DOES BIRTH-RELATED LEAVE MAKE GERMAN MOTHERS MORE SATISFIED?

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ABSTRACT

We examine the influence of being on birth-related leave (maternity and parental leave) on the life satisfaction of German mothers. We use measures of life satisfaction and leave status taken from the *German Socio-Economic Panel* (GSOEP). The effects of birth-related leave are identified using a variety of methods, including ordinary least-squares regressions with individual fixed effects, instrumental variables (IV), propensity matching and difference-in-differences approaches. An important part of the study is using temporal variation in birth-related leave policies, of which there have been many in Germany over the period from 1984-2008, to identify the effects of birth-related leave. Overall, the results from the various methods suggest that being on birth-related leave enhances life satisfaction.

JEL classifications: I30, I31, I38

1. Introduction

Birth is a major life event with both social and economic implications for families. An important development in social policy making in many OECD countries, especially since the 1970s, has been the introduction and expansion of paid maternity and parental leave schemes. These schemes have had a number of aims, including improving well-being on infants and supporting child development, enhancing well-being of caregivers, keeping parents (especially women) connected to the world of paid work, and helping families with issues of work-life balance. Such schemes account for a significant proportion of family spending by governments in many OECD countries today. The rising importance of social spending on birth-related leave over this time period for Germany is revealed by the OECD's Social Expenditure database. In 2007, the database indicated that Germany spent 5,300 million Euros on birth-related leave benefits, or 11.8% of total social welfare spending on families. This amount was up considerably from 4.7% of total social welfare spending on families in 1984.

At the same time, economists and other social scientists have begun exploring the determinants of self-assessed well-being, measured subjectively, especially in terms of measures of happiness and life satisfaction. Despite the burgeoning of research into subjective well-being since the mid-1990s, there has been very little research which has explicitly addressed the question of whether policy, especially social policies, can directly influence such outcomes.

This study moves into this sparsely populated territory. It addresses the question of whether the policy of birth-related leave increases life satisfaction of women who take such leave. There is very limited existing research on the effects of birth-related leave on life satisfaction, and even on closely-related mental health and self-reported health outcomes. What evidence there was available comes to mixed conclusions regarding the effect of leave on psychological states.

Small non-representative sample United States studies suggest that employed women have worse mental health following giving birth, though the evidence was mixed (Hyde *et al*. 1995; Gjerdingen *et al*. 1994; McGovern *et al*. 1997). These research designs were not sufficiently sophisticated to make it clear whether the observed associations were causal. However, other studies have used more sophisticated methodologies and larger samples to overcome these problems.

Chatterji and Markowitz (2004) investigate the impact of the length of maternity leave on maternal health using two measures of depression and a measure of overall health in a sample of working mothers in the United States. They use instrumental variables models to account for the possible endogeneity of the return-to-work decision. The findings suggest that returning to work later reduces depressive symptoms, but not the probability of clinical depression or hospital outpatient visits after childbirth. In a later paper, Chatterji and Markowitz (2008) consider the impact of leave on maternal depression, overall health status, and substance use. They again employ an instrumental variables approach with county-level employment conditions and state-level maternity leave policies as instruments to address reverse causality issues. Their results suggest that longer maternity leave was associated with declines in depression and improvements in overall health. Additionally, if men take paternal leave there was less maternal depression. The effects were however small. Their findings suggest that doubling total maternal leave length from 9 to 18 weeks reduces maternal depressive symptoms by about five percent, the likelihood of mothers' experiencing severe depression by one percent, and the likelihood of mothers' reporting overall poor/fair health status by one percent.

Other research uses quasi-experimental methods. Baker and Milligan (2007) find that the doubling in Canadian birth-related leave to one year resulted in a large increase in the time women take off work of 2.3 months and also in breastfeeding rates. However, when it comes to maternal health, measured alternatively

by an indicator of mothers' self-reported health, an index of depression, a binary indicator of no post-partum depression, and a count of post-partum problems, there was no impact found of the large extension of birth-related leave. A similar absence of an effect was found for the Swedish leave expansion in 1988 from 12 to 15 months by Liu and Skans (2009). They consider the effect on parental well-being – measured by divorce and mothers' mental health. The measure of mental health was hospital admissions for mental health reasons. They find no effect of the policy change on these measures of maternal well-being. In a regression using two waves of the *German Socio-Economic Panel* (1992 and 1997), Frey and Stutzer (2003) include a variable for maternity leave and find a positive but statistically insignificant effect on life satisfaction.

Rather than looking at the effect of parental leave on the treated, Pezzini (2004, 2005) exploits variation in parental leave durations across countries and time to examine if there is an intention-to-treat effect of leave on life satisfaction of women during the fertile years. Using *Eurobarometer* data staring in the early 1970s, and a variety of control groups (men, post-menopausal women) she finds no effect of significant leave expansions on life satisfaction of women during their fertile years.

The study uses OLS fixed effects regression, instrumental variables, propensity matching and a regression based difference-in-differences approaches using significant German birth-related leave policy changes over the 1984-2008 period to identify causal effects of being on birth-related leave on life satisfaction.

2. Data and dependent and main independent variables

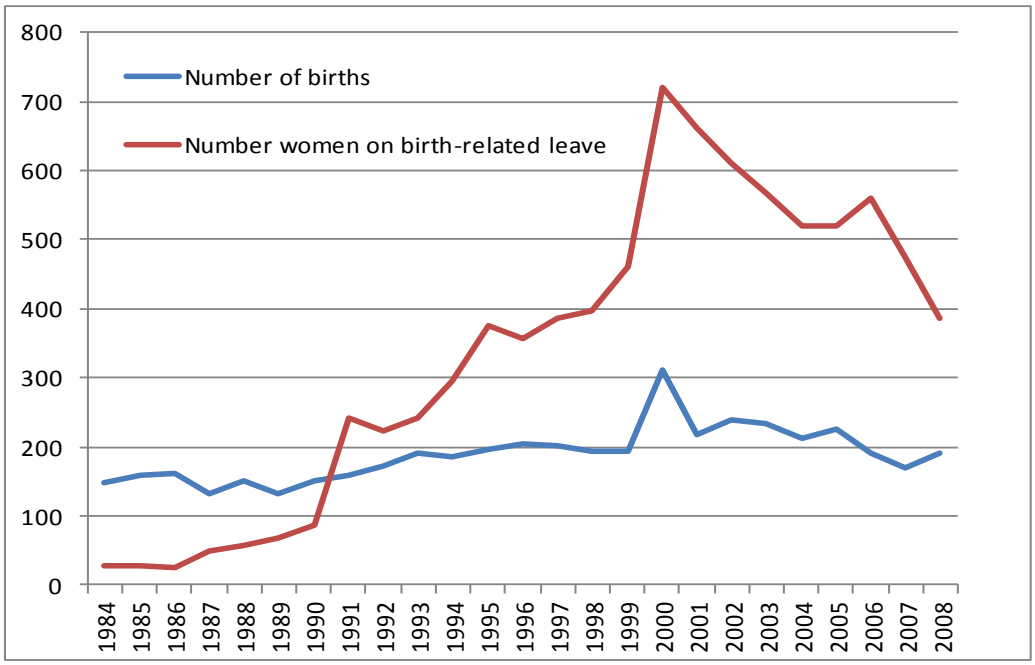
The empirical analysis uses data from the *German Socio-Economic Panel* (GSOEP) 2009 release (1984-2008). The GSOEP is a representative, longitudinal survey of more than 20,000 persons in about 12,000 private households in Germany. It has been carried out every year in the Federal Republic of Germany since 1984 with the same persons and families. The sample has been amended several times. As the only long-term, longitudinal representative set of individual and household data in Germany, the GSOEP provides a platform for examining socio-demographic and economic outcomes.

Our sample is restricted to women. Women only are considered as the number of men ever on parental leave in the *Socio-economic Panel* is extremely low, in the dozens. Low male representation in part reflects a general OECD trend. It may also additionally reflect the fact that gender attitudes in Germany are fairly conservative compared to some other OECD countries.

In terms of the variable our study is seeking to explain, in each interviewing year of the GSOEP all adult household members are asked to rank their overall life satisfaction, using an 11-point scale. The level of life satisfaction is based on responses to the question: "Finally, we would like to ask about your overall level of life satisfaction. Please answer again according to the following scale, "0"means completely and totally dissatisfied, "10" means completely and totally satisfied. How satisfied are you at the present time, all things considered, with your life?" We used this measure for subjective well-being for each respondent for every year from 1984-2008.

As no single unique question for maternity leave is included over the entire GSOEP 1984-2008 sample period, we used a combination of questions about the particular months of the previous year in which the respondents received maternity pay (1984-1990) and the particular months of the previous year in which the respondents have been on parental or maternity leave (1991-2008). The question, in both instances, relates to the January-December calendar year prior to the year the subject was interviewed, regardless of the interview month.

Chart 1: Numbers of births of women in the GSOEP and numbers of women on birth-related leave by year



3. Federal birth-related leave policy in Germany

German maternal and parental leave policy has a long history, dating to the 1870s. In 1878 a code was introduced to forbid pregnant women working for three weeks before birth (Wikander *et al*. 1995). There were further amendments to the code in 1903 and 1911 which increased the leave period to six weeks and supplied women with paid time off work for two weeks before delivery (Merz 2004). In 1924 job-protection was introduced for women taking maternity leave (Jordan 1999).

The modern expansion of birth-related leave in Germany dates to the late 1960s. From 1 January 1968, employed women expecting a child were granted fourteen weeks of mandatory maternity leave (*Mutterschutzgesetz*). Six weeks had to be taken before and eight weeks after birth. During those fourteen weeks, a sickness insurance benefit was paid by the social security system at a flat rate equal to about the average salary for women workers. Employers were required to supplement this benefit to cover the woman's full salary (Merz 2004).

From 1 January 1979 (Merz 2004) or 1 May (Dustman and Schoenberg 2008) employed women on maternity leave could opt to take an additional four months of leave immediately following maternity leave. From six weeks before to eight weeks after childbirth, mothers were paid their average income, estimated over the three months before giving birth. For the additional four months, payment was a flat rate of roughly one third of average pre-birth earnings (Dustman and Schoenberg 2008). Women could not be dismissed and had the right to return to their employer, albeit not necessarily to their previous job (Merz 2004). The prime motivation of the 1979 reform was maternal health. The later reforms would be more focused on enhancing child development (Dustman and Schonberg 2008).

From 1 January 1986 a new parental leave scheme was introduced. Following the 14-week maternity leave, parents were entitled to a further eight months of job protected parental leave as a shared right, with a total of post-birth job-protected leave of 10 months. The benefit paid became disconnected from an employment condition. Any new parent working less than a maximum of fifteen hours per week was

entitled to receive a benefit from the federal government, regardless of his or her previous labor market status. The parental benefit equaled 600 DM for the first six months of the additional eight months (about 20% of average pre-birth wages). The benefit during the seventh and eighth months was means-tested, based on family income before child-birth. A married couple received the benefit as long as annual net family income was less than 29,400 DM**.** For a single parent, this income limit was 23,700 DM per year. Each additional child increased the upper limit by 4,200 DM (Dustman and Schonberg 2008; Merz 2004; Kamerman and Kahn 1991).

There was an increase from eight months to ten months job-protected parental leave from 1 January 1988, a further rise to 13 months from 1 July 1989, and a final rise to 16 months from 1 July 1990 (Dustman and Schonberg 2008; Merz 2004). Payment was extended at the same time.

The next reform was introduced from 1 January 1992. Eligible parents were entitled to take job-protected leave up to three years after the birth of their child. Payments still lasted in total for 18 months following birth, with eight weeks maternal leave and 16 months parental leave (Merz 2004; Gauthier and Bortnick 2001). Thereafter parents could use unpaid but job-protected parental leave up to the child's third birthday.

The 1992 reform was further extended from 1 January 1993, with the payment period for parental leave rising from 16 to 22 months, making a total of two year paid maternal and parental leave (Dustman and Schonberg 2008; Merz 2004). As Dustman and Schonberg (2008) point out**,** the federal government had committed to providing subsidized child care for every child over age three from 1996. The intent was to encourage mothers to stay home until the child was age three, and then aiding a return to work via subsidized child care thereafter.

Reforms from 1 January 2001 introduced flexibility in the parental leave system. Parents became able to choose a shorter and better paid leave (DM900 per month for 10 months) or a longer but less well paid leave (DM600 per month for 22 months). Benefits remained income-tested. Paid leave could be used until child's second birthday. The third year of leave could be used until child reached eight years old (Merz 2004).

On 1 January 2007 a new earnings-related parental leave benefit with floors and ceilings was introduced (*Elterngeld*, or "parental money"). It replaced the old, means tested flat rate benefit (*Erziehungsgeld*). The duration of the job-protected maternal plus parental leave remained at a maximum of three years following childbirth. The parental leave payment was 67% of parent's average earnings during the year before childbirth, with a ceiling of 1800€ per month and a floor of 300€. The new parental leave payment was for ten months, plus two extra months for the father if he used at least two months of parental leave, making 14 months of payment in total when including the eight weeks post-birth maternity leave. The maternity leave payment was included in this period, reducing the actual *Elterngeld* payment period to 12 months. It is possible to extend leave up to 24 plus four months (if each parent takes at least four months leave), with a proportionate reduction in the monthly payment rate. The actual *Elterngeld* payment period was then 28 months less the two months maternity payment, i.e. 26 months. (Moss and Korintus 2008, p. 208). The effects of the 2007 policy-change differed for rich and poor parents. Before the policy change, the poor received *Erziehungsgeld* of 7.200€ in total over 24 months. Post-reform they get 3.600€ (12 months) to 4.320€ (14 months). Pre-2007, richer parents also received 7,200€, or nothing if they were in excess of the income threshold. Post-2007 they could obtain up to 25,200€.

4. Results: OLS and IV regressions

This section documents regression results explaining life satisfaction with the aim of investigating the impact of being on birth-related leave on women. Ordinary least squares are used as an estimation method,

for reasons of simplicity and ready interpretation (Ferrer-i-Carbonell and Frijters 2004). Such an estimation approach is standard in the subjective well-being literature. An individual fixed effects regression approach is used, reflecting a belief that there are important unobserved time invariant factors which may cause an endogeneity problem between being on birth-related leave and life satisfaction. In particular, it may be that fixed personality characteristics associated with individuals may simultaneously give rise to both life satisfaction and decisions to be on birth-related leave.

The choice of most explanatory variables reflected a standard specification for life satisfaction (see Table 1). Standard controls include employment status (being on birth-related leave is not included as being employed in the *Socio-economic Panel*, unlike the conventional labour force survey approach), number of children, German nationality, years of education, age, household income, marital status and geographical location (*Länder*).

Earlier research work in both Britain and Germany had suggested some interesting dynamics around life satisfaction immediately before and immediately after the birth of a child (Clark et al. 2008). Consequently a variety of leads and lags prior to and after birth were added to capture some "anticipation" and "actuality" effects of giving birth. The choice of time periods of the leads and lags reflected in part biological factors (nine months before birth being the approximate onset of pregnancy for a normal birth) and in part also reflected periods where mothers could approximately commence and complete maternity leave. Finally choice of time period cut-points also reflected policy changes making extensions of leave. For example, being on leave for 12-15 months following birth only became an option following the July 1990 policy reform.

Considering Column 1 of Table 1, the patterns and significance of the standard covariates follow expected patterns. Employment has a positive and strongly significant impact on life satisfaction compared to non-employment, numbers of children and years of education are not important, life satisfaction diminishes to age 45+ years, and marriage is positive while marital separation and widowhood are negative and significant. The natural log of family income has a small positive effect. The *Länder* dummies indicate a significantly and respectable life satisfaction premium, compared to Nordrhein-Westfalen, for a number of *Länder*. For example, Bayern, Hamburg, and Rheinland-Pfalz/Saarland have a premium in the order of a quarter of a point on the 11 point life satisfaction ladder.

In terms of the patterns of life satisfaction and leads and lags of age of the child, the biggest positive effect of giving birth on life satisfaction comes just before and just after birth – 40% of a point on the 11 point scale, more than twice the positive effect of being employed. However, it is a very temporary effect, which swiftly disappears as the infant grows older. After two months the effect is more than halved, and by about one year of age any positive effect on life satisfaction arising from the new-born child has gone.

Now consider Column 2 of Table 1. Obviously the key explanatory variable here is the impact of being on birth related leave on life satisfaction. The highly significant coefficient is 0.171, which is virtually identical to the impact of being in paid employment on life satisfaction. Perhaps it is the job protected nature of the birth related leave which is driving the similarities between being at work and being at home but with a job guarantee. Note that because the regression controls for household income, the coefficient on birth-related leave refers to the non-monetary effects only of leave. To the extent that being on birth-related leave leads to a reduction in household income with less than full replacement of market wages, this non-monetary effect will be an over-estimate of the positive influence of leave on life satisfaction. Overall it would appear that being on birth-related leave, on average, allows a person to preserve the positive effects of being employed while they stay at home and raise their children.

Table 1: Birth-related leave and life satisfaction

Fixed effects OLS life satisfaction regressions for women (standard errors in brackets)

VARIABLES	**(1)**	**(2)**	**(3)**
Birth-related leave		0.171***	
		(0.028)	
9 to 2 months before birth	0.215***	0.207***	0.214***
	(0.033)	(0.033)	(0.033)
2 to 0 months before birth	0.411***	0.378***	0.395***
	(0.059)	(0.060)	(0.070)
… and on maternity leave			0.0582
			(0.128)
Birth and 2 months after	0.557***	0.467***	0.433***
	(0.049)	(0.052)	(0.081)
… and on maternity leave			0.197**
			(0.100)
2 to 6 months after birth	0.306***	0.234***	0.196***
	(0.045)	(0.0461)	(0.071)
... and on maternity leave			0.182**
			(0.090)
6 to 10 months after birth	0.189***	0.128***	0.185***
	(0.042)	(0.043)	(0.061)
... and on maternity leave			0.010
			(0.082)
10 to 12 months after birth	0.085	0.013	0.166*
	(0.066)	(0.067)	(0.095)
... and on maternity leave			-0.152
			(0.130)
12 to 15 months after birth	0.109*	0.054	0.090
	(0.057)	(0.058)	(0.074)
... and on maternity leave			0.050
			(0.114)
15 to 18 months after birth	0.018	-0.032	-0.053
	(0.056)	(0.057)	(0.072)
... and on maternity leave			0.188*
			(0.114)
18 to 24 months after birth	0.074	0.049	0.098
	(0.051)	(0.051)	(0.060)
... and on maternity leave			-0.148
			(0.119)
18 to 36 months after birth	-0.088***	-0.105***	-0.115***
	(0.032)	(0.033)	(0.036)
... and on maternity leave			0.160*
			(0.0827)
Employed	0.165***	0.181***	0.169***
	(0.014)	(0.014)	(0.014)
Number of children	-0.007	-0.005	-0.006
	(0.008)	(0.008)	(0.008)
German nationality	0.058	0.056	0.057

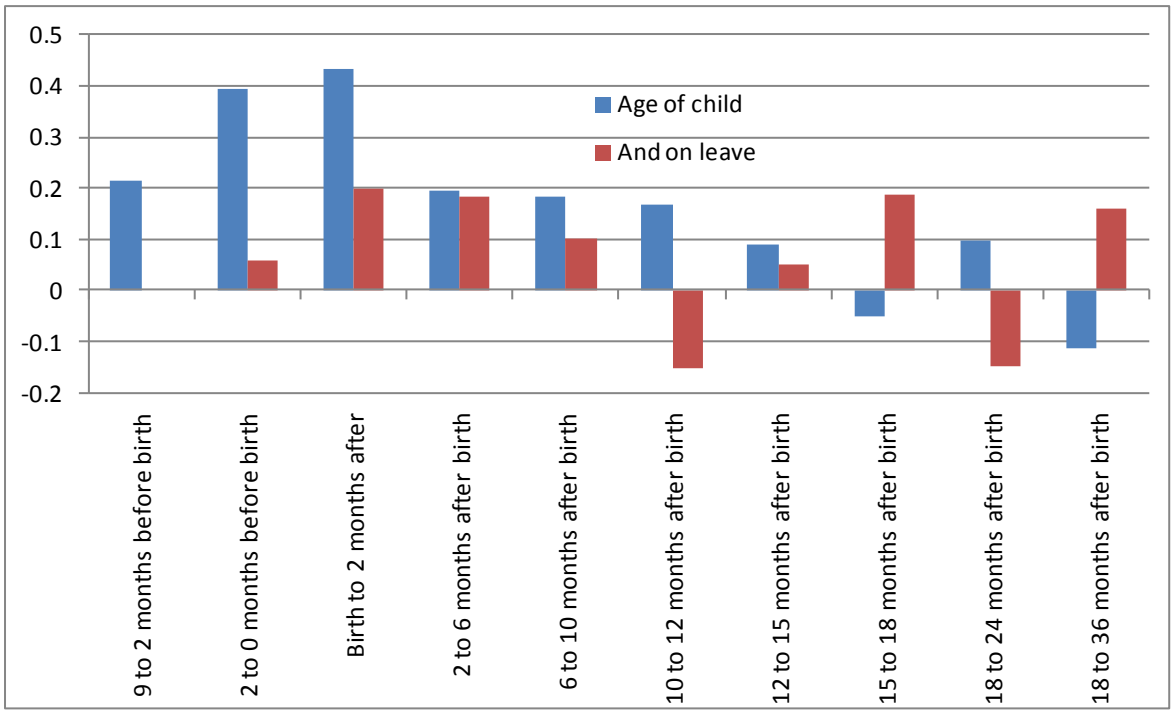
	(0.055)	(0.055)	(0.055)
Education (years)	0.006	0.005	0.006
	(0.006)	(0.006)	(0.006)
Age below 20	1.177***	1.182***	1.183***
	(0.043)	(0.043)	(0.043)
Age 20-24	0.942***	0.943***	0.946***
	(0.032)	(0.032)	(0.032)
Age 25-29	0.784***	0.781***	0.786***
	(0.027)	(0.027)	(0.027)
Age 30-34	0.618***	0.616***	0.619***
	(0.024)	(0.024)	(0.024)
Age 35-39	0.458***	0.458***	0.459***
	(0.021)	(0.021)	(0.021)
Age 40-44	0.288***	0.289***	0.288***
	(0.018)	(0.018)	(0.018)
Age 45+ (Ref.)			
Household income ln	0.212***	0.210***	0.211***
	(0.011)	(0.011)	(0.011)
Married	0.099***	0.087***	0.098***
	(0.027)	(0.027)	(0.027)
Separated	-0.253***	-0.263***	-0.254***
	(0.043)	(0.044)	(0.043)
Single (Ref.)			
Divorced	-0.020	-0.030	-0.022
	(0.040)	(0.040)	(0.040)
Widowed	-0.417***	-0.429***	-0.418***
	(0.067)	(0.067)	(0.067)
Nordrhein-Westfalen (Ref.)			
Baden-Württemberg	0.118*	0.114*	0.117*
	(0.069)	(0.069)	(0.069)
Bayern	0.257***	0.258***	0.258***
	(0.069)	(0.069)	(0.069)
Berlin	0.005	0.002	0.005
	(0.101)	(0.101)	(0.101)
Brandenburg	0.323	0.325	0.328
	(0.223)	(0.223)	(0.223)
Bremen	0.060	0.060	0.059
	(0.132)	(0.132)	(0.132)
Hamburg	0.251**	0.252**	0.253**
	(0.104)	(0.104)	(0.104)
Hessen	0.177**	0.178**	0.179**
	(0.072)	(0.072)	(0.072)
Mecklenburg-Vorpommern	0.465	0.486	0.476
	(0.301)	(0.301)	(0.301)
Niedersachsen	0.041	0.040	0.042
	(0.070)	(0.070)	(0.0702)
Rheinland-Pfalz/ Saarland	0.290***	0.289***	0.290***
	(0.074)	(0.074)	(0.074)
Sachsen	0.275	0.273	0.273

	(0.207)	(0.207)	(0.207)
Sachsen-Anhalt	-0.006	0.001	-0.005
	(0.250)	(0.250)	(0.250)
Schleswig-Holstein	0.215*	0.215*	0.211*
	(0.128)	(0.128)	(0.128)
Thüringen	-0.045	-0.052	-0.043
	(0.327)	(0.327)	(0.327)
Lander missing	0.017	0.021	0.014
	(0.187)	(0.187)	(0.187)
Constant	6.108***	6.118***	6.107***
	(0.094)	(0.094)	(0.094)
Number of observations	111237	111237	111237
Number of individuals	15092	15092	15092
Prob > F	0.000	0.000	0.000
R^2 within	0.0263	0.0267	0.0265
R^2 between	0.0159	0.0155	0.0158
R^2 overall	0.0227	0.0225	0.0227

* = 1% significance, ** = 5% significance, *** = 10% significance

Column 3 of Table 1 interacts birth-related leave status with the age of the focal birth-child. Our hope was that this might show some variation in the positive effects of being on leave, enabling an identification of the optimal duration of leave in terms on life satisfaction. These child age coefficients and coefficients interacted with being on birth-related leave are shown in Chart 1. There was no evidence that being on birth-related leave before birth contributed positively to life satisfaction. However, being on birth related leave for up to six months following birth had a positive and significant influence at a 5% level. While there was no significant discernible effects of being on leave when the child was aged between six and 15 months and 18 to 24 months, there was some suggestion of significant positive effects (at a 10% level) at 15-18 months and 18-36 months of child age. One might interpret this finding as some mild evidence in favour of a policy of birth-related leave for a period of up to six months, if the policy goal is women's life satisfaction.

Chart 2: The effects of child age and being on birth-related leave and child age on life satisfaction (from Column 3 of Table 1)



While the use of fixed effects and multi-variate controls address some of the issues associated with omitted variables and causality, it is still possible that the coefficient on birth-related leave will be biased upward due to high-life satisfaction mothers being more likely to take birth-related leave. One way of addressing this issue is to find instruments which are unrelated to life satisfaction but which explain being on birth-related leave. The instrument used here is the duration of total paid birth-related leave, which changes on account of policy changes. These changes have been discussed in section 3 above. The instrumental variables results are present in Table 2. The impact of being on birth-related leave on life satisfaction nearly doubles in size to 0.32 – one third of a life satisfaction point. However, while the effect on maternity leave becomes larger, it is less precisely estimated, with a large rise in the standard error of the coefficient. However, the IV estimation of the effect of being on birth-related leave is still statistically significant at a 10% level.

Table 2: Birth-related leave and life satisfaction

Fixed effects IV life satisfaction regressions for women (standard errors in brackets)

	(1)
Birth-related leave	0.320*
	(0.177)
9 to 2 month before birth	0.236***
	(0.038)
2 to 0 month before birth	0.401***
	(0.0622
Birth and 2 month after	0.424***
	(0.0963)

2 to 6 month after birth	0.233***
	(0.090)
6 to 10 month after birth	0.081
	(0.079)
10 to 1 2 month after birth	-0.085
	(0.108)
12 to 15 month after birth	-0.010
	(0.084)
15 to 18 month after birth	-0.037
	(0.083)
18 to 24 month after birth	0.072
	(0.064)
18 to 36 month after birth	-0.139***
	(0.042)
Employed	0.156***
	(0.014)
Number of children	-0.051***
	(0.006)
German nationality	0.088***
	(0.016)
Education (years)	0.046***
	(0.002)
Age below 20	0.787***
	(0.033)
Age 20-24	0.503***
	(0.024)
Age 25-29	0.292***
	(0.022)
Age 30-34	0.159***
	(0.021)
Age 35-39	0.129***
	(0.019)
Age 40-44	0.037**
	(0.018)
Age 45+ (Ref.)	
Household income ln	0.414***
	(0.010)
Married	0.337***
	(0.019)
Separated	-0.321***
	(0.045)
Single (Ref.)	
Divorced	-0.161***
	(0.028)
Widowed	0.033
	(0.043)
Nordrhein-Westfalen (Ref.)	
Baden-Württemberg	-0.018
	(0.016)
Bayern	-

	0.056***
	(0.016)
Berlin	-
	0.381***
	(0.035)
Brandenburg	0.359**
	(0.176)
Bremen	0.179***
	(0.066)
Hamburg	0.148***
	(0.039)
Hessen	0.010
	(0.020)
Mecklenburg-Vorpommern	-0.078
	(0.155)
Niedersachsen	-0.032*
	(0.019)
Rheinland-Pfalz/ Saarland	0.065***
	(0.021)
Sachsen	0.170
	(0.119)
Sachsen-Anhalt	-0.090
	(0.164)
Schleswig-Holstein	0.612***
	(0.044)
Thüringen	-0.239
	(0.214)
Land missing	-0.213
	(0.213)
Constant	5.682***
	(0.037)
Number of observations	111237
Number of individuals	15092
Prob > F	0.000
R^2	0.053

* = 1% significance, ** = 5% significance, *** = 10% significance

Consideration now turns from the OLS and instrumental variables regression approaches used above to find an effect of birth related leave on life satisfaction to propensity matching and difference-in-difference estimators.

5. Results: Propensity score method

Method

Treatment effects have been estimated in econometric models with dummy endogenous regressors, in order to classify the individuals into two different groups: the treated and control. Let:

$$Y_{it} = \beta' X_{it} + \alpha D_i + u_{it}, \quad t = 1, 2, \ldots, T \qquad (1)$$

where $D_i = 1$ for the treated and $D_i = 0$ for those in the control group. Here Y_{it} is the observed outcome of individual i at period t, X_{it} includes a set of observed characteristics, and u_{it} is the error term denoting unobserved characteristics. We assume that $E(u_{it} \mid X_{it}) = 0$. Then, α represents the average treatment effect (ATE). When assignment to the treatment or control group is random, D_i can be considered as exogenous, and the standard OLS estimator is consistent. This occurs in data with randomized experiments or controlled social experiments, but not in the non-random or non-experimental data that are common in practice. When assignment to the treatment group is non-random, selection bias in estimating α can occur because u_{it} and D_i are correlated, which yields:

$$E(u_{it} \mid D_i, X_{it}) \neq 0 \text{ and } E(Y_{it} \mid D_i, X_{it}) \neq \beta' X_{it} + \alpha D_i. \quad (2)$$

Thus, the OLS estimator does not yield consistent estimates of α and β because of the endogeneity problem, $E(u_{it} \mid D_i, X_{it}) \neq 0$, which is caused by the fact that participation (or treatment) is based on each individual's decision-making procedure. This procedure is often dealt with the Heckman's treatment model. However, this estimation method needs an important identifying condition to be met (i.e. at least one variable in Z_i that is not included in X_i, a variable that affects choice but is not correlated with u_{it} in(1)) which may be very difficult in practice.

One method that overcomes this problem is the propensity score method, which avoids the difficulty of finding instrumental variables. Moreover, the propensity score method allows estimation of the treatment effect by simulating a randomized experiment in a non-parametric way. In the matching step observations in the treatment group (in this case, those on birth-related leave) are first matched with observations in the control group (the no birth-related leave group) that are as alike as possible – based on observables. The crucial assumption is that two observations with the same values for the observables will display no systematic differences in their reactions to the treatment. Thus, these matched observations meet the conditions of a randomized experiment. In theory, each observation in the treatment group is mirrored by an observation in the control group. The anticipated result is that the differences in the outcomes across each matched pair will be due to only the treatment's effect and not to those observable differences.

The matching method is valid when the relationship between u_{it} and D_i is due to observed variables, Z_i, that affect selection into the treatment. Therefore when by controlling for the selection on observables Z_i, the dependence between u_{it} and D_i can be removed the result will be $E(u_{it} \mid D_i, X_{it}, Z_i) = E(u_{it} \mid X_{it}, Z_i)$. The estimated effect of the treatment will be in this case unbiased. The matching condition is referred to the conditional independence assumption (CIA), implying that given observable control variables, assignment to the treatment group is random and is independent of the outcome:

$$(Y_{i1,} Y_{i0}) \perp D_i \mid Z_i \quad (4)$$

where $\perp$ denotes independence, and where Y_{i1} denotes the outcome for individual i if the treatment occurs ($D_i = 1$) and Y_{i0} denotes the outcome if the treatment does not occur ($D_i = 0$). The treatment effect is given by:

$$\alpha = E(Y_{i1} - Y_{i0} \mid Z_i, D_i = 1) = E(Y_{i1} \mid Z_i, D_i = 1) - E(Y_{i0} \mid Z_i, D_i = 1), \quad (5)$$

where the second term after the last equality is not estimable if matched pairs are not available. In general, the matching estimator is calculated by

$$\alpha,^{\wedge} = \textbf{Error!}[Y_i - \textbf{Error!}\omega_{ij} Y_j] \gamma_i \quad (6)$$

where T and C denote the treatment and control groups respectively; and where ω_{ij} is the (kernel) weight applied to the matched observation j for the observation i in the treatment group, and γ_i represents the re-

weighting on the treated observation. One simple case is the nearest neighbourhood matching method, in which case the matching estimator becomes:

$$\alpha,^{\wedge} = \textbf{Error!}[Y_i - Y_j] \textbf{ Error!} \quad (7)$$

where N_T denotes the number of matched observations. This amounts to finding an observation from the control group ($D_i = 0$) that matches each observation in the treatment group ($D_i = 1$), and comparing the means of these matched groups. The above condition in (4) is difficult to implement in practice since Z_i involves a vector of observable variables. The same condition is met when the propensity score, $P(Z_i) = P(D_i = 1| Z_i)$, replaces Z_i in (4). That is:

$$(Y_{i1,} Y_{i0}) \perp D_i \mid P(Z_i) \quad (8)$$

Given that the propensity score $P(Z_i)$ is a scalar, the above condition facilitates matching because of the dimension reduction to one. A major contribution of condition (8) is to shrink the dimensionality of observable characteristics used for matching observations. Using the propensity score yields a more efficient estimate of the treatment effect. The propensity score is obtained as the predicted probability $P,^{\wedge}(Z_i)$ from a probit model. Matching is then performed using like propensity scores.

Results

The results of the propensity matching exercise are shown in Table 3 below. The effect on life satisfaction is statistically significant and at 0.20 of a life satisfaction point is actually very close to the 0.17 life satisfaction points given by the OLS fixed effects regression reported in Column 1 of Table 1 above. These results were robust to inclusion of year-dummies.

Table 3: Birth-related leave and life satisfaction

Propensity matching)

Sample	Life satisfaction of the treated (1)	Life satisfaction of the controls (2)	Difference, (1) – (2)	T statistics on the difference
Unmatched	7.33	7.00	0.33	15.67
Average treatment on the treated	7.33	7.13	0.20	4.81

6. Results: Difference-in-difference estimator

Method

Longitudinal methods rely on having multiple periods of data on outcomes, with at least one period being prior to treatment. The main methods with this kind of data are:

- The before-after estimator. In this estimator, the outcomes of participants in a period prior to participation estimate the counterfactual of what would have happened to them, had they not participated.

- The difference-in-differences estimator. In this, before-after changes for participants are compared to before-after changes for non-participants.

Taking the difference-in-differences cancels out the difference in period effects, leaving only the impact, as desired.

Suppose that there are two groups indexed by treatment status T = 0, 1 where 0 indicates individuals who do not receive treatment, i.e. the control group, and 1 indicates individuals who do receive treatment, i.e. the treatment group. Assume that we observe individuals in two time periods, t = 0, 1 where 0 indicates a time period before the treatment group receives treatment, i.e. pre-treatment, and 1 indicates a time period after the treatment group receives treatment, i.e. post-treatment. Every observation is indexed by the letter i = 1, ..., N ; individuals will typically have two observations each, one pre-treatment and one post-treatment.

In our estimations, because we don't have a true experiment, we will use a sort of natural experiment. We assume that people entering the maternity leave after each policy changes are the "treated" while those before the change are the "untreated".

For the sake of notation let $\overline{Y_0^T}$T and $\overline{Y_1^T}$ be the sample averages of the outcome for the treatment group before and after treatment, respectively, and let $\overline{Y_0^{C-}}$ and $\overline{Y_1^T}$1 be the corresponding sample averages of the outcome for the control group. Subscripts correspond to time period and superscripts to the treatment status.

The outcome Y_i (i.e. the life satisfaction) is modelled by the following equation

$$Y_i = \alpha + \beta T_i + \gamma t_i + \delta (T_i \cdot t_i) + \varepsilon_i \qquad (9)$$

where the coefficients given by the Greek letters α, β, γ, δ , are all unknown parameters and εi is a random, unobserved "error" term which contains all determinants of Y_i which our model omits. By inspecting the equation you should be able to see that the coefficients have the following interpretation

α = constant term
β = treatment group specific effect (to account for average permanent differences between treatment and control)
γ = time trend common to control and treatment groups
δ = true effect of treatment

The purpose of the program evaluation is to find a "good" estimate of δ, ˆδ, given the data available.

For the estimator to be "good" it is necessary that it is unbiased, i.e. "on average" the estimate will be correct, or that the expected value of the estimator E[δ]=1.

In order for the difference in difference estimator to be correct, the following assumptions hold:

1. The model in equation (Outcome) is correctly specified.
2. The error term is on average zero: E [εi] = 0.
3. The error term is uncorrelated with the other variables in the equation:

   cov (ε_i, T_i) = 0
   cov (ε_i, t_i) = 0
   cov (ε_i, $T_i \cdot t_i$) = 0

the last of these assumptions, the parallel-trend assumption, is the most critical.

The difference in difference (or "double difference") estimator is defined as the difference in average outcome in the treatment group before and after treatment minus the difference in average outcome in the control group before and after treatment:

$$\hat{\delta}_{DD} = \bar{Y}_1^T - \bar{Y}_0^T - (\bar{Y}_1^C - \bar{Y}_0^C)$$

The difference estimator for the pre-period is used to estimate the permanent difference β, which is then subtracted away from the post-period estimator to get δ.

Results

The results of the difference-in-differences estimation exercise are shown in Table 4 below. Eight policy changes relating to birth related leave are examined are shown. The pre-1990 policies creating and extending the duration of paid parental leave all had positive but not statistically significant effects on life satisfaction. The further rise in parental leave from 16 to 22 months had a significantly negative effect on life satisfaction. The two most recent German policy changes – the introduction of flexibility in durations and the introduction of earnings related leave – both had a positive and statistically significant impact of life satisfaction.

Table 4: Birth-related leave policy changes and life satisfaction

Difference-in-differences

Birth-related leave policy changes in Germany	Impact on life satisfaction of those on birth-related leave (difference-in-differences)	T statistic on the impact of the policy change
1986 introduction of 8 months of paid parental leave	0.133	0.72
1988 rise in paid parental leave from 8 to 10 months	0.164	0.80
1989 rise in paid parental leave from 10 to 13 months	0.012	0.08
1990 rise in paid parental leave from 13 to 16 months	-0.032	-0.27
1992 rise in unpaid parental leave to three years	-0.016	-.012
1993 rise in paid parental leave from 16 to 22 months	-0.105	-2.53
2001 introduction of flexibility in taking parental leave	0.108	2.61
2007 introduction of earnings related paid parental leave	0.147	2.19

As with the propensity matching results, these results were robust to inclusion of year-dummies.

Conclusion and next steps

The results from a variety of different methods suggests that birth-related leave polices generally have a significant positive impact direct impact of life satisfaction of German women. Women on birth-related leave have higher life satisfaction controlling for observable and unobservable personal characteristics. This result is robust to using instrumental variables and propensity matching techniques. Using a difference-in-differences approach, several recent policy changes are shown to have had a significant positive impact on life satisfaction.

It would seem that job protected leave for women maintains the positive effect on life satisfaction of employment. The effect is relatively large, about the size of being employed, or equating in value to a 70-80% rise in household income. It may well be the combination of time off *and* the right tor return to work that results in higher life satisfaction. The effect seems to be causal, running from leave to satisfaction.

The next steps are to see whether it is possible to replicate the German analysis for other countries which have longitudinal data sets, measures of subjective well-being and relevant policy changes to birth related leave. There are two obvious candidates. In the United Kingdom, the *British Household Panel Survey* (BHPS) can be used. This data set includes life satisfaction as a subjective measure. While the time window is shorter, there are three parental leave policy changes which can be used for instruments and policy evaluation (Baldi and Chapple 2011). We can also replicate the study using the rather less known and used *Panel Study on Belgium Households* (PSBH) running from 1992 to 2002. There was a large 1998 Belgian policy change introducing private sector parental leave for fathers and mothers which can be studied (Baldi and Chapple 2011). The Belgium survey includes a multi-item measure of subjective well-being which focuses on depressive variation in the left tail of well-being. It will be interesting to see if a robust set of results can be established.

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