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James Albrecht
Georgetown University and IZA

Per-Anders Edin
Uppsala University

Raquel Fernández
NYU, NBER, CEPR and IZA

Jiwon Lee
NYU

Peter Thoursie
Stockholm University

Susan Vroman
Georgetown University and IZA

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Parental Leave: Economic Incentives and Cultural Change*

The distribution of parental leave uptake and childcare activities continues to conform to traditional gender roles. In 2002, with the goal of increasing gender equality, Sweden added a second "daddy month," i.e., an additional month of pay-related parental leave reserved exclusively for each parent. This policy increased men's parental leave uptake and decreased women's, thereby increasing men's share. To understand how various factors contributed to these outcomes, we develop and estimate a quantitative model of the household in which preferences towards parental leave respond to peer behavior. We distinguish households by the education of the parents and ask the model to match key features of the parental leave distribution before and after the reform by gender and household type (the parents' education). We find that changed incentives and, especially, changed social norms played an important role in generating these outcomes whereas changed wage parameters, including the future wage penalty associated with different lengths of parental leave uptake, were minor contributors. We then use our model to evaluate three counterfactual policies designed to increase men's share of parental leave and conclude that giving each parent a non-transferable endowment of parental leave or only paying for the length of time equally taken by each parent would both dramatically increase men's share whereas decreasing childcare costs has almost no effect.

JEL Classification: D10, J16, Z10, Z18
Keywords: parental leave, gender equality, childcare, culture

Corresponding author:
Susan Vroman
Department of Economics
Georgetown University
Washington, DC 20057
USA
E-mail: susan.vroman@georgetown.edu

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1 Introduction

Increasing gender equality is a central goal of many governments, multilateral institutions, NGOs, and activists. In this area, Sweden (along with Iceland, Norway, Finland, and New Zealand) excels, ranking in the top 5 countries in terms of its gender gap index in 2024.[1] The uptake of parental leave, however, as in all other countries in which universal parental leave is offered, remains very unequally distributed between women and men.[2] With the explicit goal of increasing gender equality, Sweden pioneered the introduction of earmarked, non-transferable, parental leave time (daddy months) in order to incentivize men to take a greater share of parental leave. This innovation – first introduced in 1995 by reserving one month of leave for each parent – is widely agreed to have increased men's share of parental leave.[3] In 1989, men took 6.9 percent of parental leave and by 1999 they were taking 10.6 percent. This reform was followed by the introduction of an additional daddy month in 2002 and a third one in 2016.[4]

The objective of our paper is to understand the role of the various potential determinants of parental leave uptake and how future policies may affect its gender distribution using a policy reform in Sweden. There are a wide variety of factors that influence how parental leave is shared between parents. First, there are direct economic considerations as the loss of labor income is not fully compensated during parental leave. In addition, while childcare is very inexpensive in Sweden once a child turns one year old, that is not the case for a younger child for which parents must turn to the private market. This makes it very expensive for both parents to take short parental leaves that total less than a year. Second, there are penalties, both economic and social, associated with different leave times. In the economic sphere men and, to a lesser extent, women may face penalties in terms of their future wages and promotion prospects by taking "excessive" leave. From an employer's perspective,

[1] The Global Gender Gap Index benchmarks the current state of gender parity across four dimensions: economic participation and opportunity, educational attainment, health and survival, and political empowerment. See World Economic Forum (2024). Since the index's inception in 2006, Sweden has always ranked among the top 5 nations.

[2] According to Försäkringskassan (the Swedish Social Insurance Agency) at the end of 2022, men took 30% of parental allowance and women 70%. This is far from equal, of course, but a large increase over the 0.5% taken by men in 1974. See Försäkringskassann (2024).

[3] See, e.g., Ekberg, Eriksson and Friebel (2013) and Avdic and Karimi (2018).

[4] See Duvander and Cedstrand (2022) for an excellent review of the history of parental leave in Sweden.

an employee's length of leave time may signal something about their dedication to their firm or their degree of ambition. In the social sphere, people are concerned with how the length of their parental leave will be perceived and judged by others, independently of any material consequence. This includes the opinions of coworkers, friends and relatives, and even strangers in a playground, grocery store, or childcare center. Third, and related to the second, there is an idiosyncratic element governing how much a particular individual enjoys staying at home with a baby. This idiosyncratic factor, however, may well depend on social norms/culture as individual beliefs regarding what is "right" influence how content they are, and these beliefs are themselves dependent on social beliefs and the behavior of peers.

To understand and quantify how the forces above interact, we develop a simple choice model of a unitary household in which parents jointly decide how much parental leave each should take. Households, divided into four types by the education level of each parent (distinguishing between those with at least 3 years of university versus less), care about consumption (and hence income both during the parental leave period and after) and the amount of leave time each spends with the child. While all households are assumed to have the same utility function over consumption, an individual's preferences over parental leave time is not a pure primitive but rather depends also on the behavior of an individual's peers. In particular, we assume that an individual's enjoyment of parental leave time depends both on its length and on an idiosyncratic element that is drawn from a distribution whose mean is itself a function their peers' behavior. Peers consist of individuals of the same gender and, as will be made clear further on, also of the same household type.

We study the 2002 reform that introduced the second daddy month in Sweden and estimate our model using Swedish administrative data primarily from two time periods: the pre-reform period of 1998-2001 and the post two-daddy-month reform period of 2008-2011. We take (pre-birth) wages in each period as given and estimate, for men and women separately by education, the future wage penalty associated with different lengths of parental leave. While unobservable characteristics may influence this choice, these concerns are to some extent allayed by using not only individual fixed effects (which take care of time-invariant individual characteristics) but by also incorporating individual time trends that take into account the individual's wage growth prior to the birth of the child. We find significant

changes in wage penalties between the two time periods which we then use as inputs to the model.

We ask our model to match key moments in the data, by gender and household type in *both* periods. This implies that the parameters governing the mean of the idiosyncratic draw of preferences influencing enjoyment of leave time, for example, are disciplined by the requirement of matching moments of the leave distribution both before and after the reform (as are, of course, all other parameters in the model). Overall, given that we have have four household types and two time periods, the model has 31 internally estimated parameters which are identified via simulated methods of moments by 48 moments in the data.

We use the estimated model to analyze how much of the changes in parental leave behavior over the two time periods is due to the changed opportunity set (i.e., the reform itself, independently of any other changes), the changed wage parameters (including penalties), and the change in social norms (as reflected by the behavior of others similar to oneself). We find that the reform on its own is able to account for a significant fraction of the changes in parental leave uptake. The changes in wage parameters (in addition to the reform), on the other hand, are responsible for only modest adjustments after this. Keeping the economic environment at its pre-reform parameters, on the other hand, and allowing social norms to change in response to the change in behavior induced by the reform, significantly increases men's parental leave and decreases that of women. Overall, our conclusion is that the change in the economic environment had little effect relative to changes in the opportunity set (which of course itself changed economic incentives) and social norms.

We then use the model to investigate three counterfactual policies, all aimed at increasing gender equality in parental leave. The first subsidizes the cost of childcare during the first year, equating it to the low cost of publicly provided childcare that is only available once the child turns one. The second policy (the "endowment policy") is similar to current policy in Iceland and Finland. It endows each parent with six months of non-transferable leave (and one month that can be transferred freely). The last policy (the "equal share policy") is significantly stricter in its approach to gender equality: with the exception of one month that can be freely allocated, a parent's length of (paid) leave is not allowed to exceed that of the other parent's. We find that decreasing the cost of childcare has very little effect

on the share of parental leave taken by men. The last two policies, on the other hand, significantly increase men's share of parental leave. Interestingly, if social norms are kept constant, the two policies generate significantly different parental leave distributions. Once culture adjusts, however, the long-term implications are very similar.

Our paper is related to a few areas of research. There is a large and growing literature on the effects of parental leave. These papers have focused on a diverse set of issues ranging from the consequences of parental leave for maternal welfare and children's health and human capital (e.g., Cools, Fiva and Kirkebøen (2015), Carneiro, Løken and Salvanes (2015), Dustmann and Schönberg (2012), and Rossin-Slater (2018)), fertility (e.g., Lalive and Zweimüller (2009) and Farré and González (2019)), and labor supply at home and in the labor market (e.g., Dahl et al. (2016), Duvander and Johansson (2019), and Schönberg and Ludsteck (2014)), among others. Excellent surveys of this literature can be found in Olivetti and Petrongolo (2017) and Canaan et al. (2022).[5]

While the general literature on the importance of peers for various outcomes is too large to survey here, there are a small number of papers showing the importance of peer effects for parental leave decisions. Dahl, Løken and Mogstad (2014) study a 1993 Norwegian reform that earmarked an extra month of leave for fathers exclusively. Using a regression discontinuity design, they show that this reform significantly increased the proportion of fathers taking paternity leave immediately after the reform. More importantly, it also increased the subsequent take-up of paternity leave by the father's coworkers and brothers, relative to their counterparts with a peer who became a father in the window prior to the reform. Welteke and Wrohlich (2019) examine peer effects stemming from a German reform in 2007 that changed parental leave payments from means tested to universal as well as the length of time these were paid. Exploiting whether a woman had peers that were affected by the reform, they found that a woman's choice of length of parental leave was affected by her coworkers' decisions. Lastly, a recent paper by Dottori, Modena and Tanzi (2024) exploits an Italian reform in 2015 that increased the flexibility of paid parental leave time from requiring its use by age four of the child to age six. The authors find that the reform increased the take up of parental leave for mothers especially if the share of post-reform

[5]See Ruhm (1998) for an early survey.

peers taking leave was larger.

Our paper contributes to a small literature on cultural change, especially regarding gender roles. There is a small set of papers that directly examine how household chores and gender roles are affected by parental leave. Kotsadam and Finseraas (2011) show that the Norwegian daddy quota led to greater sharing of household labor and fewer conflicts over household chores. Using the introduction in 2007 of paternity leave that increased by 13 days the number of fully compensated leave days in Spain, Farré and González (2019) show that fathers become more involved in childcare. Intriguingly, there is also evidence that the effects of paternity leaves spill over to the children's generation. Using a 2010 Norwegian survey of high school students, Kotsadam and Finseraas (2013) show that girls (but not boys) born right after the 1993 Norwegian paternity leave reform were less likely to report doing housework compared to those born right before. Farré et al. (2023) show that the 2007 Spanish paternity leave reform affected the gender norms of children born right after the reform. These were more likely to support more gender-equal attitudes and both genders were more likely to engage in "counter-stereotypical" household tasks.

Our paper complements the causal empirical literature in this area by taking a quantitative modeling approach. This allows us to disentangle the relative importance of different mechanisms and to study the potential effects of alternative reforms. It adds to a small literature that uses quantitative models to understand the consequences of parental leave. For example, Erosa, Fuster and Restuccia (2010) use a general equilibrium search model to study how parental leave affects fertility and labor market decisions and Yamaguchi (2019) estimates a dynamic discrete choice model of female employment and fertility to evaluate how different lengths of job protection and paid family leave might affect women's career and fertility choices. Tô (2018) uses data from a Danish parental leave reform to estimate a signaling model of women's choice of parental leave length. Lastly, our paper is also related to a small literature on cultural change.[6] It is closest to Fernández (2013) who estimates a quantitative model of married women's labor force participation over 120 years in the US in which both economic factors – men's and women's wages – and cultural beliefs play a role in determining women's work decisions. That paper, however, models cultural change

[6]See Fernández (2025) for a review.

as the (Bayesian) evolution of beliefs generated by women learning about the true cost of working through observing the decisions of prior cohorts. In our model, on the other hand, social norms are captured by the mean of the distribution governing idiosyncratic preferences towards spending time on parental leave. These evolve endogenously as a result of prior decisions made by individuals who are similar in various dimensions (gender and household type).

Our paper is organized as follows. The next section briefly discusses the Swedish parental leave system and the time periods of the analysis. Section 3 presents the datasets and the sample construction. Section 4 examines the distribution of parental leave takeup and estimates the future wage penalties. Section 5 presents the model and section 6 its estimation. Section 7 analyzes the contributions of the reform, of the changed wage parameters, and of changes in culture or social norms to the takeup of parental leave by gender and household and section 8 studies several potential alternative policies. Section 9 concludes.

2 Some Preliminaries

2.1 The Parental Leave System

Sweden has been a leader in parental leave. In 1974 it became the first country to extend paid parental leave equally to fathers.[7] This reform granted 6 months of earnings-related benefits for parental leave at a 90% replacement rate up to a fairly generous ceiling. Mothers and fathers were free to split these 6 months as they pleased. The system was extended several times, and by 1994, 12 months of earnings-related benefits were available plus an additional 3 months at a low flat rate. This was complemented by a public daycare system that became available once a child turned one year old, and most parents avail themselves of this option.[8] In addition, parental leave could be taken on a part-time basis and could also be taken later (up to when the child was 8 years old).[9] Furthermore, a parent's job

[7] Before 1974, there was a less generous leave policy that was reserved solely for mothers.

[8] For example, in 2004, 74 percent of all children aged 1-3 and 96 percent of children 4-5 were registered in childcare (Skolverket, 2004).

[9] More than 90% of all leave days are taken in the first two years, however (Ekberg, Eriksson and Friebel (2013)).

was protected for up to 18 months.[10]

The most important change in Sweden's parental leave system was the introduction of months reserved for each parent – an innovation that Sweden spearheaded and that later spread to other countries, particularly in the European Union. The first "daddy month" was introduced in 1995. In principle, the reform allocated one of the earnings-related months of benefits to each of the parents. The remaining 10 months could be used as the parents wanted. In practice, this meant that the father needed to take at least one month of parental leave or it would be lost; hence the name daddy month. In 2002, a second month of benefits earmarked to each parent was introduced (the second daddy month). The maximum duration of earnings-related parental leave was simultaneously increased by one month from 12 to 13 months meaning that, in practice, women could still take 11 months of earnings-related leave as before. This is the reform that we are studying. Later, in 2016, a third month of earmarked benefits was added to the system.

Since 1998, the earnings-related replacement rate has been constant at 80%. Earnings related payments are subject to a ceiling, and this ceiling has eroded to some extent over time. On the other hand, many unions have collective agreements that top up the benefits that their workers receive. On net, our judgment is that the effect of the top-ups exceeds that of the erosion of the ceiling. In our analysis, we therefore assume an effective earnings-related replacement rate of 85%. The flat rate that is available once earnings-related payments are exhausted was sufficiently low that we simply set it to zero in our model.[11]

2.2 Time Periods of Analysis

To understand the role of economic and societal forces in changing household behavior, we analyze the response to the 2002 reform. This reform introduced a second daddy month and also lengthened the earnings-related parental leave period to 13 months.

Our estimation is disciplined by focusing on two four-year time periods: one before the reform and one after. The "pre-reform period" is from 1998 to 2001. During this period

[10] See Duvander and Cedstrand (2022) for more detail.

[11] The flat rate was 60 SEK per day (approximately 9 USD per day) from 1998 to 2001, the earlier period that we analyze, and was 180 SEK per day (approximately 27 USD per day) from 2008 to 2011, the later period that we analyze. This nominal increase corresponds to more than a doubling of the real rate.

there was only one daddy month and 12 total months of earnings-related parental leave. We chose the years to allow for the maximum adjustment to the one daddy month reform without overlapping with the 2002 reform. The "post-reform period" is from 2008 to 2011.[12] We chose this period to be six years after the introduction of the second daddy month to allow time for changes in behavior, especially those driven by changes in cultural attitudes and wage penalties.[13]

As can be seen in Figure 1, the share of parental leave taken by fathers was fairly stable between 1995 and 2001 and increased discontinuously in 2002, the year of the reform, from 14.0% to 16.1%. By 2014 men were on average taking 20.9% of parental leave time. It is important to take into account that the parental leave behavior of both men and women differs by education. As shown in Figure 2 with data as of 1995, the proportion of university-educated men (those with at least 3 years of university) taking more than 1 month or more than 2 months of parental leave is markedly higher than for men with less education. Similarly, the proportion of women taking strictly less than 11 months of parental leave is significantly higher for university-educated women (Figure 3). These observations suggest that education is an important factor to take into account in our analysis.

3 Data and Sample Construction

This section describes the main Swedish administrative registers from which we derive our data and discusses the construction of the samples that are used in our analysis.

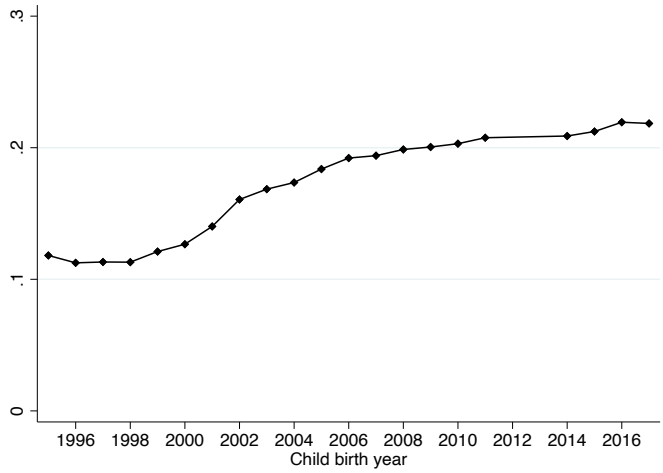
3.1 Datasets

The Parental Leave Registers constructed by the Social Insurance Agency contain information on the number of paid parental leave days taken by each person. We use the start and end dates for parental leave spells to construct a measure of how many months an individual spent on parental leave in the first 16 months after the birth of their child. A spell represents

[12] In July 2008 a "gender equality bonus" was also introduced. This was a tax incentive for parents who split their parental leave equally. Duvander and Johansson (2012) analyze the latter and conclude that it did not change parental leave decisions perhaps because it was complicated and received less public attention.

[13] Note that Sweden was not greatly affected by the Great Recession in 2008. As noted in the data section, missing parental leave data in 2013 means that starting the second period later would be problematic.

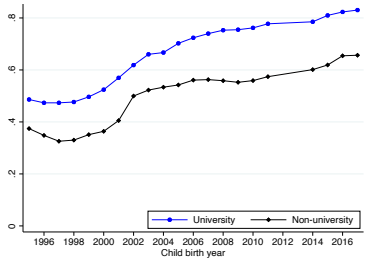
Figure 1: Fathers' Share of Parental Leave



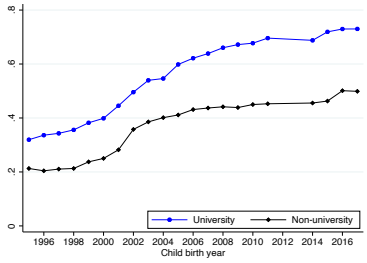
Note: Based on authors' calculations using the couples data as specified in the next section.

Figure 2: Percent of Fathers Taking More than 1 and 2 Months Parental Leave

(a) More than 1 month

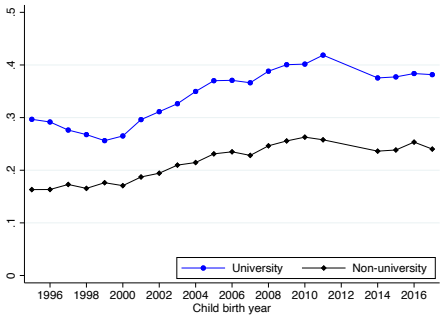


(b) More than 2 months



Note: Based on authors' calculations using the couples data as specified in the next section.

Figure 3: Percent of Women taking fewer than 11 Months of Parental Leave



Note: Based on authors' calculations using the couples data as specified in the next section.

a period of time that a parent informs the Social Insurance Agency that they will be away from work on parental leave.[14] For each parent, our parental leave variable is the sum of the length of all spells taken in the 16 months. Note that mothers-to-be have the option to start to take their paid leave 2 months prior to birth. This means that a few of the mothers in our sample are recorded as taking more than 16 months of leave. In our analysis, we group together these individuals who are recorded as taking 17 months or more. The parental leave data cover the period from 1994 to the first quarter of 2022. Unfortunately, data are missing from October to December 2013.

The Multi-Generation Register records all births by month and year. We use this dataset to link children to their biological parents. To obtain other characteristics of parents, we use LISA. This administrative database includes information on parents' education levels and also records individuals' annual earnings as well as standard background characteristics such as a parent's age, country of origin, and region of residence. We use these data to classify individuals by education (non-university versus university) and, as described below, to limit our sample to Swedish-born parents.

Finally, we link the data described above to the Wage Structure Statistics database to obtain full-time-equivalent monthly earnings. Full-time-equivalent monthly earnings are based on employer reports of individual earnings and contracted hours during a survey month (typically September). We use full-time-equivalent monthly earnings as an individual's monthly wage, even if the individual did not work full time. Of course, these data are only available for individuals who had some working hours during the survey month. It is important to note that although these monthly wage data are available for all public-sector employees with positive hours in the survey month, this is not the case for the private sector. For the latter, wages are available for workers in firms with 500 or more employees and for a stratified sample (based on industry and firm size) of workers in smaller firms. As a result, wage data are available for roughly 50 percent of private-sector workers.

[14] The parent may be receiving full or partial benefits during a spell.

3.2 Sample Construction

We restrict the sample in several ways. First, we include only first births for Swedish-born mothers and fathers where we observe both parents in our data. Focusing on first births allows us to avoid issues related to the relative timing of prior births which may affect the uptake of parental leave. Restricting the sample to Swedish-born parents eliminates issues concerning when immigrant parents came to Sweden and whether their use of the parental leave program is affected by their immigrant status. Moreover, it is very likely that the cultural attitudes of immigrants differ from those of native Swedes.[15] Second, we limit our sample to heterosexual couples between the ages of 20 and 60 at the time of childbirth as same-sex couples are likely to have different social norms regarding parental leave.

As noted previously, the second daddy month was introduced in January 2002 and we therefore restrict our attention to births in the years 1998 to 2001 – the pre-reform period – and in the post-reform period of 2008 to 2011. Starting the post-reform period with 2008 allows six years for the adjustment of wage penalties and cultural change in reaction to this policy change. In total, this leaves us with an overall sample of 226,369 childbirths (102,547 in the pre-period and 123,822 in the post-period).

The wage penalties associated with different lengths of parental leave are an important part of our analysis. As described below, to estimate these wage penalties, we use data on individual monthly wages, i.e., full-time monthly equivalent earnings, three years after childbirth as well as two years prior to the birth. Eliminating parents missing wage observations in those years substantially reduces our sample, leaving us with 56,120 mothers (23,417 in the pre-period and 32,703 in the post-period) and 52,991 fathers (22,580 in the pre-period and 30,411 in the post-period). Note that we include individuals even if we do not have wage data for their partners. We refer to this as the "wage sample."

We take the couple as our unit of observation for the parental leave decisions as decisions made by one parent necessarily affect the other. This requires us to further restrict our sample to observations for which we have wages for both parents, reducing the sample to 9,926 couples in the pre-period and 13,796 couples in the post-period. As discussed previously, education appears to be an important determinant of the length of parental leave.

[15] See the discussion in Tervola, Duvander and Mussino (2017).

We classify individuals into university (u) versus non-university (n) categories according to whether they have at least three years of university studies versus less. This partitions our couples into four household types, denoted by nn, un, nu, and uu, where the first entry indicates the father's education and the second the mother's. The following table gives the distribution of household types in the couples samples by period.

Table 1: Distribution of Household Types

	nn	un	nu	uu	Total
Pre Period	5,266	880	1,757	2,023	9,926
	(53.1%)	(8.9%)	(17.7%)	(20.4%)	
Post Period	4,200	975	3,326	5,295	13,796
	(30.4%)	(7.1%)	(24.1%)	(38.4%)	

Note: Tabulation of the couples samples. Household types refer to education of man first, woman second, n = non-university, u = university. See text for exact definition of education.

Appendix Table A1 reports the summary statistics for the wage and couples samples as well as for the original sample without any wage data requirements.

4 Parental Leave and Future Wage Penalties

In this section, we turn to a description of some of the key features of our data. We provide statistics on parental leave length by gender and household type and estimate, by gender and education, wage penalties associated with different lengths of parental leave.

4.1 Parental Leave

In this section, we show the distributions of parental leave across mothers and fathers in the pre- and post- periods. As we noted in the previous section, we restrict our attention to parental leave spells that occur in the first 16 months after birth.[16] We do this for two reasons. First, doing so avoids confounding parental leave associated with the first birth with parental leave associated with subsequent births.[17] Second, parental leave data are

[16] Parents can take parental leave starting 60 days before the due date, implying that we observe some who are recorded as taking more than 16 months. In our sample, we code these observations as 17 months.

[17] Only 4 percent of couples have an additional child within 16 months.

unavailable in the October-December 2013 window. Allowing for more than 16 months of parental leave after childbirth would limit the length of the post-period.

To receive parental leave benefits, a parent needs to inform the Social Insurance Board. We measure parental leave by the length of the periods that a parent informs the Social Insurance Board that they will be on parental leave. Although parents may take less than full benefits in these periods, one can assume that they are not working full time during these periods. We measure parental leave in months so that a parent who does not take any parental leave has leave equal to 0, while leave equal to t months indicates that the parent took more than t-1 months, but no more than t months.

Table 2: Months of Parental Leave

	Fathers		Mothers	
	non-university	university	non-university	university
Pre-Reform Period				
Mean	2.15	2.96	13.62	12.38
Median	1	2	14	13
SD	2.34	2.62	3.22	3.42
Post-Reform Period				
Mean	3.35	4.37	12.78	11.63
Median	3	4	13	12
SD	2.69	2.67	3.16	3.29

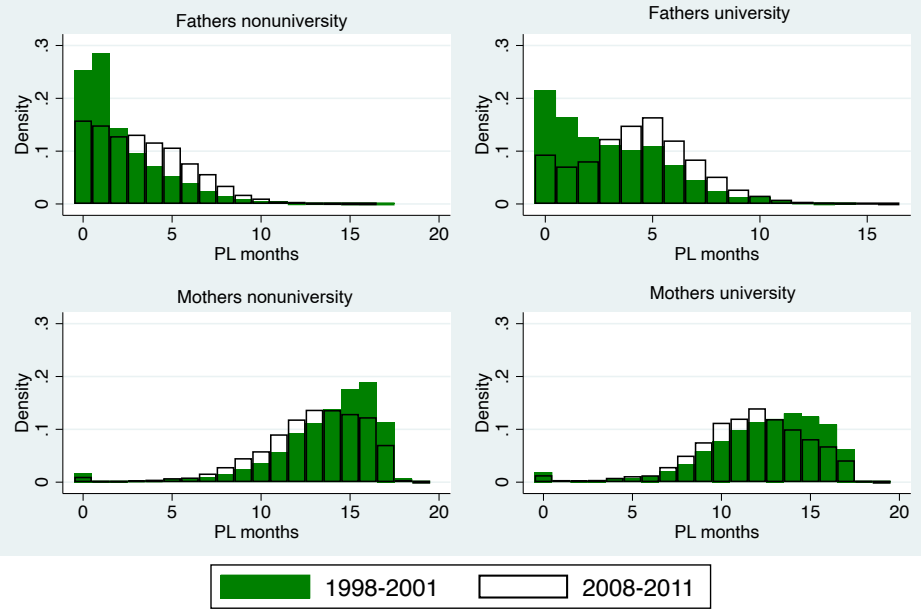
Note: Tabulation of the couples sample. Parental leave is expressed in months so that a parent who does not take any parental leave has leave equal to 0, while leave equal to t months indicates that the parent took more than t-1 months, but no more than t months.

Table 2 shows the mean, median, and standard deviation of parental leave by sex and education in the two periods separately. Note that the median length of leave for both university and non-university men increased by more than the one additional daddy month between our two periods. This suggests that the 2002 reform had an effect above and beyond the simple desire not to "leave money on the table"; that is, fathers are going beyond the incentive to take an additional month of earnings-related leave for which they are almost fully paid, indicating that something else – economic and/or social – may have changed as well. The change in the median and mean number of months of parental leave taken by mothers between the pre- and post-periods is not as dramatic as the corresponding changes

for fathers, but they both fell in both education groups. It is important to note that this happened even though mothers had 11 months of highly paid earnings-related parental leave available both before and after the 2002 reform.

A richer portrayal of parental leave and its change over the two periods is given by the histograms shown in Figure 4 displaying the distribution over months of parental leave by sex and education before and after the 2002 reform. The green is the distribution in the pre-reform period and the white/transparent is its counterpart for the post-reform period. It is worth noting that the change in men's parental leave distribution occurred over the entire range of the distribution, as did women's. It is also worth noting that a large percentage of men, over 20% regardless of education, were taking zero months of parental leave prior to the 2002 reform. Women's parental leave distributions show a significant reduction in long duration parental leave, i.e., leaves of 15 or more months.

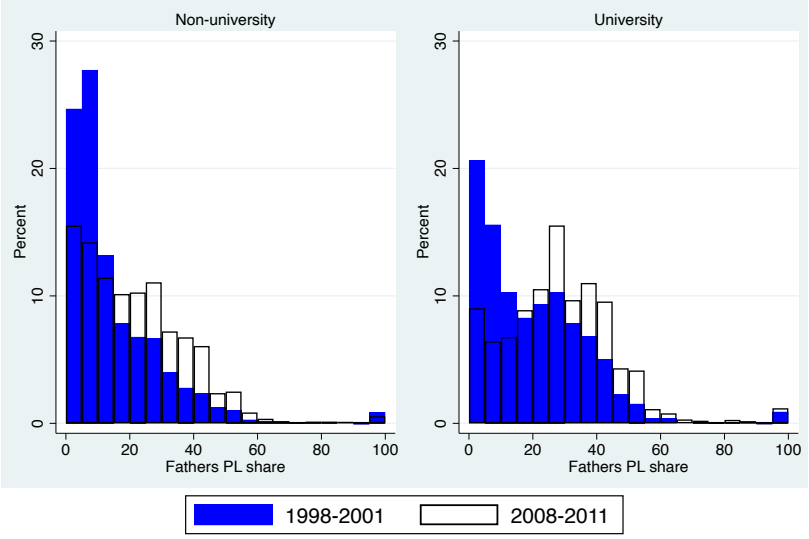
Figure 4: Parental Leave Distributions by Education and Sex



Note: Based on authors' calculation using the couples sample.

Lastly, we can examine couples directly and, by averaging over the share of leave taken by the father in each couple, show how the distribution of the father's share of parental leave changed over the two time periods. This is portrayed in Figure 5, distinguishing here only by the man's education category.

Figure 5: Fathers' share of parental leave



Note: Based on authors' calculation using the couples dataset. The education category here is that of the father's.

4.2 Wage Penalties

In this subsection, we estimate the wage penalties associated with different durations of parental leave. These wage penalties are potentially an important input into the family's decision about how much leave to take. While there is now a large literature that examines the effect of parenthood on gender wage and earnings gaps using event studies (see Kleven, Landais and Søgaard (2019)) to compare the trajectory of men's and women's earnings before versus after having a child, here we are interested instead on the effect of different durations of parental leave on the within-gender and education distribution of wage growth. Albrecht et al. (1999) is an early predecessor that used a rich Swedish dataset that distinguished between parental leave and leave for other reasons (unemployment and household time) for several cohorts to estimate wage penalties.

To estimate wage penalties, we use the full wage sample described above, i.e., we do not limit ourselves to the couples data, and express all wages in 2014 SEK. Presumably an individual's wage penalty does not depend on his or her household type but rather on that individual's gender and education. An important factor to consider is the possibility of selection into different lengths of parental leave. There may be unobservables that impact both the individual's pre-birth and post-birth wages. For example, individuals who are

doing poorly in their jobs before the first birth may respond by spending more time on parental leave, and then experience low post-birth wage growth as a result of the same factors as prior to becoming a parent. Estimating a model in first differences absorbs these unobserved individual fixed effects. It does not take care, however, of time-varying individual effects. We therefore use a second-difference specification that accounts for wage growth two years prior to the birth of the child. In particular, we estimate

$$\Delta_1 \log(w_i^{g,e}) - \Delta_0 \log(w_i^{g,e}) = \alpha_0^{g,e} + \sum_{j=0}^{T} \beta_j^{g,e} \cdot \mathbf{1}[j = \text{plcat}_i] + \epsilon_i^{g,e} \tag{1}$$

where $\Delta_1 \log(w_i^{g,e})$ is the change in the log wage of individual i of gender $g \in \{m, f\}$ and education $e \in \{n, u\}$ between $t-1$ and $t+3$ given that the first child was born in year t. $\Delta_0 \log(w_i^{g,e})$ is the individual's log wage change between years $t-2$ and $t-1$, and $plcat_i$ is a categorical variable (defined below) representing the number of months of parental leave taken by individual i. This double-difference specification eliminates individual time trends as captured two years prior to the child's birth. Note that we estimate these wage penalties separately for each gender-education group and for each period (pre vs post reform).

Our estimate of equation 1 groups men with 9 months or more of parental leave into one category of 9 months and women who took 10 months or less into a category of 10 months (there were too few otherwise). The plots of the coefficients obtained are given in the Appendix. Table 3 reports these wage penalties averaged within intervals of months over which the coefficients are similar (but not all individually significant). The omitted category for men (in both periods and for both levels of education) is zero months of parental leave, and the omitted category for women (again, in both periods and for both levels of education) is 0 to 10 months of parental leave. The penalties reported here will be used as an input in the estimation of the parental leave choice model.

There are several interesting patterns in Table 3. For non-university men, there are penalties associated with taking any amount of parental leave. In the pre-period, these men suffer a wage penalty on the order of 1.65%. In the post-period, the penalty is smaller for the first 6 months, returning close to its original level only for those who take 7 months or more. In both the pre- and post-periods, university men can take some leave without incurring

any penalty (4 in the pre-period and 5 in the post-period) but there is a substantial penalty of 3 to 5.5% associated with taking more leave in the pre-period. In the post-period, this penalty is 1.76%. Non-university women in the pre-period suffer close to a 1% wage penalty if they take 11 to 14 months which grows to 1.6% if they take 15 months of leave or more. Interestingly, these penalties become zero in the post-period. Among university women, there are penalties associated with taking 11 months of leave or more, about 1.7% up to 16 months and 3.2% for 17 months in the pre-period whereas in the post-period, it is lower for 11-13 months (1.1%), higher for 14-16 months (2.1%), and finally lower for 17 months (2.1%).

Overall, on average men's parental leave penalties decreased between the pre- and post-periods as did those of non-university women, whereas university women's penalties on average increased. It is worth discussing how to interpret these results, especially those pertaining to women. The evidence presented in Kleven, Landais and Søgaard (2019) suggests that women in Denmark become more likely to work in the public sector and for a firm with a female manager (both more likely to be family friendly) after the birth of their first child. Thus, the "wage penalty" associated with longer leaves may at least in part reflect that Swedish women are choosing to change sectors or take other steps (e.g. decrease their hours) leading to less career advancement. For men, a pure signalling story seems more likely.

Table 3: Estimated Wage Penalties

	Men				Women			
	Non-Univ		Univ		Non-Univ		Univ	
Period	Intervals	Wage Penalty	Intervals	Wage Penalty	Intervals	Wage Penalty	Intervals	Wage Penalty
Pre	1 - 17	-0.0165	1 - 4 5 - 8 9 - 17	0 -0.0314 -0.0547	11 - 14 15 - 17	-0.00935 -0.0157	11 - 16 17	-0.0166 -0.0321
Post	1 - 6 7 - 17	-0.00714 -0.0163	1 - 5 6 - 17	0 -0.0176	11 - 17	0	11 - 13 14 - 17	-0.0111 -0.0215

Note: The calculated wage penalties use coefficients from the wage penalty regressions, as shown in equation 1. The wage penalties presented in this table represent averages of the individual monthly wage penalties ($\beta_j^{g,e}$) over intervals of months over which the coefficient values are very similar. See Appendix Section 9 for details. The omitted category for men is zero months of parental leave; for women it is 10 months or fewer.

5 A Simple Model of Parental Leave

As noted previously, the objective of the daddy month reform was to increase the amount of parental leave taken by fathers. There are several reasons this could happen. First, there is a direct incentive effect. The daddy month is an extra month which can be taken for close to full pay. If a father fails to take his daddy month(s) and that time is instead covered by the mother at the low flat rate, the couple is "leaving money on the table" in the sense that the father could have been home with the baby at a lower cost to current household income. Second, as shown in Section 4.2, men's wage penalty associated with longer spells of parental leave on average decreased between the pre- and post-reform periods, increasing men's incentive to take more parental leave. For women, on the other hand, the wage penalty for taking more than 13-16 months increased if they had a university education but disappeared for non-university women. A third factor operates through changing social norms. Men may be hesitant to take longer parental leave if other men are not doing so. As more men respond to the direct financial incentives associated with daddy months, other fathers may be more comfortable taking additional parental leave themselves.[18] This would also affect mothers' behavior as their desire to take more months of low-paid parental leave might change if their partners are now taking more leave. This would in turn also change the social pressure facing women to take lengthy spells of parental leave.

5.1 The Model

We next present a model that captures these incentives and concerns in a simple and transparent fashion. To this end, consider a unitary family of a woman and man who have just had a child and need to decide how many months of parental leave they each wish to take over a period of length τ of which there is a maximum of T months of paid parental leave. These would be 12 months in the pre-reform period and 13 in the post-reform period. While technically there are also an additional 3 months available at a low flat pay, we will treat these months as paying zero.

[18] Dahl, Løken and Mogstad (2014) cite a Norwegian survey taken prior to the parental reform of 1995 as saying "Fathers are concerned that both employers and coworkers will perceive them as less invested in their careers if they exhibit a large commitment to family."

Let t_m and t_f be the parental leave taken by fathers and mothers (measured in months) where m and f denote male and female, respectively. We assume that the household preferences can be modeled as:

$$V_{ij} = A \cdot U(\tilde{y}_{ij}) + B \cdot U(y_{ij}) + \gamma_m^{ij} \cdot h_m^e(t_m) + \gamma_f^{ij} \cdot h_f^e(t_f) \tag{2}$$

where $A, B > 0$ and i, j denotes the household type (i.e., the education i of the man and j of the woman, $i, j \in \{n, u\}$).[19] The first term is the utility over the average monthly family income $\tilde{y}$ received during the period of potential parental leave τ, where

$$\tilde{y} = \tilde{y}_m(t_m, t_f) + \tilde{y}_f(t_m, t_f) - C$$

is the (average over) the sum of both parents' labor and parental leave incomes net of the total cost of child care C during that period. The second term is the utility over average monthly *future* family income

$$y = y_m(t_m) + y_f(t_f)$$

which depends on each parent's parental leave time as these determine the future wage penalties associated with these decisions. As discussed previously, the length of parental leave each individual takes potentially affects future income as firms may interpret longer leave times as signalling something about the worker's type such as a lower commitment to work, to the firm, or to their career.

The third and fourth terms represent the utility that each parent obtains from the time spent with their child during parental leave. We model this as an idiosyncratic enjoyment of spending time with one's child, γ, and a function of the time spent $h(t)$.[20] These preferences are not pure primitives, however, as γ is also assumed to depend on the behavior of others.

In particular, we assume that an individual's γ is drawn from a normal distribution

[19] In order to simplify notation, equation 2 has suppressed individual-specific subscripts. In particular, as will be made clear later, both income and γ are individual-specific and do not only depend on gender and household type.

[20] We chose to model the utility from parental leave as separable in men's and women's time. An alternative would be to have the weighted sum of parental time matter, although it would require us to also estimate the weights attached to each time input. Furthermore, we would need to introduce two additional terms to capture social norms for each parent. We think that the present specification is more transparent and does not require us to model social norms separately from preferences.

$\mathcal{N}(\mu_\gamma^{g,ij}, \sigma_\gamma^{g,ij})$ with mean and standard deviation that depend on gender and household type. The mean of this distribution, moreover, evolves according to the following rule:

$$\mu_s^{g,ij} = a^{g,ij} + b^{g,ij} \cdot \bar{t}_{s-1}^{g,ij} \tag{3}$$

where $\bar{t}_{s-1}^{g,ij}$ denotes the mean parental leave taken in the previous period, $s-1$, by individuals of the same gender g and household type ij. The standard deviation, $\sigma_\gamma^{g,ij}$, is assumed to stay constant. This formulation captures the idea that how an individual feels about taking parental leave depends on the choices made by others. The restriction to caring about the choices of same-gender individuals is natural. Caring more about the choices made by those who are similar to one is also natural. One possibility would be to care only about the choices made by those with the same education. Here we go a step further and assume that the education of one's partner also matters. That is, women care about the choices made by women with their same education and whose partner has the same education as their partner, and similarly for men. This can reflect that individuals are influenced not only by their coworkers and friends, who are likely to be of a similar education as themselves, but also by those with whom they socialize, which is likely to depend as well on the education of their partner.

For simplicity, we assume that the mean of the γ distribution is a linear function of the mean time spent on parental leave in the previous period by those similar to oneself (as defined above), $\bar{t}_{s-1}^{g,ij}$. In equation 3, a fixes the intercept whereas the marginal response to changes in others' parental leave choices is given by b, where both parameters are allowed to be gender and household type specific. Lastly, we assume last period's, rather than the current period's, mean parental leave influences μ. As shown by Dahl, Løken and Mogstad (2014) in the context of a parental leave reform in Norway, there is a "snowball" effect of past parental leave choices made by coworkers whose effects accumulate over time. While this does not matter in a steady state, it implies that studying the effect of a reform may require time as social interactions can gradually lead to a higher long-run equilibrium.[21] Furthermore, this formulation allows the model to avoid the usual multiplicity of equilibria

[21] We will not estimate the transition path and therefore do not define what time length to assign to a period.

that would arise if μ depended instead on the current mean level of parental leave.

5.2 The Maximization Problem

The couple chooses their parental leave durations, t_m and t_f, to maximize their welfare in equation 2 subject to the following constraints: (i) τ is the maximum amount of leave time (it corresponds to the range of time that we choose to observe individuals) and therefore, effectively, the amount of leave that an individual can take independently of whether it is paid or not. For the estimation, we take $\tau = 17$ months. As discussed previously, we treat months as a discrete variable, so $\tau = 17$ implies $t_g \in \{0, 1, ..., 17\}$ for $g \in \{m, f\}$. (ii) Let T be the maximum possible number of paid months. If the couple jointly takes more than T months of leave and both partners take at least D, where the latter is the number of daddy months, parental leave is paid for T months (more on this below) and the remaining months of parental leave pay zero.[22] (iii) If a parent j takes fewer than D months, then the aggregate parental leave constraint at which pay becomes zero becomes $T - (D - t_j)$.

We assume a uniform monthly wage replacement rate of κ when a worker takes paid parental leave. Furthermore, we assume that childcare costs are incurred whenever both parents are working. The monthly cost is C_r when the child is less than a year old and hence the parents are assumed to use private child care, and it is C_u when the child is a year or older and can use public child care, with $C_r > C_u$. In the estimation, we set $\kappa = 0.85$ as discussed in Section 2.1. We set C_r and C_u equal to 0.6 and 0.06, respectively, times the average monthly wage of a non-college woman.[23]

We are now set to express household income for both the pre- and post-reform periods during the observation period $\tau = 17$. Note that in the pre-period, $T = 12$ and $D = 1$, whereas in the post-reform period, $T = 13$ and $D = 2$. In both cases, the maximum number of paid months one parent can take is 11, though as a couple they can take more

[22] As noted above, these months are paid at a sufficiently low flat rate that we set to zero.

[23] We derive the figures for childcare costs as follows. First, the cost of providing public daycare is available from government reports (Skolverket (2010): Kostnader för förskoleverksamhet, skolbarnsomsorg, skola och vuxenutbildning 2009) and Skolverket (1999) Beskrivande data om barnomsorg och skola 1998, Rapport 157). Public daycare is, however, very heavily subsidized - parents pay about 15 percent of the cost for the first child. This gives the monthly fee that parents pay, which is equal to about 6 percent of the average wage of a non-university woman. We assume that the cost to parents of private daycare is 10 times that of public daycare, i.e., 60 percent of the average wage of a non-university woman.

by respecting the daddy month(s).

First, some notation. We denote the wage of the parent with the greater wage by $\bar{w}$ and the wage of the other parent by $\underline{w}$. Similarly, we denote by $\bar{t}$ the parental leave time taken by the parent whose wage is greater and by $\underline{t}$ the parental leave time taken by the paarent whose wage is lower. Lastly, we denote by t_d, w_d the parental leave time and wage of a parent who is taking less parental leave than the prescribed daddy months, i.e., $t_d < D$, and by t_{nd}, w_{nd} the parental leave time and wage of the other spouse.[24] Depending on the total length of parental leave time taken by the couple and how this leave is divided between them, we have the following cases for earnings during the observed 17 month period.

One possible case is for both parents to jointly take no more than T months – the period of time in which parental leave is paid – and to respect the daddy months restriction by having each parent take at least D months. In this case, net household income incorporates the cost of private child care, C_r, for those months in which both parents are working and the child is below the age of 1, and the public cost C_u when the child is over 1 year old. Total household income is then given by:

- Case 1: $t_m + t_f \leq T,\ \min\{t_g\} \geq D$
  $17\tilde{y} = (17 - t_m)w_m + (17 - t_f)w_f + \kappa(t_m w_m + t_f w_f) - (\max\{12 - t_m - t_f, 0\})C_r - (5 - \max\{t_m + t_f - 12, 0\})C_u$

To understand the algebra in Case 1, note that total household income over the 17 month period is given by the man's monthly wage multiplied by the number of months not spent on parental leave (17 - t_m) (the first term), an equivalent expression for the mother (the second term) plus the parental leave income which is simply the months each parent spent on parental leave multiplied by the replacement rate κ (the third term). From this income, one needs to subtract the cost of the months the child received private childcare, which is positive only if parents are jointly taking less than 12 months of parental leave (hence the max expression). In addition, one needs to subtract the cost of the months in which the child receives public childcare which, given that for this case $t_m + t_f \leq T$, implies that this is either the full remaining 5 months in the pre-reform period since T=12 and either 5 or

[24] It is theoretically possible to have both parents take less than D, in which case the budget constraint is the same as in case 1.

4 months depending on whether the couple jointly took 13 months or strictly fewer (when T=13) in the post-reform period for which $D = 2$.[25]

A second case is for the couple to jointly take more than T months, i.e., they take some unpaid parental leave. If the daddy months are respected and no parent takes strictly more than 11 months, this yields the following expression for net household income:

- Case 2: $t_m + t_f > T,\ \min\{t_g\} \geq D$ and $t^M \equiv \max\{t_g\} \leq 11$
  $17\tilde{y} = (17 - t_m)w_m + (17 - t_f)w_f + \kappa(\bar{w}\bar{t} + \underline{w}(T - \bar{t})) - (17 - t_m - t_f)C_u$

Note that in this case the parent with the greater monthly wage will take all their parental leave months as paid whereas the other parent will have some months unpaid.

A third case is that the couple jointly takes more than the paid parental leave but, in contrast to case 2, one parent takes more than 11 months. Assuming that the daddy months are taken, we can distinguish between two sub-cases according to whether the parent with the higher wage takes more or less than 11 months:

- Case 3: $t_m + t_f > T,\ \min\{t_g\} \geq D$ *and* $t^M \equiv \max\{t_g\} > 11$
  - 3a). $\bar{t} > 11$
    $17\tilde{y} = (17 - t_m)w_m + (17 - t_f)w_f + \kappa(11\bar{w} + D\underline{w}) - (17 - t_m - t_f)C_u$
  - 3b). $\bar{t} \leq 11$
    $17\ \tilde{y} = (17 - t_m)w_m + (17 - t_f)w_f + \kappa(\bar{t}\bar{w} + \underline{w}(T - \bar{t})) - (17 - t_m - t_f)C_u$

Lastly, suppose that the daddy months are not fully taken. Here we can distinguish two cases according to whether the other parent takes more or less than 11 months (the amount that is paid).

- Case 4: $\min\{t_g\} < D$
  - 4a). $t_{nd} \leq 11$
    $17\ \tilde{y} = (17 - t_m)w_m + (17 - t_f)w_f + \kappa(t_d w_d + t_{nd} w_{nd}) - (12 - t_m - t_f)C_r - 5C_u$
  - 4b). $t_{nd} > 11$
    $17\tilde{y} = (17 - t_m)w_m + (17 - t_f)w_f + \kappa(t_d w_d + 11 w_{nd}) - (17 - t_m - t_f)C_u$

[25] The algebra for the remaining cases can be derived similarly so we do not provide detailed explanations for them.

Note that we have described only how parental leave choices affect income during the 17 month period. Future income, as discussed in Section 4.2, is also a function of these choices.

6 Estimation

This section describes how we parameterize and estimate the model. Some model parameter values are directly taken from the data using model restrictions whereas the majority are estimated "internally" from the simulation of the model. There are a total of 31 internally estimated parameters which can be thought of as: 1) 3 parameters that govern preferences over current and future income; 2) 4 parameters that govern the curvature over the utility of time spent on parental leave; and 3) 24 parameters associated with the mean, variance, and evolution of the distribution of preferences over parental leave. Table 4 summarizes the list of parameters.

6.1 Wage Parameters and Functional Forms

We assign (monthly) wages to an individual, based not only on that person's gender and education, but also by the education of their partner. In particular, we assume that the (log) wages for a couple are draws from a bivariate normal distribution with parameters that differ by gender-household type and that are obtained directly from the data on log wages of each gender-household type.[26] The parameters of this joint distribution are given in Appendix Table A2.

We normalize the mean of the bivariate normal distribution for non-university women in nn households (μ_f^{nn}) to equal 1 and then express all other parameter values relative to it. This implies that the joint distribution for household wages takes the following form:

$$\begin{pmatrix} \log w_m \\ \log w_f \end{pmatrix} \sim N\left(\frac{\boldsymbol{\mu}}{\mu_w^{f,nn}}, \quad \frac{\Omega}{(\mu_w^{f,nn})^2} \right)$$

[26] These are monthly full-time equivalent wages.

where

$$\boldsymbol{\mu} = \begin{pmatrix} \mu_w^{m,ij} \\ \mu_w^{f,ij} \end{pmatrix}, \quad \Omega = \begin{pmatrix} (\sigma_w^{m,ij})^2 & \rho^{ij}\sigma_w^{m,ij}\sigma_w^{f,ij} \\ \rho^{ij}\sigma_w^{m,ij}\sigma_w^{f,ij} & (\sigma_w^{f,ij})^2 \end{pmatrix}$$

and where ρ is the correlation of log wages.

To obtain future income, we use equation 1, the couple's parental leave decisions, and the corresponding wage growth penalties in Table 3. That is, we calculate

$$log(w_{i,t+3}) = log(w_{i,t-1}) + \alpha_0^{g,e} + \Delta_0 \log(w_i^{g,e}) + \sum_{j=1}^{T^g} \beta_j^{g,e} \cdot \mathbf{1}[j = \text{plcat}_i]$$

but, since we do not assign wages at $t-2$ to agents, we substitute $\Delta_0 \log(w_i^{g,e})$ with its expected value (that is, its mean, by gender and education). Appendix Table A3 reports the relevant values of $\alpha_0^{g,e}$ and $\mathbb{E}\Delta_0 \log(w_i^{g,e})$. We calculate future total monthly household income, $y_{ij}(t_m, t_f)$, by summing both spouses' future wages and subtracting the wage penalty as indicated by Table 3 and each parent's choice of parental leave time.

We assume that utility over income (current and future) is given by CRRA preferences:

$$u(y) = \frac{y^{1-\eta}}{1-\eta} \tag{4}$$

where $\eta \geq 0$. The constants (A, B) multiplying the utility function over household income in equation 2 are the same for all households.

Utility governing the time spent with a child during parental leave is given by:

$$h_{g,e}(t) = \frac{t^{1-\zeta_{g,e}}}{1-\zeta_{g,e}} \tag{5}$$

where the curvature is a function of both gender and education.

Table 4: Description of Parameters

Categories	Parameters	Symbol	Value
External parameters	Mean of log wage draws by gender & hh type	$\mu_w^{g,ij}$	see Table A2
	SD of log wage draws by gender & hh type	$\sigma_w^{g,ij}$	
	Correlation coefficient of spousal log wage draws by hh type	ρ^{ij}	
	Wage growth (zero penalty) by gender & education	ψ_g^e	see Table A3
	Monthly wage replacement rate for paid parental leave	κ	0.85
	Monthly cost of childcare under age of 1 (as % of average wage of nn women in pre)	C_r	0.6
	Monthly cost of childcare over age of 1 (as % of average wage of nn women in pre)	C_u	0.06
Utility	Utility over average hh income during the first 17 months	A	
	Utility over future average hh income	B	
	Curvature of utility function	η	
	Curvature of utility of time with children by gender & education	ζ_g^e	
Social norms	Intercept for mean of γ distribution by gender & hh type	a_g^{ij}	
	Sensitivity of mean of γ distribution to peers by gender & hh type	b_g^{ij}	
	SD of γ distribution by gender & hh type	$\sigma_\gamma^{g,ij}$	

Note: The γ distribution is assumed to be normal. See text for definitions of all variables.

6.2 Internally Estimated Parameters

The remaining 31 parameters are estimated internally using the method of simulated moments to match key empirical moments for both the pre- and post-reform periods. These moments are calculated using data with sample restrictions as described in Section 3 and are reported in Table 6 where we also give their model estimated values. These consist of, for each period and household type, the mean months of parental leave taken by men and women (2x8 moments), the standard deviation of these months (2x8 moments), the percentage of men who took zero months (2x4 moments), and the mean household share of leave taken by men (2x4 moments), totaling 48 moments.[27] In particular, it is important for the model to capture the fact that, despite incentives to do so, a substantial share of men do not take any parental leave, which is why we choose to match the percentage of men who take zero months of parental leave.[28]

While all parameters are simultaneously identified, one can think of the parameters that govern the mean of the γ distribution (the a_g^{ij}, b_g^{ij}) as being identified in the following way. For given parameters of the utility function over income which, recall, are common to

[27] Note that this mean share is computed by first calculating the within-couple share of parental leave taken by the father and averaging these shares

[28] Note that this is not an approximation as we report the proportion of men who did not apply for any parental leave.

all individuals, and for a given a_g^{ij} parameter, the b_g^{ij} parameter governs how the mean of the distribution will change given the change in the mean parental leave of that gender-household type from pre to post reform (which is data). The a_g^{ij} parameter must then adjust so as to obtain the correct mean level in the pre period.

6.3 Estimation Procedure

An overview of our estimation procedure is as follows. For each guess of the parameter vector, we compute model-generated moments by simulating households and solving for the steady-state distributions of parental leave taken for both pre- and post-reform periods. In the model simulation, the choice set for households consists of a discrete number of parental leave months for each spouse ($t_m, t_f \in \{0, 1, \ldots, 17\}$), subject to the constraint that the total leave taken per household does not exceed 17 months. Using the specification of household utility of Equation 2, the model identifies the combination of leave taken by men and women that maximizes household utility.

We start the estimation process with an initial guess of the parameter vector θ_0. For this guess of parameters, we solve for the steady states for both periods sequentially: first solving for the pre-reform period and then for the post-reform period. To begin, we use the pre-reform empirical means of parental leave for each gender and household type, denoted as $\bar{t}_0^{g,ij}$, as our starting point. Note that this choice then determines the means of the γ distributions ($\mu_{\gamma,0}^{g,ij}$) as a_g^{ij} and b_g^{ij} are specified in θ_0. We then simulate the parental leave decisions of 40,000 households (10,000 for each household type) under the prevailing budget constraints, wages, and wage penalties of the pre-reform environment. This simulation produces a distribution of parental leave taken for each gender and household type, from which we calculate updated means of parental leave, $\bar{t}_1^{g,ij}$, for each gender-household type.

Next, we check for convergence to a fixed point by comparing the differences between these new means ($\bar{t}_1^{g,ij}$) and initial means ($\bar{t}_0^{g,ij}$). Specifically, we evaluate if the maximum absolute difference in means across all groups between $\bar{t}_1^{g,ij}$ and $\bar{t}_0^{g,ij}$ is less than our convergence threshold of 0.01. If the convergence criterion is not met, $\bar{t}_1^{g,ij}$ are used to simulate another 40,000 households with updated $\mu_{\gamma,1}^{g,ij}$ parameters, yielding a new set of parental leave means, $\bar{t}_2^{g,ij}$. The process of calculating the differences of parental leave means between successive

iterations continues until convergence between successive means ($\bar{t}_{s-1}^{g,ij}$ and $\bar{t}_{s}^{g,ij}$) is achieved. Upon reaching a fixed point, we perturb the resulting means (for all gender and household types) by a small amount, ϵ, to ensure the model returns to the same mean values, thus verifying local stability.[29]

After solving for the steady state of the pre-reform period, we employ the same process to solve for the post-reform period steady state, with the same guess of the parameter vector θ_0 but with the post-reform opportunity set (i.e, a second daddy month) and the post-reform budget constraints, wages, and wage penalties. For the post-reform simulations, however, we use the previously obtained steady-state parental leave means as the starting point to define $\mu_{\gamma,0}^{g,ij}$. The convergence and local stability criteria remain the same as in the pre-reform period.

Once steady states for both periods are found, we generate moments for both pre- and post-reform periods using the steady state distributions, and compare them to the empirical moments. We then update our guess for the parameter vector to θ_1 using the Nelder-Mead algorithm and repeat the process of finding steady states and computing moments for both periods with a new guess of parameters.[30] This iterative process continues until we find a parameter vector that minimizes our objective function. Specifically, the estimated parameters minimize the weighted sum of squared differences between model-generated and empirical moments, defined as:

$$\hat{\theta} = argmin_{\theta} \sum_{i=1}^{48} \omega_i \cdot \left(\frac{m_i^s(\theta) - m_i^d}{m_i^d} \right)^2$$

Here, m^d represents the 48 empirical moments, while $m^s(\theta)$ denotes the moments simulated under parameter vector θ. ω_i represents the weight assigned to moment i, with all moments receiving a weight of one, except for standard deviations, which are given a weight of 0.25.

Table 5 reports the values of the estimated parameters.

[29] We also checked global stability, which was also satisfied.

[30] The Nelder-Mead algorithm was chosen for its robustness in handling non-differentiable models typical of discrete choice frameworks.

Table 5: Estimated Parameters

Parameters	Symbol	Estimate							
Utility over average hh income during the first 17 months	A	38.098							
Utility over future average hh income	B	30.147							
Curvature of utility function	η	0.398							
		Men				Women			
		nn	nu	un	uu	nn	nu	un	uu
Intercept for mean of γ distribution by gender & hh type	a_g^{ij}	-0.737	-0.399	-0.723	0.413	6.754	7.108	5.474	5.914
Sensitivity of mean of γ distribution by gender & hh type	b_g^{ij}	2.378	2.512	2.836	2.562	0.830	0.852	1.165	1.040
SD of γ distribution by gender & hh type	$\sigma_\gamma^{g,ij}$	5.347	6.635	7.860	8.398	6.236	6.806	6.804	6.466
		Non-Univ		Univ		Non-Univ		Univ	
Curvature of utility of time with children by gender & education	ζ_g^e	0.913		0.902		0.684		0.674	

Note: See Table 4 for descriptions of all variables. Parameters a_g^{ij}, b_g^{ij}, and $\sigma_\gamma^{g,ij}$ are estimated for each gender and household education type. Household types are denoted by the education level of the man first and the woman second, where n represents non-university and u represents university education. Parameters ζ_g^e are estimated for each gender-education type.

6.4 Estimation Results and Parameter Interpretation

As can be seen from Table 6, the model does a very good job of matching the data.[31] The estimates for the mean months taken by men and women by household type are generally very close to the data moments as are the mean shares of parental leave taken by men.[32] The model does worst in matching the percent of men in un households who take zero leave in the pre-reform period and the mean share of leave taken by men in nn households in the post-reform period. For all parental leave moments, it underestimates their standard deviations.

It is useful to provide an interpretation of some of the parameters reported in Table 5. First note that η – the parameter governing the curvature of the utility function over income, common to all – is less than one and thus the function is concave, and that the parameters weighing the utility of income during parental leave and three years later (A, B) are similar in magnitude. ζ – the parameter governing the curvature of the utility function over the amount of time spent on parental leave – is also below one for all gender-education pairs (hence concavity), but it is higher for men than for women, indicating that men's marginal utility from an additional month spent on parental leave is lower, ceteris paribus. Lastly, the b parameter governing the sensitivity of the mean of the γ distribution to changes

[31] The weighted sum of squared errors is 0.41.

[32] Note that being close for means does not imply being close in shares as the mean shares taken by men are calculated couple by couple before being averaged.

in the mean parental leave of one's peers, is higher for men than for women, independent of household type. This implies that, ceteris paribus, men will respond more to a change in their peer's parental leave behavior than women. Note that the standard deviation of γ is similar across all gender-household types, though somewhat higher for university men (independently of the household type) and lower for non-university men, especially in nn households.

Table 6: Estimation Targets, Model vs Data

Panel A: Pre-Reform Period

	Men				Women			
	Mean and SD PL Months		% Taking 0 Month		Mean and SD PL Months		Mean Share Taken by Men	
HH Type	Data	Model	Data	Model	Data	Model	Data	Model
nn	1.99 (2.31)	1.76 (1.73)	26.68	25.84	13.67 (3.18)	12.47 (2.84)	10.86	12.73
nu	2.62 (2.37)	2.33 (2.08)	21.40	20.62	12.79 (3.36)	12.72 (3.07)	15.60	16.44
un	2.31 (2.49)	2.08 (1.89)	28.18	24.56	13.28 (3.42)	13.08 (2.72)	13.26	13.64
uu	3.25 (2.62)	2.97 (2.34)	18.49	16.80	12.03 (3.43)	11.93 (3.01)	19.75	19.94

Panel B: Post-Reform Period

	Men				Women			
	Mean and SD PL Months		% Taking 0 Month		Mean and SD PL Months		Mean Share Taken by Men	
HH Type	Data	Model	Data	Model	Data	Model	Data	Model
nn	2.97 (2.62)	2.53 (1.83)	18.74	16.28	12.88 (3.11)	12.18 (2.68)	22.50	17.47
nu	3.83 (2.70)	3.20 (2.15)	12.15	12.16	12.16 (3.27)	11.62 (2.89)	22.50	21.90
un	3.45 (2.64)	2.90 (2.08)	15.28	16.28	12.35 (3.36)	12.74 (2.67)	20.55	18.65
uu	4.54 (2.65)	4.18 (2.55)	8.29	9.06	11.30 (3.26)	11.06 (2.99)	27.60	27.56

Note: The moments for the percentage taking 0 months and mean share taken by men are multiplied by 100. Standard deviation moments are in parentheses. Household types are denoted by the education level of the man first and the woman second, where n represents non-university and u represents university education.

To understand how different gender-household types value parental leave, we need to evaluate the product of γ and the utility function $h(t)$ at some given t. We perform the

following exercise: we calculate the percentage of household income an individual would be willing to sacrifice in order to obtain an additional month of leave assuming that gamma takes the mean value for the gender-household type, $\mu_\gamma^{g,ij}$ and that they are endowed with the mean income for their household type, $\bar{y}^{ij}$.[33] We arbitrarily choose to evaluate this at 6 months of parental leave which is high for men and low for women. That is, we solve for x below for each gender and household type:[34]

$$AU(\bar{y}^{ij}) - AU(\bar{y}^{ij}(1-x)) = \mu_\gamma^{g,ij} \cdot (h_{g,e}(7) - h_{g,e}(6))$$

using the appropriate means of household incomes and $\mu_\gamma^{g,ij}$ which differ in the pre-reform versus post-reform period as shown in the first row of each panel of Table 7.

Not surprisingly, as can be seen in the second row of Table 7, men of all household types are willing to sacrifice a much smaller percentage of household income than women in both periods. This percentage grows for men in the post-period whereas it decreases for women. Given that mean household income increased for all types, men's willingness to sacrifice a larger percentage than in the pre-period indicates that the endogenously higher means of the γ distributions in the post-period are large enough to offset the decrease that would otherwise follow from their higher average household income. For women, on the other hand, both the higher household income and the lower $\mu_\gamma^{f,ij}$ work in the same direction to decrease the percentage of income they would want to sacrifice.

It is also interesting to note that in both the pre- and post-reform periods, non-university men have a lower mean γ than university men when partnered with a woman of a given education. This feature helps match the fact that non-university men take less parental leave than their university counterparts, given their partner's education. The same pattern does not hold for women: in both periods, non-university women have a lower mean γ than university women when partnered with non-university men but have a higher mean γ than university women when partnered with a university man.

[33] Household income here abstracts from any cost of parental leave – both from only receiving κ of one's monthly wage and from any childcare costs.

[34] Note that x can be solved for algebraically.

Table 7: Parameter Interpretation

Panel A: Pre-Reform Period

	Men				Women			
Exercise	nn	nu	un	uu	nn	nu	un	uu
$\mu_\gamma^{g,ij}$	3.45	5.47	5.17	8.02	17.10	17.54	21.03	18.46
Additional month at 6 Months (%)	0.59	0.93	0.90	1.39	4.52	4.71	5.53	4.92

Panel B: Post-Reform Period

	Men				Women			
Exercise	nn	nu	un	uu	nn	nu	un	uu
$\mu_\gamma^{g,ij}$	5.28	7.63	7.49	11.11	16.87	17.01	20.32	17.43
Additional month at 6 Months (%)	0.89	1.28	1.28	1.89	4.38	4.48	5.24	4.55

Note: The second row in each panel reports the percentage of average household income (where the latter varies by household type and pre vs post reform period) an individual of a given household and gender would be willing to sacrifice in order to increase its parental leave from 6 months to 7. Household types are denoted by the education level of the man first and the woman second, where n represents non-university and u represents university education.

7 Economic Incentives and Cultural Change

We can now turn to one of the principal concerns of this paper: determining how different changes in the environment – regulations, wage parameters (see Appendix Table A2) including the changed future wage penalties (see Table 3), and endogenously changing social norms – contributed to the evolution of parental leave choice from the pre-reform distribution to the post-reform one.

We do this by first introducing only the change in the parental leave regulation, i.e., increasing the number of daddy months from 1 to 2 and the total earnings-related months of parental leave from 12 to 13, keeping all other economic incentives and preferences unchanged (i.e, keeping the $\mu_\gamma^{g,ij}$ at their original pre-reform levels). Note again that this reform did not affect the maximum number of months a woman could take with full parental leave pay – they were still 11.

The consequences of only introducing the reform while holding all wage parameters and social norms fixed are shown in column 2 of Table 8, titled "Reform Only." For men, the reform on its own accounts for a substantial portion of the total increase in their parental leave spells, (i.e, of the increase from the pre-reform to the post-reform simulated moments). It generates from 15% (for uu men) to 40% (for nn men) of the total increase in their mean parental leave. For women, on the other hand, the reform barely changed their choices on

average. These results can be explained by noting that the reform increased the number of paid parental leave months reserved (de facto) solely for men, which increased their incentive to take more time without changing women's incentives in a substantial manner. Ceteris paribus, if their male partner took another month of leave this would slightly decrease their household income by $(1-\kappa).w_m$ but would also decrease childcare costs.

When the wage parameters of the post-reform period are introduced in addition to the reform (column 3 titled "Wages"), the incremental effects over those obtained with the reform only are small.[35] Non-university men slightly decrease their leaves whereas university men slightly increase theirs. Women are also relatively unaffected, with some increasing and others decreasing their leave only slightly. It is important to note that, for both of these experiments, the percentage of men who are taking zero months of leave barely changes. These men did not want to take any leave when there was only 1 daddy month available so increasing it to 2 months has almost no effect, even though the wage penalty for non-university men decreased.[36] These men have very low draws of gamma and have almost no incentive to change their behavior.

Next, we examine the effect of the reform keeping the wage parameters constant at pre-reform levels, but allowing the mean of the γ distributions to change endogenously in response to the reform. The effects of this are substantially greater than in the prior experiment. Allowing culture to change accounts for from 46% of the final increase in men's parental leave for uu men to 122% of the increase for nn men. Women also experience large changes, decreasing substantially the mean months of parental leave they take. The changes account for 24% to 160% of the final decrease, for uu and nn women respectively. Importantly, the percent of men taking zero months changes dramatically in response to the change in social norms, dropping to only around 57% of its original value for non-university men and around 76% for university men.

The last column includes all changes in the environment and is therefore identical to the post-reform simulated moments. As with the comparison of the reform only with the reform plus wage parameters, introducing the wage parameter changes along with endogenous social

[35] Note that the change in wage parameters also affect childcare costs as these are expressed as a percentage of non-university women's mean wage which increased over this time period.

[36] The wage penalty for taking 2 months was already zero in the pre-period for university men.

norms works to decrease non-university men's parental leave (relative to the prior column) and increase that of university men. Social norms, of course, further change endogenously, reinforcing the decrease for non-university men and the increase for university men. For women, including wage changes in addition to social norms further decreases parental leave for all but those in nn households. This is the result of higher wage penalties in the post-reform period for university women taking between 14-16 months of leave and the fact that men taking on average more leave implies that more of the women's months are unpaid, creating further incentives to decrease their parental leave. For non-university women, on the other hand, wage penalties disappeared, increasing their incentive to take longer leaves and resulting in nn women taking more leave (relative to only social norms changing) whereas un women took less.

Overall, both the reform by itself, which changed the household's economic incentives for men to take more leave, and changes in social norms, which affected (in opposite directions) men's and women's preferences regarding leave, played a quantitatively important role in changing behavior between these two time periods. Changes in wage parameters governing the distribution of wages, childcare costs, and wage penalties played a relatively minor role.

Table 8: From Pre to Post Reform

Moments	Pre-Reform Simulated Moments	Reform Only	Wages	Social Norms	Post-Reform Simulated Moments
			nn		
Mean months of men	1.76	2.07	2.02	2.70	2.53
SD months of men	1.73	1.74	1.70	1.90	1.83
Mean months of women	12.47	12.53	12.57	12.01	12.18
SD months of women	2.84	2.58	2.54	2.74	2.68
% Men Taking 0 month	25.84	25.84	25.66	14.90	16.28
Mean share taken by men	12.73	14.30	13.98	18.66	17.47
			nu		
Mean months of men	2.33	2.59	2.57	3.22	3.20
SD months of men	2.08	2.07	2.03	2.20	2.15
Mean months of women	12.24	12.32	12.18	11.78	11.62
SD months of women	3.07	2.84	2.77	2.98	2.89
% Men Taking 0 month	20.62	20.64	20.58	12.14	12.16
Mean share taken by men	16.44	17.58	17.60	21.88	21.90
			un		
Mean months of men	2.08	2.28	2.31	2.69	2.90
SD months of men	1.89	1.86	1.92	1.98	2.08
Mean months of women	13.35	13.33	13.31	12.94	12.74
SD months of women	2.72	2.51	2.54	2.61	2.67
% Men Taking 0 month	24.56	24.56	24.54	18.20	16.28
Mean share taken by men	13.64	14.67	14.85	17.37	18.65
			uu		
Mean months of men	2.97	3.15	3.24	3.52	4.18
SD months of men	2.34	2.31	2.36	2.38	2.55
Mean months of women	12.06	12.14	11.97	11.82	11.06
SD months of women	3.01	2.81	2.82	2.88	2.99
% Men Taking 0 month	16.80	16.88	16.92	12.90	9.06
Mean share taken by men	19.94	20.66	21.33	23.09	27.56

Note: Column 2 introduces the reform but no other changes. Column 3 allows, in addition to the reform, the wage and penalty changes in the post period as given in Tables 3 and A2. Social norms (the $\mu_\gamma^{g,ij}$) are kept constant at the pre-reform values Column 4 returns to the wages and wage penalties of the pre-reform period but now allows the values of the $\mu_\gamma^{g,ij}$ to evolve endogenously. Column 5 allows all changes. Household types are denoted by the education level of the man first and the woman second, where n represents non-university and u represents university education.

8 Increasing Gender Equality: Some Alternative Policies

Achieving greater gender equality by having men "assume an equal share of caring responsibilities" is an explicit objective of the paternity and parental leave directives issued by the European Union.[37] Following the example of Sweden in earmarking parental leave months for each parent, the directive instructs its members to endow each worker with the right to four months of paid parental leave, of which 2 months are not transferable across parents.[38] In Sweden, during the period we study, this reform increased men's share of leave, but still left it below 30% and, for some household types, below 20%. In this section we make use of one of the main virtues of an estimated model by employing it to study how alternative policies could affect gender equality.

We start by considering a policy that, keeping the two daddy months policy in place, lowers the cost of childcare during a child's first year. It offers childcare before age one at the same price as public childcare after the age of one – a tenfold decrease. Next we consider an "endowment policy", which gives each parent 6 months of non-transferable paid leave, with an additional 1 month that can be taken by either parent. Both Iceland and Finland have parental leave systems similar to this policy.[39] In Iceland, for children born as of 2021, each parent is endowed with 6 months of parental leave benefits of which 6 weeks can be transferred to the other parent. In Finland, for children born as of September 4, 2022, each parent is endowed with 160 working days of parental leave benefits of which 63 days can be transferred. Lastly, we examine a stricter "equal sharing" policy under which a parent can take up to six months of paid leave but the months in excess of those taken by their partner are forfeited. There is one paid month, however, that can be taken by either partner independently of whether it is matched.[40]

We evaluate these policies assuming that the economic parameters remain the same as those under the two daddy months policy, i.e., with the same wage distribution parameters

[37] The quote is from the EU directive. See the summary of this directive (EU Directive 2019/1158 on "Work-life balance for parents and carers"): https://eur-lex.europa.eu/legal-content/EN/LSU/?uri=CELEX:32019L1158.

[38] The directive does not limit the generosity of the leave system, permitting countries to provide greater lengths of paid leave.

[39] See norden.org/en/info-norden/parental-benefits-iceland and norden.org/en/info-norden/parental-benefits-finland.

[40] The extra month in both this policy and the endowment policy keeps the maximum number of paid months at the same level as in the second daddy month policy.

including future wage penalties, and that preferences regarding parental leave are *initially* given by the post-reform estimates of $\mu_\gamma^{g,ij}$.[41] That is, the economy is in its steady state under the two daddy months policy. The consequences of these counterfactual policies are reported in Table 9. For ease of comparison, the first column reproduces the moments of the 2-daddy months simulation, i.e., the post-reform simulated moments. The second, fourth, and sixth columns report the moments that result from these policies assuming that social norms do not react, (i.e., assuming that the $\mu_\gamma^{g,ij}$ stay constant at the 2-daddy-months reform levels of column 1), whereas columns 3, 5, and 7 report the new steady states resulting from allowing social norms to endogenously change. Panel A reports the simulated moments by household type and panel B reports the $\mu_\gamma^{g,ij}$s.

As can be seen in column 2, providing inexpensive childcare during the child's first year has an insignificant effect on men's mean months of parental leave. Women's mean months only very slightly decrease and the percentage of men taking zero leave slightly increases now that it is less expensive for a couple to take less than a year of leave in total. Given the lack of behavioral responses to this policy, preferences remain basically unchanged (see panel B) and therefore the moments in column 3 are very similar to those in the preceding two columns. Thus, according to our model, the significantly higher cost of childcare in the child's first year is not responsible for the gender asymmetry in parental leave and changing its price would not result in greater sharing of care responsibilities.

Columns 4 and 6 report the moments resulting from the endowment and equal-sharing policies, respectively, assuming that cultural preferences are unchanged. Even with no change in preferences, these policies increase men's average parental leave substantially. Under the endowment policy, men's mean parental leave increases from 1.28 months for uu men to 2.03 months for nn men. Women's parental leave decreases by similar magnitudes. These changes both work in the same direction to increase men's share of parental leave which increases substantially under both policies but by more under equal sharing. Underlying this is a larger increase in men's average parental leave, which increases from around half a month to 4/5ths of a month more under the equal sharing policy. Similarly, women's

[41] As we do not have a model of wage determination or signalling nor one of sorting in the "marriage market," the quantitative exercise implicitly assumes that these do not respond to changes in parental leave behavior. Given the results of the previous section, we think that small changes in these variables would not make a significant difference to the results that follow.

parental leave decreases by an extra 0.4 to 0.8 months under the equal sharing policy.

It is easy to understand why the equal sharing policy produces greater changes in men's and women's parental leaves than the endowment policy. When a father with, say, 3 months of parental leave increases it by one month under the endowment policy, this does not have any repercussions for the mother, except via the adjustment of household income.[42] When a similar father increases his parental leave by one month under the equal sharing policy, it not only has the same repercussions for household income as with the endowment policy, but in addition allows the mother to take an additional month of paid leave. If her parental leave had been more than a month longer than the father's leave, this would increase household income by an additional $.85w_f$ as now this month is compensated. Consequently, men have an additional incentive to take parental leave under the equal sharing policy that is absent under the endowment policy.[43] A similar logic explains why women decrease their parental leave more under the equal sharing versus the endowment policy. Taking more than an extra month of parental leave than the father is more expensive under the equal sharing policy as those months are not compensated whereas under the endowment policy they are (if she was taking no more than 7 months). Thus, ceteris paribus, there is a greater incentive for women to reduce their months of parental leave under the equal sharing policy. The difference in incentives created by these two policies is most clearly seen in the share of men who take zero months of parental leave. This share barely changes with the endowment policy, but decreases by 2.3 to 5 percentage points under the equal share policy as, by not taking any leave, these men are allowing their partners to take only one month of paid leave.

Lastly, we compare the steady-state implications of these two policies allowing preferences to change endogenously, generating the moments in columns 5 and 7. The final results are markedly different then those obtained with fixed preferences. The average months of men's parental leave increase significantly under both policies, but now reach very similar magnitudes. On average, under both policies non-university men end up taking around 6.5 months of parental leave whereas university men take around 7.4 months independently of household type or policy. The percentage of men who take zero months of leave is under

[42] Household income decreases by $0.15w_m$ as only 85% of his wage is paid during leave, but it also increases by the extra month of childcare expenditures saved by the couple.

[43] If both parents were taking more than 6 months of parental leave, the two policies would have identical incentives as there are no additional months of paid leave available.

0.7 percent for all but men in uu households where it is 1.02% with the endowment policy. Under both policies, women take around 8.7 months of parental leave with university women in uu households taking the least (8.4 months). Thus, although incentives with constant social preferences gave rise to some significant differences in behavior between the two policies, evolving social preferences imply that the final results are very similar. Finally, while neither policy obtains a 50-50 split of parental leave, they come very close with a share ranging from around 43% for non-university men to 46-47% for university men.

Panel B of Table 9 shows the mean values of the $\mu_\gamma^{g,ij}$ under the four policies: the post-period (i.e., 2 daddy months policy, which is the same in columns 2, 4, and 6), and those in the steady-states of the different policies (columns 3, 5, and 7). Given the preceding discussion, it is not surprising that the steady state values of $\mu_\gamma^{g,ij}$ are almost unchanged in column 3 from those in the original steady state. The steady state values under the endowment and equal share policies, on the other hand, are markedly different from those of the 2-daddy-months steady state, especially for men. It is interesting to note that not only are men's and women's $\mu_\gamma^{g,ij}$ very similar under these two policies whereas initially they were very different, but that men's $\mu_\gamma^{g,ij}$s are now higher than women's, with the exception of men in nn households. This does not imply, however, that men prefer to spend more time with children than women. The curvature of the utility function over time with one's child also plays an important role. As can be seen in table 5, men have a substantially higher value of ζ than women, independently of education, implying that their marginal utility of spending time with children is lower.

Table 9: Alternative Policies

Panel A: Simulated Moments

Moments	Post-Reform (2 Daddy Months) Steady State	Reduction in Childcare Unchanged $\mu_\gamma^{g,ij}$	Reduction in Childcare Steady State	Endowment Unchanged $\mu_\gamma^{g,ij}$	Endowment Steady State	Equal Sharing Unchanged $\mu_\gamma^{g,ij}$	Equal Sharing Steady State
				nn			
Mean months of men	2.53	2.53	2.54	4.56	6.40	5.34	6.42
SD months of men	1.83	1.82	1.84	2.29	1.10	1.92	0.93
Mean months of women	12.18	12.11	12.07	10.65	8.77	10.02	8.79
SD months of women	2.68	2.72	2.73	2.61	2.24	2.07	2.04
% Men Taking 0 month	16.28	16.36	16.22	16.00	0.40	11.30	0.24
Mean share taken by men	17.47	17.48	17.62	29.82	42.93	34.49	42.83
				nu			
Mean months of men	3.20	3.19	3.20	4.96	6.64	5.56	6.67
SD months of men	2.15	2.14	2.15	2.12	1.43	1.72	1.25
Mean months of women	11.62	11.56	11.53	10.25	8.69	9.77	8.71
SD months of women	2.89	2.91	2.92	2.50	2.25	2.00	1.99
% Men Taking 0 month	12.16	12.22	12.22	11.98	0.70	8.44	0.40
Mean share taken by men	21.90	21.90	22.00	32.61	43.93	36.11	43.85
				un			
Mean months of men	2.90	2.90	2.91	4.43	7.28	5.30	7.38
SD months of men	2.08	2.08	2.09	2.31	1.79	2.08	1.65
Mean months of women	12.74	12.69	12.65	11.44	8.67	10.66	8.64
SD months of women	2.67	2.71	2.72	2.56	2.28	2.06	2.04
% Men Taking 0 month	16.28	16.34	16.20	16.26	0.60	12.78	0.36
Mean share taken by men	18.65	18.66	18.79	27.76	46.06	32.86	46.35
				uu			
Mean months of men	4.18	4.18	4.22	5.46	7.26	5.94	7.38
SD months of men	2.55	2.55	2.56	2.13	1.83	1.80	1.67
Mean months of women	11.06	11.02	10.96	10.05	8.45	9.68	8.41
SD months of women	2.99	2.99	3.01	2.42	2.20	2.02	1.95
% Men Taking 0 month	9.06	9.08	8.96	8.84	1.02	6.72	0.70
Mean share taken by men	27.56	27.59	27.91	35.21	46.53	37.97	46.93

Panel B: Mean values of $\mu_\gamma^{g,ij}$

Moments	Post-Reform (2 Daddy Months) Steady State	Reduction in Childcare Unchanged $\mu_\gamma^{g,ij}$	Reduction in Childcare Steady State	Endowment Unchanged $\mu_\gamma^{g,ij}$	Endowment Steady State	Equal Sharing Unchanged $\mu_\gamma^{g,ij}$	Equal Sharing Steady State
Men							
nn	5.28	5.28	5.31	5.28	14.47	5.28	14.52
nu	7.63	7.63	7.64	7.63	16.27	7.63	16.37
un	7.49	7.49	7.54	7.49	19.92	7.49	20.21
uu	11.11	11.11	11.21	11.11	19.02	11.11	19.32
Women							
nn	16.87	16.87	16.76	16.87	14.04	16.87	14.05
nu	17.01	17.01	16.93	17.01	14.51	17.01	14.53
un	20.32	20.32	20.21	20.32	15.57	20.32	15.54
uu	17.43	17.43	17.32	17.43	14.70	17.43	14.66

Columns 2 and 3 report the moments from a policy that reduces monthly childcare in the first 12 months from $0.6w_n$ to $0.06w_n$. Columns 4 and 5 study an equal endowment policy of 6 months for each parent (with an additional month allocated freely) whereas columns 6 and 7 study an equal share policy that only pays parental leave for the minimum months taken by a parent, with one month not subject to that rule. The first column for each policy keeps the $\mu_\gamma^{g,ij}$ at the steady-state values of the 2-daddy months policies. The second column for each policy allows preferences to adjust endogenously. Household types are denoted by the education level of the man first and the woman second, where n represents non-university and u represents university education.

9 Conclusion

Even in countries in which gender equality is more advanced, care responsibilities continue to follow traditional gender roles. This paper studies the 2002 parental leave reform in Sweden that introduced a second reserved month for each parent (2 daddy months). This reform increased the share of parental leave months taken by men, but the division remained far from equal and, even today, men's share does not exceed 30%. What reforms might work to change this? To answer this question, we develop a unitary household model in which individuals care about consumption (both during the parental leave period and in the future) and also derive utility from spending parental leave time with their child. The latter is not a primitive, however, as it is influenced by the behavior of one's peers, making it an equilibrium object.

We distinguish individuals by their education (university and non-university), implying four types of households. Taking wage parameters including estimated wage penalties associated with different lengths of parental leave as given, we estimate the model to match key parental leave moments both pre- and post-reform for each household type. We then study the quantitative importance to post-reform outcomes of the incentives introduced by the reform itself keeping all else constant, by the changed wage parameters along with the reform (keeping social norms constant), and by the reform along with endogenously changing culture. We find that the reform alone played a quantitatively significant role but that changed norms played an even larger one, with the importance of changed wage parameters being relatively minor.

Lastly, we use the estimated model to evaluate three alternative reforms: providing low-cost childcare before the age of one, giving each parent a non-transferable endowment of parental leave (the "endowment" policy), and only paying for the months of parental leave that do not exceed those taken by one's partner (the "equal share" policy). We find that decreasing the cost of childcare has almost no effect on men's share of parental leave whereas both the endowment and the equal share policies have similar steady-state consequences, increasing men's share significantly. Although it is possible to argue that how partners share parental leave time is of second-order concern, greater sharing of parental leave responsibility is likely to have significant spillover effects. As fathers take more time

caring for children over the life-cycle, their demand for more flexible jobs should increase. This in turn could decrease the "motherhood penalty" in earnings that is found virtually everywhere. Furthermore, as shown by Kotsadam and Finseraas (2013) and Farré et al. (2023), it may have important intergenerational consequences that further change attitudes and economic outcomes.

Appendix

Summary Statistics

Table A1: Summary Statistics

	Base Sample		Wage Sample		Couples Sample	
	Pre-Period	Post-Period	Pre-Period	Post-Period	Pre-Period	Post-Period
			Men - Non-University			
Monthly Wage $(t+3)$			24704	31361	24568	31212
Monthly Wage $(t-1)$			19758	26801	19644	26663
Annual Earnings $(t+3)$	279747	313569	336506	367649	334092	363138
Annual Earnings $(t-1)$	239911	285877	305836	357262	299384	351648
PL (months)	1.80	2.82	2.15	3.26	2.15	3.35
Age	30.1	30.6	31.2	31.7	31.4	32.1
Obs	85128	87121	16511	17450	7023	7526
			Men - University			
Monthly Wage $(t+3)$			33404	40502	32721	39966
Monthly Wage $(t-1)$			24121	32544	23892	32322
Annual Earnings $(t+3)$	451517	443157	445911	461048	429377	445431
Annual Earnings $(t-1)$	358084	396308	371321	426953	357245	416799
PL (months)	2.49	4.00	2.84	4.27	2.96	4.37
Age	32.7	32.8	33.3	33.3	33.2	33.4
Obs	17419	36701	6069	12961	2903	6270
			Women - Non-University			
Monthly Wage $(t+3)$			19830	25734	20058	26279
Monthly Wage $(t-1)$			16606	22622	16808	22987
Annual Earnings $(t+3)$	114341	140652	174228	209900	179303	220099
Annual Earnings $(t-1)$	175277	201381	227821	263031	227172	266240
PL (months)	13.7	12.9	13.9	13.1	13.6	12.8
Age	28.0	27.7	29.2	29.0	29.4	29.3
Obs	78107	68998	15515	13491	6146	5175
			Women - University			
Monthly Wage $(t+3)$			24933	32054	25039	32258
Monthly Wage $(t-1)$			19612	27096	19712	27132
Annual Earnings $(t+3)$	171934	217577	223570	271368	227366	282537
Annual Earnings $(t-1)$	255341	306341	283550	336115	277883	331620
PL (months)	12.8	11.9	12.7	12.0	12.4	11.6
Age	30.2	30.9	30.7	31.4	30.7	31.5
Obs	24440	54824	7902	19212	3780	8621

Note: Authors' calculations. Monthly wages and annual earnings are expressed in 2014 SEK. See the text for how months of parental leave (PL) are defined

Table A1 presents summary statistics for the three data sets discussed in Section 3 above. Note that there are no monthly wages for the basic sample, although it does contain annual earnings. Also note that for mothers, both non-university and university, average annual earnings in year t+3 are lower than in year t-1. This reflects the child penalty that reflects reduced annual hours since the monthly wage increases.

Wages

The parameters for the log normal distribution of wages are taken directly from the data. The table below reports the means, variances, and correlation of log wages, expressed in 2014 SEK, from the year prior to the first birth as well as their normalized counterparts for the individuals in the couples sample. We normalize wages using the mean of the log wages for women in nn households in the pre-period.

Table A2: Log Wage Parameters

	Pre-Reform							
	Men				Women			
	nn	nu	un	uu	nn	nu	un	uu
Log wages								
$\mu_w^{g,ij}$	9.840	9.901	10.006	10.038	9.697	9.798	9.770	9.910
$(\sigma_w^{g,ij})^2$	0.513	0.624	0.975	0.933	0.377	0.431	0.470	0.625
Normalized log wages								
$\mu_w^{g,ij}$	1.015	1.021	1.032	1.035	1.000	1.010	1.007	1.022
$(\sigma_w^{g,ij})^2$	0.0055	0.0066	0.0104	0.0099	0.0040	0.0046	0.0050	0.0066
	Post-Reform							
	Men				Women			
	nn	nu	un	uu	nn	nu	un	uu
Log wages								
$\mu_w^{g,ij}$	10.132	10.195	10.298	10.336	10.005	10.128	10.092	10.212
$(\sigma_w^{g,ij})^2$	0.510	0.600	1.010	0.897	0.361	0.426	0.515	0.553
Normalized log wages								
$\mu_w^{g,ij}$	1.045	1.051	1.062	1.066	1.032	1.044	1.041	1.053
$(\sigma_w^{g,ij})^2$	0.0054	0.0064	0.0107	0.0095	0.0038	0.0045	0.0055	0.0059
	Pre-Reform				Post-Reform			
	nn	nu	un	uu	nn	nu	un	uu
ρ^{ij}	0.398	0.383	0.388	0.491	0.374	0.384	0.373	0.469

Note: These are the means and variances of real (2014 SEK) log wages for each gender-household type along with the correlation of partners' log wages. All variances on this table are multiplied by 10. We used real log wages from the year prior to the first birth for both the pre-reform period and the post-reform period. We also report the normalized log wage parameters using the mean of log wages for women in nn households during the pre-reform period. Household types are denoted by the education level of the man first and the woman second, where n represents non-university and u represents university education.

Wage Growth Parameters

This table shows the estimates of $\alpha_0^{g,e}$ and the expected value of $\Delta_0 \log(w_i^{g,e})$ by gender and education.

Table A3: Wage Growth Parameters

	Men				Women			
	Non-Univ		Univ		Non-Univ		Univ	
Period	$\alpha_0^{g,e}$	$\mathbb{E}[\Delta_0 \log(w_i^{g,e})]$	$\alpha_0^{g,e}$	$\mathbb{E}[\Delta_0 \log(w_i^{g,e})]$	$\alpha_0^{g,e}$	$\mathbb{E}[\Delta_0 \log(w_i^{g,e})]$	$\alpha_0^{g,e}$	$\mathbb{E}[\Delta_0 \log(w_i^{g,e})]$
Pre	0.157	0.065	0.225	0.100	0.132	0.054	0.172	0.078
Post	0.108	0.053	0.152	0.069	0.080	0.049	0.115	0.060

Note: $\alpha_0^{g,e}$ is the constant term in the wage penalty regression, as shown in equation 1. $\mathbb{E}[\Delta_0 \log(w_i^{g,e})]$ is the expected growth in log wages between period $t-2$ and $t-1$ (i.e., between two years and one year before the birth of the child) for individuals of gender g and education e. All are estimated using the wage sample.

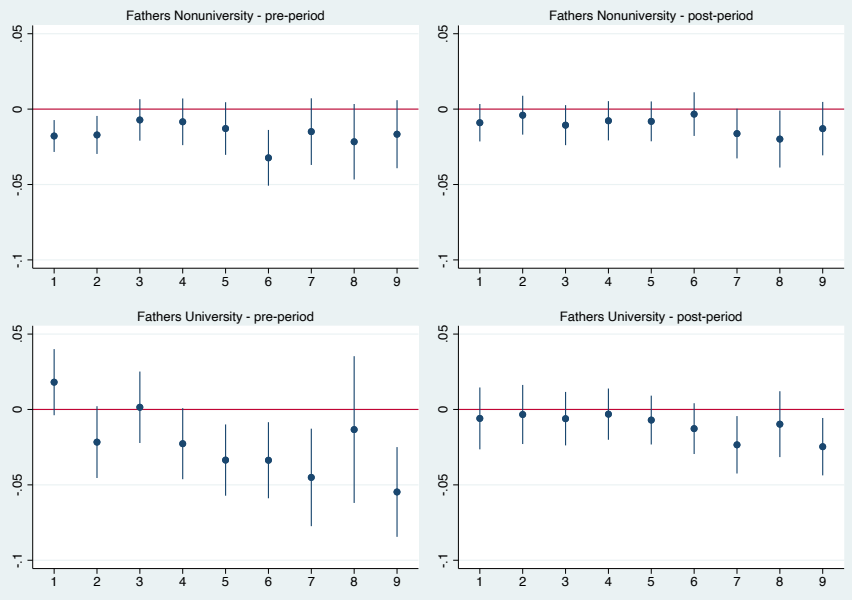
Wage Penalties

In the text, we presented the wage penalties in Table 3. In constructing that table, we chose intervals in which the point estimates of wage penalties are similar and averaged those estimates as described in the text. Here, we present graphically the estimated coefficients from the wage penalty regressions that lie behind Table 3. The figures show point estimates and 95% confidence intervals.

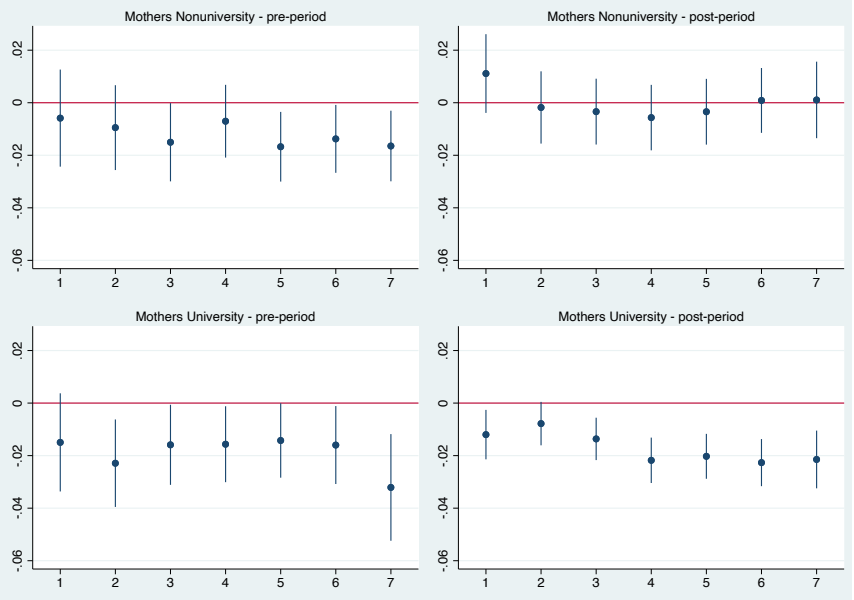
Figure 6 shows the wage penalty estimates for fathers in (a) and mothers in (b). Recall that we assign parental months t to those taking more than t-1 and less than or equal to t months. The parental leave categories in the figure are defined as follows. For men, the omitted category is 0 months of leave whereas 1-8 refer to those months of parental leave and category 9 is 9 months or more. For women, the omitted category is 10 months or less. Categories 1-7 correspond to 11 months through 17 months of parental leave, respectively. The top graphs are for the non-university men and women (pre-reform followed by the post-reform period) and the bottom graphs are for university men and women (pre-reform followed by the post-reform period).

Figure 6: Wage Penalty Estimates

(a) Men



(b) Women



Note: Coefficients from estimation of equation 1. For men, parental leave categories from 1 to 8 represent the number of months taken, and category 9 is for 9 months or more. The omitted category is 0 months. For women, the omitted category is 10 months or less, category 1 is for 11 months, 2 is for 12 months, and so on. For both men and women, the top graphs are for non-university in the pre-period followed by the post period; the bottom graphs are for university in the pre-period followed by post period.

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