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Can public policy increase paternity acknowledgement? Evidence from earnings-related parental leave

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Can public policy increase paternity acknowledgment? Evidence from earnings-related parental leave*

Anna Raute† Andrea Weber‡ Galina Zudenkova§

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Abstract

A child's family structure is a fundamental determinant of future well-being, making it essential to understand how public policies affect the involvement of fathers. In this paper, we exploit a reform of the German parental leave system—which increased mother's income and reduced legal father's financial support burden—to measure the impact on the relationship contract choices of parents who were unmarried at conception. Based on detailed birth record data, we demonstrate that short-run reform incentives during the first period after birth nudge unmarried fathers into the long-term commitment of acknowledging paternity. This shift reduces single motherhood by 6% but leaves the share of marriages at birth constant. Moreover, the change in relationship contract choices is mostly driven by parents of boys. These findings are compatible with predictions from a model where parents choose between three types of relationship contracts based on the mother's and father's incomes and support obligations. Our results highlight the necessity of studying intermediate relationship contracts (i.e., between the extremes of marriage and single motherhood) to improve our understanding of potential risk groups among the rising number of children growing up outside of marriage.

JEL classification: I38, J12, J13, J16, J18.

Keywords: paid parental leave, family structure, paternity establishment.

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†Queen Mary University of London, CEPR, CESifo and CReAM. *E-mail address*: a.raute@qmul.ac.uk.

‡Central European University, CEPR, CESifo and IZA. *E-mail address*: WeberA@ceu.edu.

§TU Dortmund University and CEPR. *E-mail address*: galina.zudenkova@gmail.com.

1 Introduction

In recent decades, high and middle income countries have witnessed a large rise in the share of children born outside of marriage. While in 1970 less than 10 percent of children across the OECD countries were born to unmarried mothers, by 2018 this was true of close to half of births in the OECD-28.[1] These trends have raised concern as the legal role of fathers is not clearly defined for children born out of wedlock. While for married couples, the husband is automatically recognized as the legal father, an unmarried father and his child are legal strangers until paternity is formally acknowledged. Otherwise, the mother is the single legal guardian of the child.

A number of scholars have explored the effects of public policies on family structures for a variety of programs and in different settings. Theoretical models predict that public support for unmarried mothers will incentivize out-of-wedlock childbearing and mothers to rear children on their own. In contrast, increasing child support obligations and paternity establishment enforcement would reduce out-of-wedlock childbearing (Willis, 1999). The empirical evidence, meanwhile, paints a more nuanced picture. Studies evaluating large US income support programs provide only weak evidence for incentive effects on single motherhood (Moffitt, 1992, 1998), while welfare reforms aimed at reducing single motherhood show mixed results on marriage and child living arrangements (Bitler, Gelbach, Hoynes and Zavodny, 2004; Bitler, Gelbach and Hoynes, 2006). Child support and in-hospital paternity establishment programs directly target the commitment of unmarried fathers. Empirical evidence shows that the introduction of some programs is related to increased rates of paternity establishments. Though, such research also suggests that these programs may crowd out parental marriages following non-marital pregnancies (Rossin-Slater, 2017; Tannenbaum, 2020; Aizer and McLanahan, 2006) or distort fathers' non-pecuniary investments (Rossin-Slater and Wüst, 2018).

A common feature in this literature is a focus on children living in married versus non-married households. However, a wide range of family structures exist between marriage and single parenthood. We argue here that, for several reasons, paternity acknowledgement among unmarried parents may be a particularly relevant margin to study. First, acknowledgement of paternity is irreversible. While married or cohabiting partners can divorce or separate, paternity is established for life. Second, the presence of a legal father shifts part of the child support financial burden from the government to the father. Third, it is widely recognized that paternal financial and other support is beneficial to child development and welfare (see,

[1] In Germany, the country we focus on here, 41 percent of first born children in 2019 were nonmarital births, comparable to 40 percent of all births in the US in that same year. See OECD (2020) for statistics on the OECD countries, Martin et al. (2021) for the US, and Statistisches Bundesamt (2020) for statistics on Germany by parity.

e.g., Argys and Peters, 2001; Mincy, Garfinkel and Nepomnyaschy, 2005).

In this paper we study Germany, where unmarried couples can acknowledge paternity up to the birth of their child through a simple standardized process, which bears no financial cost. With acknowledgement, the father gains certain rights to the child as well as assumes the obligation to financially support the child and mother, particularly in the early period after birth when most German mothers do not work. This setup allows us to study the relationship choices made prior to birth on the part of parents who were unmarried at conception. It furthermore helps us explore whether government policy can affect parents' decisions with respect to the family structure into which their child is born.

Our empirical analysis uses novel data on 4.1 million births from the universe of German birth records, which include precise information on the marital status of parents at conception as well as paternity acknowledgements and marriages established at the birth of the child. To our knowledge, no other country-wide administrative or survey data records information on paternity establishment and marriage behavior prior to birth for the entire population of births.[2] We observe that pregnancy is an exceptionally active period in terms of making relationship contract choices. Close to a third of parents unwed at conception marry before the child is born (shotgun marriage), more than half decide to acknowledge paternity, while the mother is the sole legal guardian in around 15 percent of the cases. The data also contain detailed information on birth outcomes, such as the child's gender and birth weight. Longer-run outcome variables beyond birth are not, however, available.

We study changes in relationship contracts at birth around the introduction of a new parental leave scheme in 2007.[3] This scheme replaced the means tested flat rate benefits with earnings-related benefits and significantly increased the benefit income of mothers who had been working prior to giving birth. A sharp cutoff determined eligibility for the new earnings-related benefits; namely, all mothers of children born on or after January 1, 2007 qualified. We use a regression discontinuity difference-in-differences design to estimate the causal impact of the reform on the relationship contract chosen at birth. Crucially, the large sample size and detailed data allow us to estimate the reform's effects with high precision.

We find that the introduction of earnings-dependent leave benefits increased the share of children with a legally established father. This overall surge appears to be exclusively driven by a reduction in single motherhood by close to 6%, while the share of shotgun marriages did not change significantly. Our results suggest that increasing support for new mothers can in

[2]The study by Almond and Rossin-Slater (2013) is a notable exception, where paternity establishment behavior is analyzed based on birth records merged with the State of Michigan's paternity registry. Unlike us, however, they are unable to observe marital status.

[3]Throughout the paper, we use relationship contract and family structure interchangeably. Note, however, that in the data we only observe the relationship contract chosen by the parents, and not the composition of the household in which the child lives.

fact encourage unmarried fathers' legal involvement, in contrast to the evidence on targeted policies such as child support and paternity establishment.

Which children and which parents are most affected by the introduction of earning-dependent parental leave benefits? We show that the reform primarily leads to an increase in paternity establishment for boys rather than girls. The administrative data include only limited information on parental characteristics and none at all on fathers who did not acknowledge paternity. To overcome these limitations, we examine heterogeneity by average local male earnings and observe that the reform effects appear to be driven by districts with relatively high male earnings. Turning to other birth outcomes, we do not find discernible effects of the reform on weight or health outcomes at birth, in line with evidence from other European countries (Ginja, Jans and Karimi, 2020; Ahammer, Halla and Schneeweis, 2020).

To interpret our empirical findings, we introduce a conceptual framework that analyzes the impact of the reform on the relationship contract choice of couples unmarried at the conception of their first child. Our aim is to develop a parsimonious framework that incorporates the main features of our empirical setting; namely, how financial incentives applicable in the period immediately after birth influence relationship contract choices at birth. In doing so, we build on the theoretical literature that rationalizes couples' decision-making with regard to consumption and parental investments within marriage (Becker, 1973, 1993; Weiss and Willis, 1985; Lundberg and Pollak, 1996; Browning, Chiappori and Weiss, 2014; Edlund, 2013), as well as when facing an out-of-wedlock birth (Akerlof, Yellen and Katz, 1996; Willis, 1999; Roff and Lugo-Gil, 2012; Rossin-Slater, 2017; Tannenbaum, 2020).

We consider parents that derive utility from their private consumption, child quality, and, in the case they get married by the time the child is born, their match quality. We assume that couples are heterogeneous in their match quality and that child quality is determined by custodian(s)' monetary investments. While the literature mostly limits couples' choice to two relationship contracts (marrying or not), here we investigate the choice between three contract types: marriage, voluntary paternity acknowledgment, and no legal relationship. Paternity establishment offers an intermediate relationship contract between no legal relationship and marriage, granting unmarried fathers some custodial rights over the child in return for providing financial support to mothers. In line with the German institutional setting, paternity acknowledgment occurs prior to birth on a voluntary basis and fathers play a crucial role in the decision. This feature distinguishes our model from Rossin-Slater (2017), who also considers three relationship contracts but assumes that mothers can decide unilaterally on paternity acknowledgment.

The model highlights that parents' relationship choices respond to the introduction of earnings-dependent parental leave via two channels. First, higher parental leave benefits increase mothers' income, leading to higher investment in child quality. Second, higher ben-

efits decrease fathers' financial obligations to mothers in the case of paternity acknowledgment. This is due to the fact that fathers' alimony duties are temporarily substituted by the government-provided coverage of mothers' foregone labor earnings. The reform thus enables fathers to obtain custodial rights for a higher-quality child at a lower price, resulting in a shift from single motherhood to paternity acknowledgement. Mothers' utility and investment in child quality increase as a result of the reform, both for couples who now chose paternity acknowledgement but also for those who did not switch. While the decreased costs of paternity acknowledgement and a higher child quality in paternity acknowledgement as a result of the reform may make marriage less attractive for both parents, the higher parental leave benefits to be shared in marriage make this type of contract more attractive. The net effect of the reform on marriages is hence theoretically ambiguous.

The model also motivates the two potential sources of heterogeneity in the reform's effects examined in the empirical analysis. Fathers' earnings need to be sufficiently high, otherwise they are exempt from paying child support. The model thus predicts that the reform does not affect the paternity establishment decisions of low-earning fathers. We also show that if families have son preferences or fathers have an important role model function, particularly for boys (Lundberg, 2005; Dahl and Moretti, 2008; Blau, Kahn, Brummund, Cook and Larson-Koester, 2020), the reform might generate stronger incentives for fathers to acknowledge paternity when they have sons.

In addition to the literature on the rise in non-marital childbearing and decline in shotgun marriages (Akerlof, Yellen and Katz, 1996; Willis, 1999) and that on the relationship between public policies and family structures, our paper also contributes to the growing body of work on parental leave expansions. This literature has largely focused on maternal labor supply and child outcomes,[4] with only a few papers examining the effects on newborns' family structure and living arrangements. Most of these studies focus on outcomes in the first years after birth but leave policy impacts on parental decisions during pregnancy unexplored (Avdic and Karimi, 2018; Olafsson and Steingrimsdottir, 2020; Dahl, Løken, Mogstad and Salvanes, 2016; Cygan-Rehm, Kuehnle and Riphahn, 2018). While our study cannot analyze longer-run outcomes, it does complement the existing findings by first, providing evidence that fundamental decisions that potentially set the stage for longer-term outcomes are taken in the period between conception and birth, and second, by highlighting the importance of decisions at the margin between paternity acknowledgement and single motherhood as opposed to marriage and non-marriage.

Lastly, we add to the aforementioned literature on son preferences and recent papers documenting boys' and girls' differential responses to family structure (Bertrand and Pan, 2013;

[4]See, for example, Lalive and Zweimüller (2009); Dustmann and Schönberg (2012); Rossin-Slater, Ruhm and Waldfogel (2013); Schönberg and Ludsteck (2014); Carneiro, Løken and Salvanes (2015); Dahl, Løken, Mogstad and Salvanes (2016).

Autor, Figlio, Karbownik, Roth and Wasserman, 2019; Wasserman, 2020). We show that parents' relationship contract choices at birth differ by the gender of the child, complementary to the evidence that gender affects both marriage behavior (Dahl and Moretti, 2008) and fathers' parental inputs, inside and outside marriage (see, e.g., Lundberg, 2005). To the best of our knowledge, we are also the first to theoretically and empirically analyze how the same (gender neutral) public policy change can differentially affect the behavior of parents depending on whether they are expecting a son or daughter.[5]

The remainder of the paper is organized as follows. In Section 2, we provide institutional details on paternity acknowledgement in Germany and the parental leave reform, describe the data and define the main variables. In Section 3, we develop the conceptual framework that motivates our empirical analysis. Section 4 then outlines our empirical strategy. In Section 5, we present the main results and robustness checks, followed, in Section 6, by a discussion of heterogeneity in the impact of the parental leave reform by male earnings and child's gender. We offer concluding remarks in Section 7.

2 Background and Data

2.1 Paternity Acknowledgement in Germany

As in many other countries, paternity acknowledgement on the part of an unmarried father is a requirement in Germany for legally establishing parental rights and obligations. If not established (independent of the parents' living arrangement), the child and biological father are strangers from a legal standpoint. Paternity acknowledgement is predominantly done prior to birth (or at latest in the first few weeks after birth) at the youth welfare office, registry office, or with a notary on a voluntary basis. Both parents must be present for the appointment and are informed about the legal rights and obligations tied to paternity acknowledgement. In the case where the father does not voluntarily make this acknowledgement, paternity can also be established by court ruling. Court based paternity establishments are, however, rare in Germany and typically involve a longer process, which is unlikely to be completed by the birth of the child.[6]

Paternity acknowledgement not only grants the father visiting rights over the child but is also the necessary legal requirement for the father to request partial custody. Once the child is of legal age, she in turn has legal responsibility of care towards her father. In acknowledging paternity, the father has a legal duty to financially support the child and the

[5]Looking at children's living arrangements, Cygan-Rehm et al. (2018) find a stronger reduction in the probability of living only with the mother for girls compared to boys. However, they do not provide any theoretical explanation as to why the reform appears to benefit girls more.

[6]Less than 8% of all paternities were established by court rulings in the period 1995-2004, according to own calculations based on data from Statistisches Bundesamt (2019).

mother. In addition to the child's claim to maintenance ("child support," or *Kindesunterhalt*) and inheritance, a non-custodial father is legally required to pay support to the custodial mother up until at least the child's third birthday if the mother is unable to work while raising the child ("child care alimony," or *Betreuungsunterhalt*).[7] [8]

Minimum child support payments as well as child care alimony payments are regulated and strongly enforced by the German authorities. Child support is to be paid by the non-custodial father to the custodial mother. The payment formula takes into account the non-custodial father's net income, and the number and ages of the children the couple has together, but is independent of the mother's earnings.[9] Child support payments must be paid up until the child has completed vocational education (i.e., vocational training or tertiary education).

The child care alimony payment from the non-custodial father to the custodial mother aims to ensure that the mother has sufficient resources for the care and education of the child, "if she cannot be expected to work because of the care or upbringing of the child" (Article 1615I BGB). The payment is meant to cover the mother's earnings losses up to three years of the child's life and is determined by the mother's pre-birth earnings.[10] Non-custodial fathers are in principle required to compensate the mother for her full pre-birth earnings, but child support and alimony payments are capped to ensure that the non-custodial father is left with a minimum level of subsistence. Child support always takes priority over child care alimony in cases where the father's income is not high enough.

2.2 The Paid Parental Leave Reform

In Germany, government-provided paid leave has a long tradition, and has been extended several times since its initial introduction in the 1950s. Since 1992, mothers have been granted a maximum of 36 months of post-birth job protection, as well as government transfers for a maximum of two years while on leave.[11]

The previous parental leave scheme, know as "child-rearing money" (*Erziehungsgeld*),

[7] We define a non-custodial father as a father who does not live with the child.

[8] Mothers can receive minimum time-limited child support from the government in case paternity has not been established or if the father is not paying the child support. This government support, however, is only equivalent to the minimum amount a father would have to pay and restricted to a maximum of six years and the father is liable to repay the transfer to the government.

[9] In 2007, the minimum monthly per-child support for children aged 0-5 ranged between 202 EUR for fathers with net income below 1300 EUR and 404 EUR for fathers with net income between 4400-4800 EUR (in 2021, this respectively ranged from 393 to 929 EUR for fathers with net income below 1900 or between 5101-5500 EUR).

[10] The law reflects Germany's more traditional gender norms, where maternal labor force participation has been persistently low compared to other Western European countries. In 2006, only 36 percent of mothers with a child below age 3 were working (see Raute (2019)).

[11] Since 1986, fathers have also been eligible for parental leave, though as very few take any leave, the program is effectively a maternity leave program.

covered mothers who gave birth before January 1, 2007, and primarily targeted low-income families. It disbursed flat transfers irrespective of the mother's pre-birth earnings under either a 24-month option, which the majority (85 percent) of eligible women opted for, or a shorter 12-month option for mothers who preferred to work in the second year after childbirth. Full-time employment was not permitted under the scheme (i.e., mothers could work at most 30 hours a week) and benefit eligibility was solely means-tested on the mother's partner's income in the preceding calendar year. If the mother was employed part-time after birth, her projected earnings during benefit receipt would also be considered as means-tested income, setting a strong disincentive to work. In 2006, around 74 percent of mothers were eligible to receive some leave benefits, with the average benefits paid to them being between 3,850 and 4,440 EUR in total (based on data from Statistisches Bundesamt (2006)).

In 2007, a major structural reform of the paid parental leave system introduced a much more generous income replacement for maternal time out of the labor market following childbirth (see Raute (2019) for additional details on the reform). A new universal leave benefit, "parental money" (*Elterngeld*), replaced the old scheme, and all mothers with children born on or after January 1, 2007 were eligible. The reform, born out of a newly established (and rather unexpected) coalition between the two largest political parties, the Christian Democrats and Social Democrats, aimed to "prevent income drops after childbirth [...], enhance the economic independence of both parents, and allow a fair compensation of the opportunity costs of childbearing" (BMFSFJ, 2008). Besides the key goal of providing parents with the financial means to care for their child during the first year of life, the reform sought to increase fertility rates by tying benefits closely to women's net pre-birth earnings, as analyzed in Raute (2019).

Public discussion over a reform of the parental leave system began with the proposal of a draft bill by the coalition government on June 20, 2006. The final law was passed in parliament several months later, on September 29, 2006, and then ratified by the second chamber on November 3, 2006. As the draft proposal was finalized 6.5 months before the final implementation on January 1, 2007, public discussion only started after the conception period for births occurring at the reform date. Consequently, fertility decisions relative to the births around the cutoff date were not yet affected by the reform discussion. Fertility only responded to the passing of the law, resulting in a discontinuous increase in births in August 2007 (Raute, 2019). However, parents who were expecting to deliver after the proposed policy cutoff of January 1 could respond to the draft bill—anticipating that the reform would pass—and establish paternity or marry; an effect we want to capture empirically.

For the majority of mothers, the new parental leave benefit replaces 67 percent of previous net labor earnings for up to 12 months after the birth of a child, with benefits calculated on

the basis of the average net earnings during the 12 months prior to birth.[12] As in the previous system, mothers who had not previously been working were paid a minimum benefit. Mothers employed prepartum received average leave benefits of 10,128 EUR in 2008, making the new system considerably more generous than the old. The duration of benefit eligibility can be extended by two months, if both parents take the leave for at least two months. In the initial reform year (2007), only 15.4 percent of fathers took any leave (Statistisches Bundesamt, 2008). Kluve and Tamm (2013) do not find statistically significant short-run effects on the implementation of these "daddy months" on paternal employment rates or time devoted to childcare in the first year after birth, in line with evidence for Sweden (Ekberg, Eriksson and Friebel, 2013). So as not to discriminate, single mothers are similarly eligible to extend their leave by an additional two months.

Again as with the old system, part-time work is disincentivized in that mothers who work more than 30 hours a week are not eligible and benefits are reduced with increasing women's labor earnings below 30 hours. As a result, in the first and last months of benefit receipt in 2010, only 1.7 and less than 9 percent of new mothers were employed part-time. There was close to full take-up of the new leave benefits (about 96 percent of all mothers in 2007 to 2010) with many taking advantage of the benefits for the full eligibility period (an average duration of 11.7 months).

The existing literature on the reform's effects on maternal labor supply documents heterogeneous patterns post childbirth—short-run reductions in maternal labor supply in the first year after childbirth, but increases in the medium term (e.g., Kluve and Schmitz, 2018)—see Raute (2019) for a more detailed summary. The overall impact on the cumulative maternal labor supply and earnings after childbirth is thus likely to be small.[13] At the same time, because the reform provides universal leave benefits with high income replacement, the cumulative incomes of most families increased in response to the reform.

2.3 Data and Outcome Variables

Our analysis employs administrative microdata from the German Statistical Office's vital statistics for the years 2004-2009, in total 4.1 million live births. These records cover the universe of births in Germany and include month and year of birth of the child as well as

[12] At the top of the earnings distribution, the transfer is truncated, meaning a maximum benefit of 21,600 EUR for women with very high pre-birth earnings.

[13] Kluve and Schmitz (2018) are unable to provide estimates for the reform's effect on maternal earnings since the Microcensus they use does not contain precise earnings measures. Using full population pension registry data and applying a similar estimation strategy comparing women who give birth in January 2007 and December 2006 (with January 2006 and December 2005 mothers as the comparison group), Raute (2019) estimates the average reform effect on total cumulative labor earnings in the two years following childbirth to be small and statistical insignificant.

basic socio-demographic characteristics of the mother and the child.

As outlined above, a unique feature of the German setting is that paternity acknowledgement for births to unmarried mothers occurs prior to or just after birth. Hospitals, or parents in the case of home births, register the birth within a week of delivery and a birth certificate is issued by the local registry office. As a result of this administrative feature, information on the father is recorded for children born to unmarried mothers in the case that paternity has been acknowledged.[14] The data further record information on parents' date of marriage, thus allowing us to explicitly distinguish between births to parents already married more than 9 months before giving birth—i.e., before approximate conception—and parents who chose to marry within 9 months before delivery, which we refer to as shotgun marriages.[15] Figure A1 plots the distribution of the duration of marriage in months at birth for the first child and graphically confirms that shotgun marriages are relatively prominent: over a third of married parents wed within 9 months prior to giving birth.[16] These observations further underscore the importance of studying the relationship choices parents make before the birth of their child.

The data also include information on the infant's gender, birth outcomes (i.e., birth weight, birth length, ponderal index), as well as the mother's age, nationality, work status at the onset of maternity, and place of residence. Using social security records obtained from the Statistical Office and the Federal Employment Agency, we are able to combine this individual-level data with information on socio-demographic characteristics at the district level (i.e., number of inhabitants, average daily earnings).

In order to study the reform's effects on relationship contract choices at birth for parents unmarried at conception, we restrict our sample to live births to German mothers who were unwed nine months prior to delivery (around 45 percent of all births). We further focus on mothers who worked up until going on maternity leave. The reasons for doing so are twofold. First, as our data do not contain information on the parity of the birth for unmarried women, looking only at mothers employed when taking maternity leave is our best proxy for capturing first births in the German context, where many mothers drop out of the labor market after their first child. Secondly, and most importantly, mothers working prepartum were eligible for the new earnings-dependent parental leave benefits and on average gained substantially from the increase in parental leave benefits. This leaves us with a sample of at least 10,000 births a month.

Our empirical analysis focuses on the three legal relationship contract options at birth that

[14] While most parents establish paternity prior to birth, some do so shortly afterwards. These late establishments will be recorded in the data up to a year after delivery and hence feature in our data.

[15] As the data do not contain information on gestation, we consider a mother to be married at conception if she had been married for more than 9 months prior to giving birth.

[16] Shotgun marriages are formed on average 3.8 months before birth.

initially unmarried parents-to-be would need to choose among. Specifically, we distinguish between single motherhood, an indicator variable for whether the mother is neither married and no father is recognized; paternity acknowledgement, a dummy for whether the parents have established paternity up until shortly after birth; and shotgun marriage, characterized as having married within the nine months prior to delivery.

Table 1 shows that in 2006, the year prior to the reform, 14 percent of births were to single mothers (i.e., without a legal father), paternity was established by around 54 percent of parents, and 32 percent opted for a shotgun marriage. In 2007, the reform year, the share of children born to single mothers drops to around 12 percent, while the proportion of cases where paternity has been established rises to 57 percent. Differences in mothers' background characteristics and birth outcomes appear rather stable. Across both years, mothers are on average 29.5 years old when giving birth, just below 30 percent reside in East Germany, and around 51 percent give birth to a boy. Neonatal health is also stable between the pre and post-reform year. Newborns weigh on average 3,312 grams with an average birth length of 51 cm and a ponderal index of 2.5. Around 1.3 percent of children are born with critically low birth weight (below 1500g).

Panel D in Table 1 shows average birth weight by contract choice in the pre-reform year. The comparison highlights a stark difference between, on the one hand, single motherhood, and on the other hand, paternity acknowledgement and shotgun marriage, where the average birth weight is 88 g higher (which equates to 77 percent of the average birth weight difference between girls and boys). Differences in terms of low birth weight markers are also sizable: while (1.9) 10 percent of children born to single mothers have a (critically) low birth weight of below (1500g) 2500g, this is true of only around (1.1-1.2) 6-7 percent of children born under paternity acknowledgment or shotgun marriage. This variation in birth outcomes, likely driven by differences in socio-economic status, highlights the importance of a detailed distinction between relationship contract types among mothers unmarried at birth.

In Panel E we compare relationship contract choices at birth by the gender of the baby. With the availability of ultrasound technology, parents can know this information before delivery, and this may influence their relationship contract choice. For 1980s/90s US, Dahl and Moretti (2008) show how a child's gender matters even before the baby is born. Specifically, a son increases the probability that parents with access to ultrasound are married at birth by around 4 percent. Thus, more girls grow up within a family outside of marriage than boys. We observe a similar pattern in mid-2000s Germany. In the pre-reform year 2006, 32.3 percent of parents having a son opt for a shotgun marriage compared to 31.8 percent of parents having a daughter. The 1.9 percent difference in marriage rates by the gender of the child is comparable in magnitude to the US findings. The German birth records also allow us to compare alternative family structures by gender. We see that parents of boys tend

to substitute marriage for paternity acknowledgement, but there is no difference in single motherhood by the sex of the child. Thus, more girls than boys will grow up with a legal but unmarried father, while boys are more likely to grow up with married parents than are girls.

3 Analytical Framework

In this section, we provide a simple analytical framework to formally describe the relationship contract choice that unmarried parents make at the time of the child's birth and to predict the impact of the paid parental leave reform. The reform generated two changes, namely, an increase in mothers' parental leave benefits—a direct product of the reform—and a decrease in fathers' child support and alimony payments—an indirect by-product of the reform. Nevertheless, mothers' cumulative income in case of paternity acknowledgment increased as a result of the reform. In particular, we focus on monetary incentives during the immediate period after birth as crucial determinants of the parents' choice at birth and thus abstract from various long-term considerations that were not altered by the reform.

3.1 Baseline Model

Consider parents unmarried at conception of their first child who choose between three relationship contracts by the time the child is born: marriage MA, paternity acknowledgement PA, or single motherhood SI (i.e., no legal relationship). Paternity is automatically established if parents get married.

Parents derive utility from child quality q, their private consumption c, and–conditional on marriage–their match quality $\theta \in \mathbb{R}$, which can take both positive and negative values, i.e., some parents incur benefits while others incur costs from being in a marital relationship with one another.

Child quality q is solely determined by custodian(s)' investment and is a public good to both parents if paternity is established, i.e., in the cases of marriage and paternity acknowledgement. Otherwise (i.e., in the case of single motherhood), only mothers derive utility from child quality.[17] Parents' utilities are therefore given by

$$\begin{aligned} U_m(q, c_m, \theta) &= u_{qm}(q) + u_{cm}(c_m) + \mathbb{1}_{MA} \cdot \theta, \\ U_f(q, c_f, \theta) &= \mathbb{1}_{PA \cup MA} \cdot u_{qf}(q) + u_{cf}(c_f) + \mathbb{1}_{MA} \cdot \theta, \end{aligned}$$

where subscripts m and f stand for mothers and fathers, respectively; $u_{qi}(\cdot)$ denotes utility of parent $i \in \{m, f\}$ from child quality; $u_{ci}(\cdot)$ denotes utility of parent $i \in \{m, f\}$ from private consumption; $\mathbb{1}_{PA \cup MA}$ stands for an indicator function that takes value 1 when parents opt

[17] We follow Chiappori and Oreffice (2008), Edlund and Korn (2002), and Neal (2004), and assume that fathers derive no utility from children if no legal relationship is established between the parents.

for paternity acknowledgment or marriage, and value 0 otherwise; finally, $\mathbb{1}_{MA}$ denotes an indicator function that takes value 1 when parents choose to marry, and value 0 otherwise. Utility functions $u_{qi}(\cdot)$ and $u_{ci}(\cdot)$ are assumed to be strictly increasing and concave.

In the first months of the child's life, mothers take parental leave and receive leave benefits b while fathers work and obtain labor earnings w.[18] We assume for now that fathers' labor earnings w are sufficiently high to pay child support to the mother and at least some child care alimony under the paternity acknowledgement contract.[19] Note that we focus on mothers who had been working prior to the child's birth.

Single Motherhood Single mothers allocate benefit income b between investment into child quality q and private consumption c_m to maximize their utility $U_m^{SI}(q, c_m) = u_{qm}(q) + u_{cm}(c_m)$.[20] The constrained utility maximization yields the levels of child quality investment $q^*(b)$ and mother's private consumption $c_m^*(b)$, which are implicitly defined by $u'_{qm}(q^*) = u'_{cm}(c_m^*)$ and $q^* + c_m^* = b$. A single mother's indirect utility amounts to

$$V_m^{SI}(b) = u_{qm}(q^*(b)) + u_{cm}(c_m^*(b)).$$

Since paternity has not been acknowledged, fathers derive no utility from child quality and retain for themselves their total labor earnings w. A father's indirect utility therefore amounts to

$$V_f^{SI}(w) = u_{cf}(w).$$

Paternity Acknowledgement Paternity acknowledgement grants fathers parental rights but also implies certain obligations. Fathers receive some custody and visitation rights and can thus derive utility from child quality. In addition, fathers are legally required to pay mothers child support and child care alimony during their leave period. We denote by p the amount of legally binding payments fathers make to mothers in the case of paternity acknowledgement.

We assume that the mother is the primary custodian who decides on child quality investment. Mothers receive parental leave benefits b and fathers' payments p, which they allocate between investment into child quality q and private consumption c_m to maximize their utility $U_m^{PA}(q, c_m) = u_{qm}(q) + u_{cm}(c_m)$. In this case, mothers solve the analogous problem as single mothers but with a larger budget, $b + p$.[21] The chosen levels of child quality investment $q^*(b + p)$ and mother's private consumption $c_m^*(b + p)$ are therefore implicitly defined by

[18] Given the German institutional setting described in detail in Section 2.2, we do not model parents' labor supply choices and assume that the mother is the primary caregiver during the first months of the child's life.

[19] We relax this assumption later to investigate the heterogeneity by fathers' earnings.

[20] The price for consumption is normalized to unity.

[21] Rossin-Slater (2017) assumes that outside marriage, fathers can choose to transfer a higher payment amount than is legally required to mothers. The qualitative predictions of our model are robust to extending in this direction.

$u'_{qm}(q^*) = u'_{cm}(c^*_m)$ and $q^* + c^*_m = b + p$. A mother's indirect utility is given by

$$V_m^{PA}(b,p) = u_{qm}(q^*(b+p)) + u_{cm}(c^*_m(b+p)),$$

while a father's indirect utility is given by

$$V_f^{PA}(b,p,w) = u_{qf}(q^*(b+p)) + u_{cf}(w-p).$$

Marriage In marriage, both parents are legal custodians of the child and so jointly decide on investment into child quality q. We assume that married parents choose q, c_m and c_f cooperatively to maximize their joint utility $U_m^{MA}(q, c_m, \theta) + U_f^{MA}(q, c_f, \theta) = u_{qm}(q) + u_{cm}(c_m) + u_{qf}(q) + u_{cf}(c_f) + 2\theta$ subject to their joint budget constraint $b+w$. The constraint utility maximization yields child quality investment $q^{**}(b+w)$ and parents' consumption levels $c_i^{**}(b+w)$, $i \in \{m, f\}$, implicitly defined by $u'_{qm}(q^{**}) + u'_{qf}(q^{**}) = u'_{cm}(c_m^{**})$, $u'_{cm}(c_m^{**}) = u'_{cf}\left(c_f^{**}\right)$ and $q^{**} + c_m^{**} + c_f^{**} = b + w$. A married parent's indirect utility is thus given by

$$V_i^{MA}(b,w) = u_{qi}(q^{**}(b+w)) + u_{ci}(c_i^{**}(b+w)) + \theta.$$

Choice of Relationship Contract A couple marries only if both parents prefer marriage to single motherhood and paternity acknowledgement. In other words, neither parent can force the other parent into marriage if it does not generate the highest utility value to the latter. Paternity acknowledgment is chosen in two scenarios. Firstly, both parents prefer it to single motherhood and marriage. Secondly, parents disagree on marriage and paternity acknowledgment but both prefer the latter to single motherhood. Said differently, parents opt for paternity acknowledgment even if one of them would be better off married (but worse off single).[22] In the rest of cases, parents establish no legal relationship by the time the child is born.[23]

Note that mothers prefer paternity acknowledgment to single motherhood. Intuitively, paternity acknowledgement implies no losses for unmarried mothers but instead generates extra gains in the form of child support and child care alimony payments p, i.e., $V_m^{PA}(b,p) > V_m^{SI}(b)$ for $p > 0$.

Comparing mothers' indirect utilities $V_m^{MA}(b,w)$ and $V_m^{PA}(b,p)$ reveals that they prefer marriage to paternity acknowledgment if the match quality is sufficiently high, i.e., if $\theta > \theta^m(b,p,w)$, where

$$\theta^m(b,p,w) \equiv u_{qm}(q^*(b+p)) + u_{cm}(c^*_m(b+p)) - u_{qm}(q^{**}(b+w)) - u_{cm}(c_m^{**}(b+w)) \quad (1)$$

[22] In order to accurately represent the German institutional setting under consideration, we assume that paternity acknowledgment is voluntary (see Section 2.1 for details).

[23] We assume that in the case of indifference, no legal relationship is preferred to paternity acknowledgement and marriage, while paternity acknowledgement is preferred to marriage.

is the match quality at which mothers are indifferent between MA and PA. Otherwise (i.e., for $\theta \leq \theta^m(b,p,w)$), mothers prefer paternity acknowledgment to marriage.

We turn next to fathers and analyze their indirect utilities under the three relationship contracts. Firstly, comparing $V_f^{MA}(b,w)$ and $V_f^{PA}(b,p,w)$ yields that fathers–similarly to mothers–prefer marriage to paternity acknowledgment for sufficiently high levels of match quality, $\theta > \theta_1^f(b,p,w)$, and vice versa otherwise, where $\theta_1^f(b,p,w)$ stands for the match quality at which fathers are indifferent between marrying and establishing paternity:

$$\theta_1^f(b,p,w) \equiv u_{qf}\left(q^*(b+p)\right) + u_{cf}\left(w-p\right) - u_{qf}\left(q^{**}(b+w)\right) - u_{cf}\left(c_f^{**}(b+w)\right). \quad (2)$$

Secondly, comparing indirect utilities of married fathers and fathers who have no legal relationship to their child, $V_f^{MA}(b,w)$ and $V_f^{SI}(w)$, yields another match quality threshold, $\theta_2^f(b,w)$, above which fathers prefer marriage to no legal relationship and below which no legal relationship to marriage:

$$\theta_2^f(b,w) \equiv u_{cf}\left(w\right) - u_{qf}\left(q^{**}(b+w)\right) - u_{cf}\left(c_f^{**}(b+w)\right). \quad (3)$$

Finally, fathers prefer paternity acknowledgment to no legal relationship when $V_f^{PA}(b,p,w) > V_f^{SI}(w)$, which amounts to

$$u_{qf}\left(q^*(b+p)\right) > u_{cf}\left(w\right) - u_{cf}\left(w-p\right), \quad (4)$$

and single motherhood to paternity acknowledgment otherwise.

Our detailed analysis of the relationship contract choice is provided in Appendix A.1. The following proposition summarizes our results.

Proposition 1 *The parents' optimal relationship contract is given by*

$$\begin{cases} MA & \textit{if} \quad \theta > \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\}, \\ \\ PA & \textit{if} \quad \theta \leq \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\} \\ & \qquad \textit{and } u_{qf}\left(q^*(b+p)\right) > u_{cf}\left(w\right) - u_{cf}\left(w-p\right), \\ \\ SI & \textit{if} \quad \theta \leq \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\} \\ & \qquad \textit{and } u_{qf}\left(q^*(b+p)\right) \leq u_{cf}\left(w\right) - u_{cf}\left(w-p\right). \end{cases}$$

Intuitively, parents opt for a shotgun marriage if the match quality θ is sufficiently high to compensate both of them for the foregone opportunities of the other two relationship contracts. If the match quality θ is not high enough to make both of them strictly prefer marriage, parents do not get married and the contract choice is solely determined by fathers' preferences between paternity acknowledgment and single motherhood (since for $p > 0$, mothers

always prefer paternity acknowledgment to single motherhood). In particular, if a father's utility from child quality, $u_{qf}(q^*(\cdot))$, is high enough to compensate him for a decrease in his private consumption induced by child support and alimony payments, he will be willing to acknowledge paternity. Otherwise, no legal relationship will be established between the parents, even though the mother would like the father to acknowledge the child.

Reform Impact In Appendix A.2, we formally study the reform's impact on parents' contract choice. The following proposition outlines our findings.

Proposition 2 *The implementation of the paid parental leave reform has generated an increase in b, a decrease in p, and an increase in $b+p$. These simultaneous exogenous changes lead to a decrease in single motherhood rates in favor of both paternity acknowledgment rates and marriage rates. The reform's effect on the choice between marriage and paternity acknowledgment is, however, ambiguous.*

Intuitively, the choice between paternity acknowledgment and single motherhood is solely determined by fathers' benefits and costs of paternity acknowledgment, which the reform impacts as follows. Firstly, a decrease in the child support and alimony payment p leads to a higher level of fathers' retained labor earnings, thus increasing their private consumption and making paternity acknowledgment less costly. Secondly, an increase in mothers' overall income $b+p$ leads to a higher investment in child quality, and so increases fathers' utility from the child, making paternity acknowledgment more beneficial. Formally, the reform makes inequality (4)–which defines the fathers' choice between paternity acknowledgment and single motherhood–hold for a larger set of values of w, b and p. Fathers, who would marginally prefer to establish no legal relationship before the reform, will now be willing to acknowledge paternity.[24]

The choice between marriage and single motherhood is again solely driven by fathers, as mothers strictly prefer paternity acknowledgment to no legal relationship and so can be decisive only between marriage and paternity acknowledgment (but not between marriage and

[24]Closest to our study is a paper by Rossin-Slater (2017), who analyzes a similar setting in which parents unmarried at conception of their child choose between three relationship contracts. In contrast to Rossin-Slater (2017) but in line with Chiappori and Oreffice (2008), Edlund and Korn (2002), and Neal (2004), in our framework fathers must legally establish paternity in order to enjoy fatherhood. A second key difference, as mentioned, is that we assume paternity acknowledgment to be voluntary. Importantly, both of these assumptions correspond to the legal setting under study and are crucial for our predictions. Firstly, paternity establishment as a prerequisite for enjoying fatherhood implies that in the case of no legal relationship between parents, fathers' utility is solely determined by their individual consumption and as such is not affected by the increase in mothers' parental leave benefits generated by the reform. Secondly, as long as fathers' labor earnings are high enough to pay mothers at least some child support and alimony, the voluntary nature of paternity acknowledgement results in fathers' being decisive between establishing paternity or not, and so fathers' willingness to establish paternity increases as a result of the reform.

single motherhood). Given that the private consumption of fathers with no legal relationship to their child is not affected by the reform, we take a closer look at the reform's impact on fathers' payoff in marriage. An increase in the mothers' parental leave benefits b raises the joint income of married parents, leading to a higher investment in child quality and enhancing fathers' private consumption. Marriage therefore becomes more attractive for fathers as a result of the reform. Formally, the match quality threshold (3), at which fathers are indifferent between marriage and single motherhood, drops and so marginal fathers switch into marriage out of no legal relationship.

The reform's impact on the choice between marriage and paternity acknowledgement is, however, ambiguous. On the one hand, an increase in b raises the joint income of married parents, making marriage more attractive for both parents. On the other hand, an increase in the mother's overall income $b + p$ makes paternity acknowledgment more attractive to both parents since it generates a higher investment in child quality. Furthermore, it raises the mother's private consumption under paternity acknowledgment. At the same time, a decrease in the father's alimony payment p eases his monetary obligations (therefore increasing his private consumption) in the paternity acknowledgement case. Formally, the match quality thresholds (1) and (2), at which mothers and fathers, respectively, are indifferent between marriage and paternity acknowledgment, are ambiguously affected by the reform. It follows that while some couples might switch into marriage out of paternity acknowledgment, other couples might switch the other way around, with the net impact of the reform then being determined by the relative magnitudes of these two opposite effects.

Extensions In our baseline setting, we concentrate on three common legal contracts—namely, marriage, paternity acknowledgement, and no legal relationship—and do not separately consider cohabitation, which has become increasingly popular among parents (Lundberg et al., 2016). In Appendix A.3, we formally show that cohabitation does not qualitatively alter the parents' relationship contract choices. Furthermore, in Appendices A.4 and A.5, we account for means-tested benefits and eligibility duration extension (so-called "daddy months") and show that the empirical implications of the model hold in these cases as well.

3.2 Heterogeneity

Heterogeneity by Father's Earnings We have so far assumed that fathers' labor earnings are sufficiently high to pay child support and at least some child care alimony under the paternity acknowledgement contract. In the case of low-wage fathers who are legally exempt from paying p, paternity acknowledgement generates no extra benefits to mothers in comparison to single motherhood. Given the assumptions of our model, no paternity acknowledgment is established in this case. Therefore, the model predicts a zero reform impact on paternity

acknowledgment rates for low income fathers.[25] We will test this prediction by comparing births in low and high male wage districts.

Heterogeneity by Child's Gender To analyze potential heterogeneous effects of the reform by the child's gender, our baseline model can be extended in several ways, building on Dahl and Moretti (2008).[26]

First, suppose that fathers (or both parents) derive higher utility from boy quality than from girl quality.[27] Under such preference for sons, a reform-induced increase in investment in child quality will generate stronger incentives for fathers of boys to switch into paternity acknowledgment out of no legal relationship.

Second, suppose that fathers play an important role-model function or have other forms of comparative advantage in bringing up boys but not girls. We can formalize this idea by assuming that investing in child quality pays off more when fathers are involved in raising boys.[28] Under this role model hypothesis, an equivalent increase in child quality investment in response to the reform will be more productive for boy quality than for girl quality, if the father is present. Given this asymmetric impact of father's presence, fathers of boys will have higher incentives to switch into paternity acknowledgement out of no legal relationship.

Note, furthermore, that under the role-model assumption, a mother of a boy would still be willing to establish the paternity of a low-wage father. Despite not paying any child support, the father's presence still generates a higher return to the mother's monetary investment in the son. This implies that even if fathers are low-wage, the reform will negatively affect single motherhood rates for sons to the benefit of paternity acknowledgment rates, though arguably at a lower magnitude than in the case of high-wage fathers.[29]

4 Empirical Strategy

To empirically test the model's predictions of the reform's impacts, we exploit the sharp introduction of the policy, applicable to children born from January 1, 2007 on. This allows

[25] Alternatively, we could assume that indifferent mothers agree to paternity acknowledgment. Our model would then predict a negative effect of the reform on single motherhood rates in favor of paternity acknowledgment rates even in the case of low-wage fathers. However, the magnitude of this effect is smaller than that in the case of high-wage fathers since it is only driven by an increase in fathers' utility from the child quality and not by a decrease in the child support and alimony payments.

[26] Parents are assumed to find out the sex of the child before they decide on their relationship contract.

[27] Formally, the same child quality q generates a higher utility to fathers (or to both parents) if the child is a son, i.e., $u_q^S(q) > u_q^D(q)$, where S and D stand for son and daughter, respectively.

[28] Formally, in a father's presence, the same investment I pays off more for son quality, i.e., $q^S(I|father) > q^D(I|father) = q^S(I|no\,father) = q^D(I|no\,father)$.

[29] The reason being that the latter face even stronger incentives to switch into paternity acknowledgement out of no legal relationship due to a reform-generated decrease in child support and alimony payments.

us to evaluate the parental leave reform's effect on parents' relationship contract choices. A simple comparison between children born shortly before and after the reform might lead to biased estimates of the causal impact of the reform on relationship contract choices if there are systematic differences between mothers who give birth in different months, as documented by Buckles and Hungerman (2013) and Clarke, Oreffice and Quintana-Domeque (2019).[30] In order to isolate the causal reform effects from such seasonal effects, we adopt a regression discontinuity difference-in-differences design (RD-DID) and use children born in the same months but in non-reform years as a control group. The key assumption here is that the seasonality in relationship contracts is the same in reform and non-reform years. A similar strategy is used, for instance, by Lalive and Zweimüller (2009) and Lalive et al. (2014) to analyze the effects of an Austrian maternity leave reform on mothers' fertility and labor market outcomes; by Dustmann and Schönberg (2012) and Schönberg and Ludsteck (2014) to analyze the effects of a German expansion of maternity leave on child outcomes and maternal labor supply respectively; and more recently, Avdic and Karimi (2018) to evaluate the effects of paternity leave on marital stability in Sweden.

We estimate regressions of the following type:

$$Y_{i,m} = \alpha_0 + \alpha_1 Treat_{i,m} + \alpha_2 C2_{i,m} + \alpha_3 PostJan2007_{i,m} + x'_{i,m}\alpha_4 + \sum_m \theta_m D_{i,m} + u_{i,m}, \quad (5)$$

where $Y_{i,m}$ is the relevant outcome variable of mother i who gave birth in month m, i.e., a dummy variable for the mother's relationship contract at birth (either single, paternity established, or shotgun-married). $Treat_{i,m}$ is an indicator variable equal to one if mother i belongs to the cohort that was affected by the reform (referring to mothers who give birth between July 2006 and June 2007 in our widest specification). In order to allow for differences between the two control cohorts used, we also include an indicator variable $C2_{i,m}$ equal to one if a mother belongs to the second control cohort (i.e., births between July 2007 and June 2008). $PostJan2007_{i,m}$ is equal to one if the child is born after the reform in January 2007, and $D_{i,m}$ is a dummy variable equal to one if the mother gives birth in month m. Including month-of-birth dummies allows us to account for time-constant seasonality effects in a flexible way. We also control for a vector of baseline characteristics of the mother (i.e., a quadratic in mother's age and state of residence), $x'_{i,m}$, though their inclusion in our regressions hardly impacts our estimates. The coefficient of interest is α_3, which identifies the effect of the parental leave reform on a mother's relationship contract just after birth.

Our baseline regressions include all mothers giving birth six months before or after the policy reform. Our control group consists of mothers giving birth in the same months, but one year before and after the reform's implementation. We also report robustness checks showing

[30] The German income tax code may additionally induce seasonality in marriages by incentivizing couples to marry late in a given year instead of early in the subsequent year (Fink (2020)).

that the estimated reform effects hardly change when restricting the estimation sample to include only children born three months before and after the reform or when omitting one control cohort.

Our identification strategy relies on the assumption that women were not able to time their pregnancies in response to the reform. As discussed in Section 2.2, there was, indeed, little opportunity for women in the treatment group to strategically time conception. Figure A2, taken from Raute (2019), documents that fertility rates did not in fact change until nine months after the passing of the law in the fall of 2006. We see that while fertility still evolves smoothly in March 2007, nine months after the announcement of the policy, it only increases discontinuously in August 2007, 9 months after the final passage of the law.

If timing conception in anticipation of the reform is unlikely, it is not impossible that women with due dates close to the cutoff date sought to delay delivery in order to benefit from the more generous leave policy starting January 1, 2007, particularly for employed women.[31] While Figure A3 plots the monthly number of births for employed women in our sample around the reform cutoff, we do not observe any systematic effect of the reform on delaying births at the monthly level. Nevertheless, as an additional robustness check we re-estimate the reform effects, this time excluding mothers who gave birth right around the cutoff, i.e., those mothers most likely to be able to manipulate the date of delivery. As we will show, excluding these observations has little impact on our estimated reform effects.

To further validate our identification strategy, we compare observed characteristics of mothers who give birth before the expansion with those who deliver after the expansion in Appendix Table A1. We estimate regressions of type (5), but with variables of mothers' relationship status around conception (indicator variables for being unmarried 9 months prior to childbirth, and for having married 9-12 months prior to giving birth, i.e., shortly before conception) as well as mother and child characteristics at birth (i.e., mother's age, employment status at birth, whether she delivered in East Germany, and whether she gives birth to a boy) as dependent variables that should not be affected by the reform. Differences are very small and not statistically significant around the policy cut-off, except for a small and marginally statistically significant increase in age.[32] These estimates reassure us that our sampling restrictions are valid and that the sample of mothers giving birth before January 2007 is similar to the set of mothers giving birth from January 2007 onward. The fact that there are no differences in mothers' employment status at birth also speaks against potential endogenous selection of women into employment in order to benefit from higher parental

[31] Indeed, Neugart and Ohlsson (2013) and Tamm (2013) find that 5-8 percent of employed women with due dates very close to the policy cut-off (i.e., the last week of December 2006) managed to intentionally delay their births to the first week of January 2007.

[32] The point estimate for age becomes even smaller and insignificant when we exclude the immediate cutoff months.

leave benefits, as similarly observed by Raute (2019).[33] These results lend support to our identifying assumption that any observed differential change in the relationship contract choice at birth in the reform cohorts compared to the non-reform cohorts indeed captures the causal effect of the policy change. As an additional test of the robustness of our results, we also specify several placebo treatments by assigning a treatment status to mothers giving birth in non-reform years. Estimates from these placebo regressions show much lower, statistically insignificant effects compared to our true reform effect estimates.

5 Empirical Analysis

5.1 The Reform's Effect on Relationship Contracts

In Figure 1, we plot the seasonality adjusted (residual) shares of single mothers, the share of births with paternity establishments, and with married parents by birth month for the years 2004-2009. The running variable, child's month of birth, has been normalized so that January 2007 equals zero. We include an estimated regression line using separate quadratic trends on each side of the cutoff month throughout our sample period. The figure shows a sharp drop of nearly 2 percentage points in the share of single mothers, followed by a decreasing trend (Part 1a). This drop is mirrored by a jump in the share of births with paternity establishment (Part 1b), while the share of shotgun marriages (Part 1c) revolves fairly smoothly around the reform cutoff. The graphical evidence in Figure 1 suggests that the reform in parental leave benefits increased the share of children born with a legal father.

We investigate this further in Table 2, which presents results of the reform's effect (α_3) when estimating equation (5). The result in column (1) reveals that the reform immediately reduces the likelihood that a newborn child is born without a legal father by close to 1 percentage point—a 6 percent decrease at the pre-treatment mean of 14 percent. Column (2) shows that the reduction in single motherhood seems to be driven entirely by an 0.8 pp increase in the likelihood that unmarried parents establish the paternity of the child, rather than (column (3)) by a change in the likelihood that the parents of the child marry. The point estimates are robust to the inclusion of the mothers' characteristics in row (2). Our estimate of the immediate effect implies that the reform resulted in paternity acknowledgement for approximately 1,500 children born to parents unmarried at conception a year, or around 21,000 children since its implementation up until 2021.

The empirical results suggest that the reform did decrease the likelihood of a child being born without having a legal father (i.e., born to a single mother), consistent with our theoretical framework in Section 3. According to our conceptual framework, the reform's effect

[33] Raute (2019) empirically documents that there was no discernible pre-birth labor supply adjustment of mothers-to-be at either the extensive or at the intensive margin in response to the reform.

on marriage rates is ambiguous. In fact, the aggregate reform effect on the decision to marry is small in magnitude and not statistically significantly different from zero. Our empirical findings indicate that overall, the reform primarily encouraged parents to establish paternity rather than change their marriage behavior.

Our estimated reform effect on paternity acknowledgement is smaller in magnitude and more precisely estimated than the 21 percentage point (or 38 percent) increase in the paternity establishment rate that Rossin-Slater (2017) observes for the adoption of in-hospital voluntary paternity establishment (IHVPE) programs in the US. The more modest effect we find is not surprising as the introduction of earnings-dependent parental leave did not aim to affect parents' relationship choices, while the explicit objective of the IHVPE programs was to largely reduce the costs and improve access to legal paternity establishment. However—and in contrast to our empirical findings—these programs also partially crowded out parental marriages.

5.2 Robustness Checks

Before moving on, we present robustness checks in Table 3. We first examine whether our results are sensitive to the sample window chosen around the policy cutoff (Panel A). Our findings hardly change when excluding mothers who give birth in December and January around the immediate cutoff date (row 2). This limits the concern that our baseline estimates in row 1 are affected by a potential strategic timing of births right around the cutoff date. Restricting the sample to mothers who give birth 3 months before or 3 months after the expansion (row 3) reveals very similar reform effects, but with a slight loss in precision.

We further probe the robustness of our results to the choice of the control cohort (Panel B). Excluding the post-reform cohort from our estimation sample hardly changes the estimated reform effect. As an additional test, we define several placebo treatments (Panel C) by assigning a treatment status to mothers giving birth either later in the reform year (i.e., from June 2007 on in row 1) or instead in January 2006 of the control year (row 2). The point estimates from these placebo interventions are much smaller than our estimated reform effect and not statistically significant.

5.3 Effect on Child Outcomes

The results thus far show that the reform induces more fathers to establish paternity for a newborn child, which lowers the share of young children born without a legal father. The increased legal commitment of fathers to their children as well as the expected higher parental leave benefits in the first year of the child's life may improve children's health at birth. Potential mechanisms for such an effect could be higher prenatal investments or reduced stress experienced by the mother, in turn affecting the newborn's (see, e.g., Aizer, Stroud and

Buka, 2016; Black, Devereux and Salvanes, 2016; Persson and Rossin-Slater, 2018) or mother's health (see, e.g., Evans and Garthwaite, 2014). The existing literature finds, however, mixed evidence of effects of changes in maternity leave on child health at birth (e.g., Rossin, 2011; Ginja, Jans and Karimi, 2020; Ahammer, Halla and Schneeweis, 2020).

Table 4 reports estimates of the reform's effects on the birth outcomes of children whose parents were unmarried at conception, controlling for women's background characteristics and sex of the child. We estimate the effects on birth weight and an indicator variable for very low birth weight (below 1500 g)–key markers of lifetime health and economic outcomes (Currie, 2011). We also assess the reform's effects on birth length and the ponderal index, a combined measure of birth weight and length often referred to as the "Baby-BMI." We additionally report results where we change the sample window around the cutoff (rows 2 and 3). All point estimates are small in magnitude, precisely estimated, and not statistically significantly different from zero across all specifications, indicating no discernible effect of the reform on infant health, in line with the existing evidence for other European countries.[34]

As mothers in Germany are covered by universal health insurance, the reform is unlikely to change their access to and quality of health care. Furthermore–and unlike the US social safety net programs (for a recent survey see Hoynes and Schanzenbach, 2018) that lead to improvements in health at birth–the reform we study does not entail government transfers prior to birth and can only briefly and indirectly affect pre-birth income or child investment.

6 The Reform's Effects by Male Earnings and Child's Gender

Heterogeneity by Father's Earnings According to our conceptual framework, the reform's effect on paternity acknowledgement should be greater for high-wage fathers who, compared to low-wage fathers, are able to cover child support and alimony payments. To investigate this empirically, we split the sample into births occurring in high vs. low male wage districts. We categorize a district as high(low)-wage if average male daily earnings in that district fall above (below) the respective East or West German average (Panel A, Table 5). The estimates suggest that the reform's effect is indeed driven by high male wage districts. Single motherhood decreases by 1.3 percentage points, a 9 percent drop when evaluated against the baseline mean, or around 1,750 children amongst the 134,000 children in our sample in 2007.[35]

Heterogeneity by Child's Gender We next turn to differences by child's gender. As seen

[34]While here we condition our sample on live births, we also checked that the reform did not affect the probability of a stillbirth.

[35]This difference in the reform's effect persists and is even larger in size when we additionally account for average female wages in the district, suggesting that the heterogeneity is not driven by differences in female earnings.

in Table 1, the gender of the unborn child does impact relationship contract choices at birth, thus begging the question of whether the effect of the parental-leave reform similarly differs between sons and daughters. Estimates in Panel B of Table 5 reveal that most of the reform's effect on increased paternity establishment is in fact driven by parents having a boy. While parents of boys are nearly 2 percentage points more likely to acknowledge paternity in response to the reform (an effect of 3.5 percent when evaluated against the baseline mean), the aggregate reform effect for daughters is small and statistically insignificant. In comparison to the differences in relationship contract choices at birth between sons and daughters in Table 1, the heterogeneity in reform effects appears quantitatively large. Given our model predictions in Section 3.2, these gender differences in the reform's effect could be explained by a preference for sons. Another explanation may be that fathers are particularly important in bringing up boys (role model effect).[36]

Heterogeneity by Father's Earnings and Child's Gender We further investigate these differences by looking at the effect by sex of the child in high vs. low male wage districts (Panel C of Table 5). While the overall effect on daughters shown in Panel B is small and insignificant, the reform appears to induce parents with daughters to switch into paternity establishment only in high male wage districts. This finding is consistent with the theoretical predictions in Section 3.2 and empirical evidence in Panel A, both of which suggest that the reform's effects are larger in districts with higher male wages. The results differ, however, for parents having sons. We find that not only did the reform increase paternity establishment in high wage districts—with a point estimate that is twice as high as for parents with daughters—it also even increased paternity acknowledgement in low-wage districts. As outlined in Section 3.2 above, the importance of male role models rather than son preferences could explain this finding. That is, mothers recognize that fathers might have a comparative advantage in bringing up sons versus daughters and are accordingly willing to agree to paternity establishment, even if the father is unable to financially contribute. In turn, these low-wage fathers face higher incentives to establish paternity because of the reform-induced increase in maternal investment in child quality. Our finding thus lends some empirical support to the role model hypothesis as well as suggests that a child quality channel may play a part in parents' switching into paternity acknowledgment as a result of the reform.

Heterogeneity by Region Finally, we assess potential differences in the reform's effects for West and East Germany, areas that are marked by stark differences in relationship contracts at birth (Panel D, Table 5). While around 18 percent of East Germans unmarried at conception in 2006 opt for single motherhood compared to only 12 percent of West Germans, the differences are particularly pronounced for the choice of paternity acknowledgement. In East Germany, 69 percent of parents choose this middle-ground option compared to just 48

[36]Note that these explanations are not mutually exclusive and could both be at play in our data.

percent of West Germans, who are instead more likely to opt for a shotgun marriage (40 percent). That said, the reform appears to affect relationship contract choices across East vs. West German districts in a similar fashion.

7 Conclusion

In this paper, we study the relationship contract choices of parents who are unmarried at conception. We use large scale data from German birth records, which provide information on fathers who have, by the birth of their child, acknowledged paternity. Paternity establishment, an intermediate relationship contract type between shotgun marriage and single motherhood, turns out to be the preferred contract choice of the majority of couples in our sample. We analyze the impacts of the introduction of earnings-dependent parental leave on parents' relationship contract choices, exploiting the reform's sharp eligibility cutoff using a regression discontinuity design.

We introduce a theoretical framework that models parents' contract choice based on their income and the unmarried father's support obligations towards the mother and child. This model rationalizes that fathers make a long-run commitment to the child by acknowledging paternity based on financial incentives during the period immediately after birth. Given the change in incentives induced by the introduction of earnings-dependent parental leave, which increased mothers' income and reduced fathers' support obligations, the model predicts a shift from single motherhood towards paternity acknowledgement, with indeterminate effects on marriage rates.

The empirical analysis confirms these predictions. We show that the German reform increased paternity acknowledgements, leading to a 6% reduction in the rate of single motherhood, while marriage rates were left unaffected. These findings shed light on two long-standing debates in the literature. First, we contribute to the discussion on the risks and benefits of welfare programs targeting (single) mothers (Moffitt, 1992; Willis, 1999; Bitler et al., 2004; Moffitt et al., 2020; Low et al., 2018). Our results show that public benefit programs that support mothers' earnings change relationship contract choices in the range between single motherhood and marriage, without necessarily affecting outcomes at the marriage margin. They further imply that these programs can positively affect fathers' involvement in child rearing without inevitably crowding out marriages. An important feature of the German parental leave benefit program is its universality, in contrast to typical welfare, child support, or targeted paternity acknowledgement programs that condition eligibility on the family status of the mother. The program's availability to all mothers, independent of their family status, might limit negative incentive effects on fathers. In addition, our findings suggest that short-run alterations in financial incentives can in fact change parental decisions bearing long-term consequences, contrary to the hypothesis by Rosenzweig (1999). Second,

our results speak to the literature on the impact of son preferences at early life-stages on long-term outcomes. In particular, we find that shifts in parents' relationship contracts due to the parental-leave reform are much more pronounced for male than for female babies.

Our study of the determinants of relationship contract choices at birth opens interesting avenues for future research. For data security reasons it is not possible to link the German birth records to other individual level data sources. It would, however, be crucial to learn more about the persistence of relationship contract choices at birth and their impact on children's longer-run outcomes. Our research also highlights the relevance of investigating intermediate relationship contracts that fall between marriage and single motherhood so as to better understand, for example, the risk groups among the growing number of births outside of marriage. As conventional data sources lack information on the legal status of the father and his contribution to child rearing, including such questions in survey data would represent an important step forward.

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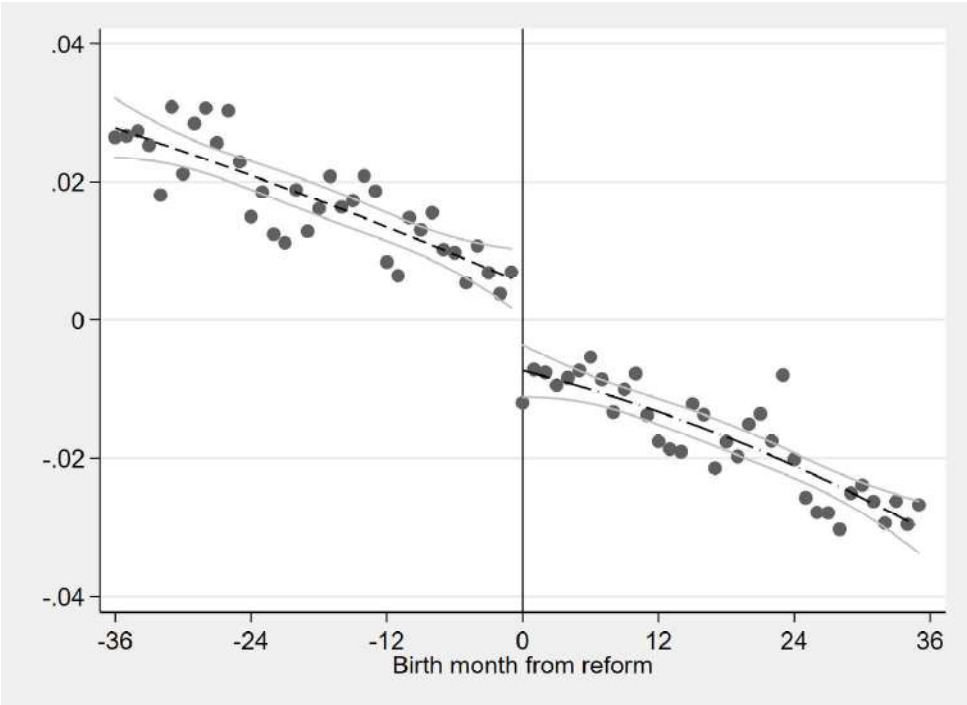
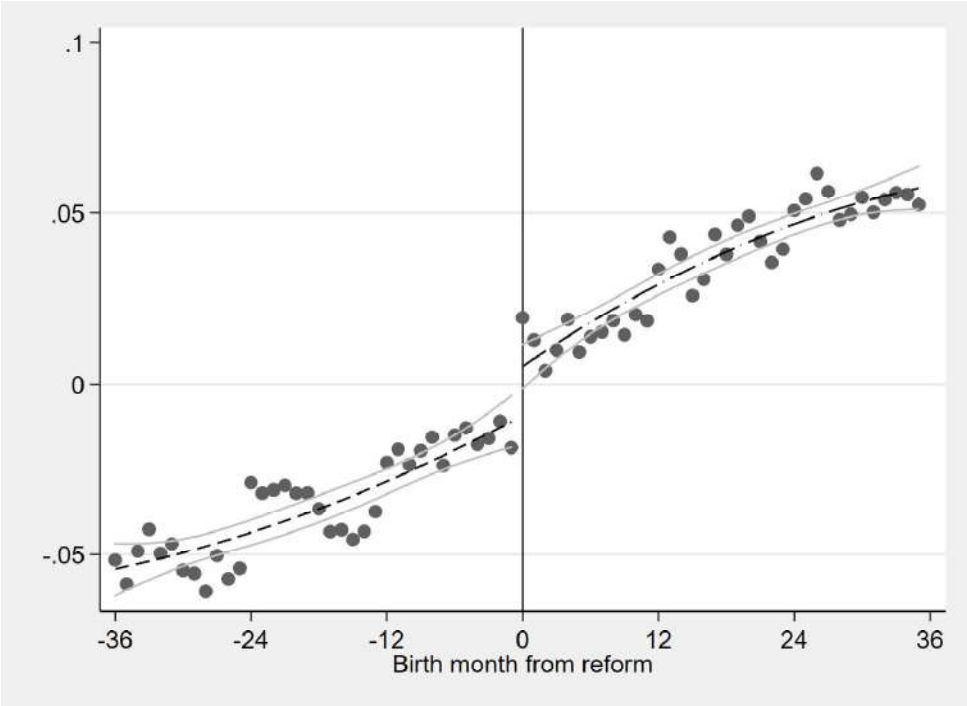
Figure 1: Evolution of relationship contract choices over time

(a) Share single mothers (no legal father)



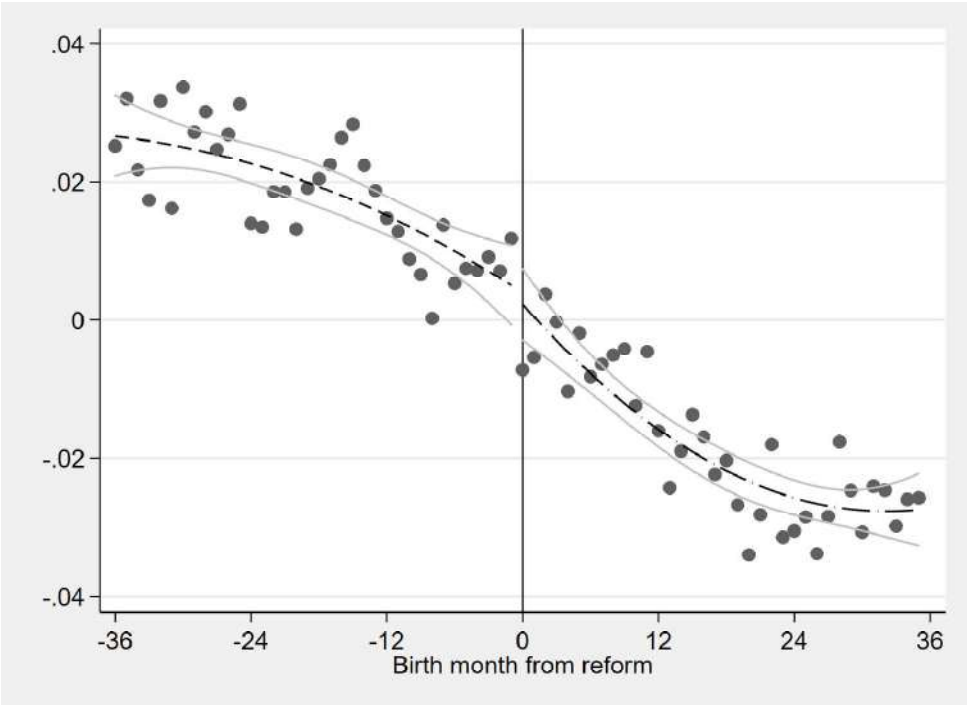
(b) Paternity Acknowledgement



Continued on next page

Figure 1: Evolution of relationship contract choices over time (Continued)

(c) Shot-gun marriage



Notes: The figures show the distribution of the seasonality adjusted (residualized) monthly share of births to single mothers, i.e., births with no legal father (Part 1a), share of births with paternity acknowledgement (Part 1b), and share of births to mothers who opted for a shot-gun marriage (Part 1c). Monthly outcome variables are seasonality adjusted by netting out month of birth effects. The solid vertical line denotes the reform cutoff, January 2007. We plot quadratic fits (with a 95% confidence interval) stemming from separate regressions on each side of the cut-off month.
Source: German Vital Statistics, all births to working women unmarried at conception in 2004-2009.

Table 1: Descriptive statistics

	2006	2007
Panel A: Outcome Variable		
Single Mother	0.140	0.122
Paternity Acknowledged	0.539	0.571
Shot-gut married	0.320	0.307
Panel B: Mother's characteristics		
Mother's age at birth	29.473	29.561
Mother resides in East Germany	0.296	0.291
baby boy	0.515	0.513
Panel C: Child birth outcomes		
birthweight	3312.402	3310.543
birthlength	50.958	50.930
below 1500g	0.013	0.013
ponderal index	2.490	2.493
Observations	128,096	133,944

Panel D: Child birth outcomes by relationship contract (2006)			
	Single Mother	Paternity Acknowledged	Shot-gun married
birth weight	3242.201	3330.019	3313.469
below 2500g	0.100	0.067	0.070
below 1500g	0.019	0.012	0.011

Panel E: Relationship contract choice by gender of child (2006)		
	Girl	Boy
Single Mother	0.140	0.141
Paternity Acknowledged	0.542	0.536
Shot-gut married	0.318	0.323

Notes: Panel A reports sample means of relationship contracts at birth in our sample. Panel B displays sample means of selected mother and child characteristics and Panel C reports sample means of selected birth outcomes. Panel D shows the mean birth outcomes across the different relationship contracts in the pre-reform year 2006. Panel E displays sample means of relationship contracts at birth by sex of the child for the pre-reform year 2006.

Source: German Vital Statistics, all unmarried at conception and previously working women giving birth in calendar years 2006 and 2007.

Table 2: The impact of the reform on relationship contract choices

	Single Mother	Paternity Acknowledged	Shot-gun married
no controls	-0.008^{***}	0.008^{***}	0.000
	(0.002)	(0.003)	(0.002)
with controls	-0.007^{***}	0.011^{***}	-0.003
	(0.002)	(0.003)	(0.002)
baseline mean	[0.14]	[0.54]	[0.32]

Notes: The table reports regression discontinuity difference-in-differences estimates based on regression equation (5), for the impact of the 2007 maternity leave reform on the probability that the birth occurs to a single mother (column 1), i.e., the mother is neither married nor has paternity been acknowledged, the probability that paternity for the birth has been acknowledged (column 2), and on the probability that the mother has married between conception and giving birth (column 3). In row 1, we solely account for birth-month dummies, and in row 2 we add baseline mother's characteristics (quadratic in mother's age and dummies for the state of residence). Results refer to our baseline specification and include mothers giving births 6 months before and 6 months after the reform. The control group consists of women who gave birth in the same months, but 1 year before and 1 year after the reform. Standard errors clustered by month-calendar year are in parentheses and comparison means for the year 2006 are reported in brackets. * statistically significant at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level.

Source: German Vital Statistics, all unmarried and previously working women giving birth in our sample period, i.e., July 2005-June 2008 (N=394,038).

Table 3: The impact of the reform on relationship contract choices (Robustness checks)

	Single Mother (1)	Paternity Acknowl-edged (2)	Shot-gun married (3)
Panel A: Different Window Sizes			
1. July-June	-0.007^{***}	0.011^{***}	-0.003
N=394,038	(0.002)	(0.003)	(0.002)
2. July-June (excl. December and January)	-0.007^{***}	0.007^{***}	-0.000
N=328,872	(0.002)	(0.002)	(0.002)
3. October-March	-0.005^{***}	0.010^{**}	-0.004
N=191,872	(0.002)	(0.004)	(0.003)
Panel B: Sensitivity to choice of control year			
1. exclude post-reform control year	-0.009^{***}	0.009^{***}	-0.000
	(0.001)	(0.002)	(0.002)
Panel C: Placebo reforms			
1. Placebo reform in June 2007	0.000	-0.002	0.002
	(0.002)	(0.004)	(0.003)
2. Placebo reform in January 2006	0.002	0.002	-0.004
	(0.001)	(0.003)	(0.002)

Notes: The table reports robustness checks on the regression discontinuity difference-in-differences estimates based on regression equation (5), for the impact of the 2007 maternity leave reform on our outcomes from Table 2. In Panel A, we vary the sample window. The control group consists of women who gave birth in the same months, but 1 year before and 1 year after the reform (i.e., births between July 2005 and June 2006 and between July 2007 and June 2008 in row 1 in Panel A). In row 1 we report our baseline estimates from Table 2 (accounting for baseline mother's characteristics (quadratic in mother's age and state dummies) in all regressions). In row 2, we exclude the cutoff months December and January from the estimation sample. In row 3, we restrict the sample to mothers who give birth 3 months before and after the policy reform. In Panel B, we exclude the control group who gives birth 1 year after the reform (row 1). In Panel C, we perform various placebo checks, by assigning treatment status to mothers giving birth in June 2007 of the treatment cohort instead (keeping the same control years) in row 1 and assigning treatment status to mothers who gave birth in January in the control year 2006 (and excluding the treatment cohort, N=263,547) in row 2. We account for birth-month dummies in all regressions. Standard errors clustered by month-calendar year are in parentheses. * statistically significant at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level.
Source: German Vital Statistics, all unmarried and previously working women giving birth in our sample period, i.e., July 2005-June 2008.

Table 4: The impact of the reform on birth outcomes

	birth weight	Baby below 1500g	birth length	Ponderal index
	(1)	(2)	(3)	(4)
baseline	-4.668	0.001	-0.024	0.000
	(3.298)	(0.001)	(0.018)	(0.001)
3 month window	0.488	0.001	-0.009	0.003
(October-March)	(4.672)	(0.001)	(0.024)	(0.002)
excl. cutoff months	-3.889	0.000	-0.018	-0.000
	(3.522)	(0.001)	(0.019)	(0.002)
baseline mean	[3312.4]	[0.013]	[50.96]	[2.49]

Notes: The table reports regression discontinuity difference-in-difference estimates based on regression equation (5), for the impact of the 2007 maternity leave reform on the birth weight in grams (column 1), an indicator whether the child was of very low birth weight, i.e., below 1500g (column 2), the birth length in cm (column 3), and on the Ponderal index of the newborn (column 4). We include mothers giving births 6 months before and 6 months after the reform. The control group consists of women who gave birth in the same months, but 1 year before and 1 year after the reform. In row 1, we show baseline results that account for birth-month dummies, baseline mother's characteristics (quadratic in mother's age and state dummies) and a dummy variable for whether the child is a boy. In row 2, we additionally restrict the sample to children born in a 3 month window around the cutoff, i.e., October-March, and in row 3, we exclude the cutoff months December and January from our baseline sample. Standard errors clustered by month-calendar year are in parentheses and comparison means for the year 2006 are reported in brackets. * statistically significant at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level.
Source: German Vital Statistics, all unmarried and previously working women giving birth in our sample period, i.e., July 2005-June 2008.

Table 5: The impact of the reform on relationship contract choices: Heterogeneous Effects

	Single Mother	Paternity Acknowledged	Shot-gun married
	(1)	(2)	(3)
Panel A: Effects for high vs. low male wage districts			
low wage districts	-0.002	0.004	-0.002
N=204,398	(0.003)	(0.004)	(0.003)
baseline mean	[0.134]	[0.54]	[0.326]
high wage districts	-0.013^{***}	0.018^{***}	-0.005^{*}
N=189,640	(0.002)	(0.003)	(0.003)
baseline mean	[0.145]	[0.538]	[0.316]
Panel B: Effects by gender of child			
boys	-0.011^{***}	0.019^{***}	-0.008^{**}
N=202,066	(0.002)	(0.004)	(0.003)
baseline mean	[0.141]	[0.536]	[0.323]
girls	-0.004^{*}	0.002	0.002
N=191,972	(0.002)	(0.003)	(0.003)
baseline mean	[0.140]	[0.542]	[0.318]
Panel C: Effects for high vs. low male wage districts by gender of child			
girls			
low wage districts	0.003	-0.007	0.004
N=99,608	(0.004)	(0.006)	(0.004)
high wage districts	-0.011^{***}	0.011^{***}	-0.000
N=92,364	(0.003)	(0.004)	(0.005)
boys			
low wage districts	-0.007^{**}	0.014^{***}	-0.007
N=104,790	(0.003)	(0.005)	(0.004)
high wage districts	-0.015^{***}	0.025^{***}	-0.010^{*}
N=97,276	(0.003)	(0.005)	(0.005)
Panel D: Effects for East vs. West Germany			
East	-0.009^{***}	0.012^{**}	-0.003
N=115,813	(0.003)	(0.004)	(0.003)
baseline mean	[0.184]	[0.691]	[0.125]
West	-0.008^{***}	0.009^{***}	-0.001
N=278,628	(0.002)	(0.003)	(0.002)
baseline mean	[0.122]	[0.475]	[0.402]

Continued on next page

Table 5: The impact of the reform on relationship contract (Continued)

Notes: The table reports regression discontinuity difference-in-differences estimates based on regression equation (5), for the impact of the 2007 maternity leave on our outcomes from Table 2 for different sample splits. As in Table 2, the control group consists of women who gave birth in the same months, but 1 year before and 1 year after the reform (i.e., births between July 2005 and June 2006 and between July 2007 and June 2008). In Panel A, we report estimates when we split the sample by low and high male wage districts, which are classified according to whether the district is above or below the (East or West German) average male daily earnings across districts. In Panel B, we report estimates seperately by sex of the newborn. In Panel C, we additionally divide the sample by low and high male wage districts by sex of the newborn. In Panel D, we report estimates seperately by whether the birth occured in East or West Germany. We account for birth-month dummies and baseline mother's characteristics (quadratic in mother's age and state fixed effects) in all regressions. Standard errors clustered by month-calendar year are in parentheses and comparison means for the year 2006 are reported in brackets. * statistically significant at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level.
Source: German Vital Statistics, all unmarried and previously working women giving birth in our sample period, i.e., July 2005-June 2008.

Appendix (for Online Publication)

A Theoretical Appendix

A.1 Relationship Contract Choice

Marriage Parents opt for marriage if both of them prefer it to paternity acknowledgment and single motherhood, i.e., $MA \succ_i SI$ and $MA \succ_i PA$ for $i \in \{m, f\}$. This amounts to

$$\theta > \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\}.$$

Paternity Acknowledgement A couple chooses to establish paternity in the following scenarios.

1. Both parents prefer it to single motherhood and marriage, i.e., $PA \succ_i SI$ and $PA \succeq_i MA$ for $i \in \{m, f\}$.

2. The father prefers paternity acknowledgment while the mother prefers marriage to paternity acknowledgment to single motherhood, i.e., $PA \succ_f SI$, $PA \succeq_f MA$, and $MA \succ_m PA \succ_m SI$.

3. The mother prefers paternity acknowledgment while the father prefers marriage to paternity acknowledgment to single motherhood, i.e., $PA \succ_m SI$, $PA \succeq_m MA$, and $MA \succ_f PA \succ_f SI$.

Given that for $p > 0$, mothers strictly prefer paternity acknowledgment to single motherhood, the first two items simplify to $PA \succ_f SI$ and $PA \succeq_f MA$ while the last item simplifies to $PA \succ_f SI$, $MA \succ_f PA$, and $PA \succeq_m MA$. The parents therefore opt for paternity acknowledgment either when $V_f^{PA}(\cdot) > V_f^{SI}(\cdot)$ and $V_f^{PA}(\cdot) \geq V_f^{MA}(\cdot)$, which amounts to

$$\begin{aligned} u_{qf}\left(q^*(b+p)\right) &> u_{cf}(w) - u_{cf}(w-p), \\ \theta &\leq \theta_1^f(b,p,w), \end{aligned}$$

or when $V_f^{PA}(\cdot) > V_f^{SI}(\cdot)$, $V_f^{MA}(\cdot) > V_f^{PA}(\cdot)$, and $V_m^{PA}(\cdot) \geq V_m^{MA}(\cdot)$, which amounts to

$$\begin{aligned} u_{qf}\left(q^*(b+p)\right) &> u_{cf}(w) - u_{cf}(w-p), \\ \theta &> \theta_1^f(b,p,w), \\ \theta &\leq \theta^m(b,p,w). \end{aligned}$$

Rearranging and noting that $V_f^{PA}(\cdot) > V_f^{SI}(\cdot)$ implies $\theta_1^f(b,p,w) > \theta_2^f(b,w)$ results in

$$\begin{aligned} u_{qf}\left(q^*(b+p)\right) &> u_{cf}(w) - u_{cf}(w-p), \\ \theta &\leq \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\}. \end{aligned}$$

Single Motherhood Parents establish no legal relationship otherwise, which amounts to

$$\begin{aligned} u_{qf}\left(q^*(b+p)\right) &\leq u_{cf}\left(w\right) - u_{cf}\left(w-p\right), \\ \theta &\leq \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\}. \end{aligned}$$

A.2 Impact of the Paid Parental Leave Reform

Parents' choice between getting married and not getting married is determined by the match quality threshold

$$\max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\}.$$

Partially derivating $\theta^m(b,p,w)$, $\theta_1^f(b,p,w)$, and $\theta_2^f(b,w)$ with respect to b, p, and $b+p$ yields

$$\begin{aligned} \frac{\partial\theta^m(\cdot)}{\partial b} &< 0, \quad \frac{\partial\theta^m(\cdot)}{\partial p} = 0, \quad \frac{\partial\theta^m(\cdot)}{\partial(b+p)} > 0, \\ \frac{\partial\theta_1^f(\cdot)}{\partial b} &< 0, \quad \frac{\partial\theta_1^f(\cdot)}{\partial p} < 0, \quad \frac{\partial\theta_1^f(\cdot)}{\partial(b+p)} > 0, \\ \frac{\partial\theta_2^f(\cdot)}{\partial b} &< 0, \quad \frac{\partial\theta_2^f(\cdot)}{\partial p} = 0, \quad \frac{\partial\theta_2^f(\cdot)}{\partial(b+p)} = 0. \end{aligned}$$

As a result of the reform, b and $b+p$ have increased, while p has decreased. It follows that the reform had ambiguous effects on $\theta^m(\cdot)$ and $\theta_1^f(\cdot)$, and decreased $\theta_2^f(\cdot)$. The match quality threshold level $\max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\}$ is thus ambiguously affected by the reform.

Parents, who don't choose marriage, opt for paternity acknowledgment if

$$u_{qf}\left(q^*(b+p)\right) > u_{cf}\left(w\right) - u_{cf}\left(w-p\right),$$

and establish no legal relationship otherwise. As a result of the reform, the left-hand side of this inequality increases (since $b+p$ increases) while its right-hand side decreases (since p decreases), which makes it hold for a larger set of values of w, b and p. It implies that there exist fathers that switch from no legal relationship to paternity acknowledgment as a result of the reform.

A.3 Extension: Cohabitation

We assume that in the case of cohabitation and similar to marriage, parents derive utility from child quality, their private consumption, and their match quality, and cooperatively maximize their joint utility subject to their joint budget constraint. However, to highlight the legal differences between marriage and cohabitation, we assume furthermore that marriage grants parents certain benefits but also implies some costs that cohabitation does not. The benefits include marriage taxation with income splitting, social security benefits, health care

coinsurance, legal decision-making rights (in cases of sickness and/or disability), and also inheritance rights, while the costs are mainly expected costs of marriage dissolution/divorce.

We keep our original assumption that fathers can afford to pay child support and at least some part of child care alimony, i.e., $p > 0$. Parents' utilities are given by

$$\begin{aligned} U_m(q, c_m, \theta, \delta) &= u_{qm}(q) + u_{cm}(c_m) + \mathbb{1}_{CO \cup MA} \cdot \theta + \mathbb{1}_{MA} \cdot \delta, \\ U_f(q, c_f, \theta, \delta) &= \mathbb{1}_{PA \cup CO \cup MA} \cdot u_{qf}(q) + u_{cf}(c_f) + \mathbb{1}_{CO \cup MA} \cdot \theta + \mathbb{1}_{MA} \cdot \delta, \end{aligned}$$

where we use analogous notation as in our baseline setting, CO denotes cohabitation, and $\delta \in \mathbb{R}$ denotes the difference between the benefits and costs of marriage.

Marriage Parents get married if both of them prefer it to other relationship contracts, i.e., $MA \succ_i SI$, $MA \succ_i PA$ and $MA \succ_i CO$ for $i \in \{m, f\}$. This amounts to

$$\begin{aligned} \delta &> 0, \\ \theta &> \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\} - \delta. \end{aligned}$$

Cohabitation Parents cohabit if both of them prefer cohabitation to other relationship contracts, i.e., $CO \succ_i SI$, $CO \succ_i PA$ and $CO \succeq_i MA$ for $i \in \{m, f\}$. This amounts to

$$\begin{aligned} \delta &\leq 0, \\ \theta &> \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\}. \end{aligned}$$

Paternity Acknowledgement Parents establish paternity when they neither marry nor cohabit and when fathers prefer paternity acknowledgment to no legal relationship.[37] This amounts to

$$\begin{aligned} \theta &\leq \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\} - \delta \cdot \mathbb{1}_{\delta>0}, \\ u_{qf}(q^*(b+p)) &> u_{cf}(w) - u_{cf}(w-p), \end{aligned}$$

where $\mathbb{1}_{\delta>0}$ is an indicator function that takes value 1 when $\delta > 0$, and value 0 otherwise.

Single Motherhood Parents establish no legal relationship otherwise, which amounts to

$$\begin{aligned} \theta &\leq \max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\} - \delta \cdot \mathbb{1}_{\delta>0}, \\ u_{qf}(q^*(b+p)) &\leq u_{cf}(w) - u_{cf}(w-p). \end{aligned}$$

Impact of the Reform According to our analysis presented in Appendix A.2, the match quality cutoff $\max\{\theta^m(b,p,w), \theta_1^f(b,p,w), \theta_2^f(b,w)\}$ is ambiguously affected by the reform while inequality

$$u_{qf}(q^*(b+p)) > u_{cf}(w) - u_{cf}(w-p),$$

[37] For $p > 0$, mothers strictly prefer to establish paternity and so fathers are decisive between paternity acknowledgment and no legal relationship.

which determines the choice between PA and SI, holds for a larger set of values as a result of the reform. It follows that the reform had an ambiguous effect on marriage as well as on cohabitation, and a negative effect on single motherhood in favor of paternity acknowledgement.

We do not observe living arrangements of parents in our data and assume that cohabiting couples legally acknowledge paternity.[38] Since we cannot distinguish between cohabiting and non-cohabiting couples within the group of parents who established paternity in the data, we are unable to measure any reform-induced switchers within this group. However, and most importantly, this will not affect the estimated reform effect on overall changes in paternity acknowledgment rates. In contrast, the switchers into cohabitation out of no legal relationship can be captured in our data and amount to an additional channel driving an increase in paternity acknowledgment rates at the expense of single motherhood rates.[39]

Finally, the reform generates switchers into paternity acknowledgment (without cohabitation) out of no legal relationship among the couples with sufficiently low match quality.[40] Those switchers amount to a decrease in single motherhood rates in favor of paternity acknowledgment rates, in the exact same manner as in our baseline case.

A.4 Extension: Means-Testing Abolishment

The paid parental leave reform has not only introduced a generous income replacement for working mothers during the parental leave period but has also abolished means-testing for cohabiting and married couples. Before the reform, cohabiting and married mothers were eligible for parental leave benefits only if their partners' labor earnings were sufficiently low. After the reform, however, all mothers independently of their relationship contract became eligible to receive parental leave benefits.

We extend our setting to account for the abolishment of means-testing and show that our predictions hold in this case. In particular, we extend the model as follows. Before the reform, cohabiting and married mothers receive no parental leave benefits. So, the joint budget of cohabiting and married parents amounts to w (in contrast to their joint post-reform budget of $b + w$). Therefore, the match quality thresholds $\theta^m(\cdot)$, $\theta_1^f(\cdot)$ and $\theta_2^f(\cdot)$, defined in (1)-(3), refer to the post-reform environment while the corresponding pre-reform thresholds, denoted

[38] In other words, we assume that children of cohabiting parents are recorded as births with established paternity.

[39] The threshold $\theta_2^f(b, w)$ in (3) at which fathers are indifferent between cohabiting and establishing no legal relationship drops as a result of the reform. It implies that fathers, who marginally prefer no legal relationship to cohabitation before the reform, would be willing to cohabit in the reform aftermath.

[40] As in our baseline setting without cohabitation, the choice between paternity acknowledgment and no legal relationship is driven by the fathers' trade-off between benefits and costs of paternity, which is shifted in favor of establishing paternity as a result of the reform.

by $\widehat{\theta}^m(\cdot)$, $\widehat{\theta}_1^f(\cdot)$ and $\widehat{\theta}_2^f(\cdot)$, are given by

$$\begin{aligned}
&\widehat{\theta}^m(b,p,w) \equiv u_{qm}\left(q^*(b+p)\right) + u_{cm}\left(c_m^*(b+p)\right) - u_{qm}\left(q^{**}(w)\right) - u_{cm}\left(c_m^{**}(w)\right), \\
&\widehat{\theta}_1^f(b,p,w) \equiv u_{qf}\left(q^*(b+p)\right) + u_{cf}\left(w-p\right) - u_{qf}\left(q^{**}(w)\right) - u_{cf}\left(c_f^{**}(w)\right), \\
&\widehat{\theta}_2^f(w) \equiv u_{cf}\left(w\right) - u_{qf}\left(q^{**}(w)\right) - u_{cf}\left(c_f^{**}(w)\right).
\end{aligned}$$

As a result of the reform, b has increased, p has decreased, $b+p$ has increased, and the match quality thresholds have shifted from $\widehat{\theta}^m(\cdot)$, $\widehat{\theta}_1^f(\cdot)$, $\widehat{\theta}_2^f(\cdot)$ to $\theta^m(\cdot)$, $\theta_1^f(\cdot)$, $\theta_2^f(\cdot)$. Therefore, the match quality threshold level

$$\max\{\theta^m(\cdot), \theta_1^f(\cdot), \theta_2^f(\cdot)\} - \delta \cdot \mathbb{1}_{\delta>0}$$

(that determines the switchers between marriage or cohabitation and paternity acknowledgement or no legal relationship) is ambiguously affected by the reform. This implies that the reform impact on marriage rates is still ambiguous when abolishment of means-testing is taken into account.[41] In turn, the inequality (4)–which defines fathers' choice between paternity acknowledgment and no legal relationship–is not altered by the abolishment of means-testing and so impacted by the reform in the same manner and magnitude as in our baseline setting.

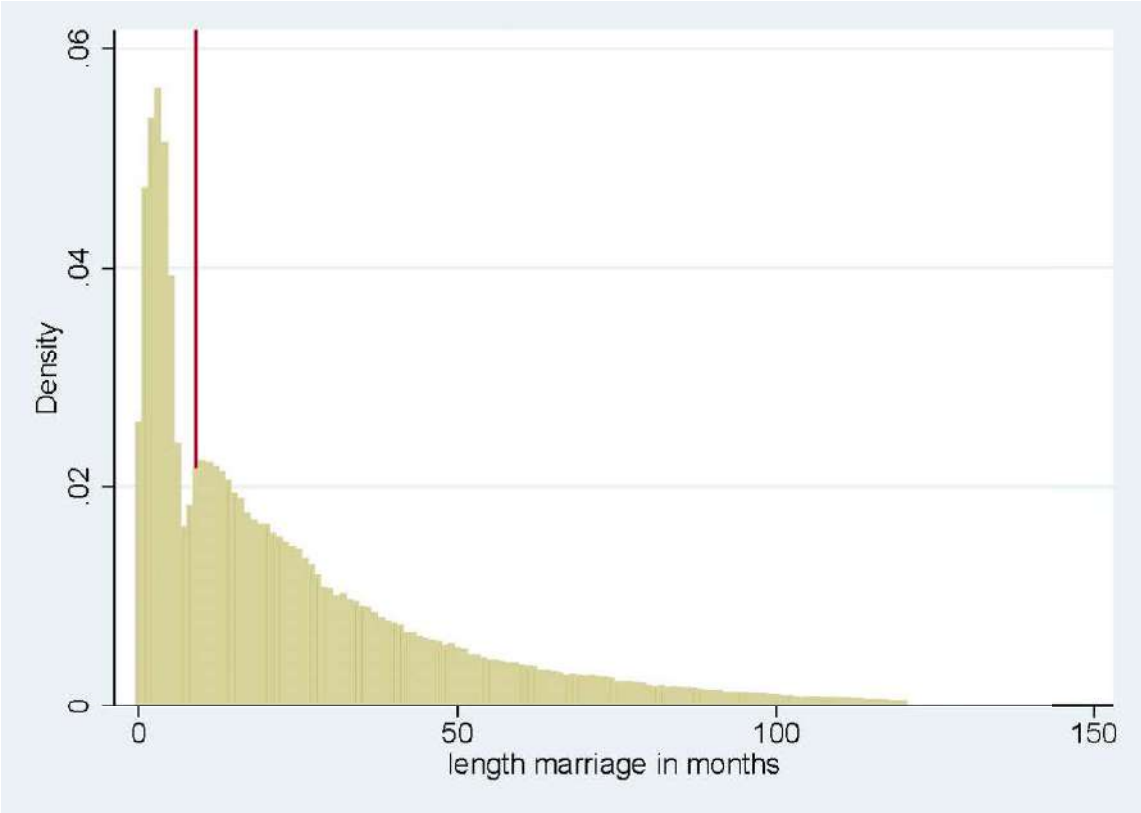
A.5 Extension: Eligibility Duration Extension

As mentioned in Section 2.2, the paid parental leave reform also introduced an option to extend the duration of benefit eligibility to 14 months, if each custodial parent takes up the leave for at least two months (so-called "daddy months") or if the mother has got sole custody. Even though the take-up of "daddy months" was remarkably low initially, we have nevertheless checked whether the model predictions hold in this case. Formally, when a custodial–i.e., married or cohabiting–father (or a sole-custody mother) has a chance to take two extra months of parental leave, he (resp., she) will do so if the daycare costs exceed corresponding foregone earnings. This will imply an additional increase in the post-reform income and, thus, in indirect utilities of the custodial parents (resp., of the sole-custody mother). This additional increase will not, however, alter the model predictions. Indeed, the non-custodial fathers will face even higher incentives to switch into paternity acknowledgment out of no legal relationship as a result of the reform since the sole-custody mothers will have even higher income to invest into the child quality. However, the reform-induced switching between marriage (or cohabitation) and paternity acknowledgement will still go both ways and so the ambiguity of the reform effects on marriage and cohabitation will stay unresolved.

[41] In other words, even though the abolishment of means-testing enhances the benefit channel of the reform on marriage incentives, whether or not those effects outweigh the reform-induced benefit and alimony effects that increased incentives for paternity acknowledgment remains an open question.

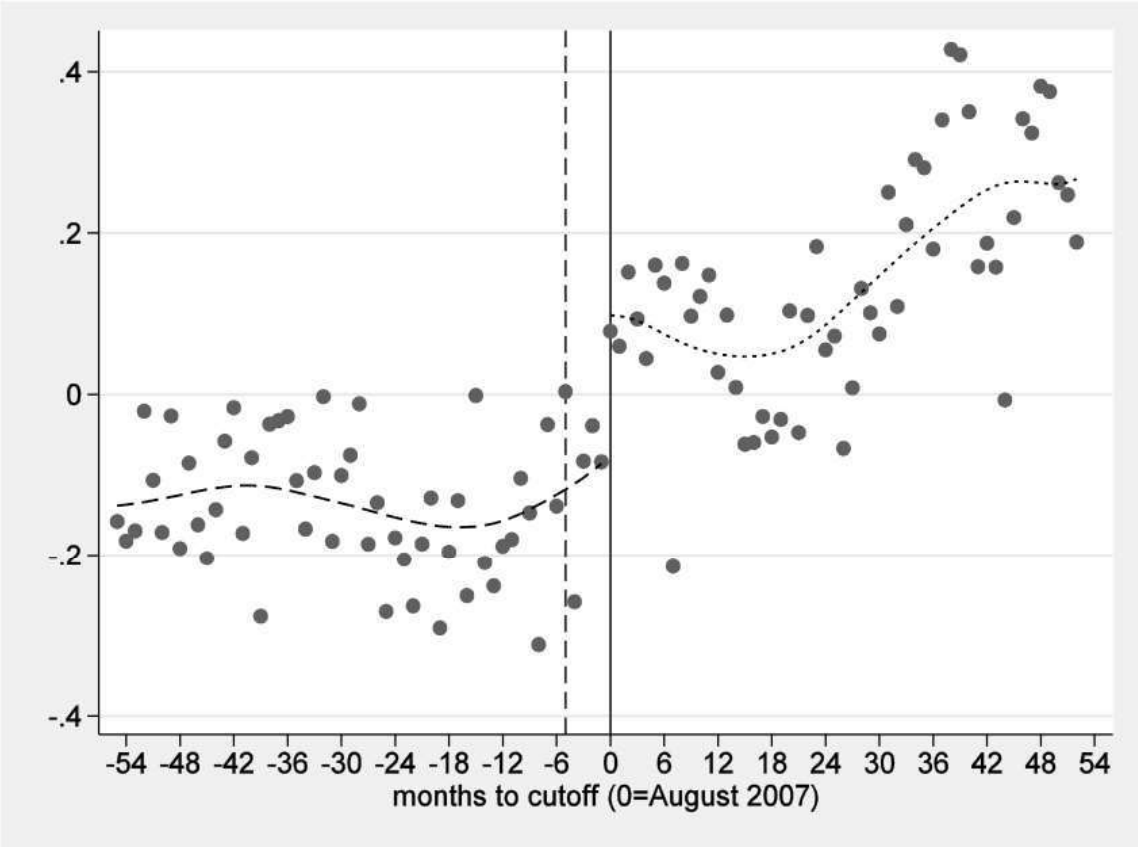
B Additional Figures and Tables

Figure A1: Distribution of time between marriage and first birth



Notes: The figure plots the density distribution of marriage duration in months at the time of first birth for mothers married at time of registration of the birth. The vertical red line indicates a marriage duration of nine months (i.e., marriage around date of conception).
Source: German Vital Statistics, all first births to mothers married at birth in sample period (July 2005-June 2008).

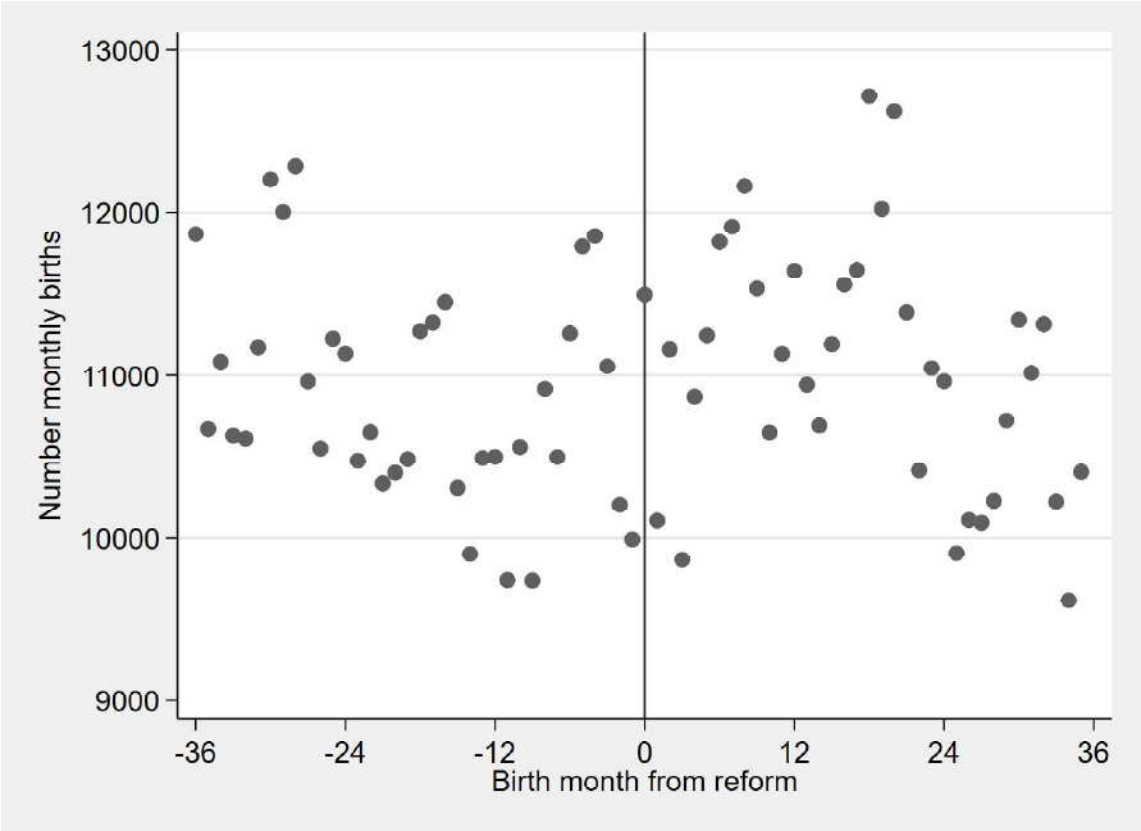
Figure A2: Evaluation of monthly births per 1000 women (aged 25-45) seasonality corrected (Figure 4 in Raute (2019))



Notes: The figure shows the seasonality-adjusted monthly birth rates over time. Lowess fit on both side of August 2007 (0 months to cutoff, denoted by the vertical solid line), 9 months after the final passage of the law.

Source: Residual (birth month adjusted) monthly live births per 1000 woman aged 25-45 (0n 31.12 of previous year), 2003-2011 German Vital Statistics. The figure corresponds to Figure 4 from Raute (2019).

Figure A3: Raw number of births around reform cut-off



Notes: The figure plots the monthly raw number of live births for women unmarried at conception and who were working before birth. The vertical line denotes the reform implementation cutoff (January 2007).
Source: German Vital Statistics, all births to working women unmarried at conception in 2004-2009.

Table A1: Reform In Maternity Leave and Mother's Prebirth Characteristics

	Probability to be unmarried at conception (all births)	Probability to marry 3 months prior to conception (9-12 months before)	Probability to work before birth	Probability for birth in East Germany	Probability to give birth to boy	Age of mother at birth
	all births (column (1) & (2))		births to mothers unmarried at conception			
Reform "effect"	-0.0032^{*}	-0.0007	-0.0005	-0.0017	-0.0027	0.0552^{*}
	(0.0017)	(0.0005)	(0.0037)	(0.0020)	(0.0020)	(0.0307)
baseline mean	[0.464]	[0.010]	[0.505]	[0.302]	[0.515]	[27.862]

Notes: The table reports regression discontinuity difference-in-difference estimates based on regression equation (5), using as dependent variables the probability to be unmarried around conception (i.e., 9 months before giving birth), the probability to marry within 3 months prior to conception (i.e., 9-12 months before birth) as well as an indicator variable whether the mother is working prior to giving birth, whether the birth takes place in East Germany, whether the mother gives birth to a boy and her age in years. We account for birth-month dummies. Results refer to our baseline specification and include mothers giving births 6 months before and 6 months after the reform. The control group consists of women who gave birth in the same month, but 1 year before and 1 year after the reform. Standard errors clustered by month-calendar year are in parentheses and comparison means for the year 2006 are reported in brackets. * statistically significant at the 0.10 level, ** at the 0.05 level, *** at the 0.01 level.

Source: German Vital Statistics, all mothers giving birth in our sample period (July 2005-June 2008) in columns (1)-(2) (N=1,677,594) and restricted to mothers unmarried 9 months before birth in columns (3)-(6), (N=758,792).

School of Economics and Finance

Queen Mary
University of London

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School of Economics and Finance Queen Mary University of London
Mile End Road
London E1 4NS
Tel: +44 (0)20 7882 7356
Fax: +44 (0)20 8983 3580
Web: www.econ.qmul.ac.uk/research/workingpapers/