Q3	1016476	21.73	9485	0.00933	0.00914	0.00952
Q4	889936	19.03	8916	0.01002	0.00981	0.01023
Father's education level						
Low	722021	15.44	6608	0.00915	0.00893	0.00938
Medium	2883493	61.65	24100	0.00836	0.00825	0.00846
High	1036879	22.17	10637	0.01026	0.01006	0.01046
NAs	34937	0.75	265	0.00759	0.00670	0.00856
Father's ethnicity						
Estonians	3103993	66.36	30688	0.00989	0.00978	0.01000
Other ethnic groups	1558587	33.32	10868	0.00697	0.00684	0.00711
NAs	14750	0.32	54	0.00366	0.00275	0.00478
Father's age at the first child's birth						
<25	1106957	23.67	11137	0.0101	0.0099	0.0102
25-29	1672434	35.76	16730	0.0100	0.0099	0.0102

30-34	1084555	23.19	9248	0.0085	0.0084	0.0087
35-39	494824	10.58	3159	0.0064	0.0062	0.0066
40-45	220089	4.71	997	0.0045	0.0043	0.0048
>45	87968	1.88	304	0.0035	0.0031	0.0039
NAs	10503	0.22	35	0.0033	0.0023	0.0046
Mother's characteristics						
Mother's income level						
No income	764558	16.35	6559	0.00858	0.00837	0.00879
Q1	1030241	22.03	9418	0.00914	0.00896	0.00933
Q2	1084249	23.18	9152	0.00844	0.00827	0.00862
Q3	997320	21.32	8765	0.00879	0.00861	0.00897
Q4	800962	17.12	7716	0.00963	0.00942	0.00985
Mother's education level						
Low	674130	14.41	6309	0.0094	0.0091	0.0096
Medium	2442620	52.22	19777	0.0081	0.0080	0.0082
High	1557823	33.31	15496	0.0099	0.0098	0.0101
NAs	2757	0.06	28	0.0102	0.0067	0.0147
Mother's ethnicity						
Estonians	3106321	66.41	30643	0.0099	0.0098	0.0100
Other ethnic groups	1571009	33.59	10967	0.0070	0.0069	0.0071
Mother's age at first child's birth						
<20	444643	9.51	4537	0.0102	0.0099	0.0105
20-24	1644105	35.15	16327	0.0099	0.0098	0.0101
25-29	1701794	36.38	15376	0.0090	0.0089	0.0092
30-34	691617	14.79	4585	0.0066	0.0064	0.0068
35-39	181580	3.88	745	0.0041	0.0038	0.0044
39-45	13591	0.29	40	0.0029	0.0021	0.0040
Place of residence						
Tallinn	2020942	43.21	16007	0.0079	0.0078	0.0080
Big towns	610468	13.05	5624	0.0092	0.0090	0.0095
Small towns and villages	1733514	37.06	17013	0.0098	0.0097	0.0100
Tallinn surroundings	294315	6.29	2809	0.0095	0.0092	0.0099
Unknowns	18091	0.39	157	0.0087	0.0074	0.0101
Couple type						
Cohabiting	3127827	66.87	27816	0.0089	0.0088	0.0090
Married	1549503	33.13	13794	0.0089	0.0088	0.0091
Previous child's sex						
Boy	2376245	50.80	21434	0.0090	0.0089	0.0091
Girl	2301085	49.20	20176	0.0088	0.0086	0.0089
Total	4677330	100.00	41610	0.0089	0.0088	0.0090

Source: Statistics Estonia, author's calculations

Table A2: Estimated person-time (months), frequency and incidence rates for transition from second to third birth, couples with children born between 2003 and 2018, Estonia

Variables	Person-time (months)	%	Failures	Rate	[95% conf. interval]	
					Lower	Upper
Father's parental leave use						
Did not use	5350817	92.78	17541	0.00328	0.00323	0.00333
Used	416571	7.22	1736	0.00417	0.00397	0.00437
Father's parental leave use and labour income receipt						
Did not use	5353427	92.82	17553	0.00328	0.00323	0.00333
No labour income	119554	2.07	462	0.00386	0.00352	0.00423
Some labour income	294407	5.10	1262	0.00429	0.00405	0.00453
Father's parental leave use and duration of the leave						
Did not use	5350817	92.78	17541	0.00328	0.00323	0.00333
< 8 months	125395	2.17	530	0.00423	0.00387	0.00460
> 8 months	291176	5.05	1206	0.00414	0.00391	0.00438
Second child's birth year						
2003	339878	5.89	969	0.00285	0.00267	0.00304
2004	441181	7.65	1282	0.00291	0.00275	0.00307
2005	436632	7.57	1324	0.00303	0.00287	0.00320
2006	463854	8.04	1381	0.00298	0.00282	0.00314
2007	480707	8.33	1445	0.00301	0.00285	0.00317
2008	455203	7.89	1402	0.00308	0.00292	0.00325
2009	443454	7.69	1449	0.00327	0.00310	0.00344
2010	471538	8.18	1571	0.00333	0.00317	0.00350
2011	422016	7.32	1479	0.00350	0.00333	0.00369
2012	374343	6.49	1295	0.00346	0.00327	0.00365
2013	325872	5.65	1216	0.00373	0.00352	0.00395
2014	295879	5.13	1139	0.00385	0.00363	0.00408
2015	262359	4.55	1126	0.00429	0.00404	0.00455
2016	232097	4.02	922	0.00397	0.00372	0.00424
2017	185174	3.21	782	0.00422	0.00393	0.00453
2018	137201	2.38	495	0.00361	0.00330	0.00394
Father's characteristics						
Father's income level						
No income	1642132	28.47	5156	0.00314	0.00305	0.00323
Q1	971458	16.84	3768	0.00388	0.00376	0.00400
Q2	1027887	17.82	3734	0.00363	0.00352	0.00375
Q3	1066195	18.49	3523	0.00330	0.00320	0.00342
Q4	1059716	18.37	3096	0.00292	0.00282	0.00303
Father's education level						
Low	604079	10.47	3151	0.00522	0.00504	0.00540
Medium	3566967	61.85	11031	0.00309	0.00304	0.00315
High	1566156	27.16	5005	0.00320	0.00311	0.00329
NAs	30186	0.52	90	0.00298	0.00240	0.00366
Father's ethnicity						
Estonians	4194239	72.72	15253	0.00364	0.00358	0.00369
Other ethnic groups	1565484	27.14	4003	0.00256	0.00248	0.00264
NAs	7665	0.13	21	0.00274	0.00170	0.00419
				Father's age at the second child's birth		
<25	318991	5.53	2188	0.0069	0.0066	0.0072
25-29	1521368	26.38	7102	0.0047	0.0046	0.0048
30-34	2184194	37.87	6464	0.0030	0.0029	0.0030
35-39	1182332	20.50	2551	0.0022	0.0021	0.0022
40-45	425373	7.38	751	0.0018	0.0016	0.0019

>45	130520	2.26	209	0.0016	0.0014	0.0018
NAs	4610	0.08	12	0.0026	0.0013	0.0045
Mother's characteristics						
Mother's income level						
No income	2381543	41.29	8851	0.00372	0.00364	0.00379
Q1	831533	14.42	3559	0.00428	0.00414	0.00442
Q2	875206	15.18	2718	0.00311	0.00299	0.00322
Q3	867071	15.03	2177	0.00251	0.00241	0.00262
Q4	812035	14.08	1972	0.00243	0.00232	0.00254
Mother's education level						
Low	522612	9.06	3069	0.0059	0.0057	0.0061
Medium	3029329	52.53	9460	0.0031	0.0031	0.0032
High	2213154	38.37	6742	0.0030	0.0030	0.0031
NAs	2293	0.04	6	0.0026	0.0010	0.0057
Mother's ethnicity						
Estonians	4165569	72.23	15256	0.0037	0.0036	0.0037
Other ethnic groups	1601819	27.77	4021	0.0025	0.0024	0.0026
Mother's age at second child's birth						
<20	37807	0.66	404	0.0107	0.0097	0.0118
20-24	680174	11.79	4672	0.0069	0.0067	0.0071
25-29	2322385	40.27	8794	0.0038	0.0037	0.0039
30-34	2100721	36.42	4608	0.0022	0.0021	0.0023
35-39	591795	10.26	767	0.0013	0.0012	0.0014
39-45	34506	0.60	32	0.0009	0.0006	0.0013
Place of residence						
Tallinn	2053420	35.60	5685	0.0028	0.0027	0.0028
Big towns	757548	13.14	2447	0.0032	0.0031	0.0034
Small towns and villages	2393381	41.50	9421	0.0039	0.0039	0.0040
Tallinn surroundings	549774	9.53	1672	0.0030	0.0029	0.0032
Unknowns	13265	0.23	52	0.0039	0.0029	0.0051
Couple type						
Cohabiting	2871988	49.80	10431	0.0036	0.0036	0.0037
Married	2895400	50.20	8846	0.0031	0.0030	0.0031
Sex composition of previous children						
Both boys	1489124	25.82	5544	0.0037	0.0036	0.0038
Both girls	1315960	22.82	4567	0.0035	0.0034	0.0036
Mixed	2962304	51.36	9166	0.0031	0.0030	0.0032
Total	5767388	100.00	19277	0.0033	0.0033	0.0034

Source: Statistics Estonia, author's calculations

Table A3. Cox models, hazard ratios of the fathers' uptake of parental leave for progression to the second births, Estonia, couples with the first child born between 2003 and 2018.

Models	Haz. ratio	Std. err.	z	P>|z|	[95% conf. int.]	
M1 = only PL use	1.069	0.018	4.01	0.000	1.035	1.105
M2 = M1 + fathers' characteristics	0.978	0.017	-1.32	0.188	0.945	1.011
M3 = M2 + remaining controls	1.04	0.018	2.26	0.024	1.005	1.077

Note: reference = father did not use parental leave
Source: Statistics Estonia, author's calculations

Table A4. Cox models, hazard ratios of the fathers' uptake of parental leave for progression to the third births, Estonia, couples with the second child born between 2003 and 2018.

Models	Haz. ratio	Std. err.	z	P>|z|	[95% conf. int.]	
M1 = only PL use	1.219	0.031	7.86	0.000	1.160	1.280
M2 = M1+fathers' characteristics	1.229	0.032	7.99	0.000	1.169	1.292
M3 = M2+ remaining controls	1.120	0.029	4.36	0.000	1.064	1.178

Note: reference = father did not use parental leave
Source: Statistics Estonia, author's calculations