The Effect of Children on Mental Health in Old Age

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Abstract

This article investigates the causal relationship between the number of biological children and mental health of elderly Europeans. Specifically, we ask whether additional children improve or threaten parents' mental health status. Our identification draws on two natural experiments that exogenously increase the number of children: multiple births and the sex composition of the first two children. This setup allows us to identify the effect of expected and desired versus unexpected additional children on mental health. Using a large and extensive survey of elderly Europeans, we find that additional children can exert a negative causal effect on the likelihood of depression and the use of antidepressant drugs for females. There is no evidence for a causal effect of having additional children on the probability to suffer from depression for elder men. We suggest that situations of financial hardship are one pathway for the effect of children on mental health.

Keywords: mental illness, fertility, causal effect
JEL-Classification: I12, J13

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1 Introduction

Depression is one of the most common health conditions among the elderly. Castro-Costa et al. (2007) estimate that prevalence rates in 10 European countries range between 18.1% (in Denmark) and 36.8% (in Spain) among individuals aged 50 and above. Understanding promotive and protective factors for the incidence of depression is therefore a major concern for public health research. This article asks whether children protect or jeopardize parents mental health status. In contrast to the previous and mostly descriptive literature we put the focus of our investigation on the identification of the causal effect of additional children.

There are arguments for and against a positive effect of children on mental health. Sociologists stress the importance of children within the social network of aging parents (Bures, Koropeckyj-Cox, and Loree (2009)). Children can provide social support and care. A higher number of children might therefore prevent loneliness in old age. Children also provide parents with a sense of gratitude and feelings of meaning in life, which might positively affect mental health (Evenson and Simon (2005)). From an economic point of view it is not obvious whether a higher number of children is associated with a higher amount of care received by their parents. When care for parents is considered a public good that is provided by children then strategic interaction among children can lead to an inefficiently low quantity of care provided.[1]

On the other hand, children can also be a source of strain, economic costs and physical pain. In particular when children are young the role of parents is physically and psychologically demanding. The larger share of responsibility in these years is mostly borne by mothers. Hence, mothers can be particularly vulnerable to mental diseases (Umberson and Gove (1989)). Raising children is connected with both direct costs (e.g. for nutrition and education) and opportunity costs. Opportunity costs arise since the birth of a child can put parents off track in their employment biographies, possibly reducing earnings and the chance of obtaining prestigious positions and increasing the risk of suffering financial shortages (Ross, Mirowsky, and Goldsteen (1990)). The birth of children increases the need for economic resources but can at the same time decrease parents' earnings potential. A recent study by Adda, Dustmann, and Stevens (2010) estimates the loss in wages due to a childbirth to equal 17% for women. The authors attribute this wage

[1]For articles modeling strategic interaction among children in the provision of care for their parents, see e.g. Bernheim, Shleifer, and Summers (1985) or Konrad, Künemund, Lommerud, and Robledo (2002).

loss mainly to the interruption of careers and the associated loss of human capital as well as to the sorting of mothers into child-friendly occupations. Childbearing not only reduces wages but likely also increases the risk of experiencing periods of economic hardship, which in turn is negatively associated with mental health (Ross and Huber (1985), Mirowsky and Ross (2001)).

A number of prior studies investigate the relationship between the number of children and mental health at higher ages. Some of these studies have pointed to differences in prevalence rates of depression by the number of children. However, the interpretation of any association between the number of children and mental health is made difficult by the complex mechanisms underlying the fertility-health nexus. The empirical identification of the causal effect of additional children on health is complicated by the fact that fertility decisions might correlate with mental health for two reasons.[2] On the one hand, it might be more difficult for individuals with poor mental health to find a mate and realize their desired level of fertility. Large evidence supports the hypothesis that individuals with good mental health status have a substantially higher probability to maintain stable relationships.[3] On the other hand, fertility preferences of individuals with poor mental health can differ from those of mentally healthy persons. If individuals self-select into their optimal level of fertility then observed fertility patterns might be the result from a mental condition rather than the other way around. Any correlation between the parity of children and measures of mental health is therefore the sum of a causal effect of the number of children and a selection effect, both of which have unknown signs.

This article provides the first estimates for the causal effect of additional children on their parents' mental health status. Specifically, we ask whether adding one child to the parity of children exerts a causal effect on the probability to suffer from depression. We focus on the role of biological children for their parents' well-being. Our identification strategy builds on three instrumental variables (IV) for the number of children: variables indicating a multiple birth at the first and second birth and a dummy variable that indicates whether the first two children have the same sex. The sex composition of the first children has been shown to be related to the probability to have further children (e.g. Andersson, Hank, Rønsen, and Vikat (2006), Hank and Kohler (2000)). We exploit that multiple births as well

[2]We define fertility as the number of biological children individuals have.

[3]The literature review by Coombs (1991) points out that married individuals have a substantially lower prevalence of psychiatric disorders compared to single, divorced and widowed individuals.

as the sex composition of children result from random experiments and have an effect on the total number of children, thus allowing to draw causal conclusions. We argue that these instruments allow calculating three different local average treatment effects and therefore provide insights about several groups of compliers and at different margins. These instrumental variables allow to study both the effect of unexpected increases in the total number of children (as induced by multiple births) and the effect of expected and desired increases in the number of children for an exogenous reason (same sex sibship). Both instruments have been used to investigate the effect of children on several economic outcomes (e.g. Black, Devereux, and Salvanes (2005)). However, they have not been applied to study the long-term consequences of fertility on mental health.
First, we investigate the total effect of additional children on the mental health status of their parents. Second, we explore possible pathways by looking at the probability of critical events that occurred after the last childbirth and that are candidates for mediating variables. [4] We use newly available data from the Survey of Health, Aging and Retirement in Europe (SHARE and SHARELIFE) that provides fertility histories of more than 20.000 elder Europeans along with extensive information on health status and socioeconomic background.

We find evidence for a negative causal effect of additional children on mental health of elder women. Women who have a third child because of a multiple birth are found to have a higher risk to incur depression. Hence, the relevant margin is the transition from the second child to the third, and the effect is only significant if the additional child was induced by a multiple birth. We do not find evidence for such an effect in the male sample. We suggest that situations of financial hardship and poor overall health status mediate between the number of children and mental health in old age.

This article is organized as follows. The next section briefly reviews the related literature on the relationship between parenthood and mental health as well as related articles that use multiple births and same sex sibships as instruments for the number of children. Section 2 describes our identification strategy in greater detail. The third section introduces our data set and section 4 presents our main results. The last section summarizes and draws conclusions from our findings.

[4] We do not investigate the effects of the timing of child bearing as this is partly result of an individual choice and therefore an endogenous variable.

Related literature

This paper draws on two strands of the literature. Evidence on the relationship between fertility and health outcomes has mainly been provided by public health researchers, psychologists and sociologists. There is a substantial number of articles investigating the manifold long-term consequences of childbearing on health. [5] We concentrate on previous research investigating the fertility – mental health nexus in the following. Several descriptive articles investigate whether parenthood is linked to mental health at higher ages. However, the results provided by the previous literature are surprisingly ambiguous and do not draw a consistent picture yet. The ambiguous evidence may in part be due to differences in definitions of study group and treatments as well as due to differences in the selection of control variables. For example, the relationship between parenthood and mental health appears to depend on whether children are still living at home or have already left the household of their parents (Evenson and Simon (2005)). It also depends on whether the association between biological or step-children and mental health is considered (Bures, Koropeckyj-Cox, and Loree (2009)).

Evenson and Simon (2005) provide evidence backing the hypothesis that parents in general have a higher risk to suffer from depression than childless couples. This finding is driven in particular by families with minor children. Evidence that parenthood is negatively associated with psychological distress is also provided by Burton (1998) for U.S. data. No association between parenthood and parents' mental well being is documented by Umberson and Gove (1989) and Mirowsky and Ross (2002) for the U.S. and Hank (2010) for middle-aged individuals from Germany. In contrast to this, Koropeckyj-Cox (1998) finds weak evidence for the hypothesis that childless elderly people have a higher probability to suffer from loneliness and depression.

There is less evidence on the effect of the parity of children on mental health. Gove and Geerken (1977) suggest that having children in the household generally increases the risk for poor mental health. However, there is no consistent evidence for the relationship between the number of children and mental health. Spence

[5] We do neither discuss short-term effects of childbearing on mental health nor long-term effects on physical health status. For a discussion of the first, see e.g. Weissman and Olfson (1995), for a discussion of the latter, we refer to Grundy and Tomassini (2005) and Hurt, Ronsmans, and Thomas (2006). There is also a literature on the consequences of the timing of fertility, see e.g. Spence (2008) or Mirowsky and Ross (2002) and on the particular consequences of early motherhood (Henretta, Grundy, Okell, and Wadsworth (2008)). Bures, Koropeckyj-Cox, and Loree (2009) provide evidence on the relationship between parenthood and mental health by different types of parenthood (biological vs. social parenthood).

(2008) documents that parents of five or more children do not have worse mental health than parents of one to four children in the U.S.. This evidence is not supported by evidence from old age Europe by Buber and Engelhardt (2008) who find evidence for a non-linear association between children and mental health for men using the SHARE data: fathers of one to three children are found to be significantly healthier compared to fathers of four or more children and childless men in terms of mental health. The authors find no evidence for such an association for women. Hank (2010) reports no differences in mental health by the parity of children for middle-aged individuals from Germany.

The second strand of the literature this article is related to explores the causal consequences of childbearing using instrumental variables. Rosenzweig and Wolpin (1980) were the first to suggest using twin births as an instrumental variable for the number of children. More recent articles also rely on the sex composition of the first born children exploiting parents' taste for a balanced sex composition as an instrument for additional children (Black, Devereux, and Salvanes (2005), Black, Devereux, and Salvanes (2010), Angrist, Lavy, and Schlosser (2010)). This methodology has mainly been used to empirically test Becker's quantity-quality hypothesis, which states that resource constrained parents can either invest in the quality or in the size of their offspring (Becker (1960)). Other applications include the analysis of the effect of children on parents' labor supply and on mothers' wages (Butcher and Case (1994), Angrist and Evans (1998)) as well as on marital stability and the probability to depend on public welfare programs (Angrist (2004)). To the best of our knowledge, these instruments have not been used before to investigate the causal impact of children on health in old age.

We are aware of only one article investigating the causal effect of fertility on maternal health using an IV setup. Cáceres-Delpiano and Simonsen (2010) find large detrimental effects of additional children on their mothers' health during their fertile years using multiple births as an IV for child parity and drawing on U.S. census data. In particular, additional children appear to increase mothers' risk for high blood pressure as well as for various risky behaviors. This paper is different from the work by Cáceres-Delpiano and Simonsen (2010) in three respects: We investigate mental health as opposed to physical health and consider a very detailed measurement of mental health status. Second, we investigate the long-term effects of childbearing as most individuals in our sample have adult children. Third, we not only rely on multiple births as an IV for fertility but contrast this to estimates from an instrument that identifies a different local average treatment effect.

2 Identification Strategy

The interpretation of any association between the number of children and their parents' mental health status is rendered difficult by the complex causal mechanisms driving both variables. Any mean difference in mental health scores by the number of children reflects both: a treatment effect running from the number of children to a certain mental state and a selection effect that expresses that people with certain psychological characteristics select into specific patterns of fertility. To disentangle treatment and selection effects we ideally need a mechanism that randomly allocates children to couples. In such an ideal experimental setting we could interpret any mean difference in mental health by the number of children as a direct consequence of the number of children. In social science, and in particular for variables like the number of children, such administered experiments are not available. We argue that two events that randomly occur and that affect the number of children mimic administered experiments and can therefore be used to calculate estimates for specific causal effects of additional children on the mental health status of their parents: multiple births and the first two children having the same gender.

2.1 Multiple births as an instrument for the number of children

Multiple births are rare events. They occur in about 1-2% of all births and can therefore be seen as unexpected events. To see how multiple births affect the total number of children consider the following setup. Assume that individuals maximize lifetime utility over the total number of children they give birth to during their fertile period. Individual optimization leads to a optimal number n^* of children. If n^* equals 1, an individual needs at least one birth to maximize utility. If the first birth is a twin birth then the total number of children is exogenously increased by 1. If twin births occur randomly, then this twin birth has randomly allocated a second child to a couple that ideally wanted only 1 child.
Note, that we do not expect the effect of a twin at first birth to be close to unity as for some people $n^* > 1$ so that they would have had more than 1 child anyway. These individuals are termed "always-takers" as they take the treatment (an additional child) regardless of their realization of the instrument (single birth vs. multiple birth). Using the occurrence of a multiple birth at the first birth as an instrument for the total number of children among all those individuals

that have experienced at least one birth allows to calculate the causal effect of this additional child on the outcome of interest for all those individuals that experienced $n = 2 > n^* = 1$ because of a twin birth.[6] Accordingly, our first stage regression looks as follows

$$nchild = \alpha_0 + \alpha_1 multi_1 + \alpha_2 X + \epsilon \tag{1}$$

where *nchild* is the total number of children, $multi_1$ is an indicator that assumes 1 if the first birth was a twin birth and that assumes 2 if the first birth was a triplet birth. X reflects other characteristics relevant to the endogenous variable. These control variables include a full set of age dummies as well as indicator variables for the age at which an individual's first child was born in 5 years intervals. We also include country fixed effects to model cross-country differences in the prevalence of depression. We do not control for education and other socioeconomic indicators as these variables might be a consequence of early childbearing rather than a confounding factor. To explore differences by gender, we conduct all analysis for men and women separately.

We also use multiple births at the second birth as an instrument for the number of children. This instrument identifies the treatment effect of an additional child among the group of compliers that would have had only two children in case of the absence of a multiple birth but were pushed into $n = 3$ by the instrument.

The second stage explains our outcome variable of interest (mental health) by the predicted values for the number of children from the first stage.

$$Health = \beta_0 + \beta_1 \hat{nchild} + \beta_2 X + u \tag{2}$$

where $Health$ represents our indicator for mental health $\hat{nchild}$ reflects the predicted values from the first stage and X contains the same controls as in equation 1. All IV regressions are conducted by using 2 stage least squares.

It is important to notice that multiple births imply, in contrast to consecutive singleton births, that the resulting children grow up at the same time. An additional child induced by a twin birth represents therefore the effect of an additional child plus the effect of having two children growing up at the same time. In our context the timing of births can play a role when the birth of twins result in events that

[6]Implicitly we assume that individuals are not constrained in the number of children they give birth to. If individuals were constrained in their capacity to attain n^* then our instrument would push some individuals closer to their optimal number of children n^*. The validity of the instrumental variable approach remains unaffected when loosening this assumption, as long as the IV monotonically increases n for each individual.

cause a depression which persists into old age. We come back to this point when investigating pathways for the effect of children on mental health.

Shortcomings of multiple births IV

A valid IV approach requires the instrument not to be correlated with the second stage error term. The identifying assumption for the multiple birth IV states that multiple births only affect parents' mental health through the increase in the number of children and by no other means. Multiple births, however, could invalidate this requirement if the probability of a multiple birth is correlated with unobservable variables. The take-up of fertility treatments increases the individual probability to experience a multiple birth and it is likely correlated with observable (e.g. age at birth) and unobservable characteristics of parents. However, these treatments became available only from the 1990s onwards. Since almost all of our twin births occurred prior to this date we do not consider the availability of fertility treatments a thread for the validity of our estimates. Moreover, dropping all multiple births occurring after 1990 does not change any of our main results.

2.2 Sex composition as an instrument for the number of children

Using sex composition of the first two children as an instrument for the number of children draws on the empirical regularity that parents whose first two children have the same sex have a higher probability to have a third child than those parents with a balanced sex composition in their first two children. This pattern represents parents' taste for variety. As the realization of a child's gender can be considered an outcome of a random experiment, this instrument affects a random selection of all those parents with at least two children. Analogously to equation 1 our first stage using sex composition of the first two children as an instrument looks as follows

$$nchild = \alpha_0 + \alpha_1 samesex + \alpha_2 X + \epsilon \tag{3}$$

where the variable *samesex* assumes 1 if the first two children have the same sex. X includes the same set of control variables as in equation 1. We also experiment with sex composition at higher parities as potential instruments. However, in our data set these instruments are not strong enough to provide credible identification. Note, that this instrument identifies a different local average treatment effect as compared to the multiple birth instrument for a number of reasons. A third child

in response to the instrument is likely to reflect an anticipated and desired increase in the total number of children where against a multiple birth is more likely to be an unintended increase in fertility. It is obvious to hypothesize that desired additional children affect parents' wellbeing differently than an unexpected and possibly less desired additional child. Moreover, the timing of child births may play an important role. Twin births induce two children being born and growing up at the same time while births induced by the balanced sex preference of parents occur consecutively. Hence, if children affect parents' mental health because of the demands for personal care when children are young, we might expect the effect of twins to be larger than the respective effect of consecutive singleton births. Lastly, the effect of children born because of the sex imbalance of first children implies (in contrast to twin births) an additional childbirth which plausibly has a separate effect on health as two singleton births are likely to affects mothers differently than one twin birth.
Using same sex sibship and multiple births as instruments allows to estimate three different local average treatment effects for three specific populations of compliers. In particular we can study the effect of an unexpected second child and an expected and unexpected third child. However, one shortcoming of this research design is that we are not able to estimate the effect of the transition from childless couples to one child families nor are we able to estimate the effect of additional children at a higher birth order.

3 Data

We use data from the first and second wave of the Survey of Health, Aging and Retirement in Europe (SHARE). SHARE collects extensive information on health status and both socio-economic characteristics as well as characteristics of the individual environment (family, social networks). The third wave of SHARE (termed SHAFELIFE) includes retrospective questions about the interviewees biographies such as employment histories, conditions in early life and fertility histories.[7] SHARE samples about 2.000-3.000 individuals of each participating country. The sample of our analysis includes participants from Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Czechia, Poland, and Belgium. An extensive assessment of mental health has been conducted in the first and second wave of SHARE which took place in 2004 and 2006 respectively.

[7]For more technical information on the SHARELIFE data see Schröder (2010)

We take the mental health information from the latter wave where possible and the mental health measurement from the first wave when individuals missed the second wave. We match these variables with the individual fertility biographies provided by SHARELIFE. Our full sample contains 23.028 individuals.

3.1 Sample restrictions

We restrict the sample of our IV-analysis to individuals with at least one reported child birth (for the multiple birth at first birth instrument), individuals with at least two births (multiple birth at the second birth instrument), and individuals with at least two children (same sex instrument) to ensure that each individual in the analytical sample could possibly be affected by the instrument. We only consider own (i.e. biological) children. Since we are interested in the total effect of children on parents' wellbeing we do not distinguish between children alive and those already deceased. The SHARELIFE questionnaire does not directly ask for twin births but rather asks for the year of birth of all natural children. Our twin instrumental variable is therefore constructed in the following way: if a respondent reports that two of his children have been born in the same year then we assume that they are twins and our instrumental variable assumes 1. If three children are born in the same year, our instrument assumes 2. In all other cases, the IV assumes 0. There are no quadruplets reported in this data set.
The OLS-benchmark analysis includes observations of all individuals with information on mental health and full fertility biographies, i.e. childless individuals are included. We restrict the female sample to individuals aged between 50 and 90. In our sample the fertility biographies of males start and end later than those of women. Men have less constraint in the timing of fertility than women. As a consequence, men have more time to react to the sex composition of the first two children by having a third child. To account for this effect, we restrict the male sample to include individuals aged between 55 and 90, as dropping individuals between 50 and 54 increases the precision of the estimates for the first stage even though the number of observations is reduced by some 500.
Table 2 presents descriptive statistics of our data. On average individuals in the sample are aged 65. The distribution of age is strongly right-skewed with many individuals between age 50 and 70 and few individuals above 80 years of age. 12.5% of our sample report to have no children. Those individuals with children have on average 2.45 children.
Only 8.3% of the individuals in the sample have minor children at the time of

the interview. Only 1.2% have children younger than 10 years. On average, individuals in our sample report that the birth of their youngest child took place 33 years ago. This indicates that the largest fraction of the individuals in the sample has concluded its fertile period a long while ago and that our results reflect the long-term consequences of child bearing.

3.2 Measurement of Mental Health

Our assessment of mental health is based on the measurement of depressive symptoms provided by the Euro-D scale. Euro-D comprises the measurement of 12 binary indicators that assess the mental condition of interviewees. In particular people are asked about depressive feelings in the last week, hopes for the future, suicide thoughts, feelings of guilt, lessening of interest in things, irritability, appetite, fatigue, ability to concentrate, enjoyable things and tearfulness. A full list of the Euro-D items is provided in table 1. The Euro-D scale has been developed with the specific objective to ensure a maximum of comparability across cultural contexts. Its reliability as well as its validity have been confirmed (Prince et al. (1999)). The criterion for the assessment of mental health is the sum of individual symptoms. As dependent variable we use an indicator that assumes 1 if the individual score is larger than three, which is regarded to be the threshold value for depression.

Moreover, we evaluate whether an individual reports to ever have suffered from depression as well as a question that assesses whether interviewees currently take anti-depressant drugs. The combination of these three indicators of mental health captures both self-reported depression (assessed by the "ever had" question) and diagnosed and treated depression (represented by the use of antidepressant drugs) as well as latent and possibly undiagnosed mental health problems (as represented by the Euro-D indicator). It has to be kept in mind that individuals undergoing medical treatment might report a Euro-D score that is "artificially" low if prescribed drugs affect symptoms. Surprisingly, this problem has been largely ignored by the previous literature. There are about 700 observations of individuals that report to take anti-depressant drugs while at the same time having a Euro-D score in the healthy range (i.e. below 4). If in these cases the score is low because of the efficacy of the drugs, our indicator for mental health is no longer a good measure of true mental health but rather reflects the willingness to undergo medical treatment in case of poor mental health. As this is not what we are mainly interested in, we recode these individuals as ill (in the Euro-D sense) and as having

suffered from depression.
Table 2 presents the descriptive statistics of our sample. On average, individuals in the sample are age 65. Overall, women report substantially more depressive symptoms than men. About 16% of all males and about 31% of all women in the sample can be classified as suffering from a depression. The number of people that report to have ever suffered from depression is lower than the means according to the Euro-D criterion. About 3% of males and 8% of females are currently treated with anti depressant drugs. There are no obvious differences across the single indicators for mental health for the sub samples of individuals with 2 or less children. The sampled individuals with more than 2 children fare worse in all three dimensions of mental health. However, parents of more than 2 children also have a considerably lower age at first birth.
Cross-tabulations of our indicators of mental health reveal that the single indicators are correlated but still, each indicator implies information that the other two lack. 50.2% of individuals that are classified as suffering from depression according to the Euro-D scale report to have ever experienced a period of depression, i.e. about half of the individuals with a latent symptomatology for depression are not aware of it. About 30% of the individuals who report to ever have suffered from depression currently take antidepressant drugs.

3.3 Measurement of possible pathways

In this article we focus on the long-term consequences of childbearing. One way in which children can affect their parents mental health status is by leading to critical periods in life that bear long term consequences. To empirically assess this hypothesis we investigate the effect of children – using the IV methodology described above – on the likelihood of critical periods in life that took place after the youngest child was born. We then explore to what extend these critical events are related to mental health in old age. The results can shed light on how the birth of children possibly affects mental health in old age.
We investigate three events: the occurrence of periods of stress, periods of poor overall health and periods of financial hardship which have also been proposed as possible pathways for the link between fertility and mental health by the previous literature (Ross, Mirowsky, and Goldsteen (1990)). We recode the single indicator variables to equal 1 if individuals report to have experienced this particular event and it took place after the youngest child has been born. This recoding is needed to make sure that the critical event followed a childbirth and can therefore be

attributed to the child birth rather than the other way around.
We cannot distinguish whether a period of poor overall health reflects a period of poor physical or mental health. Nonetheless, we consider it worthwhile to look at the probability of periods of poor overall health for two reasons. First, periods of poor physical health might be a causal link between childbearing and poor mental health in old age. Second, if periods of poor overall health reflect periods of poor mental health, then what we measure is the relation between childbearing and the persistence of poor mental health, which is also an interesting causal mechanism.

4 Results

4.1 First Stage Results

This section discusses the results of our first stage, i.e. the effect of the instruments on the total parity of children. The results are presented in table 3. Note again that we differentiate each analysis by sex and restrict the sample by the number of births. Although this reduces the sample size considerably it is necessary to make sure that all individuals in the sample are comparable, i.e. could possibly be affected by the instrument. We differentiate the analysis by sex to account for potential heterogeneity in the effect of additional children.
The first two columns in table 3 present the estimates for the effect of having two children of the same sex on the total number of children in the sample with all individuals that have at least two children. If individuals have two children of the same sex, they are significantly more likely to have an additional child. The probability increases by 7.9% for men and 9.3% for women. Overall the size of the effect of a same sex sibship is slightly larger but comparable to the effect size in the U.S. (6-7% Angrist and Evans (1998)), Israel (7%, Angrist, Lavy, and Schlosser (2010)) and Norway (8.2% Black, Devereux, and Salvanes (2010)). We also experiment with sex composition at higher parities and separate instruments for two boys vs. two girls as first children, none of which improves upon the single same sex instrument in terms of instrument strength. The sex composition of the first two children offers a borderline strong instrument for our male sample (first stage F-statistic of 9.5) and a relatively strong instrument for the female sample (F-statistic of 17).
Columns 3 and 4 show the impact of having a multiple birth at the first birth. On average, having a multiple birth increases the number of children by about 0.81 children. The results for men and women do not differ substantially. A multiple

birth at the second birth (columns 5 and 6) results in an increase in total fertility by 0.82 children for men and by about 0.75 for women. These results suggest that multiple births imply an enormous variation in the total number of children. The F-statistics for the instruments on the first stage are considerably above the critical threshold of 10, indicating that our instrument does not suffer from a weak-IV problem.
The effect of multiple births on total fertility in Europe is much larger than in Israel (0.43-0.5 Angrist, Lavy, and Schlosser (2010)) which can be explained by a much higher average number of children in Israeli families which makes the total number of children less responsive to multiple births at low parities. Our first stage estimates are comparable to previous estimates for Norway (0.68-0.75 Black, Devereux, and Salvanes (2005)).

4.2 OLS benchmark results

We start discussing our results on the relationship between fertility and mental health by documenting the results from an Ordinary Least Squares (OLS) regression. We set up the OLS model by regressing our indicators for mental health on dummy variables that assume one if individual i has 1, 2, 3, 4 or 5 and more children. The omitted category is 'childless individuals'. The control variables included are the same as in the IV regressions. This setup allows to study mean differences in mental health by the number of children. Table 4 shows our results. The results for males are shown in columns 1,3 and 5. Standard errors clustered on the individual level are presented in parentheses. Our results do not point to a systematic relationship between parenthood and mental health. Fathers and mothers are not consistently better or worse off than the reference group composed of individuals without children. Moreover, within the group of parents mental health does not systematically differ by the parity of children. Only few of the coefficients are significant. Parents of 5 and more children have a 3-4 percentage points increased probability to suffer from a depressive symptomatology according to the Euro-D criterion. This finding, however, does not hold for the other indicators of mental health we investigate. The sign of the coefficient even switches in several cases.
These results differ from the results by Buber and Engelhardt (2008) who also use the SHARE data for two reasons. First, the samples used differ as we used the second wave of SHARE and added all observations of individuals that took part in the first wave of SHARE and in SHARELIFE. Second, in contrast to Buber and

Engelhardt (2008) who use an extensive set of control variables we do not control for anything but country fixed effects, age and the age at first birth.

4.3 Second Stage Results

This section discusses the results for the 2SLS analysis of the effect of children on mental health. The main results are presented in table 5. The first two columns of table 5 provide estimates of the effect of children on the respective indicator using the same sex instrument for the number of children. The third and fourth column provide evidence using multiple births at the first birth as IV, the fifth and sixth columns present results for a multiple birth at the third birth as IV for total fertility. Our evidence suggests that increases in total fertility that result from the sex composition of the first two children do not significantly affect parents' mental health status. The estimated coefficients are negative for all indicators of mental health in the males sample. For women, the coefficients are consistently positive and the magnitude of the coefficients suggests a substantial but insignificant effect on self-reported depression and the use of antidepressant substances.
Columns three and four present the results using multiple births at first birth as IV. The results hereof do not show a consistent and statistically significant pattern across our indicators of mental health either. The estimates for the effect of children on their fathers' mental health are positive but not significant at usual levels of significance for all three indicators of mental health.
In the female sample, neither the Euro-D indicator nor the probability of reported depression are significantly affected by additional children. However, a second child appears to reduce the likelihood of using antidepressant drugs by 6% for women (significant at the 10% level).
The last two columns present the results for the twin at second birth instrument. This instrument mostly increased the number of children from two to three children. Our estimates suggest that a third child does not affect fathers' mental health status. The estimated effects are small and none is near the critical significance levels. The coefficients even switch sign when inspecting the results for the single indicators of mental health. In contrast to this result, a third child appears to strongly affect mothers' mental health. Having a third child increases women's probability to suffer from depression by 20% on the Euro-D scale and by 17% on reported depression. A third child induced by a multiple birth also increases the probability to use anti-depressant drugs by 10%. Contrasting this finding to the results shown in columns 2 and 4 suggests that the third child (rather than the sec-

ond) appears to be the critical margin for mothers. However, the adverse effect of children resulting from unexpected (and possibly undesired) multiple births is considerably larger (and significant) compared to the effect of a third child resulting from the sex composition of the first two children.

4.4 How do grown-up children affect parents' mental health?

Table 6 presents the estimated effects of additional children on the probability of experiencing specific crises. Similar to the results on mental health, we do not find consistent evidence for an effect of the third child resulting from the sex composition of the first two children on the probability of critical events for either sex. Contrasting to this result, children resulting from a multiple birth appear to affect their parents life course. The estimates for the effect of the second child (shown in columns 3 and 4) suggest that an additional child might even reduce the probability of particularly stressful periods in life. There is no evidence for an effect of the second child on periods of poor health status or on periods of financial hardship. The last two columns point out that the third child induced by a multiple birth at the second birth significantly affects the probability of crisis for both sexes. A third child increases the probability of experiencing periods of stress for men by 14.5% and for periods characterized by financial hardship by 13%. The probability of periods of stress is not increased by a third child for women. However, the third child significantly increases the likelihood for periods of poor overall health (by 15%) and financial hardship (by 13%).

Table 7 provides evidence for the relation between the experience of these critical events and mental health using the full sample. We regress our measures of mental health on the indicators for crises and the control variables used in all other regressions. Our results strongly back the hypothesis that critical periods in life are linked to mental health in old age. All of the critical events result in significant increases in the probability of depression in old age for both sexes. Periods of stress result in an increase of 4-8% in the probability of depression. Situations of financial hardship increase this risk by between 3 and 6%. Women are considerably more sensitive with respect to these events than men.

Taking the evidence from tables 6 and 7 together, our results back the hypothesis that children affect their parents' mental health status in old age by increasing the risk of experiencing critical periods earlier in life.

5 Conclusions

This article provided first evidence for the causal effect of having an additional child on her parents' probability of suffering from depression. Rather than looking at correlations we used instrumental variables for the number of children to estimate the magnitude of the causal effect. Our results point to heterogeneity in the effect of fertility on mental health. We find supportive evidence for quite large and significant positive effects for women using the twin birth instrument, i.e. having three children rather than two increases women's probability of having poor mental health by 10-22% depending on the indicator of mental health. The causal effect is heterogeneous in the sense that there is no evidence for a similar effect for men. There is also no significant evidence for such an effect when using the same sex instrument although the point estimates point to a detrimental effect for women. Moreover, we find no evidence for the transition from 1 to 2 children to negatively affect mothers' mental health status.

The results from our IV analyses are contrasting to the descriptive OLS estimates which do not point at a particular pattern in the relationship between the parity of children and mental health at higher ages.

The finding that a third child resulting from a twin birth is detrimental while a third child resulting from the sex composition does not appear to affect mental health can be attributed to the fact that our instruments identify different local average treatment effects. The multiple birth instrument forces individuals into a possibly unintended level of fertility which affects parents differently than a desired and anticipated increase in fertility. Moreover, the timing of births induced by the instruments differs: twin births result in the stress of raising two infants of equal age. Children resulting from the same sex instrument contrastingly are born in a consecutive order where parents decide upon the exact timing of births. This might explain the heterogeneity of the responses by the instrument choice that we observe. Moreover, since we did not find an effect of the same sex instrument on depression in old age, we conclude that it is not the stress of an additional childbirth that affects parents' mental health but rather the number of children and the circumstances of their respective births.

We propose an explanation for these findings. Children resulting from a multiple birth increase parents' probability of suffering financial shortages and increase women's probability of experiencing periods of particular bad overall health. These two mechanisms appear to be linked to mental health in old age and women react substantially more sensitive than men on these critical events. This finding also

implies that periods of dramatic financial shortages are likely to bear long-term mental costs in particular for women.

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References

Adda, J., C. Dustmann, and K. Stevens (2010): "The Career Cost of Children," *mimeo*.

Andersson, G., K. Hank, M. Rønsen, and A. Vikat (2006): "Gendering family composition: Sex preferences for children and childbearing behavior in the Nordic countries," *Demography*, 45(2), 255–267.

Angrist, J. (2004): "Treatment effect heterogeneity in theory and practice," *Economic Journal*, 114(494), C52–C83.

Angrist, J., and W. Evans (1998): "Children and their parents' labor supply: Evidence from exogenous variation in family size," *The American Economic Review*, 88(3), 450–477.

Angrist, J., V. Lavy, and A. Schlosser (2010): "Multiple experiments for the causal link between the quantity and quality of children," *Journal of Labor Economics*, 28(4), 773–824.

Becker, G. (1960): "An economic analysis of fertility," *Demographic and economic change in developed countries*, 11, 209–231.

Bernheim, B., A. Shleifer, and L. Summers (1985): "The strategic bequest motive," *The Journal of Political Economy*, 93(6), 1045–1076.

Black, S., P. Devereux, and K. Salvanes (2005): "The More the Merrier? The Effect of Family Size and Birth Order on Children's Education," *Quarterly Journal of Economics*, 120(2), 669–700.

——— (2010): "Small family, smart family? Family size and the IQ scores of young men," *Journal of Human Resources*, 45(1), 87–115.

Buber, I., and H. Engelhardt (2008): "Children's impact on the mental health of their older mothers and fathers: findings from the Survey of Health, Ageing and Retirement in Europe," *European Journal of Ageing*, 5(1), 31–45.

Bures, R., T. Koropeckyj-Cox, and M. Loree (2009): "Childlessness, Parenthood, and Depressive Symptoms Among Middle-Aged and Older Adults," *Journal of Family Issues*, 30(5), 670–687.

Burton, R. (1998): "Global integrative meaning as a mediating factor in the relationship between social roles and psychological distress," *Journal of Health and Social Behavior*, 39(3), 201–215.

Butcher, K., and A. Case (1994): "The effect of sibling sex composition on women's education and earnings," *The Quarterly Journal of Economics*, 109(3), 531–563.

Cáceres-Delpiano, J., and M. Simonsen (2010): "The toll of fertility on mothers wellbeing," *mimeo*.

Castro-Costa, E., M. Dewey, R. Stewart, S. Banerjee, F. Huppert, C. Mendonca-Lima, C. Bula, F. Reisches, J. Wancata, K. Ritchie, R. Tsolaki, R. Mateos, and M. Prince (2007): "Prevalence of depressive symptoms and syndromes in later life in ten European countries: The SHARE study," *The British Journal of Psychiatry*, 191(5), 393–401.

Coombs, R. (1991): "Marital status and personal well-being: A literature review," *Family Relations*, 40(1), 97–102.

Evenson, R., and R. Simon (2005): "Clarifying the relationship between parenthood and depression," *Journal of Health and Social Behavior*, 46(4), 341–358.

Gove, W., and M. Geerken (1977): "The effect of children and employment on the mental health of married men and women," *Social Forces*, 56(1), 66–76.

Grundy, E., and C. Tomassini (2005): "Fertility history and health in later life: a record linkage study in England and Wales," *Social Science & Medicine*, 61(1), 217–228.

Hank, K. (2010): "Childbearing history, later-life health, and mortality in Germany," *Population Studies*, 64(3), 275–291.

Hank, K., and H. Kohler (2000): "Gender preferences for children in Europe: empirical results from 17 FFS countries," *Demographic Research*, 2(1), 255–267.

Henretta, J., E. Grundy, L. Okell, and M. Wadsworth (2008): "Early motherhood and mental health in midlife: A study of British and American cohorts," *Aging and Mental Health*, 12(5), 605–614.

Hurt, L., C. Ronsmans, and S. Thomas (2006): "The effect of number of births on women's mortality: Systematic review of the evidence for women who have completed their childbearing," *Population studies*, 60(1), 55–71.

Konrad, K., H. Künemund, K. Lommerud, and J. Robledo (2002): "Geography of the Family," *American Economic Review*, 92(4), 981–998.

Koropeckyj-Cox, T. (1998): "Loneliness and depression in middle and old age: Are the childless more vulnerable?," *Journals of Gerontology Series B*, 53, 303–312.

Mirowsky, J., and C. Ross (2002): "Depression, parenthood, and age at first birth," *Social Science & Medicine*, 54(8), 1281–1298.

Mirowsky, J., and C. E. Ross (2001): "Age and the Effect of Economic Hardship on Depression," *Journal of Health and Social Behavior*, 42(2), 132–150.

Prince, M., F. Reischies, A. Beekman, R. Fuhrer, C. Jonker, S. Kivela, B. Lawlor, A. Lobo, H. Magnusson, M. Fichter, et al. (1999): "Development of the EURO-D scale–a European, Union initiative to compare symptoms of depression in 14 European centres," *The British Journal of Psychiatry*, 174(4), 330–338.

Rosenzweig, M., and K. Wolpin (1980): "Testing the quantity-quality fertility model: the use of twins as a natural experiment," *Econometrica*, 48(1), 227–240.

Ross, C., and J. Huber (1985): "Hardship and depression," *Journal of Health and Social Behavior*, 26(4), 312–327.

Ross, C., J. Mirowsky, and K. Goldsteen (1990): "The impact of the family on health: The decade in review," *Journal of Marriage and the Family*, 52(4), 1059–1078.

Schröder, M. (2010): "Retrospective Data Collection in the Survey of Health, Ageing and Retirement in Europe. SHARELIFE Methodology," *Mannheim Research Institute for the Economics of Aging*.

Spence, N. (2008): "The Long-Term Consequences of Childbearing: Physical and Psychological Well-Being of Mothers in Later Life," *Research on Aging*, 30(6), 722–751.

Umberson, D., and W. Gove (1989): "Parenthood and psychological well-being: Theory, measurement, and stage in the family life course," *Journal of Family Issues*, 10(4), 440–462.

Weissman, M., and M. Olfson (1995): "Depression in women: implications for health care research," *Science*, 269(5225), 799–801.

Table 1

List of Euro-D items to measure mental health

	Question item	**Indicator assumes 1 if respondent...**
1.	In the last month, have you been sad or depressed?	says yes
2.	What are your hopes for the future?	Fails to mention any hopes
3.	In the last month, have you felt that you would rather be dead?	mentions suicidal feelings or wishing to be dead
4.	Do you tend to blame yourself or feel guilty about anything?	mentions obvious excessive guilt or self-blame
5.	Have you had trouble sleeping recently?	reports trouble with sleep or recent change in pattern
6.	In the last month, what is your interest in things?	reports less interest than usual mentioned
7.	Have you been irritable recently?	says yes
8.	What has your appetite been like?	reports diminution in desire for food
9.	In the last month, have you had too little energy to do the things you wanted to do?	says yes
10.	How is your concentration? For example, can you concentrate on a television programme, film or radio programme?	reports difficulty in concentrating on entertainment
11.	What have you enjoyed doing recently?	Fails to mention any enjoyable activity
12.	In the last month, have you cried at all?	says yes

Table 2
Descriptive Statistics

Sample	no kids		one child		two children		more than two children	
	males	females	males	females	males	females	males	females
Age	65.25 (9.33)	66.2 (9.92)	65.8 (9.13)	65.31 (9.42)	65.24 (8.65)	64.26 (9.14)	67.66 (9.24)	67.17 (9.67)
Euro-D Score	1.66 (1.88)	2.54 (2.27)	1.65 (1.86)	2.45 (2.18)	1.50 (1.75)	2.40 (2.21)	1.84 (1.91)	2.73 (2.35)
Euro-D Score$\geq$ 4	0.17	0.31	0.16	0.31	0.14	0.30	0.19	0.35
Ever had depression	0.13	0.23	0.14	0.25	0.13	0.24	0.13	0.25
Use antidepressant drugs	0.03	0.08	0.04	0.08	0.03	0.07	0.03	0.08
Age first birth			29.86 (6.18)	26.6 (5.71)	27.49 (4.72)	24.28 (4.12)	26.16 (4.30)	22.83 (3.62)
ever multiple birth			0	0	0.011	0.007	0.06	0.06
Age youngest child			35.45	38.12	33.24	35.38	31.65	34.66
N	1378	1459	1588	1986	4130	5123	3197	4166

Standard deviations in parenthesis

Table 3
First Stage Results

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	*Number of Children*					
Sample	men, 2+children	women, 2+children	men, 1+b	women, 1+b	men, 2+b	women 2+b
IV	first 2 children same sex		mb at 1. birth		mb at 2. birth	
Same sex	0.079***	0.093***				
	(3.08)	(4.14)				
Twin at 1.birth			0.815***	0.826***		
			(7.07)	(7.55)		
Twin at 2.birth					0.817***	0.753***
					(6.72)	(7.00)
N	6835	9852	8303	11950	6793	9809
F-Stat excl.IV	9.46	17.17	50.00	56.98	45.16	49.02

t statistics in parentheses,* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
control variables include full set of age dummies, country fixed effects, education dummies, age at first birth in 5 years intervals, indicator for second survey wave. Sample restrictions are as follows: all individuals with at least two children (first two columns), all individuals with at least one reported birth (columns 3 and 4), individuals with at least 2 reported births (columns 5 and 6). *mb* indicates a multiple birth.

Table 4

OLS-results: Number of Children and Mental Health

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	*Euro-D Score≥4*		*depression ever*		*drugs for depression*	
Sample	Males	Females	Males	Females	Males	Females
Childless	-	-	-	-	-	-
child 1	-0.000845	-0.0100	0.0107	0.00547	0.0104	0.00288
	(-0.07)	(-0.65)	(0.87)	(0.38)	(1.60)	(0.32)
child 2	-0.0198*	-0.0167	-0.00547	-0.00487	0.0000833	0.00210
	(-1.82)	(-1.27)	(-0.53)	(-0.39)	(0.02)	(0.27)
child 3	-0.00939	-0.0255*	-0.00446	0.00258	-0.00323	0.00402
	(-0.77)	(-1.76)	(-0.38)	(0.19)	(-0.53)	(0.47)
child 4	0.0200	0.000758	0.00456	0.00185	0.0108	-0.00405
	(1.24)	(0.04)	(0.30)	(0.10)	(1.33)	(-0.36)
child 5+	0.0348*	0.0469**	-0.0276	0.00972	-0.00385	0.00494
	(1.80)	(2.29)	(-1.51)	(0.50)	(-0.40)	(0.40)
N	10935	13513	10935	13513	10935	13513

Clustered standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Control variables include age at first birth (in 5 year intervals), country fixed effects and full set of age dummies. Omitted category: childless individuals.

Table 5

The effect of children on mental health

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	men,2+c	women,2+c	men,1+b	women,1+b	men,2+b	women,2+b
IV	same sex		1.birth is mb		2.birth is mb	
Dependent Variable:	*Euro-D Score≥4*					
Number of Children	-0.108	0.0506	0.0665	0.0195	-0.0756	0.204**
	(-0.93)	(0.52)	(1.46)	(0.39)	(-1.46)	(3.17)
Dependent Variable:	*Ever had depression*					
Number of Children	-0.0368	0.149	0.0438	0.0299	0.0634	0.173**
	(-0.36)	(1.49)	(1.04)	(0.62)	(1.34)	(2.86)
Dependent Variable:	*Antidepressant Drugs*					
Number of Children	-0.0451	0.0843	0.000177	-0.0626*	-0.00725	0.100**
	(-0.81)	(1.36)	(0.01)	(-2.01)	(-0.29)	(2.66)
N	6835	9852	8303	11950	6793	9809

t statistics in parentheses, $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Control variables include age at first birth in 5 years intervals, country fixed effects and full set of age dummies.
Sample restrictions are as follows: all individuals with at least two children (first two columns), all individuals with at least one reported birth (columns 3 and 4), individuals with at least 2 reported births (columns 5 and 6).
mb indicates a multiple birth.

Table 6

PATHWAYS FOR THE RELATIONSHIP BETWEEN FERTILITY AND MENTAL HEALTH

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	men,2+c	women,2+c	men,1+b	women,1+b	men,2+b	women,2+b
IV	same sex		1.birth is mb		2.birth is mb	
Dependent Variable:	*period of stress*					
Number of Children	-0.0922	-0.00748	-0.0938	-0.139**	0.145**	0.0417
	(-0.64)	(-0.07)	(-1.61)	(-2.48)	(2.08)	(0.66)
Dependent Variable:	*period of poor health*					
Number of Children	-0.147	0.0906	-0.0431	-0.00187	0.0638	0.148**
	(-0.97)	(0.85)	(-0.73)	(-0.03)	(0.95)	(2.27)
Dependent Variable:	*period of financial hardship*					
Number of Children	-0.0377	0.131	-0.0435	-0.00211	0.133**	0.133**
	(-0.35)	(1.48)	(-0.98)	(-0.05)	(2.52)	(2.53)
N	6835	9852	8303	11950	6793	9809

t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Each coefficient represents one regression. Control variables include age at first birth in 5 years intervals, country fixed effects and full set of age dummies. Sample restrictions are as follows: all individuals with at least two children (first two columns), all individuals with at least one reported birth (columns 3 and 4), individuals with at least 2 reported births (columns 5 and 6). *mb* indicates a multiple birth.

Table 7
Crises and Depression

Dependent Variable:	(1)	(2)	(3)	(4)
	euro-D Score≥4		*depression ever*	
	Males	Females	Males	Females
Period of stress	0.0364***	0.0590***	0.0689***	0.0765***
	(4.49)	(6.72)	(8.98)	(9.15)
Period of poor health	0.112***	0.125***	0.0690***	0.112***
	(14.07)	(14.24)	(9.14)	(13.50)
Period of financial hardship	0.0314***	0.0608***	0.0316***	0.0537***
	(3.04)	(5.66)	(3.22)	(5.25)
N	9452	11950	9452	11950

t statistics in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Control variables include age at first birth in 5 years intervals, country fixed effects and full set of age dummies. *mb* indicates a multiple birth.