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Research Article

Late-life health effects of teenage motherhood

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Abstract

BACKGROUND
Teenage motherhood has been associated with a host of adverse outcomes over the life cycle. Less, however, is known about the impact of teenage motherhood on health later in life.

OBJECTIVE
To study the impact of teenage motherhood on late-life health, using a retrospective survey of almost 12,000 women aged 50+ from 13 European countries containing detailed information on early-life circumstances.

METHODS
We develop linear models of the association between teenage motherhood and late-life health outcomes. We control for early-life factors parametrically as well as through propensity score matching. In addition, we employ recently developed methods to derive consistent lower-bound estimates for the causal impact of teenage motherhood on late-life health outcomes.

RESULTS
We find that teenage mothers experience substantially poorer self-reported late-life health and are more likely to display depressive symptoms than nonteenage mothers. This result remains after controlling for early-life as well contemporaneous socioeconomic conditions.

CONTRIBUTION
We exploit recently developed empirical techniques to derive consistent lower bounds of the causal impact of teenage motherhood on health later in life using a cross-national survey of early-life and contemporaneous socioeconomic conditions.

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1. Introduction

In an ageing society, the health of older people is an important policy issue from an individual as well as a collective perspective. From an individual point of view, good late-life health ensures that the increase in longevity experienced around the world over the last 60 years translates into healthy life years. From a collective point of view, healthy ageing ensures that longevity does not put undue pressure on the welfare state. Hence, most countries affected by population ageing engage in policy debates aimed at understanding the drivers of healthy ageing. These debates often focus on events during childhood and adolescence that are related to late-life health outcomes so that at-risk groups can be targeted before the health risk has materialized.

In this paper we analyse one such group in detail. In particular, we study the impact of teenage motherhood on late-life health outcomes among women aged 50+ from 13 European countries. Because of the long timespan between teenage motherhood and late-life health outcomes, we complement our analysis by studying some of the potential mechanisms connecting the two events.

The impact of teenage motherhood on a host of outcomes has been in the forefront of economic, sociological, and demographic research for much of the last 30 years (see Section 2 for an overview). To some extent, this interest can be attributed to the fact that the identification of the causal relationship is hindered by numerous confounding factors. Such factors include parental background and women's pre-motherhood characteristics, both of which are known to be important predictors of teenage motherhood as well as later outcomes. Indeed, much of the discussion in the literature has dealt with what the best way is to identify the true underlying relationship between early childbearing and later outcomes.

The challenge of any parametric identification strategy is to find a sufficiently broad set of background characteristics so that the impact of teenage motherhood on the outcome of interest can be identified. Therefore, we use some of the innovative features of a European retrospective survey, SHARELIFE, to control for a broad set of relevant background characteristics. As our identification strategy is based on selection on observables, we follow Altonji, Elder, and Taber (2005), Bellows and Miguel (2009), and Oster (forthcoming) to assess the role of unobservables on the impact of teenage motherhood on late-life health. Essentially, this approach allows us to consider the potential impact of relevant background characteristics that, although not directly observed, are correlated with the characteristics that we do observe. Moreover, to compare our results to alternative identification techniques we also employ propensity score matching (PSM), which – in the current context – was championed by Levine and Painter (2003).

Despite the prominence of teenage motherhood in economic research, only a little is known about its consequences at later stages of the life cycle. Indeed, as we discuss in Section 2, the majority of the existing literature focuses on the consequences of teenage motherhood on outcomes such as educational attainment, labour market performance, and health during early adulthood. Webbink, Martin, and Visscher (2008) and Hotz, McElroy, and Sanders (2005) provide welcome exceptions to this pattern by focusing on, respectively, health and labour market outcomes during adulthood. The former show that beyond the age of 40 teenage mothers are more likely to be overweight, whereas the latter show that the socioeconomic consequences of early childbearing tend to be short-lived due to offsetting behaviour by teenage mothers.

Beyond the domain of economics, however, a growing literature is addressing the association between early childbearing and health outcomes – both general and mental – later in life. Grundy and Read (2015), indeed, use data from the English Longitudinal Study of Ageing to establish this association and, in developing their results further, highlight the fact that wealth, as an indicator of socioeconomic status, mediates the association to some extent. Without being exhaustive, a similar pattern is established by Pirkle et al. (2014) in a cross-national sample containing developed as well as developing countries, while Patel and Sen (2012) reveal this pattern for a representative sample of the United States 1979 youth cohort and Hobcraft (2008) for the 1958 and 1970 British cohorts.[3] A common limitation mentioned in a number of these contributions is that, on the whole, the interpretation of the found effects is hampered by the endogenous selection of disadvantaged girls into teenage motherhood.

Hence, we aim to build upon the existing literature by looking further down the life cycle than has been usual in the economics literature and focusing more closely on the isolation of causal effects than is usual in the current demographic and sociological literature. To this end, we combine the identification strategy of Altonji, Elder, and Taber (2005) and Oster (forthcoming) with two indicators of late-life health: self-reported health and mental health as assessed by using the EURO-D scale for depressive symptoms (Prince et al. 1999a, 1999b). The latter outcome indicator stands out, as depression is a leading cause of increases in disability-adjusted life years worldwide (Institute for Health Metrics and Evaluation 2010). We close our analysis by considering the influence of life-cycle socioeconomic factors, such as educational attainment and relationship stability, on the links between teenage motherhood and late-life health outcomes.

The remainder of the paper is set up as follows. The next section provides a literature review on teenage motherhood. Section 3 introduces the data. Section 4

[3] Other valuable contributions in this field include, but are not limited to, Mirowsky (2005), Henretta (2007), Henretta et al. (2008), Mollborn and Morningstar (2009), Read, Grundy, and Wolf (2011), and Grundy and Foverskov (2016).

discusses the empirical results. Section 5 discusses the results, limitations, and conclusions of the paper.

2. Literature review on teenage motherhood[4]

The literature on the drivers of teenage motherhood suggests characteristics of the parental household as well as educational attainment early in school as potential determinants of early childbearing (Imamura et al. 2007; Kearney and Levine 2014; Grundy and Foverskov 2016). From a rational choice perspective, both factors can be seen as indicative of the economic costs associated with early childbearing. Nevertheless, it is important to observe that these same factors have been identified as drivers of late-life outcomes as well (see Almond, Currie, and Duque (2017) for a review), which begs the question: does an observed impact of teenage motherhood on late(r)-life outcomes simply reflect the conditions in which the woman grew up or does it have an effect in its own right?

Until the seminal study of Geronimus and Korenman (1992), much of the literature focused on cross-sectional estimates, albeit with controls for potential confounding factors, and found quite substantial negative effects of early childbearing on a host of later-life outcomes. Geronimus and Korenman (1992) took stock of these contributions and showed that, if parental background is controlled for by focusing on siblings, the previously identified negative impact of early childbearing on the socioeconomic status of the women becomes smaller. Holmlund (2005) extended the siblings approach by controlling for pre-motherhood educational outcomes, which is a factor that is unique to each sibling. Using this approach, she finds that controlling for sibling-specific factors further reduces the impact of early childbearing on later-life outcomes – educational attainment in her case. To address the problem of sibling-specific effects, Webbink, Martin, and Visscher (2008) focus on twin sisters and study how teenage pregnancy affects medium-term health behaviour such as smoking and obesity.

An alternative identification strategy has been to use instrumental variables (IV). Hotz, Mullin, and Sanders (1997), for instance, use miscarriages as an IV for early childbearing. In accordance with the findings from the sibling approach, they show that the impact of early childbearing is much less pronounced if the potential endogeneity of early childbearing is ignored. In fact, they find that teenage mothers have higher earnings and hours worked than mothers who delayed childbearing. Ashcraft,

[4] The literature on the consequences of early childbearing is so vast that it is neither possible nor desirable to provide a full account of even the most recent additions. Therefore, this review is aimed at providing a general impression of the main empirical approaches and does not make any claim to completeness. Readers looking for a more complete account are referred to the skilful review in Kane et al. (2013).

Fernandez-Val, and Lang (2013), however, show that this approach entails some problems of its own, as miscarriage may not be random due to the social dimension of abortion choice. Controlling for such effects, they show that there is a negative impact of teenage motherhood on, among other things, educational attainment, hours worked, and earnings. Proponents of other important IV strategies include Ribar (1994), who uses age at menarche, and Klepinger, Lundberg, and Plotnick (1999), who use, among other things, proximity to abortion facilities. While for our sample we do not have information for the latter, we may note that the former suffers from potential endogeneity itself, as age at menarche has been found to be driven by socioeconomic factors (Reagan et al. 2012).

The third dominant approach in the literature is to focus on propensity score matching (PSM), which aims at constructing a synthetic control group to which the treated group (i.e., teenage mothers) can be compared. Levine and Painter (2003) pioneered this approach and showed that, as with the sibling and IV approaches, the pure impact of early childbearing on educational attainment is negative but substantially smaller than a casual reading of cross-sectional evidence would suggest.

However, more than any other strand of the literature, it is the parametric identification literature that has made significant inroads in elucidating not only the association between early childbearing and health outcomes later in life, but also the mechanisms by which the two are linked. Grundy and Foverskov (2016), for instance, highlight the role of relationship stability, educational attainment, and socioeconomic status as potential pathways between teenage motherhood and health later in life.

To summarize, the existing literature on the impact of teenage motherhood has typically, albeit with some exceptions, reported a negative impact on a variety of outcomes, with the most dominant focus being on educational attainment and labour market outcomes. Complementing these studies, in what follows we will analyse the impact of teenage motherhood on health outcomes late in life employing two common identification strategies, parametric and matching, as well as one that is new to this literature, selection on unobservables and its associated determination of consistent lower-bound estimates. In addition, in order to understand the link between teenage motherhood and late-life health outcomes, we will focus on life-cycle factors such as relationship stability, educational attainment, and socioeconomic status.

3. Data and descriptive statistics

For our empirical analysis we use SHARELIFE, which is a retrospective study conducted as part of the Survey of Health, Ageing and Retirement in Europe (SHARE). SHARE is a longitudinal survey that collects an elaborate series of indicators of, among

other things, current health and socioeconomic status for a representative sample of European individuals aged 50+ and their partners. In 2008 and 2009, the third wave of data collection invited respondents to provide retrospective information on their life histories instead of their current situation. This SHARELIFE survey interviewed 28,836 (male and female) respondents from 13 European countries.[5] Life histories providing information on early-life conditions were collected using an event history calendar (EHC): see Blane (1996) and Belli (1998). In the EHC, the respondent's life is represented graphically by a grid that is filled in throughout the course of the interview, starting with life events that are easy to remember accurately, such as the birth of their children. To assess the quality of the responses, Havari and Mazzonna (2015) provide a comprehensive treatment of the validity of the self-reported questions in SHARELIFE. They conclude that respondents remember their early-life conditions well. For our empirical analysis, we select only female respondents born between 1920 and 1957 (12,515 observations). From this sample, we drop all respondents who have missing values for at least one of the variables used in our estimation:[6] fortunately, these represent only 6.1% of the total sample. Thus, the final sample consists of 11,748 respondents who were born between 1920 and 1957.[7] For these respondents we obtain information on later-life health outcomes from the second wave of SHARE, which was conducted in 2006–2007.[8] SHARE and SHARELIFE have been used extensively to study the impact of circumstances during childhood and adolescence on various late(r)-life outcomes. For instance, in a paper related to ours, Angelini, Howdon, and Mierau (2018) analyse the effects of childhood socioeconomic status on late-adulthood mental health. However, to the best of our knowledge, we are the first to use this rich source of data to study the long-term impact of teenage motherhood.

3.1 Teenage motherhood

Our main independent variable of interest is whether or not the respondent had children at a young age. In line with the definition of the World Health Organization (Treffers 2004), we define a respondent as a teenage mother if she had her first child before the

[5] Austria, Belgium, the Czech Republic, Denmark, France, Italy, Germany, Greece, the Netherlands, Poland, Spain, Sweden, and Switzerland.

[6] This sample also includes women who have never had a child. Restricting the sample to include only mothers (regardless of when they had their first child) does not change the results, which are available on request.

[7] As this period covers the Second World War we also performed our empirical analysis dropping the cohort aged 13 to 19 during the war. This does not change our results, which are available on request.

[8] In SHARELIFE there was no refresher sample; the population includes only people previously interviewed in SHARE (Schröder 2011).

age of 20. As indicated in Table 1, about 8% of our sample can be considered to be teenage mothers. In terms of numbers, this is 911 women. The percentage of teenage mothers varies by country from a low of 3.5% in Switzerland to a high of 15.3% in Austria. When examining the prevalence by cohort, we find an increase in teenage pregnancies after the Second World War during the baby-boom years. Including teenage mothers, the average age at first birth in our sample ranges from 23 in Poland to 26 in Switzerland.

Table 1: Descriptive statistics and subgroup comparisons of the sample of women aged 50+ from the Survey of Health Ageing and Retirement in Europe (N = 11,748)

Name	Min.	Max.	Mean (All)	Mean (TM = 1)	Mean (TM = 0)	Mean (TM = 0, matched sample)
Individual characteristics						
Teenage mother (TM)	0	1	0.077	1	0***	N/A
Age	49	87	64.414	62.869	64.544***	62.682
Late-life health outcomes						
Absence of depression	0	1	0.687	0.615	0.693***	N/A
Self-reported very good or excellent health	0	1	0.264	0.195	0.269***	N/A
Childhood characteristics						
Maths performance above average	0	1	0.305	0.241	0.311***	0.250
Language performance above average	0	1	0.392	0.299	0.399***	0.322
Self-reported very good or excellent health	0	1	0.670	0.688	0.668	0.668
Rooms per person	0	8.75	0.710	0.610	0.719***	0.590
Facilities	0	5	1.956	1.608	1.985***	1.554
Books	1	5	2.098	1.828	2.120***	1.755
Low parental occupation	0	1	0.803	0.889	0.795***	0.890
Parent drinks	0	1	0.082	0.131	0.078***	0.123
Parent smokes	0	1	0.610	0.605	0.611	0.617
Missing father	0	1	0.090	0.155	0.084***	0.130
Missing mother	0	1	0.038	0.048	0.037*	0.048
Parents homeowner	0	1	0.539	0.482	0.543***	0.489
Living in rural area	0	1	0.464	0.466	0.463	0.460
Pathways						
Medium education	0	1	0.283	0.246	0.286**	N/A
Higher education	0	1	0.195	0.077	0.205***	N/A
Divorce	0	1	0.135	0.228	0.127***	N/A
Logarithm of income	2.83	13.81	9.848	9.667	9.864***	N/A

Note: */**/*** indicate significant differences at the 10%/5%/1% levels based on student's t-tests of group mean comparisons.

3.2 Late-life health outcomes

Following the literature on late-life health outcomes (e.g., Angelini, Howdon, and Mierau 2018), we select two health outcomes as our dependent variables of interest.

The first, self-reported general health, is assessed by asking the respondents how they would consider their current health status. Using this indicator, we construct a variable that equals 1 if the respondent was in very good or excellent health and 0 otherwise. The second, mental health, is assessed using the EURO-D depression scale (Prince et al. 1999a, 1999b). From this scale we construct a variable that equals 1 if the respondent scored less than 4 points on the scale – indicating an absence of depressive symptoms – and 0 otherwise. This cut-off point has been validated across Europe, against a variety of clinically relevant indicators (Prince et al. 1999a, 1999b). Our decision to focus on depression is driven by the fact that it is the leading cause of an increase in disability-adjusted life years worldwide (Institute for Health Metrics and Evaluation 2010) but that effective treatment is hampered by a lack of recognition of its symptoms and causes (Alexopoulos 2005). Table 1 provides descriptive statistics for both of the late-life health outcomes. As can be seen, a little more than a quarter of the population report having very good or excellent health and roughly 70% of the population are not currently suffering from depressive symptoms. To provide some preliminary evidence on the relationship between teenage motherhood and late-life outcomes, we split the sample and indicate subsample averages for the group of teenage mothers and all other women in the sample. This reveals that women who had a child at a young age have significantly poorer self-reported health and report having depressive symptoms more frequently.[9]

3.3 Pre-motherhood controls

As outlined above, a key challenge in studying the relationship between early childbearing and late-life health outcomes is the presence of confounding factors that are potentially driving both the process behind having children early and late-life health. As suggested by the literature, these can be classified into three main groups. First, the characteristics of the parental household. For this we use the following indicators (measured when the woman was aged ten): the rooms per person in the household, the number of facilities (such as bathroom, kitchen, etc.), a categorical indicator of the number of books in the household (ranging from 1 if there are no books or very few books (0–10) in the household to 5 if there are more than 200) and whether or not the house was owned by the parents. Second, the characteristics of the parents: the skill level of the main breadwinner, smoking and drinking status of either parent, and whether the father or mother was missing. These are measured by whether the main

[9] In a further analysis we also considered the impact of teenage motherhood on grip strength – an objectively observable health indicator; this reveals the same pattern as for self-reported health and mental health used in our main analysis. Results available on request.

breadwinner had a low-skill occupation or not, by whether either parent smoked or drank, and by whether either the father or the mother was missing in the household when the woman was aged ten. Third, individual characteristics of the woman when she was aged ten. For this we rely on self-rated maths and language performance, as well as self-reported health status. The data and its summary statistics are presented in Table 1 alongside the remaining variables. As above, we also display the subgroup averages of the childhood controls.

Although the evidence is just descriptive, a number of interesting conclusions can be drawn. First, we observe that women who had children at a young age on average had worse language and maths abilities well before they had their first child. Second, teenage mothers on average come from quite disadvantaged backgrounds. In particular, they grew up in households where there were fewer books, scarce facilities, with parents who were in low-skilled occupations and drank, and, quite regularly, the father was not present in the household. As each of these factors is also known to adversely affect outcomes later in life, it is not clear from these descriptive statistics whether the negative relationship between early childbearing and worse health later in life is, in fact, a causal one or whether early childbearing is just one pathway by which a disadvantaged background translates into worse health later in life.

3.4 Life-cycle factors

In our analysis we focus on three life-cycle factors: educational attainment, income, and relationship stability. Each of these has been associated with teenage motherhood in its own right and has also been shown to be related to late-life health. We measure educational attainment with an indicator for higher education (ISCED code equal or greater than 4, which corresponds to post-secondary and tertiary education) and one for medium education (ISCED equal to 3). For income, we use information on current household income adjusted for purchasing power. To analyse the role of relationship stability, we use the retrospective information from SHARELIFE to construct an indicator for whether the woman has divorced at least once during her life. Table 1 shows that teenage mothers, on average, have lower completed educational attainment, have a lower income, and are more likely to have experienced divorce. Such preliminary bivariate results suggest that these factors may be potential pathways from teenage motherhood to late-life health outcomes.[10]

[10] In a similar analysis we have found that marital status at the time a teenage mother's child is born does not affect the impact that teenage motherhood has on late-life health outcomes. Results are available on request.

4. Empirical results

Our approach in this paper is to return to the cross-sectional analysis of teenage motherhood and to employ the richness of the SHARELIFE data in order to control for potential confounding factors. However, in spite of the quality and range of the control variables that we have access to, there may still be a residual amount of selection that is unaccounted for. To assess the extent of the bias created by such selection on unobservables, we employ the methods of Altonji, Elder, and Taber (2005) in the implementation of Bellows and Miguel (2009) and its extension by Oster (forthcoming). To contrast our results with the rest of the literature, we also employ an identification strategy based on propensity score matching as suggested by Levine and Painter (2003). Having established the relationship between teenage motherhood and late-life health, we then turn to the role of life-cycle socioeconomic factors.

4.1 Parametric identification

Our main estimation results are presented in Table 2. To highlight the importance of controlling for individual pre-motherhood background characteristics, we start in column 1 with a logit specification that, in addition to the indicator of teenage motherhood, includes only age, age squared, and country dummies.[11] Essentially, in this set-up the estimated parameter of the teenage motherhood indicator represents the cross-sectional correlation (after controlling for a quadratic term in age and country of origin). The results show that early childbearing has a statistically significant negative association with the probability of being in very good or excellent health and not having depressive symptoms later in life.

As discussed at length above, this result cannot be interpreted causally because many of the factors driving teenage motherhood may also drive the health outcomes. Therefore, in column 2 we add a series of pre-motherhood characteristics that are known to affect early childbearing and late-life health. While the association of early childbearing with self-reported health remains negative, its magnitude decreases substantially. In column 3 we add additional indicators of parental behaviour (whether they drank or smoked). We see that the association of early childbearing with self-reported health declines further, albeit by substantially less than it declined before.

In columns 4–6 of Table 2 we repeat the same exercise but using the absence of depression as an alternative indicator. The table reveals the same pattern in the sense that consistently controlling for additional factors reduces but does not nullify the

[11] As an alternative, we performed our analysis using birth-year dummies. This did not materially affect the results, which are available on request.

negative association between teenage motherhood and the probability of not being depressed.

Table 2: Late-life health consequences of early childbearing on self-reported health and the absence of depression in logit models with and without adjustment for childhood characteristics

	Logit model					
Dependent variable	**Self-reported health**			**Absence of depression**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Teenage mother	–0.557***	–0.409***	–0.406***	–0.402***	–0.333***	–0.315***
	(0.092)	(0.094)	(0.094)	(0.075)	(0.076)	(0.076)
Age	–0.106***	–0.063*	–0.062*	0.168***	0.205***	0.201***
	(0.036)	(0.036)	(0.036)	(0.030)	(0.031)	(0.031)
Age^2	0.000	0.000	0.000	–0.001***	–0.002***	–0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Maths performance		0.103*	0.101*		0.224***	0.222***
		(0.054)	(0.054)		(0.052)	(0.053)
Language performance		0.220***	0.220***		–0.040	–0.039
		(0.053)	(0.053)		(0.050)	(0.050)
Self-reported health (at ten)		0.665***	0.665***		0.390***	0.383***
		(0.054)	(0.054)		(0.045)	(0.045)
Rooms per person		0.149**	0.144**		0.235***	0.205***
		(0.066)	(0.066)		(0.065)	(0.065)
Facilities		0.050***	0.049***		0.025	0.021
		(0.018)	(0.018)		(0.017)	(0.017)
Books		0.119***	0.119***		0.073***	0.068***
		(0.024)	(0.024)		(0.024)	(0.024)
Low parental occupation		–0.257***	–0.257***		0.028	0.032
		(0.061)	(0.061)		(0.061)	(0.061)
Missing father		–0.083	–0.102		–0.137*	–0.160**
		(0.094)	(0.094)		(0.077)	(0.078)
Missing mother		–0.152	–0.147		–0.091	–0.078
		(0.136)	(0.136)		(0.113)	(0.113)
Parents homeowner		0.009	–0.003		0.003	–0.019
		(0.052)	(0.052)		(0.047)	(0.047)
Living in rural area		–0.011	–0.011		0.074	0.069
		(0.053)	(0.053)		(0.048)	(0.048)
Parent drinks			–0.101**			–0.107**
			(0.050)			(0.045)
Parent smokes			–0.060			–0.483***
			(0.087)			(0.073)
Country fixed effects	YES	YES	YES	YES	YES	YES
Pseudo-R^2	0.116	0.145	0.146	0.058	0.069	0.073
Observations	11,748	11,748	11,748	11,748	11,748	11,748

Note: */**/*** indicate statistical significance at the 10%/5%/1% levels, standard errors in brackets.

To appreciate the magnitude of the effect of teenage motherhood on late-life health, in Table 3 we present average marginal effects. As in Table 2, we see that the cross-sectional correlation is substantially higher than the effect found in the extended

model. Indeed, the negative average marginal effect of teenage motherhood drops from 8.5 percentage points to 6.2 percentage points and from 8.4 percentage points to 6.4 percentage points for self-reported health and the absence of depression respectively. Interpreting the lower values, we can say that, after controlling for a host of childhood characteristics, teenage mothers are 6.2 (6.4) percentage points less likely to report very good or excellent health (not having depressive symptoms).

Table 3: Average marginal effect of teenage motherhood on late-life health outcomes associated with estimation results in Table 2

	Dependent variable: Self-reported health		
	(1)	(2)	(3)
Teenage mother	–0.085***	–0.062***	–0.062***
	(0.013)	(0.013)	(0.013)
	Dependent variable: Absence of depression		
	(4)	**(5)**	**(6)**
Teenage mother	–0.084***	–0.068***	–0.064***
	(0.016)	(0.016)	(0.016)

Notes: Estimation and specification are as in Table 2. */**/*** indicate statistical significance at the 10%/5%/1% levels, standard errors in brackets.

4.2 Selection on unobservables

Although we include a broad set of control variables, our results could still be biased by the presence of unobservable factors that influence both the probability of being a teenage mother and late-life health. Such factors include, but are not limited to, interesting items such as neighbourhood characteristics, peers, and school quality. Importantly, while not observed in the SHARELIFE survey, such items are likely to be correlated with the background characteristics that we do observe. Therefore, to measure the potential bias arising from unobservables, we follow the methodology proposed by Altonji, Elder, and Taber (2005): first, in the implementation of Bellows and Miguel (2009);[12] second, taking into account more recent suggestions about how to implement this method by Oster (forthcoming) and González and Miguel (2015).

Essentially, these approaches exploit the assumption that observed and unobserved factors are correlated. Therefore, studying the magnitude of the selection effects due to observed factors provides us with an indication of how large the impact of unobserved factors would have to be in order for any estimated impact of teenage motherhood on health outcomes to be completely captured by unobserved factors. To provide this indication it is necessary to consider the reduction in the magnitude of the estimated

[12] Nunn and Wantchekon (2011) use a slight variation of this method.

effect that follows from the inclusion of variables capturing selection (i.e., the observed selection variables). The advantage of this type of approach is that, in the absence of identification strategies such as instrumental variables and sibling effects, we can also get a better approximation of the causal effect.

To implement the Bellows and Miguel method we need to estimate two regressions: one with a restricted set of controls and one with the full set of controls. Let $\hat{\beta}^F$ be the coefficient of teenage motherhood estimated from the full model and let $\hat{\beta}^R$ be the estimated coefficient from the restricted model. The Altonji ratio $\hat{\beta}^R/(\hat{\beta}^R - \hat{\beta}^F)$ then tells us how much stronger the selection on unobservables must be with respect to the selection on observables to explain away the entire effect of teenage motherhood on late-life health. Turning to Table 2 once more allows us to implement the above method in our context. In particular, focusing on self-reported health, the Altonji ratio becomes $0.557/(0.557 - 0.406) = 3.69$. Similarly, the Altonji ratio for the absence of depression is 4.62. These results imply that the impact of unobserved variables would have to be respectively 3.7 and 4.6 times larger than the impact of observed variables for the impact of teenage motherhood on late-life health to be nullified.

As noted by, inter alia, González and Miguel (2015), an important, yet untestable, assumption underlying the bounding exercise above is that the variance of the observable control variables equals the variance of the unobservable control variables. As a possibility, to circumvent this issue, Oster (forthcoming) suggests that a lower bound of, in our case, the impact of teenage motherhood on late-life health can be derived using the following formula:[13]

$$\hat{\beta}^* = \hat{\beta}^F - \left(\hat{\beta}^R - \hat{\beta}^F\right) \times \frac{R^{MAX} - R^F}{R^F - R^R}, \tag{1}$$

where $\hat{\beta}^F$ and $\hat{\beta}^R$ are defined as above, R^R is the R^2 of the restricted model, R^F of the full model, and R^{MAX} is the maximum R^2. Importantly, as discussed above, this generalization of the earlier approaches takes into account the relevance of the additional control variables. However, while R^R and R^F are straightforward to obtain, R^{MAX} is more contentious. To this end we consider two options. First, following Bellows and Miguel (2009), we let $R^{MAX} = R^F + (R^F - R^R)$, implying that $\hat{\beta}^* = 2\hat{\beta}^F - \hat{\beta}^R$, so that the R^2 and their movement become irrelevant.[14] Second, as suggested by Oster (forthcoming), we set $R^{MAX} = \min(1.3R^F, 1)$, where the 1.3

[13] By construction, the lower bound does not have a confidence bound; see also Oster (forthcoming).

[14] This is not necessarily a disadvantage as the ensuing formula ($\hat{\beta}^* = 2\hat{\beta}^F - \hat{\beta}^R$) serves as a quick test for assessing a consistent estimate that does not require knowledge of the underlying R^2.

multiplication factor was derived from an analysis of randomized control trials published in leading economics journals over the period 2008–2013.

Considering self-reported health, using the pseudo-R^2 associated with the first and third columns of Table 2 provides $\hat{\beta}^* = -.255$ using the Bellows and Miguel approach and $\hat{\beta}^* = -.186$ using the Oster approach. Applying the same technique to the absence of depression provides $\hat{\beta}^* = -.228$ and $\hat{\beta}^* = -.186$ for the two respective alternatives. Using the – more conservative – Oster correction, focusing on the marginal effects implies that teenage mothers are at least 2.8 (3.4) percentage points less likely to report very good or excellent health (not having depressive symptoms).[15] Importantly, we observe that the lower bounds for the marginal effects are substantially larger than zero.

4.3 Propensity score matching

An alternative strategy for assessing the impact of early childbearing on late-life health outcomes is the propensity score matching approach, which was popularized in the current context by Levine and Painter (2003). The thinking behind the PSM approach is to construct a synthetic control group and to compare the late-life health outcomes of this group to the treatment group.[16] This consists of four steps. First of all, a prediction model is estimated to identify the relevant factors driving the process by which some women become teenage mothers and others do not. Second, using the outcome of the first step, a control group is identified consisting of women who are equivalent to teenage mothers in all respects apart from the early childbearing itself. Third, every treated woman is matched to a control woman hereby making sure that the two are as alike as possible. Fourth, the women in the treatment and the control groups are compared with each other in terms of their late-life health outcomes. In this regard it may be noted that the objective is not so much to find the best prediction model of teenage motherhood but to have a prediction model with which a control group can be constructed that is as similar as possible to the treatment group. Hence, between steps one and two, the latter is more important.

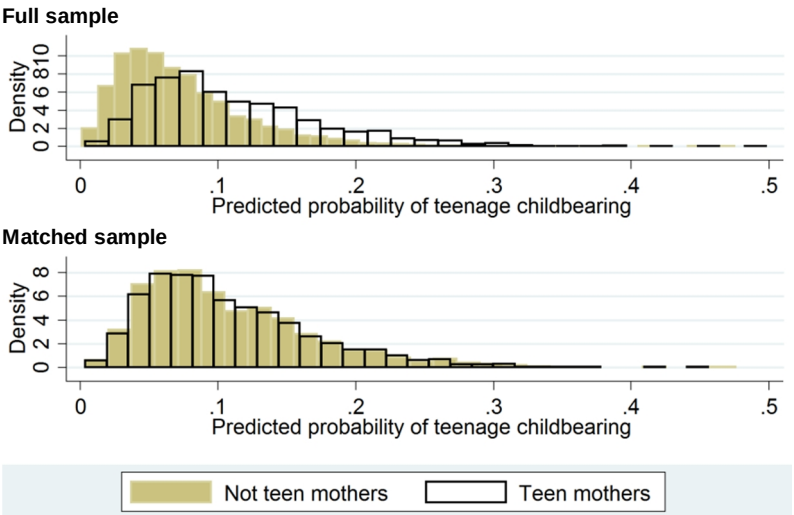
In order to maintain comparability between the parametric identification approach and the matching approach, we use the control variables as in column 3 of Table 2 (including the country fixed effects) to predict whether the woman turned out to be a teenage mother based on a logit model. Using this model, we then match each teenage

[15] Strictly speaking, Equation (1) applies to a linear model. If we re-estimate the specifications in Table 2 using a linear probability model we obtain, after the Oster correction, marginal effects of 2.2 and 3.6 percentage points for, respectively, health and depression.

[16] Even though we do not perform an experiment, we follow the vocabulary of the PSM literature, in which it is common to speak of treatment and control groups.

mother to a woman who is as similar as possible to her in all respects apart from being a teenage mother. For the matching, we use the nearest-neighbour method, but using caliper and radius matching as alternatives does not change the results (available on request). In the final column of Table 1 we display the means of the background characteristics for women in the control group of our matched sample. The balancing test reveals that by employing the matching approach there is no difference any more between the sample means of teenage and nonteenage mothers (see Rosenbaum and Rubin (1985) for additional discussion on this point). As suggested by Sianesi (2004), an alternative way of determining the quality of the matches is to focus on the (pseudo) R^2 of repeating the initial prediction model on the matched sample. In our case that is 0.00, indicating that the matching was successful. Finally, in Figure 1 we visualize the quality of the match by comparing the predicted probability of teenage motherhood for the treatment and the control groups in the full sample and in the matched sample. While there are large differences between teenage and nonteenage mothers in the full sample, the propensity score distributions overlap substantially with each other in the matched sample, indicating that the two groups are well matched.

Figure 1: Predicted probabilities of teenage motherhood for the full and matched samples



Using the matched sample, we compare the treatment and control groups in terms of our outcome variables. We display the average treatment effects in Table 4. Teenage mothers are 5.1 percentage points less likely to report very good or excellent health than

women who were not teenage mother. Similarly, they are 5.5 percentage points less likely to report not having depressive symptoms. Interestingly, these marginal effects lie between the ones derived from the full model in Table 3 and those calculated using the Oster correction presented in the previous section. Be that as it may, we observe that the Oster-corrected marginal effects provide the most conservative (i.e., lowest) estimate of the impact of teenage motherhood on late-life health. Hence, for the analysis of the life-cycle factors we return to the parametric analysis.

Table 4: Average treatment effects of teenage motherhood on late-life health outcomes using propensity score matching

	Self-reported health	Absence of depression
Teenage mother	–0.051**	–0.055***
	(0.022)	(0.027)

Note: */**/*** indicate statistical significance at the 10%/5%/1% levels.

4.4 Life-cycle socioeconomic factors

The analysis to date reveals that teenage mothers are less likely to report very good or excellent health and are less likely to report no depressive symptoms. There is, however, a long period between these two observations. In order to tackle this issue, we assess potential factors that could affect the impact of teenage motherhood on late-life health outcomes.

4.4.1 Life-cycle factors

Following the earlier literature (e.g., Grundy and Foverskov 2016), we focus on three potential life-cycle factors: education, income, and relationship stability.

As the first step of the analysis, we regress the three life-cycle factors on teenage motherhood using the same specification as in column 3 of Table 2 and display the ensuing marginal effects in Table 5. This exercise highlights the fact that teenage mothers have lower educational attainment, have lower incomes, and are more likely to have experienced divorce. Viewing the marginal effects reveals that teenage mothers are 9.8 percentage points less likely to enjoy high educational attainment, have 13.3% less income, and are 9.1 percentage points more likely to experience divorce. Moreover, we have also focused on years of education as an outcome variable because it allows for

a closer comparison to the results documented in the earlier literature. This provides an estimated 1.1-year reduction in educational attainment due to teenage motherhood.[17]

Table 5: Average marginal effects of teenage motherhood on selected life-cycle outcomes

	High education	Divorce	Log(Income)
Teenage mother	–0.098***	0.091***	–0.133***
	(0.011)	(0.013)	(0.030)

Notes: */**/*** indicate statistical significance at the 10%/5%/1% levels. Estimation as in column 3 of Table 2 but with alternative dependent variable. Average marginal effects are reported.

In Table 6 we display the results from adding the life-cycle factors to our preferred specification from column 3 of Table 2. As we explain in the discussion section below, a caveat of this approach is that these factors are potentially endogenous. Therefore, the results provide only suggestive evidence and should be used with caution. In the successive columns we include each of the factors separately and in the final column we include them all at once. In the top half of table we focus on self-reported health and in the bottom half on the absence of depression. Each of the factors reduces the impact that early childbearing has on self-reported health and the absence of depression. The largest effect is due to education, which reduces the impact of teenage motherhood on self-reported health (absence of depression) by 1 (0.7) percentage point(s) starting from a base rate of 6.2 (6.4) percentage points. This indicates that reduced educational attainment might be a channel from teenage motherhood to adverse late-life health outcomes. Income and relationship stability also play a role in the transmission. Finally, taking all these life-cycle factors into account jointly does not nullify the impact of teenage motherhood on either of the two late-life health outcomes. Thus, additional factors may be at play and/or teenage motherhood can have a direct effect on late-life health outcomes due to, for instance, the damaging effects of early motherhood.

[17] For the remainder of our analysis, focusing on education levels is preferable because they are based on the International Standard Classification of Education (ISCED), while years of education are harder to compare consistently due to, for instance, alternative school entry ages.

Table 6: Pathways leading from teenage motherhood to health outcomes later in life

	High education	Divorce	Log(Income)	All
	Dependent variable: Self-reported health			
Teenage mother	–0.052***	–0.059***	–0.058***	–0.047***
	(0.014)	(0.013)	(0.013)	(0.014)
High education	0.086***			0.079***
	(0.013)			(0.013)
Divorce		–0.035***		–0.029***
		(0.011)		(0.011)
Log(Income)			0.027***	0.021***
			(0.005)	(0.005)
	Dependent variable: Absence of depression			
Teenage mother	–0.057***	–0.059***	–0.061***	–0.051***
	(0.016)	(0.016)	(0.016)	(0.016)
High education	0.047***			0.041***
	(0.013)	–0.052***		(0.013)
Divorce		(0.012)		–0.047***
				(0.012)
Log(Income)			0.022***	0.018***
			(0.005)	(0.005)

Notes: */**/*** indicate statistical significance at the 10%/5%/1% levels. Remaining specification as in column 3 of Table 2. Average marginal effects are reported.

5. Discussion and conclusion

Our analysis has revealed that teenage motherhood is associated with adverse health outcomes later in life. This effect is unlikely to have been driven by selection on unobservables and is observed even after controlling for education, income, and relationship stability as life-cycle socioeconomic factors. Needless to say, our analysis is not without limitations.

Some variables contain missing values. However, the observations with missing values represent only 6.1% of the total sample. The respondents whom we drop due to missing values are in general less healthy, more depressed, and more likely to have been teenage mothers. Hence, we feel confident in assuming that our effect is, in fact, a lower bound of the true effect.

A potential bias affecting our results is that teenage mothers may display systematically higher mortality than other women. Assuming that the relatively healthy teenage mothers are those who survive sufficiently long to be included in our sample, our population of teenage mothers is potentially a healthy subsample of all teenage mothers. In that sense, the negative health findings we report throughout our paper are lower bounds; the true effect may well be larger.

For the analysis of the life-cycle factors, we follow Webbink, Martin, and Visscher (2008), Grundy and Foverskov (2016), and many others. However, we caution that the life-cycle factors themselves may be endogenous. In particular, when considering education we are confronted with the general problem of endogeneity of human capital-related variables. Current income is also likely to be endogenous because of reverse causality issues with current health. Hence, our results are only indicative of potential channels. To run a proper mediation analysis, the chain of events should be clear: in particular, the mediator should be post-treatment (i.e., after teenage motherhood) and pre-outcome (i.e., the late-adulthood health outcome). However, this condition is not satisfied: education is not post-treatment and income is not pre-outcome.[18]

Finally, the selection on unobservable approaches is not without shortcomings. Indeed, an important underlying assumption is that the unobserved variables and the observed variables are correlated with each other. While our broad set of childhood characteristics captures many of the background variables explaining early childbearing and its correlates, further variables, unrelated to our controls, may very well exist that will explain selection into teenage motherhood.

Our paper extends the current state of the literature on teenage motherhood in four directions. First, earlier economic research has focused mainly on the short- and medium-term consequences of teenage motherhood. By contrast, we focus on the long-term consequences of teenage motherhood, in particular its impact on late-life general and mental health. This allows us to conclude that teenage motherhood has a long-lasting health impact. Second, pushing forward the demographic and sociological analysis of teenage motherhood, the innovative feature of our retrospective data allows us to control for a broad set of pre-motherhood characteristics. Although our approach relies on selection on observables, we show that selection on unobservables is unlikely to affect the results. Indeed, using the recently developed adjustment of Oster (forthcoming) reveals that the impact of teenage motherhood on late-adulthood health outcomes remains negative after taking into account the potential role of unobserved factors. This insight suggests that the relationship between teenage motherhood and late-life health may, in fact, be causal. Third, we focus on a cross-national sample of almost 12,000 women, which contrasts with the currently dominant focus on national or regional samples. Finally, we assess the impact of life-cycle socioeconomic factors on the relationship between teenage motherhood and late-life health outcomes. In passing, the analysis of these life-cycle factors provides an indication of the impact of teenage motherhood on education, income, and relationship stability. While these factors have been addressed in the earlier literature, our analysis is the first to show these effects using the extensive cross-national sample provided by SHARELIFE.

[18] Nevertheless, the longitudinal nature of the SHARE data may make it possible to provide a closer analysis of mediators. Such an analysis would form an interesting basis for future work.

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