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Research Article

The impact of increased child benefits on tempo and quantum of fertility in Estonia

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The impact of increased child benefits on tempo and quantum of fertility in Estonia

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Abstract

BACKGROUND

On July 1, 2017, Estonia introduced a substantial child allowance for families with three or more children, supplementing regular child benefits. This universal, non-means-tested benefit aimed to alleviate financial burdens for larger families and encourage third and higher-order births.

OBJECTIVE

We examine the impact of this reform on the likelihood and timing of third births. We hypothesise that the Estonian child benefit reform had a positive impact, given that the total allowances for a family with three children amounted to 41% of the average salary at the time of implementation.

METHODS

We analyse longitudinal register data using a mixture cure model embedded within a difference-in-differences framework, which allows us to distinguish between changes in the probability of having a third child and changes in the timing of third births.

RESULTS

We find evidence that the reform was associated with a shortening of the time to third birth by nearly a quarter and a 4 percentage point increase in the probability of a third birth, corresponding to an 11% rise relative to the baseline third birth probability (37%).

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CONCLUSIONS

The results suggest that a generous child allowance can be linked to changes in both the timing and the likelihood of higher-order births.

CONTRIBUTION

The study contributes to the broader literature analysing the effects of family benefits on fertility by providing new evidence from longitudinal register data on the association between a generous, universal child benefit and changes in the timing and likelihood of third births in a low fertility context.

1. Introduction

In the absence of large-scale immigration, countries with sustained low fertility will experience a shrinking labour force and population decline. By 2024, 62 countries or areas in the world had already reached their peak population and were projected to experience a decline in population size over the next 30 years. An additional 38 countries are expected to reach their peak population between 2025 and 2054 (United Nations 2024). Against this backdrop, raising fertility as a policy goal, explicit or implicit, has become increasingly widespread globally. According to the World Population Policies Database (with the latest data on fertility policies collected in 2019), most countries and areas with a long history of low fertility have already established policies aimed at raising the fertility level (United Nations 2021). In parallel, average public spending on family policies in OECD countries increased from 1.6% of GDP in 1990 to 2.3% in 2021 (OECD 2025).

One of the family policy measures introduced by governments in low fertility countries is the provision of direct cash benefits to families. These benefits can take various forms. In some cases, they are one-time lump sum payments provided at the birth of a child, but more often they are regular monthly payments that continue until the child reaches a certain age or adulthood. Sometimes these benefits are means tested, meaning that only families with income below a certain threshold are eligible. However, they are more often universal benefits, available to all families regardless of income.

The growing body of literature examining the effects of these benefits has yielded mixed and often inconclusive findings. A widespread view in the literature is that financial incentives might primarily influence the timing of births rather than completed fertility (Gauthier and Gietel-Basten 2025). Researchers often note that while a temporary positive impact on fertility is possible, the long-term effects remain uncertain or study designs are not well suited to test the persistence of these effects (Thévenon and Gauthier 2011; Sobotka, Matysiak, and Brzozowska 2019; Bergsvik, Fauske, and Hart 2021).

However, more recent studies have provided increasing evidence that the effects of cash benefits on fertility may be both positive and enduring (Hart et al. 2024). Several scholars argue that the limited impact of such policies observed in a number of studies may stem from the relatively small share of childrearing costs that governments typically cover (Bradshaw and Attar-Schwartz 2011; Thévenon and Gauthier 2011; Sobotka, Matysiak, and Brzozowska 2019). Given that raising children requires sustained investments over many years, family benefits must be both generous and stable in real terms to meaningfully support families and influence fertility behaviour.

This study contributes to the literature by analysing individual-level fertility responses to a family policy reform in Estonia that, starting in July 2017, offered a new benefit for families with three or more children. The benefit was initially set at 300 euros per month for families with three to six children and 400 euros per month for families with more than six children, provided the children were under 19 years of age. For several reasons, the 2017 child benefit reform in Estonia presents a valuable case for investigating the impact of policy on fertility. First, the introduction of the new child benefit marked a significant shift in the country's family policy, markedly increasing financial support for families with three or more children. Second, from an international perspective, the reform stood out for its generosity: In 2018, the benefit for families with three children amounted to 39% of the average salary – the highest level among OECD countries. Estonia was followed by Poland, where the corresponding figure was considerably lower, at 22% (OECD 2019). Third, the time elapsed since the reform allows for an assessment of longer-term effects on fertility behaviour. Finally, the use of longitudinal register data makes it possible to track individual birth histories and compare fertility behaviour before and after the reform while controlling for a range of individual-level and macroeconomic variables.

Previous research has shown that family cash benefits tend to have a stronger and more consistent impact on higher-order births, particularly when policies explicitly target families with three or more children (Breton, Prioux, and Dutreuilh 2005; Schellekens 2009; Laroque and Salanié 2014; Lyssiotou 2021). The contribution of this study lies in the application of a mixture cure model, which allows us to disentangle the effects of explanatory variables on the probability of having another child from their effects on the timing of that birth. Unlike conventional event history models, which cannot separate these two processes, the cure model allows for a more nuanced analysis of fertility behaviour. In addition, the study employs a difference-in-differences (DiD) approach, comparing women at risk of a second birth (untreated) with those at risk of a third birth (treated) before and after the policy change.

2. The effects of family cash benefits on fertility

Gary Becker's seminal work on fertility views childbearing decisions as similar to other consumer decisions, where parents maximize utility within budget constraints (Becker 1960). In this framework, financial support, such as family cash benefits or tax credits, reduces the costs of childrearing, potentially encouraging higher fertility (Willis 1973; Becker 1991). However, Becker later acknowledged a trade-off between the quantity of children and investments in their quality of life. As family income grows, parents tend to invest more in each child, improving their education, health, and well-being rather than simply increasing the number of children (Becker and Lewis 1973). In the 1990s, Becker further emphasised how rising wages increase the opportunity costs of having more children, thus strengthening the focus on child quality of life. Alongside this, Willis (1973) and Becker (1991) recognized that government financial support, such as tax credits or family benefits, can reduce the overall costs of childrearing, potentially encouraging higher fertility by alleviating some financial burdens.

Empirical research on the relationship between cash benefits and fertility has employed a range of analytical approaches, yielding mixed and context-dependent results. Using a macro-level approach and cross-national data, Gauthier and Hatzius (1997) and Luci-Greulich and Thévenon (2013) reported generally positive associations between cash benefits and aggregate fertility measures, such as the total fertility rate (TFR) and adjusted TFR. Similarly, McNown and Ridao-Cano (2004) examined Canadian child benefits, which varied by provinces, from 1947 to 1999 and found that while child benefits slightly increased fertility rates for women aged 20–44, broader economic factors, such as female and male incomes, had a more substantial impact. In contrast, Gábos, Gál, and Kézdi (2009) analysed the effects of government social policy interventions from 1950 to 2006 in Hungary and found a consistently positive effect of increased child-related government spending on TFR, particularly for higher-order births. Frejka and Zakharov (2013) showed that Russia's 2007 pronatalist reforms boosted fertility rates but had no significant impact on completed fertility, while Validova (2021) reported modest increases in higher-order births and earlier timing of second births.

Research based on cross-national survey microdata on fertility and aggregated policy indicators has generally provided weaker support for the effectiveness of cash benefits. Kalwij (2010), studying 16 Western European countries with a discrete-time proportional hazard model, found no significant impact of increased child benefits on fertility or birth timing. Billingsley and Ferrarini (2014), employing multilevel modelling across 21 European countries, found that financial support to families, including cash benefits, was positively associated with first birth intentions but not with intentions for higher-parity births. Billingsley, Neyer, and Wesolowski (2022), using fixed-effects

linear probability models, observed that passive family support – encompassing cash benefits, care allowances, and tax deductions – was negatively associated with first birth probabilities in 20 European countries, particularly among educated women. For second births, this negative effect persisted among women with post-secondary education.

While the above studies offer valuable insights, many rely on methods that do not allow for causal inference regarding the impact of family benefits on fertility. This limitation is addressed in a growing body of research that applies quasi-experimental methods, such as DiD estimations and regression discontinuity designs (RDD) (Angrist and Pischke 2010). These approaches compare outcomes between groups with differential exposure to a policy, thereby approximating experimental conditions. Such variation may arise when a reform targets only a specific region, subgroup, or birth parity, enabling researchers to isolate the policy's effect from broader contextual trends.

There are three quasi-experimental studies that employ a difference-in-differences design to estimate the effect of increased family cash benefits on fertility behaviour. Parent and Wang (2007), using Canadian census data, studied Quebec's 1974 family allowance reform. Quebec significantly increased the generosity of family allowances, while no similar policy change occurred in other provinces. The authors found that the reform created a tempo effect, accelerating childbearing relative to the rest of the country; however, it did not have an impact on completed family size. Lyssiotou (2021), based on data from the Cyprus Family Expenditure Survey, found evidence that the introduction of a non-means-tested fourth child benefit in 1988 significantly increased the probability of fourth births relative to third births, which served as the control group. Utilising data from Argentina's Household Survey, Garganta et al. (2017) studied the impact of a 2009 programme that provided monthly cash benefits per child to low-income households outside the formal sector. The authors compared changes in fertility rates between this group and other households before and after the policy reform. Their results showed a significant increase in childbearing among households with at least one child, whereas the programme did not significantly affect the probability of having a first child.

Positive effects of family benefits on higher-order births have also been reported in studies that utilised somewhat less rigorous analytical methods. Breton, Prioux, and Dutreuilh (2005) investigated French family policies in the late 1970s and 1980s, when additional benefits were introduced to encourage families to have a third child. Using data from the French Family History Survey and logistic regression, they showed that the policy reform was associated not only with the earlier timing of third births but also with an increased probability of families having a third child. Laroque and Salanié (2014) applied a discrete-choice model to French Labor Force Survey data to analyse the dual decisions of working and having children. The results showed that child benefits and tax credits can positively influence fertility decisions, especially the decision to have a third child.

Schellekens (2009) studied a 1975 family allowance reform in Israel that replaced a complex system of child benefits with a more straightforward, non-means-tested programme. The reform provided minimal amounts for the first two children, larger benefits for the third child, and significantly larger sums for fourth and subsequent children. Using a discrete-time hazard model and childbearing histories reconstructed from the 1983 and 1995 Israeli censuses, Schellekens found that the reform was associated with a significant increase in the probability of having another child. The impact was observed starting from the third birth, peaking at the fifth birth, and declining for sixth and seventh births. Bokun (2024) investigated the effect of the Family 500+ programme in Poland, which in 2016 introduced generous monthly cash benefits for all families with two or more children as well as for one-child families with low income and/or a child with a disability. The analysis, based on data from the Polish Household Budget Survey and using linear probability models, showed that fertility slightly increased among eligible women aged 31–40 after the start of the programme. However, as the observation ended just a few years after the reform, the results are inconclusive regarding the persistence of the effect in the longer term.

A number of studies using DiD designs have evaluated reforms that combine cash benefits with tax deductions, often finding positive effects among specific subpopulations. Brewer, Ratcliffe, and Smith (2012) examined a series of family-related financial reforms implemented in the UK between 1999 and 2003 that markedly increased government spending per child. Using data from the Family Resources and Family Expenditure Surveys, the authors focused on women in low-income households, who gained the most from the reforms. The control group included women in higher-income households, who were not significantly impacted. The study found a positive effect of the reforms on fertility among low-income households, with a greater impact on first than on subsequent births. Riphahn and Wijnck (2017) investigated a 1996 reform of the German child benefit programme. The reform aimed to make child-related financial support more flexible and beneficial to a wider range of families, with the value of transfers depending on the number of children and household income. Utilising the German Mikrozensus and the German Socioeconomic Panel, the authors found no effect on first births, but a positive effect on second births was observed among higher-income couples. Hart and Galloway (2023) studied the effect of regional family benefit reforms in northern Norway in 1989 and 1990. These reforms, in Finnmark and North Troms, included increases in universal child benefits, enhanced additional benefits, and the introduction of tax deductions, with more substantial deductions for single parents. Using other municipalities of the same region as a control group, register-based analysis showed that enhanced benefits and tax deductions positively affected the probability of second and third births among younger, unmarried women, who received the largest subsidies.

An increase in third births was also observed among older women, suggesting a quantum effect.

In line with research showing positive fertility effects of generous family benefits, reduction in benefit generosity or the introduction of means testing has generally had discouraging effects. A 1995 policy shift in Hungary abolished earnings-related child care benefits and replaced them with means testing for benefits paid during the child care leave and family allowances, leading to delayed family formation – particularly marriage and childbirth – among higher-income families (Aassve, Billari, and Spéder 2006). These policies were reversed in 1998, reestablishing conditions that made family formation more appealing. Israel introduced widespread benefit cuts in its child benefit system in 2003, with the largest reductions targeting large families. Before the reform, benefit amounts increased with the child's birth order. Post-reform, all children born in 2003 or later received equal amounts. A study of this reform by Cohen, Dehejia, and Romanov (2013) revealed that the reduction in child benefits was associated with a decreased probability of having another child, particularly for third and higher-order births. In 2014–2015, France made child benefits conditional on household income. This policy change represented an important shift away from the previously universal system, where benefits for children were disbursed without consideration of family income. Using a regression discontinuity design, Elmallakh (2021) found that the reform resulted in a decrease in fertility rates, with part of it attributed to changes in birth timing.

In addition to recurring benefits, many studies have examined short-term financial incentives such as baby bonuses. Positive effects have been found in Canada (Milligan 2005; Malak, Rahman, and Yip 2019), although some studies report only limited impacts (Ang 2015). Positive responses have also been documented in Italy (Boccuzzo et al. 2008), Australia (Lain et al. 2009; Risse 2010; Drago 2011; Sinclair, Boymal, and De Silva 2012; Guest and Parr 2010), Spain (González 2013; González and Trommlerova 2023), Switzerland (Chuard and Chuard-Keller 2021), and South Korea (Kim 2023).

Whether short-term or long-term, the effects of financial benefits on fertility are not uniform across populations. Several studies have examined how responses differ by sociodemographic group. Schellekens (2009) found that increased allowances in Israel had a stronger effect among more educated women, while Cohen, Dehejia, and Romanov (2013) showed that benefits encouraged fertility across all groups but were weakest among high-income families. In Germany, the 1996 reform raised second birth rates for higher-income couples but had no effect on low-income families (Riphahn and Wijnck 2017). Cowan and Douds (2022) demonstrated that Alaska's Permanent Fund Dividend had a greater impact among socioeconomically disadvantaged populations. One-time "baby bonuses" tend to have more uniform effects, generally stronger for less wealthy and less educated parents (Boccuzzo et al. 2008; Lain et al. 2009; Risse 2010; Drago et al. 2011; Kim 2023). An exception is Quebec's Allowance on Newborn Children, where

the strongest response was observed among middle-income families and more educated women (Malak, Rahman, and Yip 2019).

Although much previous research found that family cash benefits had a positive effect on fertility, overview articles remain cautious about the persistence of this effect. Thévenon and Gauthier (2011) suggest that cash transfers tend to have a positive but modest impact on fertility, leaving open whether this effect is temporary or lasting. Similarly, Sobotka, Matysiak, and Brzozowska (2019) argue that financial incentives generally have a limited long-term impact on completed fertility, as they cover only a small fraction of the total costs of raising children. Bergsvik, Fauske, and Hart (2021) find that while cash benefits often have an immediate effect on fertility, most study designs are unable to test whether these effects endure over longer time periods. However, the most recent overview of causal studies by Hart et al. (2024) concludes that cash benefits predominantly positively affect fertility, with increasing evidence suggesting lasting effects on completed fertility. Gauthier and Gietel-Basten (2025) find that cash benefits show mixed effects on fertility – about half of the studies report a positive impact while others find no effect – likely because the benefits are relatively small compared to the overall costs of raising children.

In conclusion, both macro- and micro-level studies frequently find positive effects of family cash benefits on fertility, alongside negative effects when benefits are reduced or means tested. The positive impact is particularly evident in benefits that are more generous for larger families, designed to encourage higher birth rates. However, many studies struggle to determine whether these effects are temporary – primarily influencing the timing of births – or whether they lead to changes in fertility quantum. This difficulty often stems from analytical methods that do not allow for a clear separation of tempo and quantum responses to policy change, but it may also reflect data limitations, such as a short post-reform observation period.

3. Reform of child benefits and the demographic context

Starting on July 1, 2017, Estonia offered a substantial allowance for families with three or more children. The parliament decided on the reform on June 15, 2016 (*Perehüvitiste seadus* 2016). The benefit was initially set at 300 euros per month for families with three to six children and 400 euros per month for those with more than six children. The allowance was granted to parents who received regular child benefits for at least three children under 19 years of age.⁴ The aim was to ease the financial burden of raising children for parents and to recognise the upbringing of children in large families

⁴ Starting in 2017, regular child benefits in Estonia amounted to 50 euros per month for the first and second child and 100 euros per month for the third and each subsequent child.

(Estonian Ministry of Social Affairs 2017). Another aim was to encourage fertility (Parliament of Estonia 2015).

Before the child benefit reform, benefit amounts had been frozen for extended periods, on some occasions exceeding ten years (Table 1). After the reform, a family with three children could receive a combined monthly sum of 500 euros: 50 euros for both the first and second child and an additional 100 euros for the third child. The child benefit reform was financed from the central government budget; the expansion did not cut or crowd out other programmes in support of families. The amount rose to 520 euros on January 1, 2019, following a minor increase in benefits for first and second children. On January 1, 2023, the allowance for large families was further increased to 650 euros for families with three to six children and 850 euros for those with more than six children. However, in early 2024, after a change of government coalition, the benefit was reduced by 200 euros in both cases.

To illustrate the generosity of the benefit, in 2017 the average gross monthly salary in Estonia was 1,221 euros. Taking all child benefits into account, the total monthly support accounted for 41% of the average salary for a family with three to six children. Relative to the minimum monthly wage of 470 euros in 2017, the benefit was even more substantial, equalling 106% of the minimum wage (Statistics Estonia 2025; Eurostat 2025). According to Trumm et al. (2020), the average monthly cost of a first child was estimated at approximately 388 euros in 2019, shortly after the reform; using the authors' recommended weights of 1:0.7:0.7 for the first, second, and third child, the total cost for a three-child family amounts to about 932 euros per month, meaning that the post-reform benefit of 500 euros covered more than half of these expenses. The relative poverty rate in 2016 – the year before the child benefit reform – was 17.0% for families with one child, 15.5% for families with two children, and 28.2% for families with three or more children. In 2018, the year following the reform, these rates declined to 14.8% for families with one child, 14.8% for those with two children, and 16.5% for families with three or more children (Sinisaar 2021). Thus the increased generosity of the child benefits markedly reduced the relative poverty rate among larger families, bringing it closer to levels observed among families with one or two children.

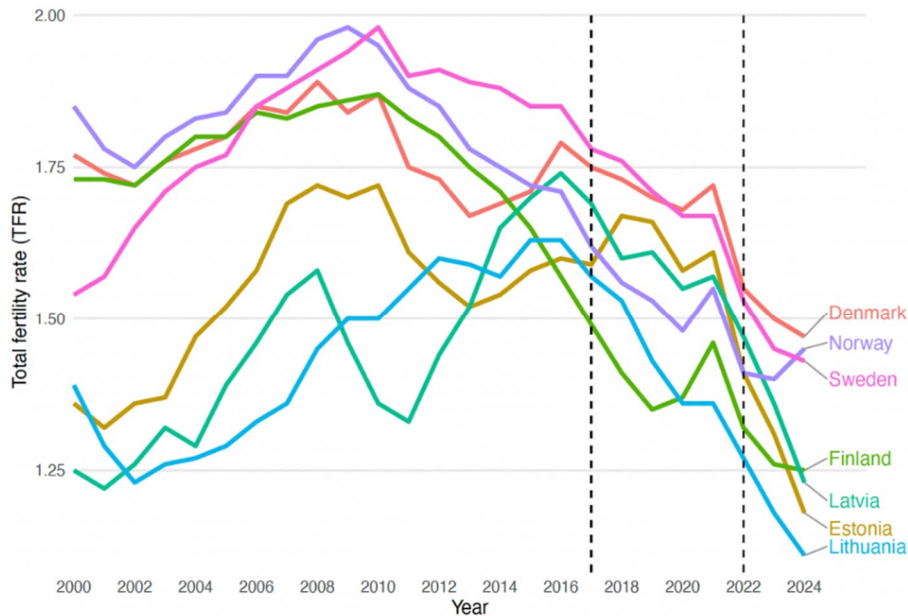
Table 1: Average and minimum monthly salary and child benefits for families with two and three children, 2005–2024

Year	Average gross monthly salary (€)	Monthly minimum salary (€)	Two children			Three children		
			Monthly benefits (€)	Benefits as % of average gross salary	Benefits as % of minimum salary	Monthly benefits (€)	Benefits as % of average gross salary	Benefits as % of minimum salary
2005	516	171	38	7.4	22.4	58	11.1	33.6
2006	601	192	38	6.4	20.0	58	9.6	30.0
2007	725	230	38	5.3	16.7	96	13.2	41.7
2008	825	278	38	4.6	13.8	96	11.6	34.5
2009	784	278	38	4.9	13.8	96	12.2	34.5
2010	792	278	38	4.8	13.8	96	12.1	34.5
2011	839	278	38	4.6	13.8	96	11.4	34.5
2012	887	290	38	4.3	13.2	96	10.8	33.1
2013	949	320	38	4.0	12.0	105	11.1	33.0
2014	1,005	355	38	3.8	10.8	115	11.5	32.4
2015	1,065	390	90	8.5	23.1	190	17.8	48.7
2016	1,146	430	100	8.7	23.3	200	17.5	46.5
2017	1,221	470	100	8.2	21.3	500	41.0	106.4
2018	1,310	500	110	8.4	22.0	510	38.9	102.0
2019	1,407	540	120	8.5	22.2	520	37.0	96.3
2020	1,448	584	120	8.3	20.5	520	35.9	89.0
2021	1,474	584	120	8.1	20.5	520	35.3	89.0
2022	1,645	654	120	7.3	18.3	520	31.6	79.5
2023	1,832	725	160	8.7	22.1	910	49.7	125.5
2024	1,981	820	160	8.1	19.5	710	35.8	86.6

Sources: Statistics Estonia and Eurostat; authors' calculations.

In 2018, shortly after the introduction of the new allowance, Estonia's public spending on family benefits reached 3.1% of GDP, with 2.2% allocated specifically to direct cash transfers, including child benefits and parental leave benefits.⁵ This positioned Estonia among the most generous OECD countries in terms of public family support, ranking fifth overall after Sweden, Denmark, Iceland, and Luxembourg (OECD 2025).

⁵ Given that the majority of families with minor children have one or two children, the aggregate fiscal impact of the increase in child benefits for families with three or more children was limited. Between 2018 and 2023, expenditure on benefits for large families amounted to between 0.39% and 0.43% of GDP (authors' calculations based on Statistics Estonia data). As population projections show that the number of children will shrink in the future, these costs can be predicted to decrease accordingly.

Figure 1: Total fertility rate in Nordic and Baltic countries 2000–2024

Note: Vertical lines in the figure denote the date of policy reform and the start of the war in Ukraine.
 Sources: Eurostat; Central Statistics Bureau of Latvia.

Unlike the Nordic countries, where fertility entered a sustained decline around 2010, Estonia did not experience a continuous downward trend at that time; instead fertility remained relatively stable and even temporarily increased until the early 2020s. In 2021 the total fertility rate was 1.61 – quite high given the tempo distortion due to postponement of childbearing. The introduction of the allowance for families with three or more children in 2017 was followed by a noticeable increase in third births and a smaller rise in fourth births. Between 2018 and 2021, the number of third and higher-order births exceeded the 2017 level by 16% on average. Over the same period, first and second births declined relative to 2017 by 7% and 3%, respectively.⁶ However, from 2022 onwards, fertility began to decrease, with TFR reaching a low of 1.18 in 2024 (Statistics Estonia 2025; see Figure 1). This decline in fertility may be partly attributed to a series of macro-level shocks that affected Estonia and other countries, starting with the COVID-19 crisis in 2020, followed by the outbreak of the Russo-Ukrainian War and a period of

⁶ Our unpublished analyses (available on request), based on register data, show no association between the child benefit reform and changes in female employment rates in Estonia.

increased inflation.⁷ In addition to the macro-level shocks, Estonia has experienced rapid wage growth in the years following the child benefit reform, which has reduced the real value of benefits because they did not increase accordingly. In terms of family policies, the past couple years have been marked by shifting government priorities, including changes, reductions, and cancellations. These developments may have contributed to the overall decline in fertility and the decline in the effectiveness of family policies in particular.

4. Research hypotheses

We formulate three hypotheses about changes in the quantum and tempo of third births associated with the 2017 Estonian child benefit reform. Our first hypothesis (H1) posits that the introduction of an allowance for families with three or more children is associated with an increased probability of third births following the child benefit reform enacted on July 1, 2017. This hypothesis is grounded in the notion that the size of the benefit was substantial relative to median income, thereby potentially reducing the economic barriers to having a third child.

Our second hypothesis (H2) posits that the allowance is associated with a shift towards shorter intervals between second and third births. This hypothesis draws on the idea that the financial incentive may have encouraged families not only to proceed with a third child but also to do so sooner, resulting in a shorter time between second and third births. A plausible mechanism is that increased financial support reduces uncertainty and accelerates progression among families that had already intended to have a third child.

Our third hypothesis (H3) posits that the effect of the reform was stronger among women with lower socioeconomic status. This hypothesis is grounded in the notion that the relative value of the new child benefit was greater for women with lower levels of education and income, potentially amplifying their responsiveness to the reform.

5. Data, methods, and variables

This study is based on longitudinal register data commissioned from Statistics Estonia. The dataset includes detailed childbearing histories of women born between 1967 and 2006. It also contains information on sociodemographic characteristics of the women and their partners, measured at the beginning of birth intervals, and register data on women's

⁷ Between January 2021 and January 2025, consumer prices in Estonia increased by 43.6%, compared to 8.2% during the preceding five-year period (Statistics Estonia 2026).

income. Our observation period starts in 2005, a year after a major family policy reform that introduced income-related parental leave benefits (Puur et al. 2023; Abdullayev and Puur 2024), and continues through to 2024. We analyse women's progression from second birth to the conception of a third child and from the first birth to the conception of a second child.⁸ Observations were right-censored when the previous child turned 20 years old, when the woman reached her 45th birthday, in cases of death or emigration, or at the end of the observation period (December 31, 2024). The register-based dataset covered both the pre- and post-reform periods, spanning nearly 12.5 years before and 7.5 years after the increase in the child allowance on July 1, 2017. The analytical dataset included 105,252 women at risk of second births and 91,047 women at risk of third births.

The association between the child benefit reform and childbearing behaviour was analysed using event history models. We employed a mixture cure model, or split population model, that comprises two sub-models: an incidence sub-model and a duration sub-model. The incidence sub-model estimates the probability of experiencing the event of interest; the duration sub-model estimates the timing of the event among individuals who eventually experience it. The method was originally developed for epidemiological studies (Boag 1949; Berkson and Gage 1952). It is rarely used in population studies, but an important advantage of this method is the ability to distinguish the effect of independent variables on the risk of the next birth from their effects on its timing (Bremhorst, Kreyenfeld, and Lambert 2016; Gortfelder and Puur 2020; Cukrowska-Torzewska and Grabowska 2023).

The model assumes that women who have had a first or second birth can be divided into two groups: (1) a group that experiences another birth with a probability of π and (2) a group that does not experience it, with a probability of $1 - \pi$. The covariate vectors z_i and x_i influence the probability of experiencing the event and its timing, respectively.⁹ The duration sub-model is specified as an accelerated failure time (AFT) model with a lognormal distribution, which captures the hazard's shape over time. Among various distributions, the lognormal distribution is preferred due to its flexible shape, which captures realistic patterns in reproductive timing (Redivo, Dribe, and Scalone 2024). Lognormal distribution fits birth intervals well because it produces a hazard that quickly rises, reflecting rapid progression to the next birth early on, and then declines. The lognormal distribution was used in previous mixture cure applications in fertility research (e.g., Cukrowska-Torzewska and Grabowska 2023). The notations $f_u(t_i | x_i)$ and $S_u(t_i | x_i)$ denote the event time density and the survival function, respectively. The full log-likelihood function is as follows:

⁸ The dates (months) of conception were imputed by subtracting nine months from the date of birth.

⁹ The covariate vectors need not differ between the sub-models and may be identical. However, in this study we use identical vectors.

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

Interpretation of the estimates depends on the component. In the incidence sub-model, a positive coefficient implies a higher probability of experiencing the event (second or third birth), whereas negative coefficients imply a lower probability. In contrast, the duration sub-model reflects the timing among those who experience the event: Positive coefficients indicate a lengthened time to the event (longer birth intervals); negative coefficients suggest shorter intervals. In this study, we used the *cureregr* command in Stata 14 to estimate the model (Buxton 2013). Stata's *cureregr* command reports coefficients with opposite sign conventions; for clarity, all coefficients are presented here in reversed form.

The key explanatory variable is a time-varying indicator of exposure to the 2017 child benefit reform, coded as 1 for periods after the reform (July 1, 2017–March 31, 2024) and 0 for periods before the reform (January 1, 2005–June 30, 2017). To assess whether the effect of the reform differs by parity, this variable is interacted with a parity-at-risk indicator. This interaction is included in both the incidence and duration components of the mixture cure model. As a result, the model estimates four categories: (1) women at risk of a second birth before the reform, (2) women at risk of a second birth after the reform, (3) women at risk of a third birth before the reform, and (4) women at risk of a third birth after the reform.

This setup embeds a DiD logic within the mixture cure modelling framework. By exploiting variation over time (pre- versus post-reform) and across groups with different exposure to the policy (women at risk of second versus third births), we examine whether the probability and timing of subsequent births differed between the post- and pre-reform periods. Rather than estimating separate models by parity, specifying an interaction between parity and time allows for direct comparison across parities.

A key identifying assumption in the DiD framework is that of parallel trends: In the absence of the reform, changes in fertility behaviour over time would have been similar among women at risk of a second birth (control group) and those at risk of a third birth (treatment group). Across parities, second birth risk is the best counterfactual for third births. Second births were not affected by the policy reform, and they bear greater resemblance to third births than to the entry into parenthood. That said, in contemporary low fertility settings, having a third child represents crossing into large-family status, associated with differences in incentives as well as constraints. Compared to the control group, members of our treatment group are assumed to feature a more pronounced family orientation, but they also face tighter economic constraints due to the larger number of dependent household members. However, we believe these differences between groups do not preclude the use of a DiD framework in our study, as the reform effect and its size

are derived from the difference between the changes in the treatment and control groups, not from the baseline difference between them. In the next section, we show that the pre-reform trajectories of second and third births evolved in a largely parallel manner. This suggests that any divergence in post-reform trends between the two groups may be linked to the 2017 policy change, which targeted families with three or more children.

To explore heterogeneity in the reform's effect, we ran additional models in which the reform indicator was interacted with key socioeconomic characteristics. Specifically, one set of models included interactions with annual income, which combines wages, parental leave benefits, and income from self-employment/entrepreneurship, categorised into four quartiles (low, medium-low, medium-high, high). Another set included interactions with educational attainment, distinguishing between women with low/medium and high education. These models allowed us to assess whether the impact of the 2017 reform differed across income and education groups.

To account for changes in individual and contextual characteristics over time, the models included a set of covariates informed by prior research and data availability. Individual-level controls included the woman's age group, partnership status, education, and area of residence and the male partner's education – all measured at the time of the previous birth – and the woman's ethnicity. Annual income, categorised in quartiles, was included as a time-varying covariate; quartiles were calculated using nominal income values (i.e., without adjusting for inflation). In addition, the models controlled for macro-economic conditions using annual, time-varying measures of GDP growth, unemployment rate, and the consumer price index, obtained from Statistics Estonia (2025). Descriptive statistics for the explanatory and control variables, stratified by parity progression, are presented in Table 2.

Table 2: Descriptive statistics for explanatory and control variables by parity progression, women born 1967–2006, Estonia

Variables	Parity progression							
	1→2				2→3			
	Exposure		Event		Exposure		Event	
	Person-months	%	Second birth	%	Person-months	%	Third birth	%
Policy indicator								
Before reform	3,710,690	57.8	38,782	61.0	3,802,183	51.7	15,034	52.6
After reform	2,704,598	42.2	24,829	39.0	3,553,991	48.3	13,529	47.4
Woman's age group at previous birth								
Under 20	616,202	9.6	6,276	9.9	53,632	0.7	573	2.0
20–24	2,031,964	31.7	20,356	32.0	814,687	11.1	5,877	20.6
25–29	2,315,428	36.1	25,117	39.5	2,747,456	37.3	11,990	42.0
30–34	1,085,216	16.9	9,880	15.5	2,739,720	37.2	8,107	28.4
35–39	327,084	5.1	1,872	2.9	916,075	12.5	1,910	6.7
40–44	39,394	0.6	110	0.2	84,604	1.2	106	0.4
Woman's partnership status at previous birth								
Married	1,826,296	28.5	19,527	30.7	3,412,408	46.4	12,295	43.0
Cohabiting	4,004,863	62.4	40,470	63.6	3,757,607	51.1	15,496	54.3
Not partnered	582,829	9.1	3,607	5.7	185,409	2.5	769	2.7
Unknown	1,300	0.0	7	0.0	750	0.0	3	0.0
Woman's education at previous birth								
Low (ISCED 0–2)	984,857	15.4	9,395	14.8	715,643	9.7	4,641	16.2
Medium (ISCED 3–4)	3,084,209	48.1	26,530	41.7	3,594,406	48.9	13,106	45.9
High (ISCED 5–8)	2,340,485	36.5	27,639	43.5	3,041,292	41.3	10,793	37.8
Unknown	5,737	0.1	47	0.1	4,833	0.1	23	0.1
Male partner's education at previous birth								
Low (ISCED 0–2)	966,578	15.1	9,383	14.8	818,145	11.1	4,673	16.4
Medium (ISCED 3–4)	3,527,397	55	32,968	51.8	4,293,317	58.4	15,486	54.2
High (ISCED 5–8)	1,478,792	23.1	18,618	29.3	2,076,681	28.2	7,705	27.0
Unknown	442,521	6.9	2,642	4.2	168,031	2.3	699	2.4
Woman's ethnicity								
Estonian	4,540,105	70.8	50,331	79.1	5,424,851	73.7	22,929	80.3
Other ethnic group	1,875,183	29.2	13,280	20.9	1,931,323	26.3	5,634	19.7
Woman's income quartile (time varying)								
Low	1,542,212	24.0	13,458	21.2	1,524,716	20.7	6,545	22.9
Medium-low	1,603,352	25.0	15,132	23.8	1,763,375	24.0	6,995	24.5
Medium-high	1,333,805	20.8	14,628	23.0	1,653,582	22.5	6,184	21.7
High	1,128,308	17.6	13,985	22.0	1,526,270	20.7	5,635	19.7
Unknown	807,611	12.6	6,408	10.1	888,231	12.1	3,204	11.2
Woman's area of residence at previous birth								
Capital	2,705,368	42.2	24,333	38.3	2,611,847	35.5	8,368	29.3
Area surrounding capital	481,866	7.5	5,589	8.8	807,233	11.0	2,894	10.1
Big town	1,204,449	18.8	11,519	18.1	1,352,548	18.4	5,016	17.6
County centre	422,068	6.6	4,279	6.7	555,067	7.5	2,368	8.3
Smaller town	283,574	4.4	2,500	3.9	336,254	4.6	1,323	4.6
Rural area	1,315,219	20.5	15,368	24.2	1,690,785	23.0	8,589	30.1
Unknown	2,744	0.0	23	0.0	2,440	0.0	5	0.0
Number of women	105,252				91,047			

Note: The observation window starts on January 1, 2005, and ends December 31, 2024.

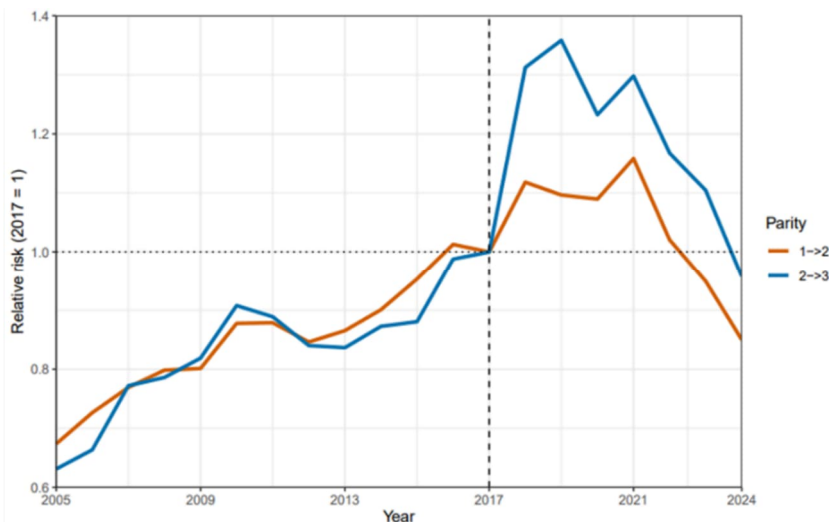
Source: Statistics Estonia; authors' calculations.

6. Results

6.1 Trends in relative birth risks

To provide context for the cure modelling results, we first present estimates from a piecewise constant hazard (PWCH) model of annual birth progression. These estimates illustrate general trends (Figure 2) in fertility behaviour before and after the 2017 child benefit reform and help us assess whether the assumption of parallel trends required for the DiD framework is met. Figure 2 shows the relative risks of progression to a second and a third birth by calendar year, standardised to the 2017 level (set as 1.0) – the year of child benefit reform. Before the reform, the relative risks of second and third births followed largely parallel trajectories when compared to 2017 (reference year). This is an important finding, as it supports the key assumption required for a DiD framework. After 2017, however, the risk of third births increased more sharply, diverging from the trend in second births and remaining higher despite a gradual decline towards the end of the observation period. By the end of the period, the index of relative risk of third births was still above that of second births, even though both had decreased compared to the immediate post-reform years, indicating a substantial reform-related shift, specifically for higher-order births.

Figure 2: Relative risks of progression to second and third births, 2005–2024

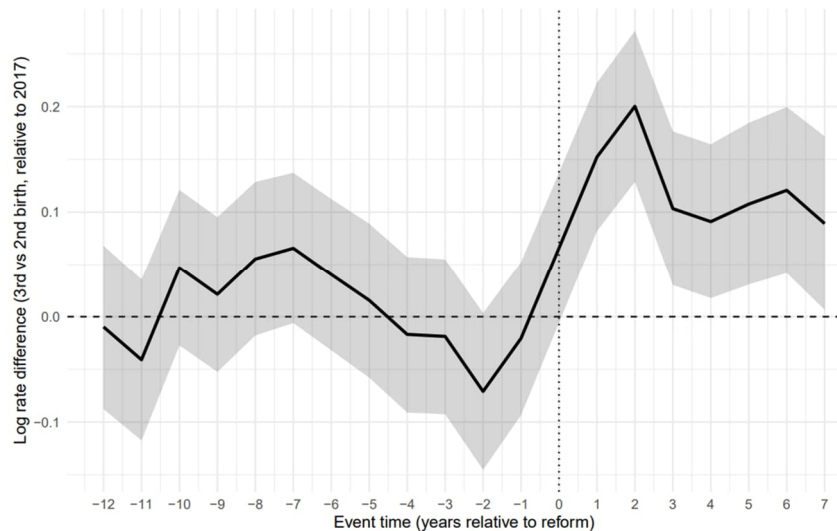


Note: The piecewise constant hazard model includes the calendar year.

Source: Statistics Estonia; authors' calculations.

To further examine the identifying assumption and to visualise the timing of reform effects more precisely, Figure 3 presents event study estimates with year-by-year coefficients relative to 2017. The specification is estimated using the same person-period dataset and piecewise duration structure used in Figure 2, implemented as a Poisson regression. The pre-reform coefficients fluctuate closely around zero and show no systematic pattern, providing formal support for the parallel trends assumption. In contrast, post-reform coefficients become positive immediately in 2018, peak within the first two years, and remain elevated thereafter. Importantly, the coefficients do not return to zero after 2021, suggesting that the subsequent aggregate fertility decline reflects broader macro-level conditions rather than the disappearance of the reform effect.

Figure 3: Year-by-year differences in third versus second birth rates relative to 2017



Source: Statistics Estonia; authors' calculations.

Based on the authors' calculations using population register data, between 2005 and 2014, the share of women who had their second child in a given year and progressed to a third birth within three years remained relatively stable, ranging between 12.3% and 15.3%. The five-year progression rate to a third birth during the same period ranged from 20.4% to 24.8%. In 2017, the year of the family benefit reform, 21.8% of women who had a second child that year went on to have a third child within three years, and 29.6% did so within five years. In the years 2018 to 2020, the three-year progression rate

remained elevated, ranging between 19.8% and 20.3%. In contrast, the five-year rates for these cohorts are increasingly affected by high inflation and heightened security uncertainty related to the Russo-Ukrainian War.¹⁰ Therefore they must be interpreted with caution.

Between 2005 and 2014, the share of women who had their first child in a given year and progressed to a second birth within three years ranged between 28.6% and 38.2%. Over the same period, the five-year progression rate varied from 44.3% to 53.3%. In 2017, the year of the family benefit reform, 42.7% of women who had their first child that year went on to have a second child within three years, and 54.6% did so within five years. In the years 2018 to 2020, the three-year progression rate was between 38.3% and 44.2%.

6.2 Mixture cure models

We used mixture cure models to analyse fertility behaviour among women at risk of a second or third birth before and after the 2017 child benefit reform. The design follows a DiD logic: Women at risk of a third birth constitute the treated group, and those at risk of a second birth serve as the control group. The event of interest is the conception of the next child, with women at risk of a third birth before the reform as the reference category. The key explanatory variable is an interaction between reform exposure and parity-at-risk status, allowing us to assess parity-specific responses to the policy.

The exponentiated parameter estimates for the four interaction groups (based on parity and reform exposure) are presented in Table 3. The coefficients from the incidence sub-model are interpreted as odds ratios, as in logistic regression. These odds ratios reflect the relative odds of ever having another child compared to the reference category. The reference category in this model is women at risk of a third birth before the reform. As expected, in the treatment group (women at risk of a third birth), the odds of having another child increased from the pre-reform period to the post-reform period. In that group, in the final model, M3, the odds of having another child were 18% higher in the post-reform period than in the pre-reform period among women at risk of a third birth. By contrast, women at risk of a second birth experienced an 11% reduction in the odds ratio from the pre-reform period to the post-reform period.¹¹ Thus the post-reform period was associated with an increased probability of having another child among the treated group and a slight decline in second births among the non-targeted control group. The changes are significant in both parity groups ($p < 0.001$). The comparison of estimates

¹⁰ In Estonia, the consumer price index increased by 43.6% from January 2021 to January 2025 (Statistics Estonia 2026).

¹¹ Calculated as $3.39 / 3.81 = 0.89$, corresponding to an 11% reduction in the odds.

based on models M1–M3 suggests that the reform effect is relatively independent of changes in population composition and macroeconomic conditions.

Table 3: Exponentiated coefficients of the policy variable interacted with women's parity for progression to a second and third birth (mixture cure model), women born 1967–2006, Estonia

	Incidence sub-model		Duration sub-model	
	Before reform	After reform	Before reform	After reform
M1				
Parity progression 1→2	4.18 (0.000)	3.53 (0.000)	0.73 (0.000)	0.62 (0.000)
Parity progression 2→3	1	1.20 (0.000)	1	0.77 (0.000)
M2				
Parity progression 1→2	3.72 (0.000)	3.34 (0.000)	0.74 (0.000)	0.62 (0.000)
Parity progression 2→3	1	1.20 (0.000)	1	0.77 (0.000)
M3				
Parity progression 1→2	3.81 (0.000)	3.39 (0.000)	0.74 (0.000)	0.62 (0.000)
Parity progression 2→3	1	1.18 (0.000)	1	0.78 (0.000)

Notes: Model M1 includes woman's age group at previous birth, partnership status at previous birth, and ethnicity. Model M2 includes, in addition to control variables in M1, woman's educational attainment at previous birth, woman's income quintile (time varying), women's partner's educational attainment at previous birth, and woman's place of residence at previous birth. Model M3 includes, in addition to control variables in Model M2, GDP growth rate, unemployment rate, and consumer price index; p-values in parentheses. *Source:* Statistics Estonia; authors' calculations.

We also calculated changes in predicted probabilities from the logistic (incidence) component of the mixture cure model. These estimates reflect the share of women expected to eventually progress to the next birth, conditional on parity and reform exposure. For third births, the predicted probability increased by about 4 percentage points after the reform. In contrast, the probability of having a second child decreased by 1.8 percentage points, suggesting a slight decline in progression to a second birth. This indicates that the reform encouraged continued childbearing among women who already had two children.

Results from the duration sub-model, which uses an AFT specification, show a change in the tempo of childbearing. The exponentiated coefficients indicate multiplicative effects on the time from the beginning of the birth interval to the conception of the next child, relative to the reference category (women at risk of a third birth before the child benefit reform). Values below one reflect a shortening of the interval, while values above one indicate a lengthening. In the final model, M3, among women at risk of a third birth (the treatment group), the interval from the second birth to conception of a third child was 22% shorter in the post-reform period.¹² Among women at risk of a second birth, the interval from the first birth to the conception of a second child was 16% shorter in the post-reform period.¹³ Both effects are precisely estimated (p

¹² Calculated as $100 \times (1 - 0.78) = 22$, indicating a 22% shorter expected interval (AFT time ratio).

¹³ Calculated as $100 \times (1 - 0.62 / 0.74) = 16$, indicating a 16% shorter expected interval (AFT time ratio).

< 0.001). The post-reform period was thus associated with an accelerated tempo of childbearing in both groups, with the change being more pronounced among women at risk of a third birth – the group targeted by the policy reform. The effect on the tempo of childbearing remains practically unchanged across models M1–M3, suggesting that the reform effect is largely independent of population composition and macroeconomic conditions.

To examine socioeconomic differences in the response to the reform, we ran additional mixture cure models where the event of interest was the conception of a third child. In the first model, the binary policy reform variable was interacted with women's total annual earned income, categorised into four quartiles (low, medium-low, medium-high, and high). In the second model, the reform variable was interacted with educational attainment, distinguishing between women with low/medium (non-tertiary) and high (tertiary) education.

The results for the income interactions are shown in Table 4, where the reference group consists of women in the low income group. In the low and medium-low income groups, the odds of having a third child increased by 18% and 22%, respectively, after the reform. By contrast, in the medium-high and high income groups, the odds decreased by 2% and 13%. Table 5 presents the results for the education interactions. Using women with low/medium education as the reference category, the odds increased by 23% for this group, while for highly educated women the odds decreased by 14%. All effects are precisely estimated ($p < 0.001$). These findings suggest that the positive quantum effect of the reform was concentrated among women with lower or medium income and education.

Results from the duration sub-model indicate a shortening of the interval from the second birth to the conception of a third child across all socioeconomic groups. The average interval decreased by more than 23%–32% in all income quartiles and by 28%–30% or more across educational groups, with a somewhat stronger acceleration among the highest income quartile. All changes are precisely estimated ($p < 0.001$), suggesting a notable post-reform acceleration in the tempo of childbearing across both income and educational groups.

Table 4: Exponentiated coefficients of the policy variable interacted with women's income for progression to a third birth (mixture cure model), women born 1967–2006, Estonia

	Incidence sub-model		Duration sub-model	
	Before reform	After reform	Before reform	After reform
Quartile 1	1	1.18 (0.000)	1	0.72 (0.000)
Quartile 2	1.02 (0.003)	1.24 (0.000)	0.97 (0.000)	0.70 (0.000)
Quartile 3	1.29 (0.000)	1.26 (0.000)	0.94 (0.000)	0.72 (0.000)
Quartile 4	1.63 (0.000)	1.42 (0.000)	0.90 (0.000)	0.61 (0.000)

Notes: The model includes woman's age group at previous birth, partnership status at previous birth, ethnicity, educational attainment at previous birth, and place of residence at previous birth; woman's partner's educational attainment at previous birth; GDP growth rate; unemployment rate; and consumer price index; p-values in parentheses.

Source: Statistics Estonia; authors' calculations.

Table 5: Exponentiated coefficients of the policy variable interacted with women's education for progression to third birth (mixture cure model), women born 1967–2006, Estonia

	Incidence sub-model		Duration sub-model	
	Before reform	After reform	Before reform	After reform
Low/medium	1	1.23 (0.000)	1	0.70 (0.000)
High	1.34 (0.000)	1.14 (0.000)	1.21 (0.000)	0.87 (0.000)

Notes: The model includes woman's age group at previous birth, partnership status at previous birth, ethnicity, income quintile (time varying), and place of residence at previous birth; woman's partner's educational attainment at previous birth; GDP growth rate; unemployment rate; and consumer price index; p-values in parentheses.

Source: Statistics Estonia; authors' calculations.

7. Summary and discussion of the findings

The aim of this article was to investigate how a generous child benefit reform in Estonia, which substantially increased allowances for families with three or more children, affected fertility behaviour. The effect on fertility behaviour was captured by comparing how pre- and post-reform behaviour differed between women at risk of second and third births. This comparison reflects a quasi-experimental strategy that follows the logic of a DiD framework, where the treatment group (women at risk of a third birth) is contrasted with a control group (women at risk of a second birth), who were not targeted by the reform.

The results support our first hypothesis (H1): The introduction of higher benefits for large families is associated with an increased probability of third births following the child benefit reform enacted on July 1, 2017. The results obtained from cure models show that the post-reform period was marked by a rise in the odds of third births, while the odds of second births declined after the reform. This finding was expected due to the

universal nature and relative generosity of the allowance for families with multiple children in Estonia. Both characteristics of the reform have contributed to the effect.

The modelling results also indicated that the predicted probability of having a second child declined in the post-reform period compared to the pre-reform period. This suggests that the broader context has generally become less favourable to childbearing. Evidence on trends in second birth and third birth risks shows a shift towards lower fertility from 2022, pointing to uncertainty and high inflation related to the war in Ukraine. This shift occurred in parallel for both second birth and third birth risks (Figure 2), indicating that the treatment and control groups were largely similarly affected by these factors. We interpret this as evidence that, in the absence of the reform, the probability of having a third child in Estonia would likely have decreased rather than increased. If this interpretation is correct, then the actual increase in the predicted probability of third births due to that reform was higher than the estimated 4 percentage points, as part of it was offset by the abovementioned factors.

This study also supports our second hypothesis (H2): The reform is associated with a shorter interval between second and third births. Specifically, we find that the post-reform period was characterised by a shortening of the interval between second and third births by nearly a quarter, while the shortening of the interval between first and second births was less pronounced. The shortening of birth intervals in both treated and control groups suggests that factors beyond the reform of child benefits made closer spacing of children more appealing to families. Identifying these factors and examining them in detail goes beyond the aims of this study. However, we can exclude factors that were used in our models as controls. They include women's age at previous birth – whose increase is known to produce time squeeze (shortening of birth intervals in response to postponement of parenthood) – and the rising proportion of women with tertiary education, who typically experience stronger time squeeze effects than their less educated peers. With reasonable certainty, we can also exclude changes in economic incentives related to women's employment over our study period. Thus we leave identifying the baseline factors responsible for the shortening of birth intervals to future research. At the same time, differential exposure to macroeconomic shocks and rising uncertainty across socioeconomic groups may also have contributed to the heterogeneous pattern of quantum effects observed after the reform.

We also find support for our third hypothesis (H3): The reform had a stronger effect among women with lower socioeconomic status. Third birth probabilities increased after the reform in the low and medium-low income groups and among women with lower or medium education but declined among higher-income and highly educated women. At the same time, the tempo of childbearing accelerated across all socioeconomic groups. These results suggest that the quantum effect was concentrated among women for whom the benefit carried greater relative value, while the absence of such effects among higher-

status women may reflect the rapid erosion of the benefit's real value during a period of strong wage growth.

Results from the mixture cure model, which allows for the simultaneous analysis of fertility timing and quantum, contrast with the views of researchers who are sceptical about the persistent effects of family cash benefits (Thévenon and Gauthier 2011; Sobotka, Matysiak, and Brzozowska 2019). Our findings indicate that the policy achieved its intended goal of encouraging the transition to a third birth. The concurrent increase in the probability of third births and their closer spacing suggests both behavioural responsiveness and policy relevance in the short to medium term. Moreover, closer spacing of second and third births may indirectly support the likelihood of progressing to a fourth child, as shorter birth intervals help keep families within the biological fertility window.¹⁴ While the long-term impact of the reform on completed fertility remains to be seen, the short- to medium-term effects appear both targeted and meaningful, although their persistence will depend on how the real value of benefits for families with three or more children evolves over time.

Unlike the many previous studies that rely on cross-sectional or survey data and find no positive effects (Kalwij 2010; Billingsley and Ferrarini 2014; Billingsley, Neyer, and Wesolowski 2022), this analysis is based on longitudinal register data, allowing for a more accurate micro-level assessment of both the probability and timing of subsequent births. Moreover, the use of a mixture cure model enables the simultaneous estimation of quantum and tempo effects, which is still relatively uncommon in family policy evaluation.

The effect of the reform identified in this article was a 4 percentage point increase in the predicted probability of third births and a 22% reduction in the interval from the second birth to the conception of the third child. Before the reform, about 37% of women with two children progressed to a third birth. A 4 percentage point increase therefore corresponds to an 11% relative rise in the probability of having a third child. Both effects are stronger than those observed for the generous 2004 parental leave reform in Estonia. Puur et al. (2023) reported a 3.7 percentage point increase in the probability of third births and a 15% reduction in the interval to the conception of a third child. Analyses of both policy reforms relied on mixture cure models and used similar register-based datasets, supporting the comparability of findings. However, it should be noted that parental leave and child benefits operate through different mechanisms (earnings replacement during shorter periods versus direct transfers during long periods), preventing full comparability. Additionally, a higher proportion of women having a third child likely affected the number of higher-order births, which were not analysed in this article.

To assess the robustness of our findings, we estimated a separate DiD model based on adjacent birth cohorts. Specifically, we compared women born in 1976–1978, who

¹⁴ Evidence supporting this claim, based on our study population, is presented in Table A-1.

were aged 34–36 in 2012 and aged 37–39 in 2015 (the control cohort), with women born in 1981–1983, who reached the same ages in 2017–2020 (the treatment cohort, exposed to the reform). Under the assumption that fertility behaviour would have been similar across these cohorts in the absence of reform, we examined how many women progressed to a third birth during the follow-up period. This design follows the approach of Comolli and Bernardi (2015), who studied the causal effect of the Great Recession on childlessness by comparing adjacent cohorts. We estimated a linear probability model including covariates for marital status at the time of the previous birth, maternal and paternal education, place of residence, income quartile at baseline, ethnicity, and maternal age at second birth. The results indicate that women in the treatment cohort had a 2.3 percentage point higher probability of progressing to a third birth compared to the control cohort ($p < 0.001$). The smaller effect relative to the mixture cure analysis may be explained by the fact that this specification restricts the sample to women aged 34 and older at the start of the observation period. That said, we admit that the results of this robustness test do not necessarily extend to younger cohorts.

As an additional robustness check, we shortened the pre-reform period to 2007–2016 to assess whether residual effects of the 2004 parental leave reform might differentially affect the treatment and control groups. The results remain substantively unchanged. For third births, the predicted probability increased by 4.1 percentage points after the reform. In contrast, the probability of a second birth decreased by 1.7 percentage points. These estimates are very similar to those obtained in the baseline specification, indicating that the findings are not driven by lingering post-2004 adjustment dynamics.

This study also has some important limitations. While the interaction approach enables a direct comparison between the targeted group (women at risk of a third birth) and the non-targeted group (women at risk of a second birth), it relies on the assumption that, in the absence of the reform, both groups would have experienced similar trends in fertility behaviour. The DiD design helps to account for broader contextual shocks (such as the COVID-19 crisis, an increase in economic uncertainty, or the war in Ukraine), as long as these shocks affected both groups similarly. This assertion is supported by the similarity of second birth and third birth risk dynamics after 2021 (Figure 2). Additional support comes from an earlier study of the parental leave reform in Estonia, which demonstrated close similarity in the effects of macroeconomic covariates on second and third birth risks (Puur et al. 2023). Although the model included a number of control variables, most individual-level covariates were time fixed and measured at the time of the previous birth, while personal characteristics such as education and partnership status may change over time – particularly when birth intervals are longer. Future research would benefit from richer time-varying covariates to capture these dynamics.

Furthermore, while the reform explicitly aimed to increase birth rates, we did not assess potential unintended consequences, such as changes in women’s labour market

participation, which have been addressed in some studies of family cash benefits (González 2013; Laroque and Salanié 2014; Ang 2015). One additional limitation is the relatively short post-reform period: While our observation window includes seven and a half years after the policy change (July 1, 2017–December 31, 2024), some of the cohorts impacted by the reform have not yet had sufficient time to complete their fertility trajectories, especially those who had their second births relatively early. Finally, although we treat the 2017 child benefit reform as a single intervention, the value of the benefit – both in nominal and real terms – has not remained constant over time. Inflation has reduced the generosity of the benefit, and there were adjustments of the amount of the benefit in subsequent years. However, cure models are ill-suited for the study of short-term changes in policy responses. Therefore we approximated the dynamics of the reform effect using event study estimates (Figure 3), which regrettably do not distinguish tempo from quantum effects.

Another limitation of this study is that our analytical approach does not account for the possibility that the increase in benefits for large families may have affected childbearing decisions by increasing the transition to a second birth among parents who would otherwise have stopped after their first child. If such an inframarginal response occurred, our strategy could lead to an underestimation of the true policy effect. Although this possibility cannot be fully excluded, the dynamics of second birth risks before and after the reform (see Figure 2) suggest that any resulting bias is likely to be limited. Finally, because the stacked parity design allows a woman to contribute up to two observation spells (e.g., in the 1→2 risk set and later in the 2→3 risk set), observations are not fully independent. Although each woman can appear at most twice and a substantial share contribute only one spell, this may lead to somewhat downward-biased standard errors and should be borne in mind when interpreting marginal significance levels. That said, we are confident that this limitation does not invalidate our key findings, given the very large analytical sample and consistently small p-values reported in Tables 3–5.

Despite these limitations, our study indicates that the effects of generous cash benefits are not limited to birth spacing but can also affect quantum. Our findings are in line with previous studies showing that benefits targeted at higher-order births, or those that are more generous for third and subsequent children, can be effective in influencing fertility behaviour (Breton, Prioux, and Dutreuilh 2005; Schellekens 2009; Laroque and Salanié 2014; Lyssiotou 2021). This underscores the importance of clearly targeted and sufficiently generous benefits in improving the material well-being of families and shaping their fertility decisions, particularly for families considering a third child. More generally, our study aligns with the notion that no single policy measure – even if very generous – can restore fertility close to replacement level in contemporary societies. However, this does not mean that the fertility impact of family policy measures is

irrelevant. Population projections demonstrate that over the long run, even small shifts in fertility can produce substantial differences in population size and age structure due to their cumulative effects (Sakkeus et al. 2017). Furthermore, the reform addressed in this study substantially reduced poverty risks among large families (Sinisaar 2021), highlighting that the societal impact of family policy measures extends beyond fertility changes alone.

While generous and targeted child benefits appear effective in the short to medium term, as demonstrated by this study, it remains for future research to ascertain whether the observed effects will persist over a longer time. Shifts in political priorities, value changes, changes to the benefit structure, and the lack of indexation to inflation or the average wage may gradually erode the policy's long-term impact on fertility behaviour.

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9. Data availability statement

Access to the data used in this study is granted by Statistics Estonia and is subject to legal restrictions. Therefore the data cannot be made publicly available. Replication code is available from the corresponding author upon reasonable request. The article provides detailed information on data sources, sample construction, variables, and analytical procedures to facilitate replication.

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Appendix

Table A-1: Proportion of three-child mothers who had a fourth child

	Descriptive %	Estimated % (linear probability model)
10–25 months	20.3	16.8
26–43 months	17.1	15.5
44–74 months	14.7	15.4
75+ months	10.3	14.8

Notes: The model is estimated on three-child mothers observed until at least age 45. Estimated percentages are standardized predicted probabilities from a linear probability model controlling for age at third birth, maternal education, and partnership status at birth.

Source: Statistics Estonia; authors' calculations.